Attachment C-

Division 2- Technical Specifications

SECTION 022310

TREE PROTECTION, TRIMMING AND RELOCATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings
B. Project Information, Instructions to Bidders, and Execution Documents
C. Standard Terms and Conditions for Construction Contracts
D. Standard Terms and Conditions Procedures Manual
E. Section 32 93 00 - Plants

1.2 SUMMARY

A. Protection and trimming of trees that interfere with, or are affected by, execution of the Work, whether temporary or new construction.

B. Protection of existing trees.

C. Relocation of existing trees as specified herein and in drawings.

1.3 SUBMITTAL

A. Product Data: For each type of product indicated.

B. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

C. Existing Conditions: Documentation of existing trees and plantings indicated to remain and to be relocated, which establishes preconstruction conditions.

1. Use sufficiently detailed photographs or videotape.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.
3. Verify trees to be relocated are free of disease and ready to survive relocation. If any trees are deemed unfit for relocation as recommended by a Certified Arborist, provide written notification to Landscape Architect and Owner’s Representative immediately detailing the conditions that make relocation unsuitable.

D. Certification: From a qualified Certified Arborist that trees indicated to remain have been protected during construction according to recognized standards. Certification to include appraised monetary value for each tree indicated to remain prior to start of construction.

E. Maintenance Recommendations: From a qualified Certified Arborist for care and protection of trees affected by construction during and after completing the Work.

F. Submit a list of equipment, procedure, and labor force anticipated for use for tree relocation for approval by Landscape Architect.

G. Submit a schedule by day and date window indicating trees to be dug and relocated.

1.4 QUALITY ASSURANCE

A. Tree Service Qualifications: Provide an experienced tree service firm acceptable to the Architect that has successfully completed tree protection, relocation and trimming work similar to that required for this Project and that will assign an experienced, qualified Certified Arborist to Project site on a full-time basis during execution of the Work.

B. Arborist Qualifications: Provide an arborist acceptable to the Architect that is certified by the International Society of Arboriculture or licensed in the jurisdiction where Project is located.

C. Tree Transplanting Standards: Comply with ANSI A300 Part 6, “Planting and Transplanting” unless more stringent requirements are indicated.

D. Tree Pruning Standards: Comply with ANSI A300, "Trees, Shrubs, and Other Woody Plant Maintenance--Standard Practices," unless more stringent requirements are indicated.

E. Preinstallation Conference: Conduct conference at Project site

1. Before starting tree protection, relocation and trimming, meet with representatives of authorities having jurisdiction, Owner, Landscape Architect, consultants, and other concerned entities. Review tree protection, relocation and trimming procedures and responsibilities. Notify participants at least three working days before convening conference. Record discussions and agreements and furnish a copy to each participant.

F. Progress Evaluation: Provide routine progress evaluation reports on relocated trees until end of maintenance period.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Temporary root protection Matting (RPM): geocomposite material comprised of a tri-planar geonet structure with thermally bonded nonwoven geotextiles on both sides.
1. Material shall be SynTec ROADRAIN T-7 or approved equivalent.
2. For short duration applications (1-2 pass/1 day or less), AlturnaMATS or 1” thick steel plates may be used in lieu of RPM.
3. Submit shop drawings / cut sheets and material samples for review by Landscape Architect.

B. Permanent root aeration matting (RAM):
1. Material shall be SynTec ROADRAIN T-7 or approved equivalent.
2. Submit shop drawings / cut sheets and material samples for review by Landscape Architect.

C. Drainage Fill: Selected crushed stone, or crushed or uncrushed gravel, non limestone, washed, ASTM D 448, Size 24, with 90 to 100 percent passing a 2-1/2-inch (63-mm) sieve and not more than 10 percent passing a 3/4-inch (19-mm) sieve and conforming to Section 31 23 18.13.

D. Topsoil: Fertile, friable, surface soil, containing natural loam and complying with Section 329113 Provide topsoil that is free of stones larger than 1 inch (25 mm) in any dimension and free of other extraneous or toxic matter harmful to plant growth. Obtain topsoil only from well-drained sites where soil occurs in depth of 4 inches (100 mm) or more; do not obtain from bogs or marshes.

E. Filter Fabric: Manufacturer's standard, nonwoven, pervious, geotextile fabric of polypropylene, nylon, or polyester fibers.

F. Chain Link Fence: Metallic-coated steel chain link fence fabric, 0.120-inch- (3-mm-) diameter wire size; 48 inches (1200 mm) high, minimum; line posts, 1.9 inches (48 mm) in diameter; terminal and corner posts, 2-3/8 inches (60 mm) in diameter; top rail, 1-5/8 inches (41 mm) in diameter; bottom tension wire, 0.177 inch (4.5 mm) in diameter; with tie wires, hog ring ties, and other accessories for a complete fence system.

G. Mulch: conforming with section 329113

PART 3 - EXECUTION

3.1 PREPARATION

A. Temporary Fencing: Install temporary fencing located as indicated or outside the drip line of trees to protect remaining vegetation from construction damage.

1. Install chain link fence according to ASTM F 567 and manufacturer's written instructions.

B. Protect tree root systems from damage due to noxious materials caused by runoff or spillage while mixing, placing, or storing construction materials. Protect root systems from flooding, eroding, or excessive wetting caused by dewatering operations.

C. Do not store construction materials, debris, or excavated material within the drip line of remaining trees. Do not permit vehicles or foot traffic within the drip line; prevent soil compaction over root systems. Maintain protection zones free of weeds and trash.

D. Do not allow fires under or adjacent to remaining trees or other plants.

E. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations in a manner approved by architect. Install one sign spaced approximately every 20 feet on protection-zone fencing, but no fewer than four signs with each facing a different direction.

F. Maintain protection-zone fencing and signage in good condition as acceptable to Architect and remove when construction operations are complete and equipment has been removed from the site.

1. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.
2. Temporary access is permitted subject to preapproval in writing by arborist if a root buffer effective against soil compaction is constructed as directed by arborist. Maintain root buffer so long as access is permitted.

3.2 EXCAVATION

A. Install shoring or other protective support systems to minimize sloping or benching of excavations.

B. Do not excavate within drip line of trees, unless otherwise indicated.

C. Where excavation for new construction is required within drip line of trees, see "Hand Excavation within Tree Protection Area".

D. Where utility trenches are required within drip line of trees, tunnel under or around roots by drilling, auger boring, pipe jacking, or digging by hand.

1. Root Pruning: Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots with sharp pruning instruments; do not break or chop.

3.3 REGRADING

A. Grade Lowering: Where new finish grade is indicated below existing grade around trees, slope grade beyond drip line of trees. Maintain existing grades within drip line of trees. In the event where new finish grade is indicated below existing grade around trees and grading is required within drip line, slope grade away from trees as recommended by qualified arborist, unless otherwise indicated.

1. Root Pruning: Prune tree roots exposed during grade lowering on if approved by Landscape Architect. Do not cut main lateral roots or taproots; cut only smaller roots if approved. Cut roots with sharp pruning instruments; do not break or chop. See Root Aeration Matting drawings.

B. Minor Fill: Where existing grade is 6 inches (150 mm) or less below elevation of finish grade, fill with topsoil. Place topsoil in a single uncompacted layer and hand grade to required finish elevations.

3.4 TREE PRUNING

A. Prune remaining trees affected by temporary and new construction.

B. Prune remaining trees to compensate for root loss caused by damaging or cutting root system. Provide subsequent maintenance during Contract period as recommended by qualified arborist.

C. Pruning Standards: Prune trees according to ANSI A300 as follows:

1. Type of Pruning: Crown cleaning.
2. Type of Pruning: Crown thinning.
3. Type of Pruning: Crown raising.
4. Type of Pruning: Crown reduction.
5. Type of Pruning: Vista pruning.
6. Type of Pruning: Crown restoration.

D. Cut branches with sharp pruning instruments; do not break or chop.

E. Chip branches removed from trees. Spread chips where indicated or as directed by Architect.

3.5 TREE REMOVALS

A. All trees to be removed from within the project area shall be removed under the direction of a Certified Arborist

B. Trees shall be cut near ground level and the stump ground out to a clear depth of thirty (30) inches below grade, or as otherwise specified

C. Trees to be removed from project areas not within tree protection zones must be felled and removed in such a way as to avoid damage to tree(s), understory to remain, and adjacent structures and properties.
   1. Tree(s) to be removed which have branches extending into the canopy of tree(s) to remain must be removed in a manner that causes no damage to the branches, limbs, trunk or bark of tree(s) and understory to remain.
   2. Trees to be removed shall be felled so as to fall away from tree protection zones and to avoid pulling and breaking of roots of trees to remain. If roots are entwined, the Architect may require first severing the major woody root mass before extracting the trees. This may be accomplished by cutting through the roots by hand, with a vibrating knife, rock saw, narrow trencher with sharp blades, or other root-pruning equipment as approved by Architect.
   3. Extraction of downed tree(s) within protection areas shall occur by lifting the material out either by hand or with equipment staged outside the tree protection zone. Dragging or skidding across the ground will not be permitted.

3.6 ROOT PRUNING

A. Any grading, construction, demolition, or other below-ground work which may reasonably be expected to encounter tree roots must be monitored by the Owner's Representative.

B. All root pruning is to be performed under the direction of a Certified Arborist.

C. Before grading, excavation or trenching for project work adjacent to tree protection zones, trees shall be root pruned to a depth of 24 inches as follows:
   1. A 24" deep trench shall be manually dug one (1) foot outside the tree protection zone perimeter.
   2. As roots are exposed, they shall be cleanly cut with a hand saw, vibrating knife, rock saw, narrow trencher with sharp blades, or other root-pruning equipment approved by the Owner's Representative.

D. Any roots damaged during grading or construction shall be exposed to sound tissue and cut cleanly with a saw.

3.7 TREE RELOCATION

A. Transplanting time
   1. Trees shall only be transplanted once they have reached their fall dormancy period. Transplanting may occur any time after the trees have reached dormancy until the ground is frozen.

B. Digging of trees
   1. Trees shall not be dug until the contractor is ready to transport them from their original locations to the site of the new locations.
   2. The maximum time lapse between digging and replanting shall be four (4) hours.
   3. All Oak trees and all trees over 4 inch caliper shall be dug carefully with a 72" minimum size tree spade, avoiding injury to the tree or damage of the roots, particular attention shall be given to fibrous roots.
   4. All other species of trees and those under 4 inch caliper shall be dug carefully with a 60" minimum size tree spade, avoiding injury to the tree or damage of the roots, particular attention given to fibrous roots.

5. Immediately after digging, roots shall be protected against drying out and freezing.

C. Moving of trees
1. Trees being moved from original location directly to new location do not have to be wrapped in burlap and twine
2. Properly handled trees during moving so trunks will not be scarred or damaged and to avoid broken limbs.
3. Keep root balls moist during relocation.
4. Protect tree crowns with shade cloth to prevent dessication and wind burn. Crowns shall be periodically sprayed with water to help ensure against dessication.

D. Planting
1. Plant in accordance with section 329200
2. Fill material in accordance with section 329200
3. Mulch in accordance with 329200

E. Maintenance
1. Maintain relocated trees as specified hereunder for the following period
   a. The Contractor is responsible for maintenance of all relocated trees from relocation time to end of one year maintenance period
   b. Work subject to maintenance: All relocated trees
   c. Maintain all relocated trees in a healthy and flourishing condition. Maintenance of new plantings consists of pruning, watering (rainfall shall be supplemented with Contractor watering operations for a total rate of one inch per week during the growing seasons), replanting, weeding, mulching and cleaning.
2. When maintenance is turned over to Owner at end of maintenance period, contractor shall provide written maintenance instructions to owner for ongoing maintenance of relocated material.

F. Warranty
1. General
   a. In lieu of the provisions as to warranties in the general conditions, the Contractor shall warranty and maintain all relocated plant material for a period of one (1) year from the date of the substantial completion of the relocation. An additional one (1) year warranty for replacement plant material shall be enforced. If any plant material relocated by the Contractor is not in a healthy and thriving condition due to, but not limited to: improper handling or planting; improper after care including trimming, watering, weeding, cultivating, etc.; or from shock of transplanting, the Contractor shall upon due notice, remove said plant(s), dispose of it/them off the project property, and furnish and plant a new plant of the same type, size and quality, at no cost to the Owner. Both the substantial completion of the plant material and the inspection one (1) year later to satisfy the warranties, shall be done when the plant material is in full leaf. The Contractor shall assume the responsibility for supplying and replacing all plants not in a healthy and thriving condition at the end of the warranty period.
   b. After receiving a Notice of substantial completion of relocated plant material, all plant materials shall be warranted against defects including death, disease or infestation, unsatisfactory growth and improper maintenance for the one year Warranty Maintenance Period.
   c. The installation contractor shall not be responsible for defects resulting from Owner negligence, or damage resulting from unusual phenomena or incidents beyond the installer's control. Actions that may be helpful due to unusual weather conditions must be presented to the Architect at or before the time of occurrence and will be negotiated with the Architect as additional services.
2. Replacements
   a. During the warranty period, replace, at no additional expense to the Owner, relocated plant materials that are dead or that are, in the opinion of the Architect, in an unhealthy or

unsightly condition, or that have lost their natural shape due to dead branches. Rejected plant materials shall be removed from the site and legally disposed of at no additional expense to the Owner.

b. Replacement plants and planting operations shall be in accordance with the original specifications. Replacements shall be made as soon as possible. Fully restore areas damaged by replacement operations to their original and specified condition.

3. All material which was replaced at the end of the one (1) year warranty maintenance period shall be subject to an extended one (1) year warranty and maintenance period. At the end of the extended warranty and maintenance period, any of the replaced materials which are not in an acceptable condition, as herein before stated, shall be replaced. Once these replacements are made and approved by the Architect and Owner's Representative, the contractors' obligation under this contract ends.

3.8 ROOT PROTECTION MATTING (RPM)

A. The purpose of the RPM is to reduce compaction, rutting, and contamination of root systems of trees to be retained should staging, temporary stockpile, or equipment access be required within the Critical Root Zone (CRZ)

B. RPM shall be used for all access within CRZ areas of trees to remain. Matting is not required where existing pavement or concrete will remain undisturbed.

C. Tree anticipated receiving temporary or repetitive materials staging, footing traffic, or equipment access within protected root zone are to receive RPM. Wood chip mulch 4-6" shall be installed under matting to further protect soils and roots.

D. If short duration access is needed, the use of "AlturnaMATS", 1" steel plate, or approved equal may be needed to avoid rutting and compaction. These materials may be shifted and re-used as work progresses.

E. All-weather staging stockpile, or other repetitive construction operations may require 12" stone layer over RPM to allow heavy vehicles have the potential to cause dynamic compaction yet without rutting original surface soils and roots. In this situation, the stone may be contained by silt fence or super silt fence where adjacent to or within a tree protection area.

F. All temporary RPM areas to be used beyond a single day or beyond continuous on site supervision of the Contract Arborist shall be surrounded by temporary tree protection fence as per specifications. For temporary staging of soils beyond 24 hours "trenchless" silt fence fabric shall be installed on the lower / downhill side or as directed by the Project Arborist

G. If silt fence is required for erosion control in RPM areas, installation of silt fence shall be coordinated with the Contract Arborist and must be performed by the Contract Arborist to prevent damage to tree roots from trenching operations. Erosion control socks may be used in lieu of silt fabric if approved by the Landscape Architect.

3.9 Root Aeration Matting (RAM)

A. The purpose of the RAM is to reduce compaction of existing soils and tree roots from permanent grade fills and provide separation from newly placed and compacted materials. It also provides an opportunity for air and water exchange to the existing soils where roots exist.

B. The areas to receive RAM shall be protected from disturbance prior to the specific RAM and fill placement. Temporary Tree Protection Fence shall be used for this purpose.

C. If temporary access is needed within RAM areas prior to the time of RAM and fill placement, a temporary placement of Root Protection Matting (RPM) with mulch shall be made to prevent soil compaction. Steel Plates or other temporary protection methods for short-term use may be used. Refer to "Root Protection Matting" in this section for additional detail.

D. Sites shall be prepared by the Contract Arborist. Any debris shall be removed by hand. Existing soils shall remain undisturbed and un-compacted unless otherwise approved. If site preparation (grading, excavation, etc.) is needed, all work shall be done in accordance with this section. Refer to "Excavation for Proposed Sidewalk within Tree Protection Areas" in this section.

E. RAM shall be placed on undisturbed and un-compacted soil except as described herein. RAM placement shall be made by the Contract Arborist.

F. RAM material shall extend to the toe of the proposed slope and "daylight".

G. RAM shall be pinned to the ground to prevent it from moving during fill placement. Pins shall be 12" "landscape nails" or approved alternative.

H. Seams within the RAM placement shall overlap by at least 2' or be connected or installed as designated by the manufacturer.

I. Fill materials (aggregate, soil, or other approved fill) shall be placed directly on the RAM and compacted only to the minimum necessary as directed by the Engineer.

J. RAM shall remain in place permanently and shall not be removed or disturbed by the contractor.

K. Filter fabric (silt fence fabric) shall be installed in 2 layers as shown in the detail (not trenched) to protect the RAM core from contamination. Installation of silt fence for erosion control shall be coordinated with the Contract Arborist and must be performed by the Contract Arborist to prevent damage to tree roots from trenching operations. Erosion control socks may be used in lieu of silt fabric if approved by the Engineer.

3.10 HAND EXCAVATION WITHIN TREE PROTECTION AREAS

A. For excavation within CRZ areas of trees to remain, the intent is to minimize tree and root damage from excavation activities.

B. Excavation shall be performed using SSAT, hand tools, or other approved non-damaging method. Roots shall not be damaged by the excavation except for approved root pruning.

C. Refer to "Supersonic Air Tool Excavation in this section for additional requirements.

D. All work shall be directly supervised by Certified Arborist.

E. RPM shall be installed along trench sides to allow for temporary soil stockpile and access.

F. Excavate along the edge of the proposed trench closest to the trees to be protected as shown on the plans. Roots shall be uncovered and care taken to avoid damage to roots and bark.

G. Contract Arborist shall prune the exposed roots. Excavation shall not extend beyond the line where roots were pruned.

H. Contractor may proceed with conventional excavation methods or with hand excavation methods if clearance to the tree is inadequate for equipment access.

3.11 Supersonic Air Tool (SSAT) Excavation

A. Refer to “Hand Excavation within Tree Protection Areas” specification in this section for additional requirements.

B. At a minimum, all SSAT work shall include the use of a barrier system such as temporary walls or tents to protect property and pedestrians from flying debris.

C. Excavate along the edge of the proposed trench closest to the tree to be protected as shown on the plans. Roots shall be uncovered and care taken to avoid damage to roots and bark.

D. Excavation shall proceed per the “Hand Excavation within Tree Protection Areas” specification in this section.

3.12 FIELD QUALITY CONTROL

A. Certification: At substantial completion, the Contractor shall engage a certified arborist to verify condition of trees indicated to remain as compared to the original certification.

3.13 TREE REPAIR AND REPLACEMENT

A. Promptly repair trees damaged by construction operations within 24 hours. Treat damaged trunks, limbs, and roots according to written instructions of the qualified arborist.

B. Remove and replace dead and damaged trees that the qualified arborist determines to be incapable of restoring to a normal growth pattern in a manner approved by the Architect.

1. Provide new trees of the same size and species as those being replaced; plant and maintain as specified in Section "Landscape Planting"
2. Replace dead and damaged trees that the qualified arborist determines to be incapable of restoring to a normal growth pattern on a caliper inch per caliper inch basis in a manner approved by Landscape Architect. The minimum size replacement trees shall be four (4) inches in caliper.

C. Aerate surface soil, compacted during construction, 10 feet (3 m) beyond drip line and no closer than 36 inches (900 mm) to tree trunk. Drill 2-inch- (50-mm-) diameter holes a minimum of 12 inches (300 mm) deep at 24 inches (600 mm) o.c. Backfill holes with an equal mix of augered soil and sand.

3.14 DISPOSAL OF WASTE MATERIALS

A. Burning is not permitted.

B. Disposal: Remove excess excavated material in accordance with Section 02110.
1. Ash Trees shall be removed in accordance with the EAB Compliance Agreement as outlined above (Part 3.5-Removals.)

END OF SECTION 022310

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 011000 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
2. Section 022130 "Tree Protection, Trimming and Relocation" for temporary protection of existing trees and plants that are affected by selective demolition.
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 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
4. Review areas where existing construction is to remain and requires protection.

1.6 INFORMATIONAL SUBMITTALS

A. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.

B. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.

C. Predemolition Photographs or Video: Show existing conditions the site that might be misconstrued as damage caused by demolition operations. Comply with Section 013233 "Photographic Documentation." Submit before Work begins.

1.7 CLOSEOUT SUBMITTALS

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

1.8 FIELD CONDITIONS

A. Owner will occupy portions of the site adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

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

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

D. 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.

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

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

1.9 COORDINATION

A. Arrange selective demolition schedule so as not to interfere with Owner's 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.

B. Standards: Comply with ASSE A10.6 and NFPA 241.

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. Comply with requirements specified in Section 013233 "Photographic Documentation."
2. 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 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Arrange to shut off utilities with utility companies.

2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.

3.3 PROTECTION

A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of the site.

3.4 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 and as follows:

1. Dispose of demolished items and materials promptly.

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 reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

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

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and recycle or dispose of them according to Section 017419 "Construction Waste Management and Disposal."

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.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

3.7 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.

3.8 SELECTIVE DEMOLITION SCHEDULE

A. Remove: all existing play structures and site furnishings as noted in the drawings.

B. Existing to Remain: stones/boulders with plaques as noted in the drawings.

END OF SECTION 024119

SECTION 033000

CAST-IN-PLACE CONCRETE

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. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.

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

1.3 DEFINITIONS

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

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

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.
1. Indicate amounts of mixing water to be withheld for later addition at project site.

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.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For the Installer: Include copies of applicable ACI certificates.

B. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Fiber reinforcement.
4. Curing compounds.
5. Bonding agents.
6. Adhesives.
7. Joint-filler strips.
8. Repair materials.

C. Material Test Reports: For the following, from a qualified testing agency:
1. Aggregates.

D. Field quality-control reports.

1.6 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. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated and employing an ACI-certified Concrete Quality Control Technical Manager.

1. Personnel performing laboratory tests shall be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

D. Field Quality Control Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

1. Personnel conducting field tests shall be qualified as an ACI Concrete Field Testing Technician, Grade 1, in accordance with ACI CPP 610.1 or an equivalent certification program.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on each concrete mixture.

1. Include the following information in each test report:
   a. Slump.
   b. Air content.
   c. Seven-day compressive strength.
   d. 28-day compressive strength.

1.8 DELIVERY, STORAGE, AND HANDLING

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

1.9 FIELD CONDITIONS

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

1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
2. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
3. Do not use frozen materials or materials containing ice or snow.
4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.
5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

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

1. Maintain concrete temperature at time of discharge to not exceed 95 deg F.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.

2.2 CONCRETE MATERIALS

A. Source Limitations:

1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
3. Obtain aggregate from single source.
4. Obtain each type of admixture from single source from single manufacturer.

B. Cementitious Materials:

1. Portland Cement: ASTM C150, Type I, gray.

C. Normal-Weight Aggregates: ASTM C33, coarse aggregate or better, graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Water: ASTM C94/C94M, potable

2.3 STEEL REINFORCEMENT

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Reinforcing bars: ASTM A 615/A 615M, Grade 60, deformed.

C. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.

D. Galvanized Reinforcing Bars: ASTM A 615/A, 615M, Grade 60 (Grade 420), deformed bars, ASTM A 767/A 767M, Class I Zinc coated after fabrication and bending.

E. Steel Bar Mats: ASTM A 184/A 184M, fabricated from ASTM A 615/A 615M, Grade 60 (Grade 420), deformed bars, assembled with clips.

F. Plain-Steel Wire: ASTM A 82/A 82M, galvanized.

G. Plain-Steel welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from galvanized-steel wire into flat sheets.

H. Galvanized-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from galvanized-steel wire into flat sheets.

2.4 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

B. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with expody coating on reinforcement and complying with ASTM A 775/A 775M.

C. Zinc Repair Material: ASTM A 780, Zinc-based solder, paint containing zinc dust, or sprayed zinc.

D. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bare supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
   1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
   2. For epoxy-coated reinforcement, use expody-coated or other dielectric-polymer-coated wire bar supports.
   3. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bare supports.

2.5 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Axim Italcementi Group, Inc.; CATEXOL CimFilm.
b. BASF Construction Chemicals - Building Systems; Confilm.
c. ChemMasters; SprayFilm.
d. Conspec by Dayton Superior; Aquafilm.
e. Dayton Superior Corporation; Sure Film (J-74).
f. Edoco by Dayton Superior; BurkeFilm.
g. Euclid Chemical Company (The), an RPM company; Eucobar.
h. Kaufman Products, Inc.; Vapor-Aid.
i. Lambert Corporation; LAMBCO Skin.
j. L&M Construction Chemicals, Inc.; E-CON.
k. Meadows, W. R., Inc.; EVAPRE.
l. Metalcrete Industries; Waterhold.
m. Nox-Crete Products Group; MONOFILM.
n. Sika Corporation; SikaFilm.
o. SpecChem, LLC; Spec Film.
p. Symons by Dayton Superior; Finishing Aid.
q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
r. Unitex; PRO-FILM.
s. Vexcon Chemicals, Inc.; Certi-Vex Envio Set.
t. Or approved equal.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.

D. Water: Potable or complying with ASTM C1602/C1602M.

E. Clear, Waterborne, Membrane-Forming, Dissipating Curing Compound: ASTM C309, Type 1, Class B.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
b. BASF Construction Chemicals - Building Systems; Kure 200.
c. ChemMasters; Safe-Cure Clear.
d. Conspec by Dayton Superior; W.B. Resin Cure.
e. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
f. Edoco by Dayton Superior; Res X Cure WB.
g. Euclid Chemical Company (The), an RPM company; Kurez W VOX; TAMMSCURE WB 30C.
h. Kaufman Products, Inc.; Thinfilm 420.
i. Lambert Corporation; AQUA KURE - CLEAR.
j. L&M Construction Chemicals, Inc.; L&M Cure R.
k. Meadows, W. R., Inc.; 1100-CLEAR.
l. Nox-Crete Products Group; Resin Cure E.
m. Right Pointe; Clear Water Resin.
n. SpecChem, LLC; Spec Rez Clear.
o. Symons by Dayton Superior; Resi-Chem Clear.
p. TK Products, Division of Sierra Corporation; TK-2519 DC WB.
q. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.
r. Or approved equal.

F. Clear, Solvent-Borne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. BASF Construction Chemicals - Building Systems; Kure-N-Seal 25 LV.
   b. ChemMasters; Spray-Cure & Seal Plus.
   c. Conspec by Dayton Superior; Sealcure 1315.
   d. Dayton Superior Corporation; Day-Chem Cure and Seal (J-22UV).
   e. Edoco by Dayton Superior; Cureseal 1315.
   f. Euclid Chemical Company (The), an RPM company; Super Diamond Clear; LusterSeal 300.
   g. Kaufman Products, Inc.; Sure Cure 25.
   h. Lambert Corporation; UV Super Seal.
   i. L&M Construction Chemicals, Inc.; Lumiseal Plus.
   j. Meadows, W. R., Inc.; CS-309/30.
   k. Metalcrete Industries; Seal N Kure 30.
   l. Right Pointe; Right Sheen 30.
   m. Vexcon Chemicals, Inc.;
   n. Or approved equal.
2. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24)

2.6 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1752, cork or self-expanding cork.

B. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

C. Epoxy Bonding Adhesive: ASTM C881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade and class to suit requirements, and as follows:

1. Types I and II, nonload bearing and Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.7 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand, as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi at 28 days when tested in accordance with ASTM C109/C109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.

1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested in accordance with ASTM C109/C109M.

2.8 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.

1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.

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

1. Fly Ash or Other Pozzolans: 25 percent by mass.
2. Slag Cement: 50 percent by mass.
3. Silica Fume: 10 percent by mass.
4. Total of Fly Ash or Other Pozzolans, Slag Cement, and Silica Fume: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
5. Total of Fly Ash or Other Pozzolans and Silica Fume: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.

C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.

1. Use admixture in concrete, as required, for placement and workability.
2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete required to be watertight, and concrete with a w/cm below 0.50.
4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
5. Use permeability-reducing admixture in concrete mixtures where indicated.

2.9 CONCRETE MIXTURES FOR SITE ELEMENTS

A. Footings: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 4500 psi at 28 days.
2. Maximum water-Cementitious Materials Ratio: 0.45.
3. Slump Limit: 5 inches (125 mm) for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing or plasticizing admixture, plus or minus 1 inch
4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2 inch nominal maximum aggregate size.
5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for ¾-inch nominal maximum aggregate size.

B. Slabs-on-grade, Pavement, Curbs and Edge Restraints: Proportion normal-weight concrete mixture as follows:
   1. Minimum Compressive Strength: 4500 psi at 28 days.
   2. Maximum water-Cementituous Materials Conent: 470 lb/cu. Yd. (279 kg/cu. m)
   3. Slump Limit: 4 inches, plus or minus inch
   4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2 inch nominal maximum aggregate size.
   5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for ¾-inch nominal maximum aggregate size.
   6. Air Content: do not allow air content of trowel-finished floors to exceed 3 percent.

2.10 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M and furnish batch ticket information.
   1. When air temperature is between 85 and 90 de 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. The Contractor shall notify the Project Administrator of any concrete delivery on site at least 24 hours in advance.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete in accordance with ASTM C94/C94M. Mix concrete materials in appropriate drum-type batch machine mixer.

   1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than five minutes after ingredients are in mixer, before any part of batch is released.
   2. For mixer capacity 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, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

   1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
   2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:

   1. Daily access to the Work.
   2. Incidental labor and facilities necessary to facilitate tests and inspections.

3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.3 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.
2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.
3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

3.4 JOINTS

A. Construct joints true to line, with faces perpendicular to surface plane of concrete.

B. 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-fourthof 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.

C. 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. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface, where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
3. 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.

E. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.

1. If a section cannot be placed continuously, provide construction joints as indicated.
2. Deposit concrete to avoid segregation.
3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.

a. Do not use vibrators to transport concrete inside forms.
b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Do not place concrete floors and slabs in a checkerboard sequence.
2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
3. Maintain reinforcement in position on chairs during concrete placement.
4. Screed slab surfaces with a straightedge and strike off to correct elevations.
5. Level concrete, cut high areas, and fill low areas.
6. Slope surfaces uniformly to drains where required.
7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
8. Do not further disturb slab surfaces before starting finishing operations.

3.6 FINISHING SLABS

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

B. Broom Finish: Apply a broom finish to exterior concrete pavement, ramps, and elsewhere as indicated.
1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.

3.7 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

A. Filling In:

1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
3. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

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. 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.

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

1. Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

3.9 TOLERANCES

A. Conform to ACI 117 (ACI 117M).

3.10 APPLICATION OF LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment in accordance with manufacturer's written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
2. Do not apply to concrete that is less than [three] [seven] [14] [28] days' old.
3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing.
4. Rinse with water; remove excess material until surface is dry.
5. Apply a second coat in a similar manner if surface is rough or porous.

B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller in accordance with manufacturer's written instructions.

3.11 JOINT FILLING

A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least one month.
2. Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints.

D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.12 CONCRETE SURFACE REPAIRS

A. Defective Concrete:

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

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.

a. Limit cut depth to 3/4 inch.
b. Make edges of cuts perpendicular to concrete surface.
c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
d. Fill and compact with patching mortar before bonding agent has dried.
e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.

a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
b. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces:

1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.

    a. Correct low and high areas.
    b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
3. After concrete has cured at least 14 days, correct high areas by grinding.
4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.

    a. Finish repaired areas to blend into adjacent concrete.

5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.

    a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
    b. Feather edges to match adjacent floor elevations.

6. Correct other low areas scheduled to remain exposed with repair topping.

    a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations.
    b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

7. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.

    a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.
    b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
    c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
    d. Place, compact, and finish to blend with adjacent finished concrete.
    e. Cure in same manner as adjacent concrete.

8. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.

    a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
    b. Dampen cleaned concrete surfaces and apply bonding agent.
    c. Place patching mortar before bonding agent has dried.
    d. Compact patching mortar and finish to match adjacent concrete.
    e. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.13 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

B. Inspections:

1. Headed bolts and studs.
2. Verification of use of required design mixture.
3. Concrete placement, including conveying and depositing.
4. Curing procedures and maintenance of curing temperature.
5. Verification of concrete strength before removal of shores and forms from beams and slabs.
6. Batch Plant Inspections: On a random basis, as determined by Architect.

C. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M shall be performed in accordance with the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.

2. Slump: ASTM C143/C143M:

a. 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.
b. Perform additional tests when concrete consistency appears to change.

3. Slump Flow: ASTM C1611/C1611M:

a. 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.
b. Perform additional tests when concrete consistency appears to change.

4. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete;

a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

5. Compression Test Specimens: ASTM C31/C31M:

a. Cast and laboratory cure two sets of two cylinder specimens for each composite sample.
b. Cast, initial cure, and field cure two sets of two standard cylinder specimens for each composite sample.

6. Compressive-Strength Tests: ASTM C39/C39M.

a. Test one set of two laboratory-cured specimens at seven days and one set of two specimens at 28 days.
b. Test one set of two field-cured specimens at seven days and one set of two specimens at 28 days.
c. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
8. Strength of each concrete mixture will be satisfactory if every 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.
9. Test results shall be reported in writing to Architect, concrete manufactrurer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project indentifition name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete bath 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.
10. 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.
11. Additional Tests:

    a. 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.
    b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.

        1) Acceptance criteria for concrete strength shall be in accordance with ACI 301, section 1.6.6.3.

12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

3.14 PROTECTION

A. Protect concrete surfaces as follows:

1. Protect from petroleum stains.
2. Diaper hydraulic equipment used over concrete surfaces.
3. Prohibit use of pipe-cutting machinery over concrete surfaces.
4. Prohibit placement of steel items on concrete surfaces.
5. Prohibit use of acids or acidic detergents over concrete surfaces.
6. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 033000

SECTION 100610

EXTERIOR SIGNAGE

PERFORMANCE SPECIFICATIONS

Required Submittals

QUALIFICATIONS

The awarded Fabricator will have provided their qualifications at or prior to the time of Bid. The Fabricator is required to submit as part of the submittal process additional qualifications for any subcontractors, including but not limited to, installers, electrician, specialty sub-contractor and/or project managers not included or accepted with the bid award of the project. The Owner reserves the right to accept or reject any sub-contractor and/or project manager submit- ted for review. Qualifications should include: a minimum of 5–10 years relevant experience and shall provide information that illustrates the following:

Firm/Personnel qualifications.

Projects of similar size and complexity.

Demonstration of high quality craftsmanship.

Project management team and experience.

SHOP DRAWINGS

Submit one (1) electronic set of shop drawings as outlined below:

Include plans, elevations, sections and large-scale details of sign construction, wording, and lettering layout. Show anchorages and accessory items.

Provide graphic layouts of each individual sign face and message for each sign location.

Show fabrication and installation details, including all sign components such as: extrusions, brackets, bracing, hardware, internal framing, etc.

Alphabet of each type style required by the contract documents; upper and lowercase, with numerals, punctuation and accents.

Shop drawings MUST include all field verified conditions and dimensions.

Show installation and mounting heights.

PRODUCT SPEC + WARRANTY INFORMATION

Provide documentation outlining all project warranties, including both product and manufacturing.

Submit cut sheets for all specified products.

SAMPLES

Samples shall be clearly labeled on the back (where possible), designating item number, name of manufacturer, sign type and location.

Fabricator shall submit a minimum of two (2) samples of each color and finish applied on each material type as indicated in the drawing package.

Samples should represent the final finish of each element and will be used as control samples for production approval.

Samples should represent extreme variations in color and texture that might occur during fabrication. Please submit the following samples as specified in the drawing package, list project specific submittal requirements.

Color Samples

Color sample(s) for each specified color, process and finish. Color submittal(s) shall be submitted on each relevant substrate specified.

Material Samples

Material samples of each specified Material (M1, M2 etc.) in each color and finish specified.

Submit manufacturer's standard color palette where required for color and finish selection.

CHPL Samples

Custom High Pressure Laminate (CHPL) manufacturer must supply project-specific electronic PDF proofs for content approval and minimum 8" x 10" x .060" actual material lab samples for color and finish approval from production-ready digital art work and specifications as provided by Designer.

Paper Templates

Templates should be fully assembled or have complete registration marks for assembly. Fabricator shall provide for Designer approval, full-size paper templates for review and approval in the field of the following sign types:

CUS.1

Sign Samples

Sign Contractor shall construct the following sign samples/mock-ups:

PID.4 (only required by Fabricator on initial fabrication contract for this program)

Each reviewing party, i.e. Designer, Owner, Architect, etc. will each require a minimum of 10 business days to review all submittals.

The process and sequence of submittal and review shall be discussed and agreed to during the project kickoff meeting.

Designer reserves the right to reject any submittal (shop drawing, sample, etc.) that does not satisfy the requirements as outlined in this document including but not limited to: field conditions, construction, finish or color requirements. Submit additional drawings/samples as required to obtain final approval

Project Requirements

WORK INCLUDED

Site verification, fabrication, delivery, and installation of all sign types and quantities indicated in the final approved Copy List and Sign Location Plan. Fabricator to verify the sign quantities from the Copy List and Sign Location Plans and if discrepancies exist, notify the Designer of any

such discrepancies.

Work shall include all support structures and fasteners re- quired for installation.

Work shall include all design engineering needed to produce the project to comply with all applicable municipal, state and federal code, and structural soundness. Fabricator is responsible for submitting engineered drawings signed and sealed by structural engineer.

Fabricator to provide all services, subcontractors, labor, materials and equipment needed to complete the work described in this design drawings and specifications document.

It is the Fabricator's responsibility to have all drawings signed and sealed by a Structural Engineer.

Fabricator shall visit site before construction begins and inspect each proposed sign location. Any issues or concerns shall be communicated to the Designer in writing within twenty-four (24) hours.

Upon award of the bid, the selected Fabricator shall arrange a meeting with the Designer to review the scope of work.

Fabricator will be responsible for providing the Designer and Owner a project schedule that outlines durations for all work including delivery dates for submittals and Designer and Owner review time. Sign Contractor shall update and reissue the schedule throughout the project and communicate all changes/impacts on the schedule to Designer and Owner.

Prior to installation, the Fabricator shall conduct a pre-install walk through with the Designer and Owner to address any potential issues/questions.

At the substantial completion of the project the Fabricator shall perform a walk-through with the Designer and Owner to inspect the installation and create a punch list of all unsatisfactory items. Fabricator is required to complete all punch list items within 3-4 weeks of receipt of punch list.WORK QUALITY

All work to be done in a professional manner and to the highest trade standards.

Fabricator is responsible for insuring the quality standards above for all related professional and trade subcontract- ed work including: general carpentry, masonry, electrical,

landscaping, or utilities required for the installation of all sign types as described, unless otherwise agreed to by Owner.

All subcontracted work must meet the general accepted professional standards.

REFERENCE STANDARD

The following materials reference standards will apply to the work materials (use most current version of reference standards):

ASTM A36 Structural Steel

ASTM A123 Zinc (Hot Galvanized) coatings on products fabricated from rodded, pressed, and forged steel shape, plates and bars.

ASTM B221 Aluminum-alloy extruded bars, rods, wire, shapes and tubes.

ASTM D822 Light and water exposure apparatus (carbon-arc type) for testing paint, varnish, lacquer, and related products.

ASTM E84 Surface-burning characteristics of building materials, lacquer and related products.

AWI Comply with applicable requirements of "Architectural Woodwork Quality Standards" published by the Architectural Woodwork Institute.

CDA Copper Development Association, Inc.

FS L-P-391 Plastic sheet, rods and tubing, rigid, cast materials

FS L-P-387 Plastic sheet, laminated, thermosetting PS-1 Construction and industrial plywood

PEI Porcelain Enamel Institute

TM B135 QQ-B-613 (Fed Spec) Brass, Muntz 280 UL-943 Fluorescent lamp ballasts

WARRANTIES

Warrant all products (including, but not limited to: materials, hardware and finishes) against any and all defects based on manufacturers' supplied warranties from date of installation. All manufacturer warranties should be submitted to the Designer and Owner for review.

Vinyl die-cut letters: warranted against delamination from substrate.

Paint finishes: warranted against fading or chalking, corrosion developing beneath paint surfaces of the support systems (except for obvious vandalism or other external damage to the paint surfaces).

Corrosion of the fastenings.

The signs not remaining true and plumb on their supports during normal wear.

Fading of the colors when matched against a sample of the original color and material.

Discoloration of metal finishes. Adhesives, e.g. tape and epoxy

Paneling not remaining true and plumb on their supports during normal wear.

The Fabricator shall correct any and all material and/or workmanship defects which may appear during the warranty period by restoring defective work to the standard of the contract documents at no cost to the Owner and to the Owner's satisfaction. Corrections include, but are not

limited to: disfiguring of any surface due to chalking, rusting, bubbling, or other disintegration of the sign face or of the messages or of the edge finish of the sign inserts or panel.

CHPL Samples

Manufacturer warrants that under normal wear and use the workmanship and materials used in the CHPL product purchased from the Manufacturer will meet the standards set forth on the applicable specification materials and that the product will not delaminate, peel, blister, crack or fade for a period ten (10) full years from the date of purchase.

In the event that the product does not perform as warranted:

Manufacturer shall be allowed to conduct an on-site inspection and investigation, or be provided digital images of defects

Manufacturer shall work directly with the end-user to resolve any warranty matter,

The sole remedy will be the repair or replacement of the defective product at the sole discretion of the Manufacturer, and/or

The repair or replacement by Manufacturer shall be limited to the re-manufacture and shipment of the replacement or repaired product to the site of the end-user's product.

This warranty only applies to the manufacture and material used in the manufacture of the product. Manufacturer shall not be liable for any other costs, including but not limited to installation, labor or other costs or expenses. Any repair or replacement shall be warranted for a period up to the remaining life of the original warranty. Further the repair or replacement costs incurred by Manufacturer shall not

exceed the purchase price paid for the product.

QUALITY ASSURANCE

Work done and materials furnished shall meet the highest industry standards in every respect and, unless otherwise specified, materials and equipment shall be new and of the latest design.

The Design Intent Package should provide everything necessary for a complete contract.

In the event of conflict or omission, the Fabricator shall consult the Designer for resolution. All clarifications are to be made in writing in the form of an RFI from the Fabricator to the Designer.

Use only personnel thoroughly skilled and experienced with the products and method for fabrication and installation of signage specified.

The Owner shall reserve the right to reject any shop drawings, samples or other submittals, as well as any finished product or installation, that cannot meet the standard of quality established. Any such decision will be considered final and not subject to recourse.

Materials and hardware not specified, but necessary to the complete functioning of the sign, shall conform to the quality level established.

Substitutions of items specifically indicated in this specifications package that serve the same function with equal performance will be considered upon submission of substitution.

PROTECTION AND STORAGE

Fabricator is responsible for storage of signs and assemblies and protection from damage at the shop, in transit and

until erected in place, complete, inspected and accepted by Owner.

Fabricator is responsible for the replacement pilferage both prior to and until inspection and acceptance of installation by the Owner.

INSPECTION

All production materials, color samples and paints, fabricated or partially fabricated items shall be available for inspection, on-site or in the shop, by the Owner or Designer during the manufacturing process and until final delivery, installation and acceptance, to determine compliance with the requirements of these specifications.

Shop inspection approvals do not guarantee final acceptance of installed work.

INSTALLATION

Install sign units and components with concealed fasteners unless otherwise shown. Refer to drawings for general method of installation. Verify each surface in field to deter-

mine appropriate mounting hardware. Fabricator is responsible for determining where below ground or in-wall structural tie-ins may be required.

All elements should be installed true and plumb in accordance with the design intent of this document.

Sign location drawings show approximate locations of signs. Fabricator, Designer and Owner shall conduct a pre-install markout walk through to confirm all locations and identify areas of conflict. Fabricator is responsible for determining the location of underground structures and utilities on ground-mounted signs. Any conflicts should be brought to the attention of the Owner and Designer.

REGULATORY REQUIREMENTS

All installation work shall comply with applicable municipal, state and federal codes, sign ordinances and ADA guidelines for handicapped and fire/life safety signing.

All OSHA safety requirements will be implemented during fabrication and installation as needed or required to comply with safety regulations.

All field/site work shall be conducted in compliance with the Owner/Construction Manager's requirements/regulations for the site, particularly areas open and accessible to the public. Work area protection shall be required as needed and all site-specific rules should be reviewed and outlined during the project kick-off meeting.

CLEAN UP

Daily and upon completion of installation remove all waste, dirt, wrappings and excess materials, tools and equipment, and thoroughly clean all surfaces to the satisfaction of

the Owner.

REORDERING

All items specified in this package shall be available to the Owner in additional quantities for a period of 10 years after completion of all work called for in this specification.

Quality of Materials

METALS

Aluminum

Aluminum shall be of best commercial quality and the various forms shall be straight and true.

There shall be no scratches, scars or buckles. Size thickness, and finish of aluminum shall be per NAAMM "Metal Finishes Manual". Comply with the following industry standards.

Aluminum sheets shall conform to ASTM B209 6061-T6

Aluminum extrusions shall conform to ASTM B241 6063 T6. Wall thickness shall be a minimum of 1/8" thick unless otherwise shown.

Brushed Finishes—Brush with abrasive of increasing grit# in a linear directional pattern.

Final surface shall have visible grain pattern to match sample approved by Designer. Spray with clear protective finish.

Polished Finish—Brush with abrasive of increasing grit#. Buff to a mirror finish with no visible grain. Match sample ap- proved by Designer. Spray with clear protective finish.

Non-Directional Finish—Brush with abrasive mounted in an random orbital sander. Match sample approved by Designer. Spray with clear protective finish.

Stainless Steel

Structural Stainless steel shapes to be rolled or laser fused, as manufactured by Stainless Structurals, LLC. (936-538- 7600, www.stainless-structurals.com)

Chromium stainless steel sheet. Use type 304 or type 316 stainless steel with 16% chromium and 10% nickel.

For steel exposed to view on completion, provide materials having flat, smooth surfaces without blemishes. Do not use materials whose surfaces exhibit pitting, seam marks, roller marks, rolled trade names, or roughness. Stainless Steel Plate, Sheet and Strip: Provide stainless steel plate, sheet, or strip, AISI Type 302, complying with requirements of ASTM A 167.

Stainless Steel Finishes: Finish designations prefixed by "AISI" conform to the system established by the American Iron and Steel Institute for designating finishes.

Finish: Beadblasted & Pickled.

CUSTOM HIGH PRESSURE LAMINATE

Provide Custom High pressure laminate as manufacturer by iZone or an approved equal.

Custom High Pressure Laminate material composed of required layers of phenolic resin impregnated brown kraft filler paper to produce specified thicknesses, surfaced by

a layers of melamine overlay, graphics imaged on saturation grade paper with UV resistant pigment based process color inks, and with an optically clear UV overlay that will resist no less that 99% of all sunlight and UV rays, as well as provide a graffiti resistant surface that allows for removal with standard cleaners.

Layers of material are to be assembled, and heat / pressure consolidated at approximately 1200 PSI at temperatures exceeding 275° Fahrenheit at manufacturer's prescribed time frames.

All manufacturing processes of printing, pressing, machining, finishing and crating to be accomplished within a single standalone manufacturing facility to ensure consistent quality control and providing standard product delivery times of three weeks.

WOOD

#1 grade black locust lumber. Sustainably harvested. Eased edges. Apply a UV clear coat to enhance the wood grain and provide additional protection.

VINYL FILM

Reflective Graphics

Provide 3M Scotchlite enclosed lens reflective sheeting or approved equal

CONCRETE

All concrete footers are to be poured in place.

All concrete footers are to be poured from thoroughly mixed and agitated concrete in order prevent unreasonable voids in the finished casting.

Concrete to meet specified “PSI Test” for strength: 3,500 psi minimum. Concrete to meet specified “Slump test” before pouring footing. All footings to extend past the frost line.

Any footers or posts for signs will be placed in wet concrete and allowed to fully cure in place before any signage

is attached or mounted to it in any way. All exposed faces of concrete shall receive a finish to match existing, adjacent surfaces.

ADHESIVES AND TAPES

VHB Foam Tapes

Provide 3M Scotch VHB 4930 Adhesive shall be Acrylic VHB Carrier shall be closed cell foam

ACCESSORIES

Anchors and Fastenings

Provide anchors and fasteners required to secure work in place. Do not expose fastenings on surface of sign panels unless specifically noted otherwise. Do not deform, distort or discolor sign face surfaces by attachment of concealed fastenings.

All fastenings shall be non-corrosive and resistant to oxidation or other corrosive action, of the same composition completely through their cross sections, particularly when used below grade. Use highest quality stainless steel hardware and fasteners.

Anchors, inserts or fasteners shall be compatible with sign materials, shall not result in galvanic action or chemical interaction of adhesives and shall have demonstrable and sufficient strength for intended use.

Steel anchors and fastenings for exterior use shall be galvanized in accordance with ASTM A153.

Fabricate and install signs with fastenings to withstand all actions imposed by use; 30 psf wind perpendicular to surfaces, water, ice, snow loads and similar forces.

Anchor bolts in concrete shall be cast in place. Fabricator shall furnish instructions for the setting of anchors and bearing plates. Fabricator shall ascertain that the items are properly set during the process of the work.

Secure work with fastenings of same color and finish as the components they secure where they are exposed to view, unless noted otherwise. All exposed fasteners must be van- dal resistant and have vandal-proof "spanner" type slots to be removed only with a special driver head.

Display Cases

Provide Display Cases as manufacturer by Allen Display (allendisplay.com) or an approved equal.

24wx36h, 1 Door Enclosed Bulletin Board, Outdoor Usage, Frame Finish: Satin Aluminum, hinged, shatter-resistant acrylic door with lock, weatherized rear panel, thick rubber door seal, interior back with tackable vinyl, self healing to withstand repeated tacking, exterior case depth is 2"

36wx48h, 1 Door Enclosed Bulletin Board, Outdoor Usage, Frame Finish: Satin Aluminum, hinged, shatter-resistant acrylic door with lock, weatherized rear panel, thick rubber door seal, interior back with tackable vinyl, self healing to withstand repeated tacking, exterior case depth is 2"

48wx36h, 2 Door Enclosed Bulletin Board, Outdoor Usage, Frame Finish: Satin Aluminum, hinged, shatter-resistant acrylic door with lock, weatherized rear panel, thick rubber door seal, interior back with tackable vinyl, self healing to withstand repeated tacking, exterior case depth is 2"

Self-healing Tack Surface

Provide Tack Surface as manufacturer by Rubber Flooring Inc. (rubberflooringinc.com) or an approved equal.

Tough Rubber Roll - 3' or 4' widths and custom lengths - 5mm thick recycled rubber buffings are the cleanest, strongest, and most consistent raw material as compared to some of the cheap recycled crumb rubber alternatives available.

Product is made in the U.S.A.

For Installation a quality adhesive with a urethane base is recommended.

Tough Rolled Rubber is easy to clean, use mild soap and water mixture. Some soaps commonly used include Dawn dish detergent and/or Tide laundry detergent.

Note: Do not use any solvent or oil style cleaners such as Pinesol, Lysol, Murphy's Oil Soap, WD40, paint thinner, etc. since these types of cleaners will break down the material over time.

The surface will not show pin holes, and resists moisture, mold, bacteria, and chemicals.

DOG WASTE BAG DISPENSER

Provide ONEpul® Bag Dispenser - Item #:DEPOT-019, (size: 11"w x 18"h x 5"d) as manufactured / distributed by Dog Waste Depot (www.dogwastedepot.com) or an approved equal.

Made from commercial grade aluminum, Black finish is recommended. Dispenser is screen-printed and powder coated for durability. For use with Holds 800 ONEpul® or 800 MittN™ Header Bags that can also be purchased at www.dogwastedepot.com. Bags hang from 2 prongs inside dispenser compartment. Bags feed automatically via an in- ternal, unbreakable spring. Dispenser has a locking compartment and comes with 2 keys. Mount dispenser to post.

TYPOGRAPHY

All type shall be computer typeset using typefaces specified in the Design Intent Package with letter spacing adjusted where needed to ensure optical spacing. Absolutely no letters are to touch. Only typefaces specified in the Design Intent Package are to be used.

Sign type drawings indicate which copy is uppercase and which is lowercase. These should be followed as much as possible. When the message on the Copy List differs from the drawing, the Copy List should be followed.

GRAPHICS

All text, arrows and symbols shall be provided in the sizes, colors, typefaces and letter spacing specified in the Design Intent Package. All text shall be a true, clean photo-mechanically accurate reproduction of the typeface(s) specified as shown in the Graphic Standards section.

Text shown in drawings is for layout purposes only (unless message layouts are included in the Design Intent Package); final text for all signs is shown in the Copy List.

Construction Standards

GENERAL

Fabricate signs to comply with the requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes and details of construction. Sign panel surfaces shall be smooth, even and fabricated to remain flat under installed conditions. Where specification calls for painted edges, they shall be routed and painted to match face color. For framed units, edges shall be painted or brushed to match finish of face of unit unless otherwise indicated on drawings.

This work may be produced by multiple contractors. Coordination with Designer and other contractors is required to provide for consistent signage across the entire project area, including color, material sizes and design intent.

CUSTOM HIGH PRESSURE LAMINATE

Quality of entire project must conform to specification and bid submittals as approved by the Designer.

Quality assurance to be provided by all printing, pressing, machining, finishing and crating of project products to be accomplished within a single stand alone manufacturing facility.

Manufacturer's craftsmen shall have a minimum of two years proven experience in this field of work and be approved by the Designer for this type of work.

Submit evidence of having successfully completed two projects of similar scope to this bid within the preceding two years.

Product to be assembled utilizing only FSC certified brown kraft paper.

Product to include a minimum of 5% Post Consumer Recycled Kraft Paper in product layup. Manufacturer to provide written confirmation and materials procurement back up of such recycled content inclusion.

Meets LC50 Pittsburgh Protocol Toxicity Test. Equal to and no more toxic than wood or paper.

DIGITALLY PRINTED MEDIA

Printer to have direct-to-substrate printing capabilities with CMYK and White ink options.

All media is to be opaque, with full even coverage, and free from dust bubbles, blemishes and other foreign matter.

Fabricator should seek to minimize visible banding over color fields and large graphics. Designer reserves the right to reject print samples that display excessive banding.

FINISHES & COATINGS

General

All exposed paint finishes shall be durable and resistant to scratching and chipping.

Finishes shall be spray painted according to manufacturer's specifications for environment, curing time, etc. All paints, inks, coatings and finishes, including primers and other sur- face preparations shall be of the highest quality, manufactured specifically for the surface materials to which they are applied, and shall be compatible with the materials to which they are applied.

Surfaces shall be smooth and free of flaws such as scratch- es, bumps or over-sprayed paint.

All paints, inks, and coatings shall be heavy-duty grade to withstand chalking, fading, discoloration, chipping, cracking, and peeling for a minimum of 7 years, or to the maximum manufacture warranty specifications.

Aluminum

Aluminum surfaces shall be spray painted with acrylic polyurethane enamel

Primer Coat: Matthews 74 760

Catalyst–43 270

Color Coat: Matthews Acrylic Polyurethane Nuance

Stainless Steel

Structural stainless steel shapes to be rolled or laser fused, as manufactured by Stainless Structurals, LLC (1.936.538.7600, www.stainless-structurals.com).

For steel exposed to view on completion, provide materials having flat, smooth surfaces without blemishes. Do not use materials whose surfaces exhibit pitting, seam marks, roller marks, rolled trade names, or roughness. Stainless Steel Plate, Sheet, and Strip: Provide stainless steel plate, sheet, or strip, AISI Type 302, complying with requirements of ASTM A 167.

Finish: Stainless Steel Finishes: Finish designations prefixed by "AISI" conform to the system established by the American Iron and Steel Institute for designating finishes.

Masonry/Stone Structures Raised concrete footers Stone work over masonry

Aluminum sign panels/letters on mason work Cladding over internal frame

ALTERNATE FABRICATION

The drawings show design intent only. The Fabricator is responsible for fabrication and overall level of quality. Any changes in design, materials, fabrication techniques or de- tails necessary to the successful completion of this project should be communicated to the Designer in a timely fashion.

Further development and engineering of Designer's details (for fabrication and installation) is expected and should be shown in the shop drawings.

The Designer recognizes that manufacturers may have shop fabrication techniques that differ from details shown. Suggested changes in fabrication that do not alter the design intent nor reduce the quality will be considered by the De- signer, provided they are submitted in sketch form, as soon as possible, prior to shop

drawing preparation.

END OF SECTION 100610

SECTION 116800

PLAY EQUIPMENT

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 freestanding and composite structure playground equipment.

B. Related Sections:
1. Section 321816.13 “Playground Protective Surfacing” and 321816.33 “Cork Playground Protective Surfacing” for protective surfacing under and around playground equipment.

1.3 DEFINITIONS

A. Definitions in ASTM F1487 apply to Work of this Section.

B. IPEMA: International Play Equipment Manufacturers Association.

C. Use Zone: According to ASTM F 1487, the “area beneath and immediately adjacent to a play structure or equipment that is designated for unrestricted circulation around the equipment and on whose surface it is predicted that a user would land when falling from or exiting the equipment.”

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Initial Selection: For each type of exposed finish.

1. Manufacturer's color charts.
2. Include Samples of accessories involving color selection.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Extent of surface systems and use zones for equipment.

2. Critical heights for playground surfaces and fall heights for equipment.

B. Qualification Data: For Installer and testing agency.

C. Product Certificates: For each type of playground equipment.

D. Sample Warranty: For manufacturer's special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For playground equipment and finishes to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm whose playground equipment components have been certified by IPEMA's third-party product certification service.

B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

C. Safety Standards: Provide playground equipment complying with or exceeding requirements in ASTM F 1487 and CPSC No. 325.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of playground equipment that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures.
b. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PLAY EQUIPMENT

A. Play Equipment: Subject to compliance with requirements, provide products by Kompan, Inc. 605 W. Howard Ln, Suite 101, Austin, TX 78753, 1-(800) 426-9788, www.kompan.us, or approved equal. Local contact: Matt Burn, matbur@kompan.com
1. Swings: Robinia Swings NRO899647. 5 belt swing seats, 1 accessible seat, 2 baby seats. Stainless steel chain.
2. 5-12 Equipment: Robinia Stilts NRO806.
3. 5-12 Equipment: Robinia Spinner Bowl ELE400024. Color yellow.
4. 5-12 Equipment: Robinia Rope Bridge NRO811. Rope color yellow.
5. 5-12 Equipment: Robinia Custom Parkour 5 US-NRO894027. Rope color yellow.
6. 2-5 Equipment: Robinia Sitting Pole NRO209

B. DEDUCT ALTERNATE FITNESS EQUIPMENT: Subject to compliance with requirements, provide products by Kompan, Inc. 605 W. Howard Ln, Suite 101, Austin, TX 78753, 1-(800) 426-9788, www.kompan.us, or approved equal. Local contact: Matt Burn, matbur@kompan.com
   1. 2-5 Equipment: Robinia School Play Panel 4 NRO616
   2. 2-5 Equipment: Robinia Theater & Music Cottage NRO606
   3. 2-5 Equipment: Robinia Dress-up Wall with Mirror NRO603
   4. 2-5 Equipment: Robinia Sitting Pole NRO209

2.2 CAST-IN-PLACE CONCRETE

A. Concrete Materials and Properties: Comply with requirements in Section 033000 "Cast-in-Place Concrete" to produce normal-weight , air-entrained concrete with minimum 28-day compressive strength of 3000 psi, 3-inch slump, and 1-inch- maximum-size aggregate.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for earthwork, subgrade elevations, surface and subgrade drainage, and other conditions affecting performance of the Work.

   1. Do not begin installation before final grading required for placing playground equipment and protective surfacing is completed.

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

3.2 PREPARATION

A. Verify locations of playground perimeter and pathways. Verify that playground layout and equipment locations comply with requirements for each type and component of equipment.

3.3 INSTALLATION, GENERAL

A. Comply with manufacturer's written installation instructions for each equipment type unless more stringent requirements are indicated. Anchor playground equipment securely, positioned at locations and elevations indicated.

   1. Maximum Equipment Height: Coordinate installed fall heights of equipment with finished elevations and critical-height values of protective surfacing. Set equipment so fall heights and elevation requirements for age group use and accessibility are within required limits. Verify that playground equipment elevations comply with requirements for each type and component of equipment.

B. Post and Footing Excavation: Excavate holes for posts and footings as indicated in firm, undisturbed or compacted subgrade soil.

C. Post Set on Subgrade: Level bearing surfaces with drainage fill to required elevation.

D. Post Set with Concrete Footing: Comply with ACI 301 (/ACI 301M) for measuring, batching, mixing, transporting, forming, and placing concrete.

1. Set equipment posts in concrete footing. Protect portion of posts above footing from concrete splatter. Verify that posts are set plumb or at the correct angle, alignment, height, and spacing.

a. Place concrete around posts and vibrate or tamp for consolidation. Hold posts in position during placement and finishing operations until concrete is sufficiently cured.

2. Embedded Items: Follow equipment manufacturer's written instructions and drawings to ensure correct installation of anchorages for equipment.
3. Finishing Footings: Smooth top, and shape to shed water.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative.

1. Perform inspection and testing for each type of installed playground equipment according to ASTM F1487, CPSC No. 325.

C. Playground equipment items will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

E. Notify Architect 48 hours in advance of date(s) and time(s) of testing and inspection.

END OF SECTION 116800

SECTION 116800.01

SPRAYGROUND 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. Extent of work is shown on the Drawings and includes but is not limited to:
   1. Verifying existing and new utility locations.
   2. Design and furnish complete sprayground system where indicated in Drawings
   3. Furnish and install sprayground system.
   4. Layout and stake, trench, install piping, valves, controller, and wiring as well as other necessary appurtenances to provide complete, operational sprayground system.
   5. Check, start-up, adjust and demonstrate operation and winterization of system.
   6. Provide an Operations and Maintenance Manual.
   7. Provide maintenance and adjustments for one (1) season of operation.
   8. Warranty and Guarantee.

B. Related Sections include the following
   1. Division 3 section “Cast-In-Place Concrete”
   2. Division 22 “Plumbing” and Section 221119 Domestic Water Piping Schedules for Backflow preventor

1.3 DEFINITIONS

A. Circuit Piping: Downstream from control valves to water features. Piping is under pressure during flow.

B. Main Piping: Downstream from point of connection to water distribution piping to, and including, control valves. Piping is under water-distribution-system pressure.

1.4 ACTION SUBMITTALS

A. Product Data: Submit manufacturer’s technical product data and catalogue cuts or equipment data for all of the required components. Include pressure ratings, rated capacities, and settings of selected models for the following:
   1. Sprayground equipment including controller and associated valves, pipes, wires, meters, etc.

B. Shop Drawings: Provide layout drawings of proposed system for review by Architect and Owner. Show system piping, including plan layout, and locations, types, sizes, capacities, and flow characteristics of piping components. Show wiring diagram. Show areas of spray and overspray.

C. Record drawings: At project closeout, submit record drawings of installed sprayground system piping and products, in accordance with Division 1 requirements.

D. Operation and Maintenance Manual: Including, but not limited to:

1. All equipment data, parts specification and manual sheets.
2. Start-up procedures.
3. Routine maintenance requirements and typical system adjustment needs.
4. Winterization procedures.
5. Controller program.
6. Terms and conditions of guarantee on labor and of warranty on products.
7. Record drawings: As-built record drawings of installed sprayground system piping and electrical conduit. Provide one (1) hard copy and one (1) digital record in PDF format.

E. Qualification Data: For qualified Installer.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms regularly engaged in manufacturing sprayground systems materials and products, of types and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Installer Qualifications: Contractor shall have experience with at least five (5) other projects of similar scope and complexity and shall perform work with personnel totally familiar with sprayground systems and construction techniques under the supervision of an experienced foreperson.

C. Applicable requirements of current editions of accepted Standards, Codes and trade practices apply to work of this Section, including, but not limited to:
1. American Society of Testing and Materials (ASTM)
2. National Plumbing Code
3. National Electrical Code (NEC)

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, handle and protect all materials from damage.

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

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

1.7 PROJECT CONDITIONS

A. Coordinate installation of sprayground system with storm drainage systems, underground raceways for electrical system, concrete paving, and stone masonry.

B. Protect existing and new construction conditions adjacent to and within the limit of work.
1. All necessary precautions for safety including barricades and other protection measures shall be taken during all work.
2. All heavy equipment shall be driven or parked on the site only where approved by Architect.
3. Elements damaged or disturbed during construction including but not limited to existing pavements, structures, walls, and utility lines (above and below grade) shall be repaired or replaced to the satisfaction of the Owner at the cost of the Contractor.
4. Repair and replace all active utility lines, above and below grade, damaged in the course of construction operations.

C. Drawings shall be verified in field. Any discrepancies must be brought to the attention of the Architect prior to proceeding with the work.

1.8 SECQUENCING AND SCHEDULING

A. Coordinate work in this Section with work of all other Sections of the Project Manual.

1.9 GUARANTEE

A. Guarantee work for two (2) years from date of acceptance against all defects in material, equipment, and workmanship. Repairs, if required, shall be done promptly. Additional work effected by sprayground system defects including but not limited to utilities, planting, site stonework, and concrete paving shall be the financial responsibility of the Contractor.

B. Guarantee shall include spring start-up and winterizing of system within the two (2) year time. Winter damage due to improper winterization is the responsibility of the Contractor.

C. All repairs and servicing required shall be made under the observation of the Owner's maintenance staff. The contractor shall include training to Owner staff at these times.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide new piping materials and factory-fabricated piping products of sizes, types, pressure ratings and capacities as required by manufacturer to install sprayground system.

B. Contractor is responsible for the design and installation of the system. Architect and Owner will review submittals and provide information as necessary to assist Contractor in development of system.

C. All work shall be in compliance with applicable codes and regulations. The Contractor is responsible to obtain required permits and coordination of inspections.

2.2 MANUFACTURERS

1. Sprayground Features – Landscape Structures, Inc. Local sales representative: Will Hemler, General Recreation Inc., will@gen-rec.com or approved equal.
   a. Coordinate design and development of sprayground system with Owner and Architect.

2.3 SPRAYGROUND FEATURES

A. Basis of Design:
1. Model: (2) Single Post Mister, 155071. Push button activation. Color: Matte Gray.

2.4 PIPE

A. Pipe schedule and material requirements to be provided by manufacturer.

2.5 CAST-IN-PLACE CONCRETE

A. Concrete Materials and Properties: Comply with requirements in Section 033000 "Cast-in-Place Concrete" to produce normal-weight , air-entrained concrete with minimum 28-day compressive strength of 3000 psi, 3-inch slump, and 1-inch- maximum-size aggregate.

2.6 ACCESSORIES

A. Sleeves: Sleeves for pipes passing beneath paving shall conform to ASTM D2241. Minimum diameter of 2 inch or 2 sizes larger than pipe scheduled to pass through them.

B. PVC Solvent Cement: Cement shall conform to ASTM D2564

2.7 WATER SUPPLY

1. Water supply shall be provided at recessed controls for sprayground as designated on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which sprayground system materials and products are to be installed. Located, identify and protect existing and new below-grade utilities.

B. Make field measurements necessary for Work noting relationship of sprayground work to work of other trades. Coordinate with other trades.
   1. Set stakes to identify locations of proposed sprayground system. Obtain architect’s approval before excavation.

C. Notify Architect of any discrepancies between the Contract Documents and field conditions.

D. Protect plants, walls, slabs and structures, lighting, waterproofing, underdrainage etc., from damage due to work of this Section. Damage to work of another trade shall be reported immediately.

E. Prior to installation, receive approval from General Contractor to proceed with construction.

3.2 EXCAVATION, BACKFILLE AND PIPE ASSEMBLY AND INSTALLATION

A. Excavate and trench to depths indicated on the Drawings.

B. Install sleeves as required prior to installation of pavement and coordinate with installation of segmental retaining walls.

C. Backfilling to be done in accordance with Division 31 Section “Earth Moving”.

D. Trenching and Backfilling:

1. Excavate trench to proper depth as shown or specified.
2. Minimum trench width shall be 3 ½ inches.
3. Over excavate trenches deeper than required in soils containing rock or other hard material that might damage pipe and backfill to proper depth with selected fine earth or sand.
4. Backfill and hand tamp over excavation prior to installing piping.
5. Keep trenches free of obstructions and debris that would damage pipe.
6. Sprayground piping shall not be installed in same trench as heating ducts, electrical ducts, storm and sanitary sewer lines, water, and gas mains.

E. Location and Arrangements: Drawings indicate location and arrangement of piping systems. Install piping as indicated on Civil drawings unless deviations are approved on Coordination Drawings.

F. Install piping at minimum uniform slop of 0.5 percent down toward drain valves.

G. Install piping free of sags and bends.
1. Snake pipe in trench at least 1 foot per 100 feet of pipe to allow for thermal expansion.

H. Install groups of pipes parallel to each other, spaced to permit valve servicing.

I. Install fittings for changes in direction and branch connections.

J. Install expansion loops in control-valve boxes for plastic piping.

K. Lay piping on solid subbase, uniformly sloped without humps or depressions.

L. Install PVC piping in dry weather when temperature is above 40 deg. F. Allow joints to cure at least 24 hours at temperatures above 40 deg F before testing.

M. Install piping sleeves as necessary.

N. No pipe shall be laid when, in the opinion of the Owner, trench or weather conditions are unsuitable. When pipe laying is not in progress, open ends of installed pipe shall be closed by approved means to prevent entrance of trench water and other foreign material into the line. Enough backfill shall be placed in the center sections of the pipe to prevent floating. Any pipe that has floated shall be removed from trench and re-laid.

O. Record pipe locations on record drawings.

3.3 SPRAYGROUND FEATURE INSTALLATION

A. Install features per manufacturers instructions.

3.4 CLEAN UP

A. Maintain the site in an orderly condition during the progress of work. Promptly remove debris and trash. Leave the site in a neat, orderly condition, broom clean.

3.5 STARTUP SERVICE

A. Perform startup service.
1. Complete installation and startup checks according to manufacturer’s written instructions.
2. Verify that controllers are installed and connected according to the Contract Documents.

3. Verify that electrical wiring installation complies with manufacturer's submittal.

3.6 ADJUSTING

A. Adjust settings of controllers.

B. Adjust automatic control valves to provide flow rate at rated operating pressure required by manufacturer.

C. Adjust sprayground system for optimal performance.

3.7 MAINTENANCE DURING GUARANTEE PERIOD

A. General: Perform procedures set forth in the submitted and approved maintenance program for the duration of Guarantee Period.

B. Winterize sprayground system in accordance with manufacturer's recommendations.

3.8 CLOSE OUT

A. Instruct the Owner's personnel in the proper operation, maintenance, repairs, and winterization of the system.

B. At completion of walk through and instruction of Owner's personnel, Contractor shall insure that the following are complete.
   1. Permits required for this work are signed-off by appropriate parties and copies furnished to Owner
   2. Maintenance and Operating Manuals and warranty cards are complete and delivered to Owner, including record drawings and other required items.

END OF SECTION 116800

Section 129300

Site Furnishings

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. Benches
2. Trash Receptacle
3. Recycling Receptacle
4. Drinking Fountain & Bottle Filling Station

B. Relate Requirements:
1. Section 033053 “Cast-in-place Concrete” for installing equipment and/or anchor bolts cast in concrete footings.
2. Section 312000 “Earth Moving” for excavation for installing concrete footings.
3. Section 321313 “Concrete Paving”

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For site furnishings to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Anchors, Fasteners, Fittings, and Hardware: Provide stainless steel: commercial quality, tamperproof, vandal and theft resistant unless indicated otherwise on the Drawings.

B. Nonshrink, nonmetallic grout: Premixed, factory packaged, nonstaining, noncorrosive, nongaseous group complying with ASTM C 1107; recommended in writing by manufacturer, for exterior applications.

C. Erosion-Resistant Anchoring Cement: Factory-packaged, nonstaining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound; resistant to erosion from water exposure without needing protection by a sealer or waterproof coating; recommended in writing by manufacturer, for exterior applications.

2.2 BENCHES

A. Basis-of-Design Product: Subject to compliance with requirements, provide furnishings manufactured by Dumor Inc. – P.O. Box 142, Mifflintown, PA 17059, Phone: (800) 598-4018, Web: www.dumor.com. Local Representative: General Recreation, P.O. Box 440, Newtown Square, PA 19073, Phone: (800) 726-4793, Web: www.generalrecreationinc.com

1. Model: 166-60D

2. Finish/Color: Powdercoat/Black

3. With center arm and 'Fairmount Park' security panel.

4. Mount: As shown on Drawings.

2.3 TRASH RECEPTACLE

A. Basis-of-Design Product: Subject to compliance with requirements, provide furnishings manufactured by Dumor Inc. – P.O. Box 142, Mifflintown, PA 17059, Phone: (800) 598-4018, Web: www.dumor.com. Local Representative: General Recreation, P.O. Box 440, Newtown Square, PA 19073, Phone: (800) 726-4793, Web: www.generalrecreationinc.com

1. Model: 157-32-SH

2. Finish/Color: Powdercoat/Black

3. Mount: As shown on Drawings

2.4 RECYCLING RECEPTACLE

A. Basis-of-Design Product: Subject to compliance with requirements, provide furnishings manufactured by Dumor Inc. – P.O. Box 142, Mifflintown, PA 17059, Phone: (800) 598-4018, Web: www.dumor.com. Local Representative: General Recreation, P.O. Box 440, Newtown Square, PA 19073, Phone: (800) 726-4793, Web: www.generalrecreationinc.com

1. Model: 157-32-FTO

2. Finish/Color: Powdercoat/Recycle Blue

3. Mount: Ash shown on Drawings.

2.5 ADD ALTERNATE 1: DRINKING FOUNTAIN & BOTTLE FILLING STATION

A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide furnishings manufacturered by Elkay, 133 Butterfield Road Ste. 200, Downers Grove, IL 60515, (630) 574-8484, www.elkay.com, or approved comparable product.

1. Model: LK4430BF1UBLK

2. Finish/Color: Black

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, counting 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 landscaping and paving have been completed.

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

D. Post Setting: Set cast-in support posts in concrete footing with smooth top, shaped 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.

E. Pipe Sleeves: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have ben inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions, with top smoothed and shaped to shed water.

3.3 CLEANING

A. After completing site furnishing installation, inspect components. Remove spots, dirt, and debris. Repair damaged finishes to match original finish or replace component.

END OF SECTION 129300

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper building wire rated 600 V or less.
2. Connectors, splices, and terminations rated 600 V and less.

1.2 DEFINITIONS

A. RoHS: Restriction of Hazardous Substances.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: Indicate type, use, location, and termination locations.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

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

1. Belden Inc.
2. Encore Wire Corporation.
3. Service Wire Co.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B496 for stranded conductors.

E. Conductor Insulation:

1. Type TC-ER: Comply with NEMA WC 70/ICEA S-95-658 and UL 1277.
2. Type THHN and Type THWN-2: Comply with UL 83.
3. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
4. Type UF: Comply with UL 83 and UL 493.
5. Type XHHW-2: Comply with UL 44.

2.2 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Manufacturers: 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. 3M Electrical Products.
2. Hubbell Power Systems, Inc.
3. Service Wire Co.

C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.

1. Material: Copper.
2. Type: Two hole with standard barrels.
3. Termination: Compression.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Feeders: Copper for feeders smaller than No. 4 AWG; copper or aluminum for feeders No. 4 AWG and larger. Conductors shall be solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

C. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

D. Branch Circuits: Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.

E. VFC Output Circuits Cable: Extra-flexible stranded for all sizes.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN/THWN-2, single conductors in raceway.

B. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

C. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor and identify as spare conductor.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.

2. Perform each of the following visual and electrical tests:

   a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
   b. Test bolted connections for high resistance using one of the following:

      1) A low-resistance ohmmeter.
      2) Calibrated torque wrench.
      3) Thermographic survey.

   c. Inspect compression-applied connectors for correct cable match and indentation.
   d. Inspect for correct identification.
   e. Inspect cable jacket and condition.
   f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
   g. Continuity test on each conductor and cable.
   h. Uniform resistance of parallel conductors.

3. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.

a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

B. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING 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 grounding and bonding systems and equipment.

B. Section includes grounding and bonding systems and equipment, plus the following special applications:

1. Underground distribution grounding.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in operation and maintenance manuals.

B. Plans showing as-built, dimensioned locations of system including:
1. Conduit/conductor locations
2. Hand hole locations
3. Light fixture/pole locations

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Certified by NETA.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 CONDUCTORS

A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B3.
2. Stranded Conductors: ASTM B8.
3. Tinned Conductors: ASTM B33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.3 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

C. Cable-to-Cable Connectors: Compression type, copper or copper alloy.

D. Conduit Hubs: Mechanical type, terminal with threaded hub.

E. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.

F. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.

G. Service Post Connectors: Mechanical type, bronze alloy terminal, in short- and long-stud lengths, capable of single and double conductor connections.

H. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.

I. Straps: Solid copper, copper lugs. Rated for 600 A.

J. Tower Ground Clamps: Mechanical type, copper or copper alloy, terminal two-piece clamp.

K. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.

2.4 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.

1. Bury at least 30 inches below grade.
2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.

C. Grounding Conductors: Green-colored insulation with continuous yellow stripe.

D. Isolated Grounding Conductors: Green-colored insulation with more than one continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

E. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.

3.4 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.

C. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

D. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.5 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
2. Use exothermic welds for all below-grade connections.
3. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

D. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.

1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.
2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

E. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; using electrically conductive coated steel reinforcing bars or rods, at least 20 feet long. If reinforcing is in multiple pieces, connect together by the usual steel tie wires or exothermic welding to create the required length.

F. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.

4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.

    a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    b. Perform tests by fall-of-potential method according to IEEE 81.

4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

C. Grounding system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.

F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1.2 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Boxes, enclosures, and cabinets.
4. Handholes and boxes for exterior underground cabling.

B. Related Requirements:
1. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior duct banks, manholes, and underground utility construction.

1.3 DEFINITIONS

A. GRC: Galvanized rigid steel conduit.

B. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

A. Metal Conduit:

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

a. AFC Cable Systems; a part of Atkore International.

b. Allied Tube & Conduit; a part of Atkore International.
c. Plasti-Bond.
d. Thomas & Betts Corporation; A Member of the ABB Group.

2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. GRC: Comply with ANSI C80.1 and UL 6.
4. ARC: Comply with ANSI C80.5 and UL 6A.
5. IMC: Comply with ANSI C80.6 and UL 1242.
6. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

   a. Comply with NEMA RN 1.
   b. Coating Thickness: 0.040 inch, minimum.

7. EMT: Comply with ANSI C80.3 and UL 797.
8. FMC: Comply with UL 1; zinc-coated steel or aluminum.
9. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

B. Metal Fittings:

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

   a. AFC Cable Systems; a part of Atkore International.
   b. FSR Inc.
   c. Thomas & Betts Corporation; A Member of the ABB Group.
   d. Topaz Electric; a division of Topaz Lighting Corp.

2. Comply with NEMA FB 1 and UL 514B.
3. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
4. Fittings, General: Listed and labeled for type of conduit, location, and use.
5. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
6. Fittings for EMT:

   a. Material: Steel.
   b. Type: compression.

7. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
8. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

C. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS AND FITTINGS

A. Nonmetallic Conduit:

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

    a. AFC Cable Systems; a part of Atkore International.
    b. Thomas & Betts Corporation; A Member of the ABB Group.
    c. Topaz Electric; a division of Topaz Lighting Corp.

2. Listing and Labeling: Nonmetallic conduit shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. Fiberglass:

    a. Comply with NEMA TC 14.
    b. Comply with UL 2515 for aboveground raceways.
    c. Comply with UL 2420 for belowground raceways.

4. ENT: Comply with NEMA TC 13 and UL 1653.
5. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
6. LFNC: Comply with UL 1660.
7. Rigid HDPE: Comply with UL 651A.
8. Continuous HDPE: Comply with UL 651A.
9. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D3485.
10. RTRC: Comply with UL 2515A and NEMA TC 14.

B. Nonmetallic Fittings:

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

    a. AFC Cable Systems; a part of Atkore International.
    b. Thomas & Betts Corporation; A Member of the ABB Group.
    c. Topaz Electric; a division of Topaz Lighting Corp.

2. Fittings, General: Listed and labeled for type of conduit, location, and use.
3. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

    a. Fittings for LFNC: Comply with UL 514B.

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

2.3 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: 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. Hubbell Incorporated; Wiring Device-Kellems.
2. Thomas & Betts Corporation; A Member of the ABB Group.
3. Topaz Electric; a division of Topaz Lighting Corp.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

F. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.

G. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb.

1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.

J. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

K. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.

L. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 4X with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

M. Cabinets:

1. NEMA 250, Type 3R galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.4 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

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

   a. Armorcast Products Company.
   b. Oldcastle Precast, Inc.
   c. Quazite: Hubbell Power Systems, Inc.

2. Standard: Comply with SCTE 77.
3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "ELECTRIC.".
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.5 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and 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 either 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 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC or RNC, Type EPC-40-PVC.
2. Concealed Conduit, Aboveground: GRC or RNC, Type EPC-40-PVC.
3. Underground Conduit: RNC, Type EPC-40-PVC, concrete encased.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFNC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 4.

B. Minimum Raceway Size: 3/4-inch trade size.

C. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

D. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

E. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Arrange stub-ups so curved portions of bends are not visible above finished slab.

E. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.

F. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.

G. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. Support conduit within 12 inches of enclosures to which attached.
   1. Change from ENT to GRC IMC before rising above floor.

I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

J. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

K. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

L. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

M. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

N. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

O. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

P. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

Q. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a

flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

R. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
   1. Where an underground service raceway enters a building or structure.
   2. Where otherwise required by NFPA 70.

S. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

T. Expansion-Joint Fittings:

   1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
   2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

      a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
      b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.

   3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
   4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
   5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

U. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semi recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

   1. Use LFMC in damp or wet locations subject to severe physical damage.
   2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

V. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to bottom of box unless otherwise indicated.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:
   1. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength.
   2. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
   3. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

      a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
      b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

   4. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits but a minimum of 6 inches below grade. Align planks along centerline of conduit.
   5. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

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, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.

D. Install handholes with bottom below frost line.

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 conduits 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.

3.5 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

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

1.2 DEFINITIONS

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

B. Duct Bank:

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

C. GRC: Galvanized rigid (steel) conduit.

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

1.3 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 manholes, handholes, boxes.
4. Include underground-line warning tape.

B. Shop Drawings:

1. Precast or Factory-Fabricated Underground Utility Structures:

a. Include plans, elevations, sections, details, attachments to other work, and accessories.

b. Include duct entry provisions, including locations and duct sizes.
c. Include reinforcement details.
d. Include frame and cover design and manhole chimneys.
e. Include grounding details.
f. Include dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
g. Include joint details.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: For duct and duct bank. Show duct profiles and coordination with other utilities and underground structures.

1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.

1.5 FIELD CONDITIONS

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

1. Notify Owner no fewer than two days in advance of proposed interruption of electrical service.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND FITTINGS

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

B. Coated Steel Conduit: PVC-coated GRC.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch, minimum.

C. Manufacturers: 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. 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

D. 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-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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. ARNCO Corp.
2. CANTEX INC.
3. CertainTeed Corporation.

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 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Allied Tube & Conduit; a part of Atkore International.
b. CANTEX INC.
c. IPEX USA LLC.

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

C. Concrete Warning Planks: Nominal 12 by 24 by 3 inches in size, manufactured from 6000-psi concrete.

1. Color: Red dye added to concrete during batching.
2. Mark each plank with "ELECTRIC" in 2-inch-high, 3/8-inch-deep letters.

2.4 PRECAST CONCRETE HANDHOLES AND BOXES

A. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.

B. <Manufacturers: 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. Christy Concrete Products.
2. Oldcastle Precast, Inc.
3. Wausau Tile Inc.

C. Comply with ASTM C858 for design and manufacturing processes.

D. Frame and Cover: Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.

E. Frame and Cover: Weatherproof aluminum frame with hinged aluminum access door assembly with tamper-resistant, captive, cover-securing bolts.

1. Cover Hinges: Concealed, with hold-open ratchet assembly.
2. Cover Handle: Recessed.

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

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

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

I. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.

1. Extension shall provide increased depth of 12 inches.
2. Slab: Same dimensions as bottom of enclosure, and arranged to provide closure.

J. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

K. Knockout Panels: Precast openings in walls, arranged to match dimensions and elevations of approaching duct, plus an additional 12 inches vertically and horizontally to accommodate alignment variations.
1. Knockout panels shall be located no less than 6 inches from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.
2. Knockout panel opening shall have cast-in-place, welded-wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct.

3. Knockout panels shall be framed with at least two additional No. 3 steel reinforcing bars in concrete around each opening.
4. Knockout panels shall be 1-1/2 to 2 inches thick.

L. Duct Entrances in Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.

1. Type and size shall match fittings to duct to be terminated.
2. Fittings shall align with elevations of approaching duct and be located near interior corners of handholes to facilitate racking of cable.

M. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.5 POLYMER CONCRETE HANDHOLES AND BOXES WITH POLYMER CONCRETE COVER

A. Description: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.

B. <Manufacturers: 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. Armorcast Products Company.
2. Oldcastle Enclosure Solutions.
3. Quazite: Hubbell Power Systems, Inc.

C. Standard: Comply with SCTE 77. Comply with tier requirements in "Underground Enclosure Application" Article.

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 SOURCE QUALITY CONTROL

A. Test and inspect precast concrete utility structures according to ASTM C1037.

B. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of manholes and 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, manholes, 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 manholes, 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 manholes and handholes, and as approved by Architect.

3.2 UNDERGROUND DUCT APPLICATION

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

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

C. Stub-ups: Concrete-encased PVC-coated 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: Polymer concrete, SCTE 77, Tier 15 Structural load rating.
2. Cover design load shall not exceed the design load of the handhole or box.

3.4 EARTHWORK

A. Restoration: Replace area immediately after backfilling is completed.

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

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 manholes and handholes and away from buildings and equipment. Slope duct from a high point between two manholes, to drain in both directions.

D. 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.

E. 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.

F. Installation Adjacent to High-Temperature Steam Lines: Where duct is installed parallel to underground steam lines, perform calculations showing the duct will not be subject to environmental temperatures above 40 deg C. Where environmental temperatures are calculated to rise above 40 deg C, and anywhere the duct crosses above an underground steam line, install insulation blankets listed for direct burial to isolate the duct bank from the steam line.

G. End Bell Entrances to Manholes and 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 manhole or 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 Manholes and Concrete and 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 manhole or 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.

K. Pulling Cord: Install 200-lbf-test nylon cord in empty ducts.

L. Concrete-Encased Ducts and Duct Bank:
1. Excavate trench bottom to provide firm and uniform support for duct. Width: Excavate trench 3 inches wider than duct on each side.
2. Depth: Install so top of duct envelope is at least 24 inches below finished grade in areas not subject to deliberate traffic, and at least 30 inches below finished grade in deliberate traffic paths for vehicles unless otherwise indicated.
3. Support duct on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
4. 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 duct 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.
5. Minimum Space between Duct: 3 inches between edge of duct and exterior envelope wall, 2 inches between ducts for like services, and 4 inches between power and communications ducts.

6. Elbows: Use manufactured duct elbows for stub-ups, at building entrances, and at changes of direction in duct unless otherwise indicated. Extend encasement throughout length of elbow.

    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 flush with finished floor and no less than 3 inches from conduit side to edge of slab.

7. Reinforcement: Reinforce concrete-encased duct where crossing disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
8. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
9. Concrete Cover: Install a minimum of 3 inches of concrete cover between edge of duct to exterior envelope wall, 2 inches between duct of like services, and 4 inches between power and communications ducts.
10. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.

    a. Start at one end and finish at the other, allowing for expansion and contraction of duct as its temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written instructions, or use other specific measures to prevent expansion-contraction damage.
    b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing-rod dowels extending a minimum of 18 inches into concrete on both sides of joint near corners of envelope.

11. Pouring Concrete: Comply with requirements in "Concrete Placement" Article in Section 033000 "Cast-in-Place Concrete." Place concrete carefully during pours to prevent voids under and between duct and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Allow concrete to flow around duct and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-installation application.

M. Warning Planks: Bury warning planks approximately 12 inches above direct-buried duct, placing them 24 inches o.c. Align planks along the width and along the centerline

of duct or duct bank. Provide an additional plank for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional planks 12 inches apart, horizontally.

N. Underground-Line Warning Tape: Bury nonconducting underground line specified in Section 260553 "Identification for Electrical Systems" no less than 12 inches above all concrete-encased duct and duct banks and approximately 12 inches below grade. Align tape parallel to and within 3 inches of centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.

3.6 INSTALLATION OF CONCRETE HANDHOLES, AND BOXES

A. Precast Concrete Handhole Installation:

1. Comply with ASTM C891 unless otherwise indicated.
2. Install units level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances.
3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

B. Elevations:

1. Handhole Roof: Install with rooftop at least 15 inches below finished grade.
2. Handhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1 inch above finished grade.
3. Install handholes with bottom below frost line, below grade.
4. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch above finished grade.
5. Where indicated, cast handhole cover frame integrally with handhole structure.

C. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.

D. Hardware: Install removable hardware, including pulling eyes, cable stanchions, and cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.

3.7 INSTALLATION OF HANDHOLES 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, Insert depth of frost line below grade at Project site> 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 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.

3.8 GROUNDING

A. Ground underground ducts and utility structures according to Section 260526 "Grounding and Bonding for Electrical Systems."

3.9 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.
3. Test handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 260526 "Grounding and Bonding for Electrical Systems."

B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.10 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 260553 - IDENTIFICATION 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. Color and legend requirements for raceways, conductors, and warning labels and signs.
2. Labels.
3. Tapes and stencils.
4. Tags.
5. Cable ties.
6. Fasteners for labels and signs.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Delegated-Design Submittal: For arc-flash hazard study.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Comply with NFPA 70E and Section 260573.19 "Arc-Flash Hazard Analysis" requirements for arc-flash warning labels.

F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service and branch-circuit conductors.

1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
2. Colors for 208/120-V Circuits:

a. Phase A: Black.
b. Phase B: Red.
c. Phase C: Blue.

3. Colors for 240-V Circuits:

a. Phase A: Black.
b. Phase B: Red.

4. Colors for 480/277-V Circuits:

a. Phase A: Brown.
b. Phase B: Orange.
c. Phase C: Yellow.

5. Color for Neutral: White or gray.
6. Color for Equipment Grounds: Green.
7. Colors for Isolated Grounds: Green with two or more yellow stripes.

C. Raceways and Cables Carrying Circuits at More Than 600 V:

1. Black letters on an orange field.
2. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."

D. Warning Label Colors:

1. Identify system voltage with black letters on an orange background.

E. Warning labels and signs shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

F. Equipment Identification Labels:

1. Black letters on a white field.

2.3 LABELS

A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

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

a. Brady Corporation.
b. Grafoplast Wire Markers.
c. Marking Services, Inc.
d. Seton Identification Products.

B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.

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

a. Marking Services, Inc.
b. Seton Identification Products.

C. Self-Adhesive Wraparound Labels: [**Preprinted**] [**Write-on**], 3-mil-thick, [**polyester**] [**vinyl**] flexible label with acrylic pressure-sensitive adhesive.

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

a. A'n D Cable Products.
b. Brother International Corporation.
c. Grafoplast Wire Markers.
d. Marking Services, Inc.
e. Seton Identification Products.

2. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.

3. Marker for Labels: Permanent, waterproof, black ink marker recommended by tag manufacturer.
4. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

D. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil-thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

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

    a. A'n D Cable Products.
    b. Brother International Corporation.
    c. Grafoplast Wire Markers.
    d. Marking Services, Inc.
    e. Seton Identification Products.
2. Minimum Nominal Size:

    a. 1-1/2 by 6 inches for raceway and conductors.
    b. 3-1/2 by 5 inches for equipment.
    c. As required by authorities having jurisdiction.

2.4 TAPES AND STENCILS

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

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

    a. Carlton Industries, LP.
    b. Marking Services, Inc.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.

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

    a. Carlton Industries, LP.
    b. Marking Services, Inc.

C. Tape and Stencil: 4-inch-wide black stripes on 10-inch centers placed diagonally over orange background and are 12 inches wide. Stop stripes at legends.

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

    a. Marking Services, Inc.

b. Seton Identification Products.

D. Underground-Line Warning Tape:

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

a. Marking Services, Inc.
b. Seton Identification Products.

2. Tape:

a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical utility lines.
b. Printing on tape shall be permanent and shall not be damaged by burial operations.
c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.

3. Color and Printing:

a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".

4. Tag: Type I:

a. Pigmented polyolefin, bright colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
b. Width: 3 inches.
c. Thickness: 4 mils.
d. Weight: 18.5 lb/1000 sq. ft.
e. Tensile according to ASTM D882: 30 lbf and 2500 psi.

5. Tag:

a. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core; bright colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
b. Width: 3 inches.
c. Overall Thickness: 5 mils.
d. Foil Core Thickness: 0.35 mil.
e. Weight: 28 lb/1000 sq. ft.
f. Tensile according to ASTM D882: 70 lbf and 4600 psi.

E. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.5 TAGS

A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

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

a. Carlton Industries, LP.
b. Marking Services, Inc.
c. Seton Identification Products.

B. Nonmetallic Preprinted Tags: Polyethylene tags, 0.023 inch thick, color-coded for phase and voltage level, with factory printed permanent designations; punched for use with self-locking cable tie fastener.

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

a. Carlton Industries, LP.
b. Grafoplast Wire Markers.
c. Marking Services, Inc.
d. Seton Identification Products.

C. Write-on Tags:

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

a. Carlton Industries, LP.
b. Seton Identification Products.

2. Polyester Tags: 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment.
3. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
4. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.6 CABLE TIES

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Marking Services, Inc.

B. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D638: 12,000 psi.

3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black, except where used for color-coding.

C. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black.

D. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D638: 7000 psi.
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F.
5. Color: Black.

2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of each item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.

1. Secure tight to surface of conductor, cable, or raceway.

H. System Identification for Raceways and Cables over 600 V: Identification shall completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.

1. Secure tight to surface of conductor, cable, or raceway.

I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

J. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

K. Vinyl Wraparound Labels:

1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.

L. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.

M. Self-Adhesive Labels:

1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.

N. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.

O. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.

P. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.

Q. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.

1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

R. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

S. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.

T. Underground Line Warning Tape:

1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
2. Limit use of underground-line warning tape to direct-buried cables.
3. Install underground-line warning tape for direct-buried cables and cables in raceways.

U. Metal Tags:

1. Place in a location with high visibility and accessibility.
2. Secure using UV-stabilized cable ties.

V. Nonmetallic Preprinted Tags:

1. Place in a location with high visibility and accessibility.
2. Secure using plenum-rated cable ties.

W. Write-on Tags:

1. Place in a location with high visibility and accessibility.
2. Secure using plenum-rated cable ties.

X. Baked-Enamel Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on minimum 1-1/2-inch-high sign; where two lines of text are required, use signs minimum 2 inches high.

Y. Metal-Backed Butyrate Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.

Z. Laminated Acrylic or Melamine Plastic Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.

AA. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.3 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

D. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:

1. "EMERGENCY POWER."
2. "POWER."

E. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use self-adhesive wraparound labels to identify the phase.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

F. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use write-on tags with the conductor or cable designation, origin, and destination.

G. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive labels with the conductor designation.

H. Conductors to Be Extended in the Future: Attach marker tape to conductors.

I. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

J. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.

K. Concealed Raceways and Duct Banks, More Than 600 V, within Buildings: Apply floor marking tape to the following finished surfaces:

1. Floor surface directly above conduits running beneath and within 12 inches of a floor that is in contact with earth or is framed above unexcavated space.
2. Wall surfaces directly external to raceways concealed within wall.
3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.

L. Workspace Indication: Apply floor marking tape or tape and stencil to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

M. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.

N. Arc Flash Warning Labeling: Self-adhesive labels.

O. Operating Instruction Signs: Laminated acrylic or melamine plastic signs.

P. Equipment Identification Labels:
1. Outdoor Equipment: Laminated acrylic or melamine sign.
2. Equipment to Be Labeled:

a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of a self-adhesive, engraved, laminated acrylic or melamine label.
b. Enclosures and electrical cabinets.
c. Access doors and panels for concealed electrical items.
d. Switchgear.
e. Switchboards.
f. Transformers: Label that includes tag designation indicated on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
g. Substations.

h. Emergency system boxes and enclosures.
i. Motor-control centers.
j. Enclosed switches.
k. Enclosed circuit breakers.
l. Enclosed controllers.
m. Push-button stations.
n. Contactors.

END OF SECTION 260553

SECTION 260923 - LIGHTING CONTROL DEVICES

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. Time switches.
2. Photoelectric switches.
3. Lighting contactors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of lighting control device to include in operation and maintenance manuals.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Faulty operation of lighting control software.
b. Faulty operation of lighting control devices.

2. Warranty Period: Two year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ELECTRONIC TIME SWITCHES

A. Manufacturers: 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. Cooper Industries, Inc.
2. Invensys Controls.
3. Leviton Manufacturing Co., Inc.

B. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.

1. Listed and labeled as defined in NFPA 70 and marked for intended location and application.
2. Contact Rating: 20-A ballast load, 120-/240-V ac.
3. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program.
4. Astronomic Time: All channels.
5. Automatic daylight savings time changeover.
6. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

2.2 ELECTROMECHANICAL DIAL-TIME SWITCHES

A. <Double click here to find, evaluate, and insert list of manufacturers and products.>

B. Electromechanical-Dial Time Switches: Comply with UL 917.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Contact Rating: 20-A ballast load, 120-/240-V ac.
3. Circuitry: Allows connection of a photoelectric relay as a substitute for the on-off function of a program.
4. Astronomic time dial.
5. Eight-Day Program: Uniquely programmable for each weekday and holidays.
6. Skip-a-day mode.
7. Wound-spring reserve carryover mechanism to keep time during power failures, minimum of 16 hours.

2.3 OUTDOOR PHOTOELECTRIC SWITCHES, SOLID STATE, FLEXIBLE MOUNTING

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

1. Cooper Industries, Inc.

2. Intermatic, Inc.
3. Leviton Manufacturing Co., Inc.

B. Description: Solid state, with SPST dry contacts rated for 1800 VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A, and compatible with ballasts and LED lamps.

1. Listed and labeled as defined in NFPA 70, by a agency NRTL, and marked for intended location and application.
2. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of the photocell to prevent fixed light sources from causing turn-off.
3. Time Delay: Fifteen-second minimum, to prevent false operation.
4. Surge Protection: Metal-oxide varistor.
5. Mounting: Twist lock complies with ANSI C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure from same source and manufacturer as switch.
6. Failure Mode: Luminaire stays ON.

2.4 LIGHTING CONTACTORS

A. <Double click here to find, evaluate, and insert list of manufacturers and products.>

B. Description: Electrically operated and mechanically held, combination-type lighting contactors with nonfused disconnect, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less THD of normal load current).
2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
3. Enclosure: Comply with NEMA 250.
4. Provide with control and pilot devices as scheduled, matching the NEMA type specified for the enclosure.

2.5 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.

B. Examine walls and ceilings for suitable conditions where lighting control devices will be installed.

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

3.2 SENSOR INSTALLATION

A. Comply with NECA 1.

B. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

C. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.3 CONTACTOR INSTALLATION

A. Comply with NECA 1.

B. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.4 WIRING INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.

C. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

D. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.5 IDENTIFICATION

A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."

1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate lighting control devices and perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections:

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Lighting control devices will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 260923

SECTION 262416 - PANELBOARDS

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. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

A. GFCI: Ground-fault circuit interrupter.

B. GFEP: Ground-fault equipment protection.

C. MCCB: Molded-case circuit breaker.

D. SPD: Surge protective device.

E. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of panelboard.

1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.
2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.

5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Include evidence of NRTL listing for series rating of installed devices.
7. Include evidence of NRTL listing for SPD as installed in panelboard.
8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
9. Include wiring diagrams for power, signal, and control wiring.
10. Key interlock scheme drawing and sequence of operations.
11. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device. Include an Internet link for electronic access to downloadable PDF of the coordination curves.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. Include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

1.7 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. Keys: Two spares for each type of panelboard cabinet lock.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: ISO 9001 or ISO 9002 certified.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NECA 407.

1.10 FIELD CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

a. Ambient Temperature: Not exceeding minus 22 deg F to plus 104 deg F.
b. Altitude: Not exceeding 6600 feet.

1.11 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

1. Panelboard Warranty Period: 36 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS AND LOAD CENTERS COMMON REQUIREMENTS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NEMA PB 1.

E. Comply with NFPA 70.

F. Enclosures: Surface-mounted, dead-front cabinets.

1. Rated for environmental conditions at installed location.
a. Outdoor Locations: NEMA 250, Type 3R.

2. Height: 84 inches maximum.

3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
5. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
6. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
7. Finishes:

    a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    b. Back Boxes: Same finish as panels and trim.
    c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.

G. Incoming Mains:

1. Location: Convertible between top and bottom.
2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.

H. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.

    a. Plating shall run entire length of bus.
    b. Bus shall be fully rated the entire length.

2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
4. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
5. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
6. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and listed and labeled by an NRTL acceptable to authority having jurisdiction, as suitable for nonlinear loads in electronic-grade panelboards and others designated on Drawings. Connectors shall be sized for double-sized or parallel conductors as indicated on Drawings. Do not mount neutral bus in gutter.
7. Split Bus: Vertical buses divided into individual vertical sections.

I. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Terminations shall allow use of 75 deg C rated conductors without derating.
3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
6. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
7. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

J. NRTL Label: Panelboards or load centers shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.

K. Future Devices: Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

1. Percentage of Future Space Capacity: 20 percent.

L. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include label or manual with size and type of allowable upstream and branch devices listed and labeled by an NRTL for series-connected short-circuit rating.

1. Panelboards rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
2. Panelboards rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

M. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

B. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 1.

2.3 POWER PANELBOARDS

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

1. Eaton.
2. Siemens Industry, Inc., Energy Management Division.
3. Square D; by Schneider Electric.

B. Panelboards: NEMA PB 1, distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches high, provide two latches, keyed alike.

D. Mains: Circuit breaker.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: 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. Eaton.
2. Siemens Industry, Inc., Energy Management Division.
3. Square D; by Schneider Electric.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

F. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: 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. Eaton.
2. Siemens Industry, Inc., Energy Management Division.
3. Square D; by Schneider Electric.

B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers:

a. Inverse time-current element for low-level overloads.
b. Instantaneous magnetic trip element for short circuits.
c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic Trip Circuit Breakers:

a. RMS sensing.
b. Field-replaceable rating plug or electronic trip.
c. Digital display of settings, trip targets, and indicated metering displays.
d. Multi-button keypad to access programmable functions and monitored data.
e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
f. Integral test jack for connection to portable test set or laptop computer.
g. Field-Adjustable Settings:

1) Instantaneous trip.
2) Long- and short-time pickup levels.
3) Long and short time adjustments.
4) Ground-fault pickup level, time delay, and I squared T response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
6. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
8. Subfeed Circuit Breakers: Vertically mounted.
9. MCCB Features and Accessories:

a. Standard frame sizes, trip ratings, and number of poles.
b. Breaker handle indicates tripped status.
c. UL listed for reverse connection without restrictive line or load ratings.

d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

2.6 IDENTIFICATION

A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.

B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.

C. Circuit Directory: Directory card inside panelboard door, mounted in metal frame with transparent protective cover.

1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

D. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.

1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

2.7 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.

B. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.

D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

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

3.2 INSTALLATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Comply with NECA 1.

C. Install panelboards and accessories according to NECA 407.

D. Equipment Mounting:

1. Install panelboards on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
2. Attach panelboard to the vertical finished or structural surface behind the panelboard.
3. Comply with requirements for seismic control devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."

E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

F. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

G. Mount top of trim 90 inches above finished floor unless otherwise indicated.

H. Mount panelboard cabinet plumb and rigid without distortion of box.

I. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

J. Mount surface-mounted panelboards to steel slotted supports 1-1/4 inch in depth. Orient steel slotted supports vertically.

K. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.

L. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.

M. Install filler plates in unused spaces.

N. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.

O. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

P. Mount spare fuse cabinet in accessible location.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers and low-voltage surge arrestors stated in NETA ATS, Paragraph 7.6 Circuit Breakers and Paragraph 7.19.1 Surge Arrestors, Low-Voltage.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:

    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
    b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
    c. Instruments and Equipment:

        1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as indicated.

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.

1. Measure loads during period of normal facility operations.
2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.

3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

3.6 PROTECTION

A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

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. Standard-grade receptacles, 125 V, 20 A.
2. GFCI receptacles, 125 V, 20 A.
3. Wall plates.

1.3 DEFINITIONS

A. GFCI: Ground-fault circuit interrupter.

B. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

C. SPD: Surge protective device.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

PART 2 - PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Comply with NFPA 70.

C. RoHS compliant.

D. Comply with NEMA WD 1.

E. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
2. Devices shall comply with requirements in this Section.

F. Devices for Owner-Furnished Equipment:

1. Receptacles: Match plug configurations.
2. Cord and Plug Sets: Match equipment requirements.

G. Device Color:

1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Essential Electrical System: Red.
3. SPD Devices: Blue.

H. Wall Plate Color: For plastic covers, match device color.

I. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 STANDARD-GRADE RECEPTACLES, 125 V, 20 A

A. Duplex Receptacles, 125 V, 20 A:

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

a. Eaton (Arrow Hart).
b. Hubbell Incorporated; Wiring Device-Kellems.
c. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Two pole, three wire, and self-grounding.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498 and FS W-C-596.

B. Weather-Resistant Duplex Receptacle, 125 V, 20 A:

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

a. Eaton (Arrow Hart).
b. Hubbell Incorporated; Wiring Device-Kellems.
c. Leviton Manufacturing Co., Inc.

2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498.
5. Marking: Listed and labeled as complying with NFPA 70, "Receptacles in Damp or Wet Locations" Article.

2.3 GFCI RECEPTACLES, 125 V, 20 A

A. Duplex GFCI Receptacles, 125 V, 20 A:

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

a. Eaton (Arrow Hart).
b. Hubbell Incorporated; Wiring Device-Kellems.
c. Leviton Manufacturing Co., Inc.

2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Type: Non-feed through.
5. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

2.4 WALL PLATES

A. Single Source: Obtain wall plates from same manufacturer of wiring devices.

B. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Unfinished Spaces: Galvanized steel.
3. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

C. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

D. Antimicrobial Cover Plates:

1. Contact surfaces treated with a coating that kills 99.9 percent of certain common bacteria within two hours when regularly and properly cleaned.
2. Tarnish resistant.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes, and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall comply with NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

    a. Cut back and pigtail, or replace all damaged conductors.
    b. Straighten conductors that remain and remove corrosion and foreign matter.
    c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.

6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

A. Install non-feed-through GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

B. Essential Electrical System: Mark receptacles supplied from the essential electrical system to allow easy identification using a self-adhesive label.

3.4 FIELD QUALITY CONTROL

A. Test Instruments: Use instruments that comply with UL 1436.

B. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

C. Perform the following tests and inspections:

1. In healthcare facilities, prepare reports that comply with NFPA 99.
2. Test Instruments: Use instruments that comply with UL 1436.

3. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

D. Tests for Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault-current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

E. Wiring device will be considered defective if it does not pass tests and inspections.

END OF SECTION 262726

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

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:
   1. Molded-case circuit breakers (MCCBs).
   2. Molded-case switches.
   3. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

   1. Enclosure types and details for types other than NEMA 250, Type 1.
   2. Current and voltage ratings.
   3. Short-circuit current ratings (interrupting and withstand, as appropriate).
   4. Include evidence of a nationally recognized testing laboratory (NRTL) listing for series rating of installed devices.
   5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
   6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.

B. Shop Drawings: For enclosed switches and circuit breakers.

   1. Include plans, elevations, sections, details, and attachments to other work.

2. Include wiring diagrams for power, signal, and control wiring.

1.5 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

2.2 GENERAL REQUIREMENTS

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

D. Comply with NFPA 70.

2.3 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: 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. Eaton.
2. Siemens Industry, Inc., Energy Management Division.
3. Square D; by Schneider Electric.

B. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.

C. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.

D. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker. Circuit breakers shall be 100 percent rated. combinations for series connected interrupting ratings shall be listed by UL as recognized component combinations. MCCBs shall be equipped with a device for locking in the isolated position.

E. Lugs shall be suitable for 140 deg F rated wire on 125-A circuit breakers and below.

F. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.

G. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

H. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

I. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.
4. Ground-fault pickup level, time delay, and I-squared t response.

J. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

K. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.

L. Ground-Fault Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

M. Ground-Fault Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).

N. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.

2.4 MOLDED-CASE SWITCHES

A. Manufacturers: 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. Eaton.
2. Siemens Industry, Inc., Energy Management Division.
3. Square D; by Schneider Electric.

B. Description: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

C. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.

D. Features and Accessories:

1. Standard frame sizes and number of poles.
2. Lugs:

a. Mechanical type, suitable for number, size, trip ratings, and conductor material.
b. Lugs shall be suitable for 140 deg F rated wire on 125-A circuit breakers and below.

3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.

2.5 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

B. Enclosure Finish: The enclosure shall be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized galvannealed steel (NEMA 250 Types 3R, 12).

C. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both end walls.

D. Enclosures designated as NEMA 250 Type 4, 4X stainless steel, 12, or 12K shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.

E. NEMA 250 Type 7/9 enclosures shall be furnished with a breather and drain kit to allow their use in outdoor and wet location applications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

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

1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.2 PREPARATION

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

1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Owner's written permission.
4. Comply with NFPA 70E.

3.3 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.

1. Outdoor Locations: NEMA 250, Type 3R.

3.4 INSTALLATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

C. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

D. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

E. Install fuses in fusible devices.

F. Comply with NFPA 70 and NECA 1.

3.5 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections.

E. Tests and Inspections for Molded Case Circuit Breakers:

1. Visual and Mechanical Inspection:

a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.

b. Inspect physical and mechanical condition.
c. Inspect anchorage, alignment, grounding, and clearances.
d. Verify that the unit is clean.
e. Operate the circuit breaker to ensure smooth operation.
f. Inspect bolted electrical connections for high resistance using one of the two following methods:

1) Use a low-resistance ohmmeter.

a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.

a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

g. Inspect operating mechanism, contacts, and chutes in unsealed units.
h. Perform adjustments for final protective device settings in accordance with the coordination study.

2. Electrical Tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
c. Perform a contact/pole resistance test. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values shall be no less than two megohms.
e. Determine the following by primary current injection:

1) Long-time pickup and delay. Pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
2) Short-time pickup and delay. Short-time pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
3) Ground-fault pickup and time delay. Ground-fault pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
4) Instantaneous pickup. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.

f. Test functionality of the trip unit by means of primary current injection. Pickup values and trip characteristics shall be as specified and within manufacturer's published tolerances.
g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of the shunt trip and close coils shall be as indicated by manufacturer.
h. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset all trip logs and indicators. Investigate units that do not function as designed.
i. Verify operation of charging mechanism. Investigate units that do not function as designed.

3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
4. Perform the following infrared scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

END OF SECTION 262816

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.

1.2 SUMMARY

A. Section Includes:
1. Removing existing vegetation.
2. Clearing and grubbing.
3. Stripping and stockpiling topsoil.
4. Removing above- and below-grade site improvements.
5. Disconnecting, capping or sealing, and abandoning site utilities in place.

B. Related Sections:

1. Section 015000 "Temporary Facilities and Controls" for temporary erosion- and sedimentation-control measures.

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. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.

C. 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.

D. 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.

E. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.

F. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated on Drawings

G. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 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.

1.5 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.

1.6 QUALITY ASSURANCE

A. Preinstallation Conference: Conduction conference at Project site.

1.7 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing 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 trafficways if required by Owner or authorities having jurisdiction.

B. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises as directed by Owner.

C. Utility Locator Service: Notify PAOne Call for area where Project is located before site clearing.

D. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.

E. 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. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. 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 according to requirements in Section 022310 “Tree Protection, Trimming and Relocation.”

C. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 EXISTING UTILITIES

A. Owner will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing, when requested by Contractor.

1. Verify that utilities have been disconnected and capped before proceeding with site clearing.

B. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.

1. Arrange with utility companies to shut off indicated utilities.
2. Owner will arrange to shut off indicated utilities when requested by Contractor.

C. Locate, identify, and disconnect utilities indicated to be abandoned in place.

D. 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.

3.3 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, and 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.

3.4 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil in a manner to prevent intermingling with underlying subsoil or other waste materials. Contractor to identify and determine depth of existing topsoil as defined in specifications.

1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects larger than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.

C. 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 72 inches
2. Do not stockpile topsoil within protection zones.
3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.
4. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.5 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.

3.6 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.

END OF SECTION 311000

SECTION 312000

EARTH MOVING

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 and grasses and plants.
3. Excavating and backfilling for and structures.
4. Subbase course for concrete walks, pavements.
5. Subbase course and base course for asphalt paving.
6. Subsurface drainage backfill for walls and trenches.
7. Excavating and backfilling trenches for utilities and pits for buried utility structures.

B. Related Requirements:
1. Section 311000 "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
2. Section 329200 "Turf and Grasses" for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.
3. Section 329300 "Plants" for finish grading in planting areas and tree and shrub pit excavation and planting.
4. Section 022310 “Tree Protection, Trimming and Relocation”

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. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

G. Fill: Soil materials used to raise existing grades.

H. 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.

I. 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.

J. 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.

K. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.4 SUBMITTALS

A. Product Data: For each type of the following manufactured products required:

1. Geotextiles.
2. Warning tapes.

1.5 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. Utility Locator Service: Notify PAOne Call for area where Project is located before beginning earth-moving operations.

C. Do not commence earth-moving operations until temporary site fencing and erosion- and sedimentation-control measures specified in Section 312500 “Soil Erosion and Sediment Control” are in place.

D. Do not commence earth-moving operations until plant-protection measures specified in Section 015639 "Temporary Tree and Plant Protection" are in place.

E. 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. Impoundment 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.

F. Do not direct vehicle or equipment exhaust towards protection zones.

G. 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: USDA Soil Classification ‘Loam’ or ‘Clay Loam’; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.

D. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

E. Sand: ASTM C33/C33M; fine aggregate.

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 (700 N); ASTM D4632.
    b. Sewn Seam Strength: 142 lbf (630 N); ASTM D4632.
    c. Tear Strength: 56 lbf (250 N); ASTM D4533.
    d. Puncture Strength: 56 lbf (250 N); ASTM D4833.

2.3 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

B. 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:

1. Red: Electric.
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 and maintain erosion and sedimentation controls during earth-moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 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.
2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:
    a. 12 inches outside of concrete forms at footings.
    b. 12 inches beneath bottom of footings, concrete paving, asphalt paving and curbing.
    c. 6 inches beneath pipe in trenches, and 12 inches on either side from outside wall of pipe.

3.3 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.

B. Excavations at Edges of Tree- and Plant-Protection Zones:
1. See Section 022310 “Tree Protection, Trimming and Relocation” for excavation procedures

3.4 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.5 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. 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.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. For pipes and conduit less than 6 inches in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depressions with tamped sand backfill.
3. For flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support conduit on an undisturbed subgrade.
4. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

D. Trench Bottoms: Excavate trenches 4 inches deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.

1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

E. 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 according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.6 SUBGRADE INSPECTION

A. Proof-roll subgrade below pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes) 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.

B. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.7 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.

3.8 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.

3.9 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. Trenches under Roadways: Provide 4-inch- thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase course. Concrete is specified in Section 033000 "Cast-in-Place Concrete."

E. Backfill voids with satisfactory soil while removing shoring and bracing.

F. Initial Backfill:

1. Soil Backfill: Place and compact initial backfill of satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 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.

2. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 12 inches over the pipe or conduit. Coordinate backfilling with utilities testing.

G. Final Backfill:

1. Soil Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.
2. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation.

H. Warning Tape: Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.10 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, use satisfactory 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.

3.11 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 dry unit weight.

3.12 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 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 D698:

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 85 percent.

3.13 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.

3.14 SUBSURFACE DRAINAGE

A. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6-inch course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches of filter material, placed in compacted layers 6 inches thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches.

1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D698

B. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches of final subgrade, in compacted layers 6 inches thick. Overlay drainage backfill with one layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches.

1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D698
2. Place and compact impervious fill over drainage backfill in 6-inch- thick compacted layers to final subgrade.

3.15 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. Shape subbase course to required crown elevations and cross-slope grades.
3. Place subbase course 6 inches or less in compacted thickness in a single layer.
4. Compact subbase 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 D698.

3.16 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
2. Determine that fill material classification and maximum lift thickness comply with requirements.
3. Determine, during placement and compaction, that in-place density of compacted fill complies with requirements.

B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

C. 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.

D. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.

E. Testing agency will test compaction of soils in place according to ASTM D1556, ASTM D2167, ASTM D2937, and ASTM D6938, as applicable.

F. 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.

3.17 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.

3.18 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 312350

SAWCUTTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section includes the sawcutting of existing concrete, bituminous pavement, and footway at the locations indicated on the plans.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 General

A. Saws shall be equipped with guides, blade guards, water-cooling system and cut-depth control. Sawcut shall be done at the nearest joint, if applicable. The joint shall be sawed continuously and shall be of sufficient depth to allow removal of paving without disturbing the paving that is to remain.

B. Contractor to mark out sawcut lines in field for approval by the Owner or Authorized Representative prior to proceeding with the pavement removal.

END OF SECTION 312350

SECTION 31 25 00 – Soil Erosion and Sediment Control

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. The work of this Section includes all temporary erosion and sediment control and related and incidental operations, including:

1. Filter Bag Inlet protection;
2. Compost filter sock;
3. Temporary seeding and mulching;
4. Rock Construction Entrance;
5. Pumped Water Filter Bag;
6. Compost Sock Washout Station;
7. Safety Fence; and,
8. Maintenance and repair of erosion and sediment control measures.

1.2 SUBMITTALS

A. Submit complete shop drawings and product information for all items to be furnished under this Section upon receipt of notice to proceed and prior to construction.

1.3 QUALITY ASSURANCE

A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary trades and who are completely familiar with the specified requirements and methods needed for proper performance of the work of this Section.

B. Codes and Standards: Perform work in compliance with applicable requirements of governing authorities having jurisdiction. Construction operations shall be carried out in a manner such that soil erosion, air pollution, and water pollution is minimized. State, County, and Municipal laws concerning pollution abatement shall be followed.

C. The recommendations and Standards set forth in Chapter 102 of the Pennsylvania Code (Erosion and Sediment Control Handbook), published by the PA Department of Environmental Protection, shall be applicable where the work is not specifically detailed in this Specification, the accompanying Drawings, or the Erosion and Sediment Control Plan.

D. The Contractor shall take action to remedy unforeseen erosion conditions and to prevent damage to adjacent properties as a result of increased runoff and/or sediment displacement. Stockpiles of wood chips, hay bales, crushed stone, and other mulches shall be held in readiness to deal immediately with emergency problems of erosion. All erosion control checks and structures shall be inspected after heavy rainfalls, and if damaged, repaired or replaced.

E. No other construction activities may take place until appropriate Erosion and Sedimentation Control devices have been installed and approved by Owner/Authorized Representative. All changes to the Erosion and Sedimentation Control Plan must be approved by Owner/Authorized Representative prior to implementation.

1.4 REFERENCES

A. PennDOT, Publication 408/2016 Specifications.

B. Pennsylvania Department of Environmental Protection, Erosion and Sediment Pollution Control Program Manual (March 2012 or most recent version).

C. Commonwealth of Pennsylvania, Department of Transportation (PennDOT)

1. Bulletin No. 15: Approved Construction Materials.

PART 2 - PRODUCTS

2.1 TEMPORARY INLET PROTECTION FILTER BAG

A. Filter bags shall be manufactured with woven polypropylene geotextile and sewn by a double needle machine, using a high strength nylon thread. Filter bags shall have a design flow rate of 40 gpm/sf.

B. Filter bags shall be manufactured to fit the opening of the catch basin or drop inlet. Filter bags will have the following features:

1. Two dump straps attached at the bottom to facilitate the emptying of the bag;

2. Lifting loops as an internal part of the system to be used to lift the filter bag from the basin;

3. Restraint cord approximately halfway up the sack to keep the sides away from the basin walls, this cord is also a visual means of indicating when the sack should be emptied.

C. Filter bag seams shall have a minimum certified average wide width strength per ASTM D-4884 of 300 psi.

D. Inlet filter bags for installation in new or existing highway grate and open mouth grate inlets shall be listed in PennDOT Bulletin 15 or approved equal.

E. City inlet (and curb opening portion of open-mouth grate inlet) protection shall be a synthetic filter manufactured from recycled synthetic fibers listed in PennDOT Bulletin 15 or approved equal.

2.2 COMPOST FILTER SOCK

A. Compost filter socks shall be a three-dimensional tubular sediment control. The compost socks shall be Filtrexx Siltsox manufactured by Filtrexx International LLC of Grafton, Ohio, or approved equal.

2.3 TEMPORARY SEEDING AND MULCHING

A. All stockpiles and inactive disturbed areas shall be seeded and mulched in accordance with the design plans if they are to be left exposed for more than twenty (20) days.

2.4 PUMPED WATER FILTER BAG

A. Pumped water filter bags shall be provided in accordance with PennDOT Publication 408, Section 855.

2.5 CHAIN LINK FENCE

A. Temporary chain link fence shall be galvanized steel and un-coated. Fence chain link fabric shall be minimum 11 gauge steel and mesh size shall be maximum 2 inches.

B. Fence shall be 6 feet high with top and bottom rails. If a continuous fence, line posts shall be maximum 12 feet on center. If a panel fence, sections shall be maximum 12 feet wide, and each individual section shall be securely fastened to its adjacent sections.

C. Fence shall be supported by panel stands or feet and shall be installed and secured without drilling holes in the cartway or footway.

2.6 ROCK CONSTRUCTION ENTRANCE

A. Stabilized (or Rock) Construction Entrance shall be as indicated on the Drawings and on the attached Rock Construction Entrance Detail (Detail E&S-09).

B. Materials and construction for the stabilized construction entrance shall be in accordance with PennDOT Publication 408/2011, Section 849.

1. AASHTO #1 Aggregate shall comply with PennDOT Publication 408, Section 703.

a. Coarse aggregates shall meet the following requirements:

i. Maximum wash loss of 1% (ASTM C117)

ii. Minimum Durability Index of 35 (ASTM D3744)

iii. Maximum abrasion of 10% for 100 revolutions and maximum of 50% for 500 revolutions

iv. All aggregate shall be clean and thoroughly washed.

b. Unless otherwise approved by PWD, coarse aggregate for the stormwater trenches shall be uniformly graded as defined in Standard Sizes of Coarse Aggregate, Table 4, AASHTO Specifications, Part I, 19th Ed., 1998, or latest edition, unless otherwise specified.

i. Grading Requirements for AASHTO No 1

U.S. Standard Sieve Size	Percent Passing
4" (100 mm)	100
3½" (90 mm)	90-100
2½" (63 mm)	25-60
1½" (37.5 mm)	0-15
¾" (19 mm)	0-5

c. Crushed concrete shall not be an acceptable substitute for coarse aggregate unless specifically authorized in writing by PWD prior to placement.

2. Geotextile shall be Class 4 Type A separation fabric per PennDOT Publication 408, Section 735.

a. Geotextile: Non-woven geotextile (separation fabric) shall be US 270NW, Mirafi 1120N, or approved equal.

i. Minimum flow rate 65 gal/min/ft² (ASTM D-4491)

ii. Minimum grab tensile strength 270 lbs (ASTM D-4632)

iii. Minimum CBR puncture strength 700 psi (ASTM D-6241)

iv. Minimum tear resistance 100 lbs (ASTM D-4533)

v. Minimum UV resistance 70% retained strength (ASTM D-4355)

2.7 ORANGE SAFETY FENCING

A. Fence shall be Blaze or International Orange colored, mono-oriented laminar polyethylene plastic, U.V. stabilized material with a mesh size of 3 in. by 1.5 in. and porosity of 60%. The fence shall have a minimum height of 4 ft.

B. Posts for attachment of the fence shall be 2-in. by 2-in. wood posts at a minimum of 6 ft long, or 5-1/2 ft high 2 in. thick steel U-channel posts.

C. Ties for attachment of fencing to posts shall consist of plastic or wire of a gauge sufficient enough to bear the weight of the fencing on the posts.

2.8 COMPOST SOCK WASHOUT STATION

A. Concrete washout water shall be directed to the compost sock washout station as indicated on the plans. The compost sock washout station shall be comprised of a compost filter sock in accordance with this specification.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. All temporary erosion and sediment control measures specified herein shall be in place before the beginning of any earthwork or excavation.

B. All erosion and sediment control devices shall be installed according to the manufacturer's specifications.

C. When temporary erosion and sediment control measures as described herein do not provide adequate control, replacement or relocation of measures may be required as directed by the owner/Authorized Representative.

D. Erosion and sediment control measures shall be inspected weekly and after every precipitation event.

E. Contractor shall maintain complete written logs of inspections and shall make them available to PWD Inspector/Owner/Engineer upon request.

F. All maintenance work, including but not limited to cleaning, repair, replacement, regrading, and restabilization of temporary erosion and sediment control measures shall be performed immediately.

G. Contractor shall ensure that erosion and sedimentation control measures remain in place and fully functional until site achieves final stabilization.

3.2 PUMPED WATER FILTER BAG

A. Sediment-laden water shall be pumped through a pumped water filter bag as specified herein.

B. Filter bags shall be removed and replaced when they have reached their capacity to filter sediment effectively, or upon any breach of the filter bag.

C. The Contractor shall not discharge to any sewer without the prior approval of PWD.

3.3 TEMPORARY INLET PROTECTION

A. The downstream inlets from the site of any disturbance or construction on the project site shall be protected with approved inlet protection practices. Downstream inlets are considered to be the next immediate inlet downslope that will receive runoff from the site of any disturbance, as well as any and all inlets within the site itself.

B. All new inlets shall be protected with approved inlet protection practices upon installation. Inlets draining exclusively to a stormwater feature shall remain fully closed to runoff until final site cleanup.

C. Final site cleanup shall include removal of all temporary inlet protection, cleaning of all permanent inlet protection, and cleaning of all inlets (existing downstream inlets and newly installed) of accumulated construction debris and sediment.

D. Highway grate and open mouth grate inlets shall be protected using inlet filter bags as specified herein.

E. Open mouth grate inlets and open mouth inlets (city inlets) shall be protected with a compost sock or synthetic filter as specified herein.

F. Inlet protection shall be installed, inspected, cleaned and replaced according to manufacturer's specifications.

1. Inlet filter bags and open mouth inlet protection shall be removed and replaced when filled with silt or when extended periods of ponding occur following a precipitation event. New inlet filter bags or approved inlet protection devices shall be installed and secured immediately after removal of silted protection devices.

3.4 STORAGE STOCKPLIES

A. Stockpiles of all loose materials (aggregate, fill, soils, etc) shall be protected from dust and rain by use of a cover. The cover shall be free of defects, and secured adequately to maintain protection of the materials. Owner/Authorized Representative reserves the right to refuse use of any material that has been compromised by inadequate protection onsite.

B. Stockpiles shall not be placed upslope from any infiltration structure. Any drainage structure (such as but not exclusively inlets) downslope of a stockpile shall be adequately protected from runoff.

C. Stockpile heights are not to exceed 20 feet high. Stockpile slopes shall be 2:1 or flatter.

3.5 REMOVAL AND FINAL CLEANUP

A. Once the site has been fully stabilized and approval is given by Owner/Authorized Representative, temporary erosion and sedimentation control measures and all accumulated silt and sediment shall be removed. All permanent inlet protection measures shall be cleaned, inspected, and verified to be in working order.

B. Any remaining dirt or debris within the public right of way shall be removed by the Contractor, using necessary means as sufficient to remove the dirt and debris from the public right of way. This may include, but is not limited to, street sweeping, sidewalk vacuuming, inlet cleaning, power washing, or hand removal.

C. Silt and waste materials shall be disposed of in a proper manner. No extra construction materials are to remain onsite upon completion of the Work. The Work of this Contract shall not be considered complete until all extraneous construction-related items have been removed (temporary traffic control devices, signage, etc).

3.6 REMOVAL AND FINAL CLEANUP

A. Once the site has been fully stabilized and approval is given by PWD, temporary erosion and sedimentation control measures and all accumulated silt and sediment shall be removed. All permanent inlet protection measures shall be cleaned, inspected, and verified to be in working order.

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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. Hot-mix asphalt paving.

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.

1.3 ACTION SUBMITTALS

A. Product Data: for each product specified, include technical data and tested physical and performance properties.

B. Hot-Mix Asphalt Designs:

1. Certification, by authorities having jurisdiction, of approval of each hot-mix asphalt design proposed for the Work.
2. For each hot-mix asphalt design proposed for the Work.

C. Material Test Reports: Indicate and interpret test results for compliance of materials with requirements indicated.

D. Material Certificates: Certificates signed by manufacturers certifying that each material complies with requirements

1.4 QUALITY ASSURANCE

A. Qualifications: Engage an experienced installer, certified in writing by tactile manufacturer as qualified for installation, who has completed asphalt paving similar in material, design, and extent to that indicated for this Project and with a record of successful service performance.

B. Manufacturer Qualifications: Engage a firm experienced in manufacturing hot-mix asphalt similar to that indicated for this Project and with a record of successful in-service performance. Firm shall be a registered and approved paving mix manufacturer with authorities having jurisdiction or with the DOT of the state in which Project is located.

C. Regulatory Requirements: Conform to applicable standards of authorities having jurisdiction.

D. Asphalt-Paving Publication: Comply with AI MS-22 "Construction of Hot Mix Asphalt Pavement," unless more stringent requirements are indicated.

E. Paving contractor to have a minimum of ten (10) years of demonstrated successful experience in the installation of asphalt surfaces.

F. Pre-installation conference: Conduct conference at Project site to comply with requirements in project General and Supplementary Conditions.

1.5 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 and Tack Coat: Minimum surface temperature of 40 deg F and rising at the time of placement.
2. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
3. Asphalt Surface Course: Minimum surface temperature of 40 deg F and rising at time of placement.

PART 2 - PRODUCTS

2.1 AGGREGATE BASE

A. In accordance with PennDOT Publication 408, Section 350.2(a).

2.2 ASPHALT MATERIALS

A. Asphalt Cement: ASTM D3381 for viscosity-graded material. ASTM D946 for penetration-graded material.

B. Asphalt: ASTM D 3141, Pumping consistency.

C. Tack Coat: ASTM D977, emulsified asphalt, or ASTM D2397 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

D. Fog Seal: ASTM D 977, emulsified asphalt or ASTM D 2397, emulsified asphalt, slow setting, factory diluted in water, of suitable grade and consistency for application.

E. Water: Potable.

F.

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 D1073, Grade No. 2 or No. 3.

C. Joint Sealant: ASTM D6690, Type I 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 Pennsylvania Department of Transportation; designed according to PennDOT Standard Specifications for Road and Bridge Construction and complying with the following requirements:

1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
2. Base Course: PennDOT Superpave, Thickness to achieve conditions indicated on plans.
3. Wearing Course: PennDOT Superpave, Thickness to achieve conditions indicated on plans.

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.Limit vehicle speed to 3 mph.
2. Proof-roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes).
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 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 (6 mm).

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.

3.4 SURFACE PREPARATION

A. Ensure that prepared subgrade has been proof-rolled and is ready to receive paving. Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces.

B. Herbicide Treatment: Apply herbicide in accordance with 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. Emulsified Asphalt Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.10 to 0.30 gal./sq. yd. per inch depth (0.5 to 1.40 L/sq. m per 25 mm depth). Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure.

1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
2. Protect primed substrate from damage until ready to receive paving.

D. 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.

3.5 HOT-MIX ASPHALT PLACEMENT

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 indicated.
2. Place hot-mix asphalt surface course in single lift.
3. Spread mix at a minimum temperature of 250 deg F.
4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
5. 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 (25 to 38 mm) 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.

3.6 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 in accordance with AI MS-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.

3.7 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, Marshall Test Method: 96 percent of reference laboratory density in accordance with ASTM D6927, but not less than 94 percent or greater than 100 percent.
2. Average Density, Rice Test Method: 92 percent of reference maximum theoretical density in accordance with ASTM D2041/D2041M, 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.

3.8 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce 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 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. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch

3.9 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 in accordance with ASTM D3910 and allow to cure.

1. Roll slurry seal to remove ridges and provide a uniform, smooth surface.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Contractor 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 in accordance with ASTM D3549/D3549M.

C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

D. Asphalt Traffic-Calming Devices: Finished height of traffic-calming devices above pavement will be measured for compliance with tolerances.

E. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement in accordance with ASTM D979.

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 in accordance with ASTM D2041/D2041M, and compacted in accordance with job-mix specifications.

2. In-place density of compacted pavement will be determined by testing core samples in accordance with ASTM D1188 or ASTM D2726/D2726M.

    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 in accordance with ASTM D2950/D2950M and coordinated with ASTM D1188 or ASTM D2726/D2726M.

F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.11 WASTE HANDLING

A. General: Handle asphalt-paving waste in accordance with approved waste management plan required in Section 017419 "Construction Waste Management and Disposal."

END OF SECTION 321216

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 construction of Concrete Sidewalks on aggregate subbase.

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 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site

1.5 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.

1.6 QUALITY ASSURANCE

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

1.7 FIELD CONDITIONS

A. 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.

B. 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 CONCRETE PAVING

A. Concrete paving shall conform to the flowing standards:

1. ACI 117 – Specification for Tolerance for Concrete Construction and Materials
2. ACI 318 – Building Code Requirements for Reinforced Concrete
3. PennDOT 408 – Construction Specifications
4. PennDOT RC-67M – Curb Ramp and Sidewalk Construction Details

B. Aggregate base

1. In accordance with PennDOT publication 408, Section 350.2(a)

2.4 RELATED MATERIALS

A. Joint Fillers: ASTM D1752, cork or self-expanding cork in preformed strips.

B. Bonding Agent: ASTM C1059/C1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

2.5 CONCRETE MIXTURES

A. Concrete shall contain either a water-reducing, plasticizing admixture or a high-range water-reducing admixture. All concrete shall contain an air-entraining admixture to provide 5%-7% air entrainment. Maximum chloride content shall be 0.15%. Maximum water/cement ratio shall be 0.45. Maximum design slump of 3 inches without super plasticizers. Aggregate size shall be 3/4 of an inch with a designation of 4S per ASTM C33.

B. Submit mix design to the owner's representative for approval. The owner's representative may reject mix for non-compliance.

2.6 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M. 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 C94/C94M. 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.

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. 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 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. Provide tie bars at sides of paving strips where indicated.
2. Butt Joints: Use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
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 (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. 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

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.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inchradius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.5 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation and items to be embedded or cast-in.

B. Remove snow, ice, or frost from subbase surface 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 or side forms. Use only square-faced shovels for hand spreading and consolidation.

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. 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.

3.6 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. 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.

3.7 SPECIAL FINISHES

A. 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. Cover paving surface with plastic sheeting, sealing laps with tape, and remove when ready to continue finishing operations.
   3. Without dislodging aggregate, remove mortar concealing the aggregate by lightly brushing surface with a stiff, nylon-bristle broom. Do not expose more than one-third of the average diameter of the aggregate and not more than one-half of the diameter of the smallest aggregate.
   4. Fine-spray surface with water and brush. Repeat cycle of water flushing and brushing until cement film is removed from aggregate surfaces to depth required.

3.8 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] 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.

3.9 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:

   1. Elevation: 3/4 inch.
   2. Thickness: Plus 3/8 inch, minus 1/4 inch.
   3. Pavements in longitudinal direction, the gap below a 10 ft unleveled straightedge resting on high spots shall not exceed 1/8 inch.

4. Pavements in transverse direction, the gap below a 10 ft unleveled straightedge resting on high spots shall not exceed ¼ inch.
5. Joint Spacing: 3 inches.
6. Contraction Joint Depth: Plus 1/4 inch, no minus.
7. Joint Width: Plus 1/8 inch, no minus.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing and inspecting of composite samples of fresh concrete obtained according to ASTM C172/C172M shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each 5000 sq. ft. 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 C143/C143M; 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 C231/C231M, 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 C1064/C1064M; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C31/C31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C39/C39M; 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.

D. 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.

E. Concrete paving will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.11 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. 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.

C. 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 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 installation of custom pavement marking material into concrete or asphalt pavement.

B. Related Requirements:

1. Section 321216 “Asphalt Paving” and Section 321313 “Concrete Paving”

1.3 ACTION SUBMITTALS

A. Product Data: for each type of product.

B. Samples: For each color

1.4 FIELD CONDITIONS

A. Environmental Limitations: Follow manufacturer’s recommendations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufactuers: 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. Ennis-Flint, 4164 Piedmont Parkway, Suite 370, Greensboro, NC 27410, 1 (800) 331-8118, www.ennisflintamericas.com

2.2 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design"

2.3 PAVEMENT-MARKING PAINT

A. Pavement-Marking Paint, Acrylic: Acrylic, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952F, Type II, with drying time of less than three minutes.

1. Color: White

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that pavement-marking substrate is dry and in suitable condition to begin pavement marking in accordance with 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 asphalt paving or concrete surfaces 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

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 321816.13

PLAYGROUND PROTECTIVE SURFACING

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. Bonded poured-in-place rubber seamless surface.

B. Related Sections:
1. Section 31200 “Earth Moving” for filling and grading and for drainage course drainage/separation geotextiles and subbase courses.

1.3 DEFINITIONS

A. Definitions in ASTM F2223 apply to Work of this Section.

B. Critical Height: Standard measure of shock attenuation according to ASTM F2223; same as "critical fall height" in ASTM F1292. According to ASTM F1292, 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 F2223.

1.4 SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For each type of protective surfacing.

C. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
1. Extent of surface systems and use zones for equipment.
2. Critical heights for playground surfaces and fall heights for equipment.

D. Samples for Initial Selection: For each type of exposed finish.

1. Include Samples of accessories involving color selection.

E. Samples for Verification: For each type of protective surfacing and exposed finish.

1. Include Samples of accessories to verify color and finish selection.
2. Unitary, Seamless Surfacing: Minimum 6 by 6 inches
3. Drainage/Separation Geotextile: Minimum 12 by 12 inches

F. Qualification Data and Certification: For qualified installer

G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each unitary synthetic playground surface system, if requested by Owner.

H. Field quality-control reports.

I. Closeout submittals – warranty: Sample of special warranty.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer. Contractor shall have had experience with at least two (2) other projects of similar scope and complexity and shall perform work with personnel totally familiar with playground safety surface installation and construction techniques under the supervision of an experienced foreperson.

B. Manufacturer Qualifications: A company specializing in the manufacture of products specified in this Section with minimum of three)3) years experiences.

C. Source Limitations: obtain playground surface materials from single source from single manufacturer.

D. Provide secondary materials including geotextiles and repair materials of type and from source recommended by manufacturer of playground surface system materials

E. Standards and Guidelines: Comply with CPSC No. 325, “Handbook for Public Playground Safety”, ASTM F 1292; and ASTM F 1487.

1.6 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. Deterioration or failure of seams.

2. Warranty Period: Five years from date of Substantial Completion.

B. Proper drainage is critical to the longevity of the Poured-in-place surfacing system. Inadequate drainage will cause premature breakdown of the poured system in affected areas; and void the warranty.

1.7 PROJECT CONDITIONS

A. Verify existing conditions in the field prior to start of work. Should Contractor, in the course of work, find any discrepancies between Drawings and physical conditions or any omissions or errors in Drawings,

inform Owner immediately in writing for clarification. Work done after such discover, unless authorized by Owner, shall be at Contractor's risk.

B. Environmental Requirements: Install surfacing system when minimum ambient temperature is 40 degrees F and maximum ambient temperature is 90 degrees F. Do not install in steady or heavy rain.

PART 2 - PRODUCTS

2.1 POURED-IN-PLACE PLAYGROUND SURFACING SYSTEM

A. Manufacturer: Safety Turf, Inc. – 201 N. 4th Ave., Royersford, PA 19468, Phone: (800) 804-4595, Web: www.safetyturf.com

B. Product: Poured-in-place playground surfacing system as per Manufacturer, including the following:
1. Poured-in-place Primer:
    a. Material: Urethane
2. Poured-in-place Cushion Course
    a. Material: Blend of 100% recycled SBR (styrene butadiene rubber) and urethane.
    b. Thickness: 2 ½" minimum – final depth to be confirmed with fall height of play equipment
    c. Formulation Components: Blend of strand and granular material
3. Poured-in-place Wearing Course
    a. Material: Blend of recycled EPDM (ethylene propylene diene monomer) rubber and aliphatic urethane binder.
    b. Thickness: Nominal ½", Minimum 3/8", Maximum 5/8"
    c. Color 1: Standard Blue
    d. Color 2: Premium Turquoise
    e. Color 3: Standard Bright Green
    f. Color 4: Premium Bright Yellow
    g. Dry static coefficient of friction (ASTM D2047): 1.0
    h. Wet static coefficient of friction (ASTM D2047): 0.9
    i. Dry Skid Resistance (ASTM E303): 89.
    j. Wet Skid Resistance (ASTM E303): 57.
4. Crushed stone base as per Manufacturer's recommendations.
    a. The stone for the base must be crushed so it compacts to a 95% standard proctor compaction (as per ASTM test). The stone should be a homogenous mixture of the following size stones:
        1) Sieve Size % Passing by Weight
            a) 1" 90 - 100
            b) 5/8" 50 - 80
            c) 1/4" 30 - 50
            d) #4 15 - 35
            e) #8 10 - 30
            f) #30 3 - 5
            a) #200 0 – 3
5. Mixes
    a. Required mix proportions by weight:
        1) Cushion Course: 16+% urethane (as ratio: 14% urethane divided by 86% rubber). 14% urethan, 86% rubber (based on entire rubber and urethane mix).
        2) Wearing Course: 22% urethane (ratio 18% urethane divided by 82% rubber). 18% urethane, 82% rubber (based on entire rubber & urethane mix).

C.

2.2 GEOSYNTHETIC ACCESSORIES

A. Drainage/Separation Geotextiles: Comply with Section 312000 "Earth Moving."

B. 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. ;ASTM D5261.
2. Water Flow Rate: [100 gpm/sq. ft. according to ASTM D4491.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

A. Comply with the instructions and recommendations of the playground surfacing manufacturer.

3.2 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.

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

3.3 PREPARATION

A. Prepare substrates to receive surfacing products according to protective surfacing manufacturer's written instructions.

3.4 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 a minimum of 4 inches with manufacturer's standard treatment for seams.

3.5 INSTALLATION OF SEAMLESS SURFACING

A. 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.

1. Substrate Primer: Apply over prepared substrate at manufacturer's standard spreading rate for type of substrate.

2. Poured Cushioning Layer: Spread evenly over primed substrate to form a uniform layer applied at manufacturer's standard spreading rate in one continuous operation, with a minimum of cold joints.
3. Intercoat Primer: Over cured cushioning layer, apply primer at manufacturer's standard spreading rate.
4. Wearing Layer: Spread over primed base course to form a uniform layer applied at manufacturer's standard spreading rate in one continuous operation and, except where color changes, with no cold joints. Finish surface to produce manufacturer's standard wearing-surface texture.

    a. 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.

5. Lacquer Topcoat: Spray or roller applied at manufacturer's standard coating rate in one continuous operation.
6. Edge Treatment: Flush. Fully adhere edges to substrate with full coverage of substrate. Maintain fully cushioned thickness required to comply with performance requirements.

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 F1292 for each protective surfacing type and thickness in each playground area.
2. Perform installed-surface-performance tests at no less than one series of tests for each 1000 sq. ft. of each type and thickness of in-place protective surfacing or part thereof.

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 321816.13

SECTION 321816.33

CORK PLAYGROUND PROTECTIVE SURFACES

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. The following documents form part of the Specifications to the extent stated. Where differences exist between Codes, Standards, Authorities Having Jurisdiction, and the Documents, the one affording the greatest protection and/or more stringent condition shall apply.

1.2 SUMMARY

A. Section includes playground surfacing materials as follows:

1. Base layer comprised of 100% cork and polyurethane binder
2. Top layer of granulated cork and polyurethane binder.

B. Related Requirements:

1. Section 312000- “Earth Moving”

C. References:

1. ASTM F 1487 – Standard Specification for Playground Equipment for Public Use
2. CPSC #325 – Public Playground Safety Handbook

1.3 ACTION SUBMITTALS

A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.

B. Product Data: Submit manufacturer’s product data and installation instructions.

C. Verification Samples: Submit manufacturer’s standard verification samples of 9" x 9" minimum.

D. Quality Assurance/Control Submittals: Submit the following:

1. Certificate of qualifications of the surfacing installer.

E. Closeout Submittals: submit the following:

1. Warranty documents specified herein.

1.4 QUALITY ASSURANCE

A. Utilize an installer trained and approved by the manufacturer, having experience with other projects of the scope and scale of the work described in this section.

1.5 DELIVERY & STORAGE

A. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

B. Store materials protected from exposure to harmful environmental conditions and at a minimum temperature of 40 degrees F and a maximum temperature of 90 degrees F.

1.6 SITE CONDITIONS

A. Install surfacing on a dry sub-surface with no prospect of rain within initial drying period, and within 40 degrees F and 90 degrees F.

B. There are three (3) Sub-Base applications acceptable for Poured In Place Applications. Any of these suggestions needs to be able to comply with permeability of Corkeen: Installations may be performed over 95% crushed aggregate/stone base (6,3-12,6''), typical. thickness of 11,8" to allow for proper compaction rates.

1.7 LIMITATIONS

A. Some chemicals may cause damage to the playground surface and should be avoided. They include disinfectants, concentrated chlorine bleach, gasoline, diesel fuel, hydraulic and lubricating oils, acids and organic solvents. Though not commonly used in water play areas, pool surrounds and similar applications, dissolved minerals and other chemicals (hydrochlorides) may cause surface discoloration over time. This condition, should it occur, is not considered to be a product failure.

1.8 WARRANTY

A. Playground surface shall maintain required impact attenuation characteristics and be guaranteed against defects in workmanship and materials for a period of no less than (5) Five Years from date of completion of work. Typical wear, abuse, or neglect will be excepted. Maintenance requirements must be maintained for duration of warranty period.

1.9 MAINTENANCE

A. Hose off entire playground surface to remove food, drink, sand, dirt and loose debris. The surface is best cleaned with brushes and water. A pressure washer may be used, but do not exceed 1500 psi (10 MPa) pressure or place nozzle closer than 12" to surface. While surface is still damp, apply a mild household or commercial cleaner to a small area using a sprayer. Scrub using a medium bristle brush. Once entire surface has been cleaned, rinse using a garden hose with spray nozzle attachment. To increase longevity and performance of your surfacing it is recommended to maintain monthly maintenance work. As a preventative measure, leaves and other organic material must be removed with a leaf blower and/or regular sweeping. This kind of cleaning prevents aging of the system, rotting caused by moss, algae, and weeds. It also prevents other vegetation to take roots. Remove sand and gravel, which can cause the risk of breaking down and deteriorating the surface. Should additional maintenance recommendations be necessary contact the manufacturer or technical services

PART 2 - PRODUCTS

2.1 BASE LAYER

A. Primer: Polyurethane.

B. Corkeen Base Layer Granules. Color: Natural Cork Colour (beige).

C. Corkeen Play Original: Blend 100% granulated cork and Polyurethane to the proper ratios based on weight: (69% BD4/5 cork & 31% Polyurethane (as divided by total combined weight)).

D. Base Thickness: May vary as determined by the fall height of the play equipment and as required meet ASTM F1292 requirements for critical fall height. Base Thickness for fall height as follows: 8'=4.13", 4'=1.38", 2' 1.00", Minimum depth: 0.75" ***ADD .5" Top Layer for Total System Thickness.

2.2 TOP LAYER

A. Aromatic polyurethane Primer

B. Top Layer Engineered Cork Granules (Ethylene Propylene Diene Monomer)

C. Colors: Cork natural color (some variation expected, given that it is a natural material).

D. Poured In Place Top Layer: Blend of Top layer engineered cork granules and Polyurethane. (52% rubber & 48% polyurethane (as divided by total combined weight))

E. Nominal thickness of Cork Top Layer 0.5", with a minimum 0.325" and a maximum 0.625".

F. System Total Thickness: To be not less than the fall height of the play equipment which may vary and as required meet ASTM F1292 requirements for critical fall height.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Site Conditions: Verify that substrate conditions are suitable for installation of the poured in place surfacing. Do not proceed with installation until unsuitable conditions are corrected.

B. Drainage: Proper drainage is critical to the longevity of the surfacing system. Inadequate drainage will cause premature breakdown of the poured system in affected areas; and void the warranty.

3.2 PREPARATION

A. Existing Substrate Preparation: Remove any loose or delaminated material that would be deleterious to application of the new surface. Fill cracks in existing concrete with cementitious patching compound.

B. Surface Preparation: Using a brush or short nap roller, apply primer to the substrate perimeter and any adjacent vertical barriers (such as playground equipment). The substrate will show different consumption levels according to its characteristics. A gravel substrate will have a consumption of 40.81 sqft/gal and a concrete substrate will require a primer consumption of 135.91 sqft/gal.

3.3 INSTALLATION

A. Do not proceed with playground surfacing installation until all applicable site work, including substrate preparation, fencing, playground equipment installation and other relevant work, has been completed. Consider dust and traffic in adjacent work areas that may impact surfacing finish.

B. Primer Application: Using a brush or a short nap roller, apply primer to the base layer perimeter and any adjacent vertical barriers that will contact the surfacing system at the rate of 300ft2/gal.

C. Base Layer Installation:

1. Using screeds and hand trowels, install the base layer at a consistent density of 89,89 ounce per cubic foot (90 kg/m^3) to the specified thickness.

2. Allow base layer to cure for sufficient time so that indentations are not left in the base layer from applicator foot traffic or equipment.

3. Do not allow foot traffic or use of the base layer surface until it is sufficiently

Cured.

D. Top Layer Installation:

1. Using a hand trowel, install top layer at a consistent 229,73 ounces per cubic foot to a nominal thickness of 0.5" (230 kg/m^3).

2. Allow top layer to cure for a minimum of 48 hours with Aromatic binder and up to 72 hours with Aliphatic binder, (dependent on weather conditions).

3. At the end of the minimum curing period, verify that the surface is sufficiently dry and firm to allow foot traffic and use without damage to the surface.

4. Do not allow foot traffic or use of the surface until it is sufficiently cured

3.4 FIELD QUALITY CONTROL

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

3.5 PROTECTION

A. Protect the installed surface from damage resulting from subsequent construction activity on the site.

END OF SECTION 321816.33

329113

SOIL PREPARATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Work includes labor, materials, tools and equipment to furnish, perform, and install the following items:

1. Soil Testing and Amendment Recommendations

a. Soil analysis testing for existing topsoil on site and any additional soil brought into project.

2. Planting soil

a. Salvaged on site topsoil or imported topsoil.

b. Soil amendments as recommended by soil testing.

3. Coordination with excavation, backfilling and planting.

4. Coordination of all finished grading activity, site utilities, irrigation, lighting, drainage, and all other related site improvements that may be simultaneously underway by separate contractors.

5. Placing, spreading, and fine grading planting soil material of the type(s) indicated for plant areas.

6. Testing installed planting soil mixes and growing media to ensure compaction rates as specified.

7. Protecting all stock piles and plant mix installations with approved means until substantial completion.

8. Supplying and installing erosion control material.

B. Related Sections:

1. 311000 “Site Clearing”
2. 312000 “Earth Moving”
3. 329200 “Turf and Grasses”.
4. 329300, "Plants".
5. 329600, “Transplanting”

1.3 REFERENCES

A. In the event that the requirements of any of the referenced standards and specifications herein conflict with each other the more stringent requirement shall prevail. Where reference is made to one of the standards, the revision in effect at the time of bid opening shall apply.

B. ASTM International (ASTM):

1. D75 Practice for Sampling Aggregates

2. D422 Test Method for Particle-Size Analysis of Soils

3. D698 Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort.
4. C136 Test Method for Sieve Analysis of Fine and Coarse Aggregates.
5. D854 Test Method for Specific Gravity of Soils.
6. D2974 Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils.
7. D3665 Practice for Random Sampling of Construction Materials.

C. USDA — United States Department of Agriculture:

1. Soil Texture Triangle Classification.
2. Handbook No. 60.

D. Soil Tests:

1. Water Release Characterization Test.
2. USDA Particle Size Analysis.
3. Infiltration Rate with bulk density.

1.4 DEFINITIONS

A. AAPFCO: Association of American Plant Food Control Officials.

B. Acceptance, Acceptable, or Accepted: Acceptance by the Landscape Architect in writing.

C. Backfill: The earth used to replace or the act of replacing earth in an excavation.

D. CEC: Cation exchange capacity.

E. Compost: The product resulting from the controlled biological decomposition of organic material that has been sanitized through the generation of heat and stabilized to the point that it is beneficial to plant growth.

F. Excessive Compaction: Except of structural planting soil mix, planting areas soil or soil mix compaction greater than 82 percent maximum dry density as determined by ASTM D698.

G. Imported soil: Soil that is transported to Project Site for use.

H. Layered Soil Assembly: A designed series of planting soils, layered on each other, which together produce an environment for plant growth.

I. Manufactured soil: Soil produced by blending soils, sand, stabilized organic soil amendments, and other materials to produce planting soil.

J. NAPT: North American Proficiency Testing Program. An SSSA program to assist soil-, plant-, and water-testing laboratories through interlaboratory sample exchanges and statistical evaluation of analytical data.

K. Organic matter: The total of organic materials in soil exclusive of undecayed plant and animal tissues, their partial decomposition products, and the soil biomass; also called “humus” or “soil organic matter.”

L. On-Grade: On or over subgrade soil, not on or over a building structure.

M. Planting soil: Existing, on-site soil; improted soil; or manufactured soil that has been modified as specified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

N. RCRA Metals: Hazardous metals identified by the EPA under the Resource Conservation and Recovery Act.

O. SSSA: Soil Science Society of America.

P. SMP: Soil Matrix Potential.

Q. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

R. 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.

S. Surface soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surfaces soil is typically called “topsoil”; in disturbed areas such as urban environments, the surface soil can be subsoil.

T. USCC: U.S. Composting Council.

1.5 SYSTEM DESCRIPTIONS

A. Preinstallation Conference: Conduct conference at Project Site.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include recommendations for application and use.

2. Include test data substantiating that products comply with requirements.

3. Include sieve analyses for aggregate materials.

4. Material Certificates: For each type of imported soil, soil amendment and fertilizer before delivery to the site, according to the following:

a. Manufacturer’s qualified testing agency’s certified analysis of standard products.

b. Analysis of fertilizers, by a qualified testing agency, made according to AAPFCO methods for testing and labeling and according to AAPFCO’s SUIP #25.

c. Analysis of nonstandard materials, by a qualified testing agency, made according to SSSA methods, where applicable.

B. Samples - Materials:

1. Topsoil for Planting Soil — 1 gallon directly to the Testing Laboratory, 1/2 pint to the Landscape Architect.
2. Sand for Planting Soil — 1 gallon directly to the Testing Laboratory, 1/2 pint to the Lead Landscape Architect
3. Organic Amendment for Planting Soil — 1 gallon directly to the Testing Laboratory, 1/2 pint to the Lead Landscape Architect.

C. Samples - Mixes:

1. Planting Soil mix — 1 gallon directly to the Testing Laboratory, 1/2 pint to the Lead Landscape Architect.

D. From USDA NRCS County Soil Survey, submit name of off-site, proposed base topsoil, County of origin, Detailed Soil Map Unit, and Tables 13, 15, and 16 for the named soil.

1.7 INFORMATION SUBMITTALS

A. Qualification data: For each testing Agency, soil mix manufacturer.

B. Test Reports:

1. Topsoil for Planter Soil Mix, with test date less than 2 weeks old.
2. Sand for Planter Soil Mix and Structural Planting Soil Mix, with test date less than 2 weeks old.
3. Organic Amendment for Planter Soil Mix, with test date less than 2 weeks old.
4. Coarse Sand for Blinding Layer, with test date less than 2 weeks old.
5. Compaction Test Results.

C. Testing of soils shall be at the Contractor’s expense.
D. Field quality-control reports.

1.8 QUALITY ASSURANCE

A. Testing agency qualifications: An independent, state-operated, or university-operated laboratory; experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in types of tests to be performed.

1. Laboratories: Subject to compliance with requirements, provide testing by an agency that meets all of these above requirements (company name and contact information to be provided to the Landscape Architect for approval.

2. Multiple laboratories: At Contractor’s option, work may be divided among qualified testing laboratories specializing in physical testing, chemical testing, and fertility testing.

B. Landscape Architect shall have right to reject any soil supplier or salvaged on-site topsoil.

1.9 PRECONSTRUCTION TESTING

A. Preconsturction Testing Service: Engage a qualified testing agency to perform preconstruction soil analyses of existing, on-site soil.

1. Notify Architect seven days in advance of dates and times when laboratory samples will be taken.

B. Preconstruction Soil Analyses: For each unamended soil type, perform testing on soil samples and furnish soil analysis and a written report containing soil-amendment and fertilizer recommendations by a qualified testing agency performing the testing according to "Soil Sampling Requirements" and "Testing Requirements" articles.

1. Have testing agency identify and label samples and test reports according to sample collection labeling requirements.

1.10 SOIL SAMPLING REQUIREMENTS

A. General: Extract soil samples according to requirements in this article.

B. Sample Collection and Labeling: Have samples taken and labeled by Contractor in presence of Landscape Architect or Owner under the direction of the testing agency.

1. Number and Location of Samples: Minimum of eight representative soil samples from varied locations as directed by Landscape Architect for each soil to be used or amended for landscaping purposes

2. Procedures and Depths of Samples: According to USDA-NRCS's "Field Book for Describing and Sampling Soils."

3. Division of Samples: Split each sample into two equal parts. Send half to the testing agency and half to Owner for their records.

4. Labeling: Label each sample with date and location keyed to a site plan or other location system, visible soil condition, and sampling depth.

1.11 TESTING REQUIREMENTS

A. General: Perform tests on soil samples according to requirements in this article

B. Physical Testing:

1. Soil Textures: Soil-particle, size-distribution analysis by one of the following methods according to SSSA's "Methods of Soil Analysis- Part 1- Physical and Mineralogical Methods."

a. Sieving Method: Report sand-gradation percentages for very coarse, coarse, medium, fine and very fine sand; and fragment-gradation (gravel) percentages for fine, medium, and coardse fragments; according to USDA sand and fragment sizes.

b. Hydrometer method: Report percentages of sand, silt, and clay.

2. Total Porosity: Calculate using particle density and bulk density according to SSSA's "Methods of Soil Analysis- Part 1- Physical and Mineralogical Methods."

3. Water Retention: According to SSSA's "Methods of Soil Analysis- Part 1- Physical and Mineralogical Methods."

4. Saturated Hydraulic Conductivity: According to SSSA's "Methods of Soil Analysis- Part 1- Physical and Mineralogical Methods"; at 85% compaction according to ASTM D698 (Standard Proctor).

C. Chemical Testing:

1. CEC: Analysis by sodiu saturation at pH 7 according to SSSA's "Methods of Soil Analysis- Part 3- Chemical Methods."

2. Clay mineralogy: Analysis and estimated percentage of expandable clay minerals using CEC by ammonium saturation at pH 7 according to SSSA's "Methods of Soil Analysis- Part 3- Chemical Methods."

3. Metals Hazardous to Human Health: Test for presence and quantities of RCRA metals including aluminum, arsenic, barium, copper, cadmium, chromium, cobalt, lead, lithium, and vanadium. If RCRA metals are present, include recommendations for corrective action.

4. Phytotoxicity: Test for plant-available concentration of phytotoxic minerals including aluminum, arsenic, barium, cadmium, chlorides, chromium, cobalt, copper, lead, lithium, mercury, nickel, selenium, silver, sodium, strontium, tin, titanium, vanadium, and zinc.

D. Fertility Testing: Soil-fertiility analysis according to standard laboratory protocol of SSSA NAPT NCR-13, SSSA NAPT NEC-67, SSSA NAPT SERA-6, or SSSA NAPT WERA-103, including the following:

1. Percentage of organic matter

2. CEC< calcium percentage of CEC, and magnesium percent of CEC.

3. Soil reaction (acidity/alkalinity pH value).

4. Buffered acidity or alkalinity.

5. Nitroen ppm.

6. Phosphorous ppm.

7. Potassium ppm.

8. Manganese ppm.

9. Manganese-availability ppm.

10. Zinc ppm.

11. Zinc availability ppm.

12. Copper ppm.

13. Sodium ppm and sodium absorption ratio.

14. Soluble-salts ppm.

15. Presence and quantities of problem materials including salts and metals cited in the Standard protocol. If such problems materials are present, provide additional recommendations for corrective action.

16. Other deleterious materials, including their characteristics and content of each.

E. Organic-Matter Content: Analysis using loss-by-ignition method according to SSSA's "Methods of Soil Analysis- Part 3- Chemical Methods."

F. Recommendations: Based on test results, state recommendations for soil treatments and soil amendments to be incorporated to produce satisfactory planting soil suitable for healthy, viable plants indicated. Include, at a minimum, recommendations for nitrogen, phosphorous and potassium fertilization; and for micronutrients.

1. Fertilizers and Soil Amendment Rates: State recommendations in weight per 1000 sp. Ft. for 6-inch depth of soil.

2. Soil Reaction: State the recommended liming rates for raising pH or sulfur for lowering pH according to the buffered acidity or buffered alkalinity in weight per 1000 sq. ft. for 6-inch depth of soil.

1.12 DELIVERY, STORAGE, AND HANDLING

A. Bulk Materials:

1. Load, ship, handle, and store bulk materials in such a manner to protect them from damage and contamination from other construction materials, soil, rock, debris, and substances toxic to plants.
2. Store materials on-site on a clean concrete surface or on geotextile fabric, and keep covered with geotextile fabric to protect against contamination.
3. Erect dams if required to prevent run-off from draining into stored materials.
4. Damaged and contaminated materials will be rejected.
5. Maintain structural planting soil mix in a moist, but not saturated, condition to prevent segregation of material during transport and storage.

B. Packaged Materials:

1. Deliver in original unopened factory containers with original labels intact and legible indicating the guaranteed chemical analysis.
2. Meet manufacturer's requirements for storage and protection of materials on-site

C. Purchase Documentation for Bulk and Packaged Materials:

1. Purchase and Delivery Invoices.
2. Amendment Purchase and Delivery Invoices.

D. Stockpiled Topsoil
1. When stockpiling topsoil from project, mound soil no higher than 4 feet for less than 1 year and preferably less than 6 months. Cover with a tarp or temporary seeding to prevent erosion and contamination from weed sources.

E. General Soil Care
1. Mitigate construction-related soil compaction in planting areas by ripping the soil to loosen its structure before planting.
2. Use tracked construction equipment near bioswales and other planting areas to reduce compaction.
3. Avoid walking, operating equipment, or driving vehicles on planting areas after soil preparation is complete and in sensitive areas, like bioswales and other stormwater conveyance systems.

1.13 EXAMINATION OF CONDITIONS

A. Carefully review this Section to understand the requirements of percolation testing, compaction, slope and absence of debris of the subgrade prior to spreading of the planting soils.

B. The Contractor shall be solely responsible for judging the full extent of work requirements involved, including but not limited to sampling and testing of on-site stockpiles of delivered off-site planting soils prior to final planting installation.

1.14 SITE CONDITIONS

A. Environmental Requirements:

1. Do not place or work soil mixes when moisture content is so great that excessive compaction will occur, nor when it is so dry that dust will form in the air or that clods will not break readily.
2. Apply water, if necessary, to bring soil mixes to an optimum moisture content for tilling.
3. Do not place or work soil mixes when muddy or frozen or during high winds.
4. Do not apply chemicals if wind conditions will cause hazardous drift to people or property.

B. Existing Conditions:

1. Prior to Work commencement review and clearly mark in field horizontal and vertical locations of existing public underground utilities and structures with respective utility companies.
2. Prior to Work commencement review and clearly mark in field horizontal and vertical locations of existing private underground utilities and structures with the Construction Manager.

1.15 SEQUENCING AND SCHEDULING

A. Coordinate mixing and delivery with Section 32 93 00, "Planting Materials" requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Sand for Planting Soil: As required to meet specified texture and drainage requirements. Uniform, silica sand, screened and washed, free of debris and stones, with an ASTM Uniformity Coefficient (Cu D60/D10) of 2.0 to 3.5, and a D50 of 0.30 mm to 0.45 mm, and meeting the following size gradation:

Soil Separate	*Size (mm)*	*Allowable %*
Sand	0.05 to 2.0	≥ 90
Silt	0.05 to .002	≤ 7
Clay	<0.002	≤ 3

Fraction Name	*Size mm (US Sieve)*	**Allowable %*
Coarse Gravel	>3.35 (6)	0

Fraction Name	*Size mm (US Sieve)*	**Allowable %*
Fine Gravel	3.35 to 2.0 (6 to 10)	≤3
Very Coarse Sand	2.0 to 1.0 (10 to 18)	≤10
Coarse / Medium Sand	1.0 to 0.25 (18 to 60)	> 45
Fines	0.25 to 0.05 (60 to 270)	≤20
Total Fractions	<0.25 (60)	≤30

Miscellaneous Criteria	*Units*	*Criteria*
Coefficient of Uniformity (CU)	No units	2.0 to 3.5
D50	mm	0.30 to 0.45

*Percent Retained within Individual Size Range.

Calcareous gravel are not acceptable.

B. Existing Topsoil: Existing, on-site surface soil, with the duff layer, if any, retained; and stockpiled on-site.

1. Clay soils, if found, should be amended to clay loam soils to improve drainage.

C. Imported Topsoil: Imported, naturally formed soil from off-site sources and consisting of sandy loam, loam, loamy sand, clay loam, or sandy soil according to USDA textures; and modified to produce viable planting soil that has the same classification as the soil test results for existing soil composition with the approximate locations of applications.

1. Sources: Take imported, unamended soil from sources that are naturally well-drained sites where topsoil occurs at least 4 inches deep, not from agricultural land, bogs, or marches; and that do not contain undesirable organisms; disease causting plant pathogens; or noxious weeds and invasive plants including, but not limited to, quackgrass, Jonsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, blindweed, bentgrass, qild garlic, ground ivy, perennial sorrel, and bromegrass.

2. Aditional Properties of Imported Soil Before Amending

a. Soil reaction of pH 5.5 to 7 OR within 1-unit change maximum of the existing soil, based on pH tests.

b. Minimum of 2-4 percent organic-matter content, maximum of 6 percent; friable, and with sufficient structure to give good tilth and aeration.

c. Soluble salts shall be less than 1.5 mmoh/cm

3. Unacceptable Properties: Clean soil of the following:

a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.

b. Unsuitable materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of 8 percent by dry weight of the imported soil.

c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 2 inches in any dimension.

2.2 MIXES

A. Planting Soil – Amended Existing Topsoil Mix:
1. Blend existing, on-site surface soil (amend with sand as required to achieve specified soil texture) with the following soil amendments and fertilizers in the following quantities to produce planting soil:
   a. Ration of Loose Compost to Soil: 1:4 by volume.
   b. Ratio of Loose Wood Derivatives to Soil: To be determined based on soil tests.
   c. Weight of Lime: To be determined based on soil tests.
   d. Weight of Sulfur or Iron Sulfate: To be determined based on soil tests.
   e. Weight of Agricultural Gypsum: To be determined based on soil tests.
   f. Weight of Superphosphate: To be determined based on soil tests
2. Existing soil after amendments shall have a soil rection of pH 5.5 to 7 and minimum of 2-4 percent organic-matter content, friable, and with sufficient structure to give good tilth and aeration.

B. Planting Soil – Imported:
1. Blend imported soil (amend with sand as required to achieve specified soil texture) with the following soil amendments and fertilizers in the following quantities to produce planting soil.
   a. Ration of Loose Compost to Soil: 1:4 by volume.
   b. Ratio of Loose Wood Derivatives to Soil: To be determined based on soil tests.
   c. Weight of Lime: To be determined based on soil tests.
   d. Weight of Sulfur or Iron Sulfate: To be determined based on soil tests.
   e. Weight of Agricultural Gypsum: To be determined based on soil tests.
   f. Weight of Superphosphate: To be determined based on soil tests
2. Soil after amendments shall have a soil reaction of pH 5.5 to 7 and minimum of 2-4 percent organic-matter content, friable, and with sufficient structure to give good tilth and aeration.

2.3 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
1. Class: T, with a minimum of 99 percent passing through a No. 8 sieve and a minimum of 75 percent passing through a No. 60 sieve.
2. Class: O, with a minimum of 95 percent passing through a No. 8 sieve and a minimum of 55 percent passing through a No. 60 sieve.
3. Form: Provide lime from dolomitic limestone.

B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent elemental sulfur, with a minimum of 99 percent passing through a No. 6 sieve and a maximum of 10 percent passing through a No. 40 sieve.

C. Iron sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.

D. Perlite: Horticultural perlite, soil amendment grade.

E. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through a No. 50 sieve.

2.4 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter produced by composting feedstock, and bearing USCC's "Seal of Testing Assurance," and as follows:
   1. Feedstock: Limited to aged leaves and vegetated material
   2. Reaction: pH 5.5 to 8
   3. Soluble-Salt Concentration: Less tha 4 dS/m.
   4. Moisture Content: 35 to 55 percent by weight.
   5. Organic-Matter Content: 30 to 40 percent of dry weight.
   6. Particle Size: Minimum of 98 percent passing through a 1-inch sieve.

2.5 FERTILIZERS

A. The following fertilizers may be needed according to soil test results but require prior approval by Landscape Architect.
   1. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of percent available phosphoric acid according to soil tests.
   2. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous and potassium in the following composition:
      a. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from qualified testing agency.
   3. Slow release fertilizers: Granular or pelleted fertilizer oconsisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
      a. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from qualified testing agency.
   4. Chelated Iron: Commercial-grade FeEDDHA for dicots and woody plants, and commercial-grade FeDTPA for ornamental grasses and monocots.

2.6 PLANTING MIX TESTING

A. Take one composite sample upon arrival to the site from each 500 cubic yards or as required by the Landscape Architect for testing each type of Planting Soil. Comply with testing requirements outlined in this section.

PART 3 - EXECUTION

3.1 EXAMINATION

A. General: Examine site and verify that conditions are suitable to receive Work and that no defects or errors are present which would cause defective installation of products or cause latent defects in workmanship and function.

B. Subgrade: Verify that the subgrade is at the correct elevation and slope.
   1. Subsoil or ordinary borrow shall have been excavated and filled as required by the Contract Documents. Do not damage the work previously installed. Maintain all required angles of repose of materials adjacent to the planter soil mix as shown in the Drawings. Do not over excavate compacted subgrades of adjacent pavement or structures.

   2. Confirm the subgrade is at the proper elevation and that no further earthwork is required to bring the subgrade to proper elevations. Subgrade elevations shall slope parallel to the finished grade and/or toward the subsurface drain lines as shown in the Contract Documents. Provide a written report to the Landscape Architect confirming the subgrade has been placed to the required elevations and that the subgrade drains water at the rates specified under the required percolation tests specified in contract documents. Perform no work of placing and spreading the planter soil

mix until elevations have been confirmed and the written report has been accepted by the Landscape Architect.

C. Underground Utilities and Structures: Verify that the locations of utilities, structures and other underground items have been clearly marked.

D. Notification of Unsuitable Conditions: Before proceeding with Work, notify the Construction Manager in writing of unsuitable conditions and conflicts.

E. Do not proceed with installation of planting soils until all utility work in the area has been installed.

3.2 SITE PREPARATION

A. Protection of Existing Conditions:

1. Use every possible precaution to prevent damage to existing conditions to remain such as structures, utilities, plant materials and walks on or adjacent to the site of the Work.
2. Provide barricades, fences or other barriers to protect existing conditions to remain from damage during construction.
3. Do not store materials or equipment, permit burning, or operate or park equipment under the branches of existing plants to remain.
4. Use every possible precaution to prevent excessive compaction of planting area soil within or adjacent to areas of work.
5. Submit written notification of damaged plants and structures to the Construction Manager immediately.

B. Subgrade Preparation:

1. Inspect soil surface for sticks, oils, chemicals, plaster, concrete, and other deleterious materials.
2. Do Work required to remove and dispose of the deleterious materials.

3. Clear subgrade of all construction debris, trash, rubble and any foreign material. In the event that fuels, oils, concrete washout or other material harmful to plants have been spilled into the subgrade material, excavate the soil sufficiently to remove the harmful material. Such construction debris, trash, rubble and foreign material shall be removed from the site and disposed of in a legal manner. Fill any over excavation with approved will and compact to the required subgrade compaction levels.

3.3 PREPARATION OF UNAMENDED, ON-SITE SOIL BEFORE AMENDING

A. Excavation: Excavate soil from designated area (s) to a depth of 6 inches and stockpile until amended.

B. If construction fill or heavily compacted fill is reached where planting is to occur or as required for building and/or utility needs, continue to over excavate this material and clean or spoil according to project spoil requirements. Keep this separate from topsoil spoil areas. Excavate to depth of up to 36 incehs.

C. Unacceptable Materials: Clean soil of concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentinve, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.

D. Unsuitable materials: Clean soil to contain a maximum of 8 percent by dry weight of stones, roots, plants, sod, clay lumps, and pockets of coarse sand.

E. Screening: Pass unamended soil through ha 2-inch sieve to remove large materials.

3.4 PLACING AND MIXING PLANTING SOIL OVER EXPOSED SUBGRADE

A. General: Apply and mix unamended soil with amendments on-site to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Subgrade Preparation: Till subgrade to a minimum depth of 6 inches for planting beds. Remove stones larger than 2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Apply, add soil amendments, and mix approximately half the thickness of unamended soil over prepared, loosened subgrade according to "Mixing" paragraph below. Mix thoroughly into top 4 inches of subgrade. Spread remainder of planting soil.

C. Mixing: Spread unamended soil to total depth of 6 inches or as otherwise indicated, but not less than required to meet finished grades after mixing with amendments and natural settlement. Do no spread if soil or subgrade is frozen, muddy, or excessively wet.

1. Amendments: Apply soil amendments, except compost, and fertilizer, if required, evenly on surface, and thoroughly blend them with unamended soil to produce planting soil.

a. Mix lime and sulfur with dry soil before mixing fertilizer, if rquired per soil tests.

b. Mix fertilizer with planting soil no more than seven days before planting.

2. Lifts: Apply and mix unamended soil and amendments in lifts not exceeding 8 inches in loose depth for material compacted by compaction equipment and not more than 6 inches in loose depth for material compacted by hand-operated tampers.

D. Compaction

1. Compact each blended lift of planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D698 and tested in-place except where a different compaction value is indicated on Drawings.

2. Compact any area where soil is to be directly under crown of shrub or tree to 90 percent of maximum Standard Proctor density to prevent tree slump or movement.

E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.5 PLACING MANUFACTURED PLANTING SOIL OVER EXPOSED SUBGRADE

A. General: Apply manufactured soil on-site in its final, blended condition. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Subgrade Preparation: Till subgrade to a minimum depth of 6 inches for planting beds. Remove stones larger than 2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Apply, add soil amendments, and mix approximately half the thickness of unamended soil over prepared, loosened subgrade according to "Mixing" paragraph below. Mix thoroughly into top 4 inches of subgrade. Spread remainder of planting soil.

C. Mixing: Spread unamended soil to total depth of 6 inches or as otherwise indicated, but not less than required to meet finished grades after mixing with amendments and natural settlement. Do no spread if soil or subgrade is frozen, muddy, or excessively wet.

1. Amendments: Apply soil amendments, except compost, and fertilizer, if required, evenly on surface, and thoroughly blend them with unamended soil to produce planting soil.

a. Mix lime and sulfur with dry soil before mixing fertilizer, if rquired per soil tests.

b. Mix fertilizer with planting soil no more than seven days before planting.

2. Lifts: Apply and mix unamended soil and amendments in lifts not exceeding 8 inches in loose depth for material compacted by compaction equipment and not more than 6 inches in loose depth for material compacted by hand-operated tampers.

D. Compaction

1. Compact each blended lift of planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D698 and tested in-place except where a different compaction value is indicated on Drawings.

2. Compact any area where soil is to be directly under crown of shrub or tree to 90 percent of maximum Standard Proctor density to prevent tree slump or movement.

E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

F. Tests for Excessive Compaction of Planter Soil Mix:

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

3.6 PROTECTION

A. Soil Mix Contamination:

1. Protect installed soil mixes from contamination by other construction materials, soil, rocks, run-off, debris, substances toxic to plants, de-icing chemicals, and other elements which will affect the permeability and fertility of the soil mixes.
2. Cover soil mixes with geotextile fabric or utilize other acceptable means as needed to prevent contamination.

B. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to pefrform planting operations:

1. Storage of construction materials, debris, or excavated material.

2. Parking vehicles or equipment.

3. Vehicle traffic.

4. Foot traffic.

5. Erection of sheds or structures.

6. Impoundment of water.

7. Excavation or other digging unless otherwise indicated.

C. Soil Mix Displacement and Excessive Compaction: Where vehicular traffic and concentrated foot traffic must travel over the soil mixes, protect installed soil mixes from displacement and excessive compaction by covering with 3/4" structural grade plywood or other acceptable covering.

D. If planting soil or subgrade is over-compacted, disturbed, or contaminated by foreign or deleterious materials or liquids, remove the planting soil and contamination; restore the subgrade by aerating as directed by Landscape Architect. If this does not reduce compaction, replace contaminated planting soil with new planting soil and retest for proper drainage and compaction.

E. Protect adjacent walls, walks, and utilities from damage or staining by the planting soils.

3.7 Cleaning

A. Protect areas adjacent to planting-soil preparation and planting areas from contamination. Keep adjacent plaving and construction clean and work area in an orderly condition.

B. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner’s property unless otherwise indicated.

1. Dispose of excess subsoil and unsuitable materials on-site where directed by Owner.

END OF SECTION 329113

SECTION 329200

TURF AND GRASSES

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. Seeding.
2. Hydroseeding.
3. Sodding.
4. Turf renovation.
5. Erosion-control materials.

B. Related Requirements:

1. Section 329100 “Planting Soil Preparation” for planting soil.

2. Section 329300 "Plants" for trees, shrubs, ground covers, and other plants as well as border edgings and mow strips.

1.3 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil.

B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

C. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

D. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329113 "Soil Preparation" and drawing designations for planting soils.

E. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For landscape Installer.

B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, 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. Include identification of source and name and telephone number of supplier.

C. Product Certificates: For fertilizers, from manufacturer.

D. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of turf and meadows during a calendar year. Submit before expiration of required maintenance periods.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf and meadow establishment.

1. Professional Membership: Installer shall be a member in good standing of either the National Association of Landscape Professionals or AmericanHort.
2. Experience: Five years' experience in turf installation in addition to requirements in Section 014000 "Quality Requirements."
3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
4. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the National Association of Landscape Professionals:

a. Landscape Industry Certified Technician - Exterior.
b. Landscape Industry Certified Lawn Care Manager.
c. Landscape Industry Certified Lawn Care Technician.

5. Pesticide Applicator: State licensed, commercial.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.

B. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" sections in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod within 24 hours of harvesting and in time for planting promptly. Protect sod from breakage and drying.

C. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with appropriate certificates.

1.9 FIELD CONDITIONS

A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of Substantial Completion.

1. Spring Season: April 15 to June 30. Perennials and warm season grasses may be planted during this time after the last frost and before ambient temperatures rise above 80 deg. F.

2. Summer Season: July 1 through September 14. Planting during this season must receive approval by Owner and Horticultural Consultant one month in advance, prior to commencing. Approval to plant under such conditions shall not relieve Contractor from guarantee and maintenance provisions of these specifications. All watering for plants must be performed daily by Contractor and at no additional cost to the Contract.

3. Fall Planting Season: September 15 –October 31. Perennials may be planted during this time before the first frost and after ambient temperatures fall below 80 deg. F.

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

C. C. Existing Conditions

1. Carefully examine the site before submitting a bid. Be informed as to the nature and location of the Work, general and local conditions including climate, adjacent properties and utilities, conformation of the ground, the nature of subsurface conditions, the character of equipment and facilities needed prior to and during execution of the Work.

2. Should the Contractor, in the course of Work, find any discrepancies between Drawings and physical conditions or in layout as furnished by the Landscape Architect, inform the Landscape Architect immediately in writing for clarification. Work done after such discovery, unless authorized by the Landscape Architect, shall be done at the Contractor's risk.

3. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions. Do not [seed] [or] [place sod] when the ground is frozen, or the soil is otherwise in an unsatisfactory condition for lawn construction.

1.10 MAINTENANCE SERVICE

A. Initial Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until acceptable turf is established but for not less than the following periods:
   1. Seeded Turf: 60 days from date of [Substantial Completion.
   2. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.
   3. Sodded Turf: 30 days from date of Substantial Completion.
   4. Plugged Turf: 30 days from date of Substantial Completion.
   5. Sprigged Turf: 30 days from date of Substantial Completion.

B. Initial Meadow Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until acceptable meadow is established, but for not less than 40 days from date of Substantial Completion.

C. Continuing Maintenance Proposal: In compliance with the maintenance procedures outlined in Section 329650 “Landscape Maintenance”.

PART 2 - PRODUCTS

2.1 SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Rules for Testing Seeds" for purity and germination tolerances.

B. Seed Species:
   1. Quality, State Certified: State-certified seed of grass species as listed below for solar exposure.
   2. Quality, Non-State Certified: Seed of grass species as listed below for solar exposure, with not less than 85 percent germination, not less than 95 percent pure seed, and not more than 0.5 percent weed seed:
   3. Full Sun, Warm-Season Grass: Bermudagrass (Cynodon dactylon).
   4. Full Sun, Cool-Season Grass: Kentucky bluegrass (Poa pratensis), a minimum of three cultivars.
   5. Sun and Partial Shade, Cool-Season Grass: Proportioned by weight as follows:
      a. 50 percent Kentucky bluegrass (Poa pratensis).
      b. 30 percent chewings red fescue (Festuca rubra variety).
      c. 10 percent perennial ryegrass (Lolium perenne).
      d. 10 percent redtop (Agrostis alba).
   6. Shade, Cool-Season Grass: Proportioned by weight as follows:
      a. 50 percent chewings red fescue (Festuca rubra variety).
      b. 35 percent rough bluegrass (Poa trivialis).
      c. 15 percent redtop (Agrostis alba).

C. Seed shall be fresh, clean, new crop seed. The contractor shall furnish to the Landscape Architect the dealer's guaranteed statement of the composition of the mixture and the percentage of purity and germination of each variety.

D. Seed containing prohibited or restricted noxious weeds will not be accepted, and shall comply with state laws governing noxious weeds.
   1. The following noxious weeds are prohibited from any mix: Bindweed, Canada Thistle, quackgrass, hedge kind weed, horse nettle, wild garlic bermuda grass, cheat, wild onion, corn cockle, dodder and wild onion, Johnsongrass, perennial sweet sudan grass, sorghum hybrids.

2.2 TURFGRASS SOD

A. Turfgrass Sod: Number 1 Quality/Premium, including limitations on thatch, weeds, diseases, nematodes, and insects, complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture that is strongly rooted and capable of vigorous growth and development when planted.

B. Turfgrass Species, Cool-Season Grass: Sod of grass species as follows, with not less than 85 percent germination, not less than 95 percent pure seed, and not more than 0.5 percent weed seed:

   1. Full Sun: Kentucky bluegrass (Poa pratensis), a minimum of three cultivars.
   2. Sun and Partial Shade: Proportioned by weight as follows:

      a. 50 percent Kentucky bluegrass (Poa pratensis).
      b. 30 percent chewings red fescue (Festuca rubra variety).
      c. 10 percent perennial ryegrass (Lolium perenne).
      d. 10 percent redtop (Agrostis alba).

   3. Shade: Proportioned by weight as follows:

      a. 50 percent chewings red fescue (Festuca rubra variety).
      b. 35 percent rough bluegrass (Poa trivialis).
      c. 15 percent redtop (Agrostis alba).

2.3 FERTILIZERS

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

   1. Composition:

      a. 1 lb/1000 sq. ft. (0.45 kg/92.9 sq. m) of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
      b. Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

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

   1. Composition:

      a. 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.

b. Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

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 2 to 5 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

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

C. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic and free of plant-growth or germination inhibitors; with a maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.

D. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.

E. Asphalt Emulsion: ASTM D977, Grade SS-1; nontoxic and free of plant-growth or germination inhibitors.

2.5 PESTICIDES

A. General: Pesticide, registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

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

2.6 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 burlap 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 be planted for compliance with requirements and other conditions affecting installation and performance of the Work.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
3. Uniformly moisten excessively dry soil that is not workable or which is dusty.

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

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

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 and hydromulching overspray.
2. Protect grade stakes set by others until directed to remove them.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 TURF AREA PREPARATION

A. General: Prepare planting area for soil placement and mix planting soil according to Section 329113 "Soil Preparation."

B. Placing Planting Soil: In accordance with section 329113 “Soil Preparation” .

1. Reduce elevation of planting soil to allow for soil thickness of sod.

C. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

D. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 PREPARATION FOR EROSION-CONTROL MATERIALS

A. Prepare area as specified in "Turf Area Preparation" Article.

B. For erosion-control mats, install planting soil in two lifts, with second lift equal to thickness of erosion-control mats. Install erosion-control mat and fasten as recommended by material manufacturer.

C. Fill cells of erosion-control mat with planting soil and compact before planting.

D. For erosion-control blanket or mesh, install from top of slope, working downward, and as recommended by material manufacturer for site conditions. Fasten as recommended by material manufacturer.

E. Moisten prepared area before planting if surface is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

3.5 SEEDING

A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph (8 km/h).

1. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
2. Do not use wet seed or seed that is moldy or otherwise damaged.
3. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.

B. Sow seed at a total rate recommended by seed supplier.

C. Rake seed lightly into top 1/8 inch (3 mm) of soil, roll lightly, and water with fine spray.

D. Protect seeded areas with slopes exceeding 1:4 with erosion-control blankets and 1:6 with erosion-control fiber mesh installed and stapled according to manufacturer's written instructions.

E. Protect seeded areas with erosion-control mats where indicated on Drawings; install and anchor according to manufacturer's written instructions.

F. 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 thickness over seeded areas. Spread by hand, blower, or other suitable equipment.

1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.
2. Bond straw mulch by spraying with asphalt emulsion at a 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.

G. Protect seeded areas from hot, dry weather or drying winds by applying compost mulch within 24 hours after completing seeding operations. Soak areas, scatter mulch uniformly to a thickness of 3/16 inch (4.8 mm), and roll surface smooth.

3.6 HYDROSEEDING

A. Hydroseeding: Mix specified seed, slow-release 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 fiber-mulch manufacturer's recommended tackifier.
2. Spray-apply slurry uniformly to all areas to be seeded in a one-step process. Apply slurry at a rate so that mulch component is deposited at not less than 1500-lb/acre (15.6-kg/92.9 sq. m) dry weight, and seed component is deposited at not less than the specified seed-sowing rate.
3. Spray-apply slurry uniformly to all areas to be seeded in a two-step process. Apply first slurry coat at a rate so that mulch component is deposited at not less than 500-lb/acre (5.2-kg/92.9 sq. m) dry

weight, and seed component is deposited at not less than the specified seed-sowing rate. Apply slurry cover coat of fiber mulch (hydromulching) at a rate of 1000 lb/acre (10.4 kg/92.9 sq. m).

3.7 SODDING

A. Lay sod within 24 hours of harvesting unless a suitable preservation method is accepted by Architect prior to delivery time. Do not lay sod if dormant or if ground is frozen or muddy.

B. 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 soil or sod during installation. Tamp and roll lightly to ensure contact with soil, 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 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 two anchors per sod strip to prevent slippage.

C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches (38 mm) below sod.

3.8 TURF RENOVATION

A. Renovate existing turf where indicated.

B. Renovate turf damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.

1. Reestablish turf where settlement or washouts occur or where minor regrading is required.
2. Install new planting soil as required.

C. Remove sod and vegetation from diseased or unsatisfactory turf areas; do not bury in soil.

D. Remove topsoil containing foreign materials, such as oil drippings, fuel spills, stones, gravel, and other construction materials resulting from Contractor's operations, and replace with new planting soil.

E. Mow, dethatch, core aerate, and rake existing turf.

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 fertilizer required for establishing new turf and mix thoroughly into top 4 inches (100 mm) of existing soil. Install new planting soil to fill low spots and meet finish grades.

1. Soil Amendment(s): according to requirements of Section 329113 "Soil Preparation."
2. Initial Fertilizer: Slow-release fertilizer applied according to manufacturer's recommendations.

J. Apply sod as required for new turf.

K. Water newly planted areas and keep moist until new turf is established.

3.9 TURF MAINTENANCE

A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.

1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches (100 mm).

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
2. Water turf with fine spray at a minimum rate of 1 inch (25 mm) per week unless rainfall precipitation is adequate.

C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third 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:

D. Turf Postfertilization: slow-release fertilizer after initial mowing and when grass is dry.

1. Use fertilizer that provides actual nitrogen of at least 1 lb/1000 sq. ft. (0.45 kg/92.9 sq. m) to turf area.

3.10 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by Architect:

1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. (0.92 sq. m) and bare spots not exceeding 5 by 5 inches (125 by 125 mm).
2. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.
3. Satisfactory Plugged Turf: At end of maintenance period, the required number of plugs has been established as well-rooted, viable patches of grass, and areas between plugs are free of weeds and other undesirable vegetation.
4. Satisfactory Sprigged Turf: At end of maintenance period, the required number of sprigs has been established as well-rooted, viable plants, and areas between sprigs are free of weeds and other undesirable vegetation.

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

3.11 PESTICIDE APPLICATION

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

B. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.12 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.

C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

D. Remove nondegradable erosion-control measures after grass establishment period.

3.13 MAINTENANCE SERVICE

A. Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in "Turf Maintenance" Article. Begin maintenance immediately after each area is planted and continue until acceptable turf is established, but for not less than the following periods:

1. Seeded Turf: 60 days from date of Substantial Completion.

    a. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.

2. Sodded Turf: 30 days from date of Substantial Completion.
3. Plugged Turf: 30 days from date of Substantial Completion.
4. Sprigged Turf: 30 days from date of Substantial Completion.

B. Meadow Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in "Meadow Maintenance" Article. Begin maintenance immediately after each area is planted and continue until acceptable meadow is established, but for not less than maintenance period below.

1. Maintenance Period: 40 days from date of Substantial Completion.

END OF SECTION 329200

SECTION 329300

PLANTS

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. Plants.
2. Tree stabilization.
3. Tree-watering devices.
4. Landscape edgings.

B. Related Requirements:

1. Section 015639 "Temporary Tree and Plant Protection" for protecting, trimming, pruning, repairing, and replacing existing trees to remain that interfere with, or are affected by, execution of the Work.
2. Section 329200 "Turf and Grasses" for turf (lawn) and meadow planting, hydroseeding, and erosion-control materials.
3. Section 329600 "Transplanting" for transplanting non-nursery-grown trees.

1.3 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with a ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.

C. Balled and Potted Stock: Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required.

D. Bare-Root Stock: 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 the minimum root spread according to ANSI Z60.1 for type and size of plant required.

E. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.

F. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of plant.

G. Finish Grade: Elevation of finished surface of planting soil.

H. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant. Some sources classify herbicides separately from pesticides.

I. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

J. Planting Area: Areas to be planted.

K. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329113 "Soil Preparation" for drawing designations for planting soils.

L. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.

M. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

N. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.

O. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 COORDINATION

A. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.

1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
2. Plant Photographs: Include color photographs in digital format of each required species and size of plant material as it will be furnished to Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. For species where more than 20 plants are required, include a minimum of three photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.

B. Samples for Verification: For each of the following:
   1. Mulch: 1-pint volume of each organic mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.
   2. Staking Materials.

INFORMATIONAL SUBMITTALS

C. Qualification Data: For landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.

D. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:

   1. Manufacturer's certified analysis of 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.

E. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

F. Notices and Scheduling:

   1. Submit the following within 45 days after Contract Notice to Proceed:
      a. Invoices or certificates of deposit from nursery(ies) guaranteeing timely delivery of all specified and tagged plant materials. If any plant materials are unavailable at the time of submittal, the Contactor shall consult with the Landscape Architect and Construction Manager to determine status for compliance or acceptable alternatives such as contract growing.
      b. Schedule itemizing landscape planting work to be performed. This schedule shall be in addition to and more detailed than Project Contract Schedule(s) required by other Contract Documents.
         1) Include in this schedule anticipated dates for commencement and sequencing of all landscape planting work, including but not limited to selections and tagging of trees in nurseries, digging plant material, layouts and layout approval, soil amendment and preparation of planting beds, delivery of plants to the site, placement of each plant type, and commencement of maintenance period. Plant placement schedule shall include dates of planting by species and location on site.
         2) Schedule shall also include, and shall be arranged together with all related work such as paving, soil placement, utility work, light fixtures etc.
         3) Schedule shall be resubmitted as follows:
            a) 3 months prior to digging of first plants
            b) 1 month prior to shipment of first plants
            c) Notify Contractor and Owner on a daily basis or as requested within two weeks prior to shipment.
            d) As requested by Owner

G. Plant List and Source Identification:

   1. Submit a complete list of all plant material for Project with nursery or seed vendor source identification for each plant or seed type.

a. Include in plant list the botanical and common names, size, quantity, form, depth and width of root ball, limb height (if applicable), whether plant is a fall dig hazard, other requested data, and source locations for all seed and plant materials.
b. Include names, addresses, and phone numbers of each nursery or seed vendor 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, as specified in Division 1 Section, PRODUCT REQUIREMENTS. Where deviations or other changes occur in plant list, identify both the original specified plant item and the new plant item.
d. Plants listed with submittal shall be available at the nursery for inspection and selection as specified in Part 1 "Plant Sourcing, Selection, and Inspection" herein. 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. Submit representative plant tag, from each nursery as applicable, prior to scheduling Landscape Architect's inspection and selection/tagging trip.
4. Color digital photographs of plant material within five (5) days of Landscape Architect's inspection and selection/tagging trip and/or request.
   a. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph.
   b. For species where more than 20 plants are required, include a minimum of three 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.

H. 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.

I. Certificates: For each type of manufactured product, signed by product manufacturer, and complying with the following. Submit inspection certificates required by authorities having jurisdiction. Supply Certificates of Compliance for all materials required for fabrication and installation, certifying that each material item complies with, or exceeds, specific requirements.

1. For Live Plants: Furnish certification that all plant material shall be true to name and in conformance with these specifications. In addition, furnish certificates of inspection as may be required by Federal, State or other authorities that plant material is free of disease or hazardous insects.
2. Furnish certifications / cultivars by supplying nursery.
3. Prior to or at Substantial Completion of Contract Work, submit written certifications for the following materials with statement of product identification and total quantities of each by weight actually used on the Project Site as work of this Contract. Relate to and arrange together with work and materials specified in other Sections:
   a. Quantity and location of each type commercial fertilizer, organic fertilizer, or other soil amendments.
   b. Quantity and location of each type pesticide or anti-fungicide.
   c. Quantity and location of antidesiccant.

J. Prior to the placement of plant materials, submit written confirmation of understanding that the following elements of work have been installed and inspected and approved prior to the start of any plant installation work of this Section in plant bed areas.

1. Newly built drainage system.

2. Complete placement of planting soil mixes including verification of acceptability of grades, and quality of planting soil mix materials, and quality of planting soil material placement.
3. Confirm also, that no other construction access (except planting work of this Contract) will be required across planting bed areas.
4. Note: Plants shipped in advance of Owner planting bed approval, may be rejected.

K. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance instructions: Include typewritten instructions recommending procedures to be established by Owner and Landscape Architect. Coordinate with the requirements of Section 32 96 50, "Landscape Maintenance Period." Include recommendations for the following:

1. Application of anti-desiccant sprays
2. Application of insecticides and fertilizers.
3. Maintenance of trees, shrubs, plants, meadow and ground covers.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.
1. Experience: Five years' experience in landscape installation on projects of a similar scale.
2. Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
4. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the National Association of Landscape Professionals:

    a. Landscape Industry Certified Technician - Exterior.
    b. Landscape Industry Certified Interior.
    c. Landscape Industry Certified Horticultural Technician.

5. Pesticide Applicator: State licensed, commercial.

B. Plant or Seed Supplier Qualification: Plant or Seed Supplier (s) shall have a nursery facility as an integral part of operation where majority of plants can be grown and reviewed, shall be reputable, and shall have been in continual operation with a minimum of 7 years experience as a plant grower. Nursery shall be located no more than 250 miles from the Project Site, located in USDA Plant Hardiness Zones 6,7, or 8. Nursery shall be capable of the following as a minimum:

1. Supplying plant material or seed conforming to the quality standards, visual characteristics, sizes, species cultivars, and quantities indicated by Contract Documents.
2. Conformance to cultural practices and maintenance procedures suitable for healthy plant material.
3. Other plant material or seed suppliers such as plant wholesalers shall be evaluated based on experience and plant quality/quantity and ability to meet requirements of Contract Documents.

C. Plant Selection Confirmation: Landscape Architect shall maintain strong control on all plant genus, species, cultivar, size, form and quality of selections. The Contractor shall identify any plant material unavailable after thorough attempt to locate plant material specified as well as identify potential substitutions similar in type and scale specified. The Contractor shall confirm ALL final plant selections and noted description for each as identified on the Plant Schedule as well as source provider for each in

written document with photographs submitted to Owner and Landscape Architect prior to final plant selection and tagging. As necessary, the Owner and Landscape Architect shall provide the Contractor with all required substitutions and/or preferred substitutions based on availability of alternative variety of comparable type, size, quantity, and/or cost or as otherwise approved by the Owner. The Contractor shall be responsible for confirming all final plant material selections and source providers prior to delivery so as to not cause delay of any kind to the scheduled timeline for plant delivery and installation.

D. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.

E. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.

1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container-grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches (150 mm) above the root flare for trees up to 4-inch (100-mm) caliper size, and 12 inches (300 mm) above the root flare for larger sizes.
2. Other Plants: Measure with stems, petioles, and foliage in their normal position.

F. Plant Material Observation: The Landscape Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. The Landscape Architect retains right to observe trees, shrubs, perennials, and grasses indicated in planting schedule further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected plants immediately from Project site.

G. Pre-installation Conference: Conduct conference at Project site with Contractor, Owner’s Representative, and Landscape Architect.

H. Inspection for Final Completion

1. The Landscape Architect will make an inspection for Final Completion of planting work of this Section prior to an inspection for Final Completion of the entire Contract Work. Final Completion of the planting work would be considered at the time that all planting and irrigation is completed with no punch list items remaining. Submit a written request for inspection at least 14 calendar days prior to the day on which the inspection for Final Completion is requested.
2. Prepare a list (Punch List) with status of items to be completed or corrected for review prior to inspection by the Landscape Architect and Owner’s Representative.
3. To be accepted at time of Substantial Completion inspection, all planting shall be alive, healthy, and installed as specified.
4. Upon completion of the inspection for Substantial Completion, the Landscape Architect will review and amend Contractor's list of items to be completed or corrected (Punch List) as determined to be necessary, and will indicate the anticipated time period for their completion or correction.
5. Where permitted by Owner’s Representative and the Landscape Architect, planting areas may be accepted in parts or sub-areas.
6. The Guarantee/Warranty Period for Plants will not begin until all items of planting have been completed or corrected. The Landscape Architect, after Contractor's acceptable completion of outstanding work, will recommend to the Owner the Final Completion of planting work of this Section.
    d. Guarantee/Warranty Period shall begin only upon issuance of acceptance by Owner of Final Completion for all related Landscape Material Contract Work of which this exterior planting work may be a part.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with appropriate certificates.

C. Deliver bare-root stock plants within 36 hours of digging. 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. Transport in covered, temperature-controlled vehicles, and keep plants cool and protected from sun and wind at all times.

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

E. Handle planting stock by root ball.

F. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F (16 to 18 deg C) until planting.

G. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.

1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.

H. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

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

1. Heel-in bare-root stock. Soak roots that are in less than moist condition in water for two hours. Reject plants with dry roots.
2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
3. Do not remove container-grown stock from containers before time of planting.
4. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly wet condition.

1.9 FIELD CONDITIONS

A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

B. Planting Restrictions: Plant during one of the following periods in accordance with restrictions noted. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.

1. Spring Season: April 15 to June 30. Perennials and warm season grasses may be planted during this time after the last frost and before ambient temperatures rise above 80 deg. F.

2. Summer Season: July 1 through September 14. Planting during this season must receive approval by Owner and Horticultural Consultant one month in advance, prior to commencing. Approval to plant under such conditions shall not relieve Contractor from guarantee and maintenance provisions of these specifications. All watering for plants must be performed daily by Contractor and at no additional cost to the Contract.

3. Fall Planting Season: September 15 –October 31. Perennials may be planted during this time before the first frost and after ambient temperatures fall below 80 deg. F.

4. Dormant Planting Season: November 1 to February 28. Trees and shrubs may be planted during this time as long as the ground is not frozen.

5. The following plants are listed in three groups according to lessening degrees of risk for fall planting. The list is not based on controlled experiments, but on years of observation by nursery men. Planting at times other than spring shall be done at Contractor's risk, and shall not relieve him of the obligation of Guarantee.
   a. Plants with significant risk of loss. Best to postpone planting the following plants until spring:
      1) Carpinus spp., hornbeams
      2) Cercis Canadensis, eastern redbud
      3) Chamaecyparis nootkatensis, nootka cypress
      4) Koelreuteria paniculata, golden-rain tree
      5) Liriodendron tulipifera, tulip tree
      6) Magnolia spp., magnolias
      7) Nyssa sylvatica, black gum
      8) Populus spp., poplars
      9) Quercus alba, white oak
      10) Quercus coccinea, scarlet oak
      11) Quercus macrocarpa, bur oak
      12) Quercus phellos, willow oak
      13) Quercus robur, English oak
      14) Quercus rubra, red oak
      15) Zelkova serrata, Japanese zelkova

   b. Plants with some degree of risk. The following plants can be transplanted if stock is freshly dug and moved quickly and carefully. Stake, wrap, and provide extra care.
      1) Acer rubrum, red maple
      2) Betula spp., birches
      3) Cornus florida, flowering dogwood
      4) Crataegus spp., hawthorns
      5) Prunus spp., stone fruits (peach, cherry, etc.)
      6) Pyrus calleryana, Callery pear
      7) Salix spp., willows (tree forms)

8) Tilia tomentosa, silver linden

c. Plants not at great risk, but avoid late planting. These are best planted in late August or September: they may have trouble if planted later.
1) Berberis julianae, wintergreen barberry
2) Cotoneaster salicifolius, willowleaf cotoneaster
3) Hedera helix, English ivy
4) Ilex crenata, Japanese holly
5) Pinus thunbergiana, Japanese black pine
6) Rhododendron spp., rhododendrons and azaleas, evergreen types
7) Tsuga canadensis, Canada hemlock
8) Viburnum rhytidophyllum, leatherleaf viburnum

6. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements. Wet or rainy conditions may require installation by hand only to avoid soil compaction.

1.10 WARRANTY

A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner.
b. Structural failures including plantings falling or blowing over.
c. Faulty performance of tree stabilization, edgings and tree grates.
d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Periods: From date of Substantial Completion.

a. Trees, Shrubs, Vines, and Ornamental Grasses: 12 months.

3. Include the following remedial actions as a minimum:

a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
c. A limit of one replacement of each plant is required except for losses or replacements due to failure to comply with requirements.
d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

PART 2 - PRODUCTS

2.1 PLANT SOURCING, SELECTION, AND INSPECTIONS

A. General Requirements:

1. Contractor shall locate plant material source(s), confirm each plant's availability in compliance with Contract Documents, and shall submit, as specified, a complete list of all plant material for Project with nursery source identification for each plant.
2. The Landscape Architect, after review of submitted Plant List and Source Identification, will inspect plant materials at place of growth from identified nursery stock and at site before planting for compliance with requirements of genus, species, variety, size, quality, and other characteristics and for the purpose of plant selection.
3. For the purpose of plant material selection by the Landscape Architect, the terms "inspect" and "inspection" are to be construed as an evaluation, consideration, judgment, and review for acceptability at time of observation.
4. In addition to inspection at place of growth, the Landscape Architect retains the right to inspect plant materials for size, condition of balls and root systems, insects, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of the work even if previously inspected and approved.
5. Plant material not selected and tagged or otherwise reviewed as acceptable shall not be delivered to Project and plant material subsequently rejected after delivery shall be removed immediately from Project site and replaced at no additional cost to the Owner.

B. Sourcing – Trees and Shrubs

1. All trees and shrubs, unless otherwise approved by the Landscape Architect shall be nursery grown for inspection and tagging in their growing locations.
2. Photos are required at the Landscape Architect's request prior to tagging trip(s).
3. Pre-dug plants shall not be acceptable unless they are indicated and accepted as container grown plants in the plant list.
4. A nursery source may be rejected by the Landscape Architect if it is determined before, during, or after inspection and/or receipt of the plants that nursery source does not meet any of the following:
    a. The quality standards set forth by Contract Documents are not met by the nursery or nursery plant stock.
    b. Nursery or nursery plant stock exhibits an infestation with pest, weeds, or disease.
    c. The intended visual characteristics of the plants are not met by the nursery stock.
    d. Nursery cannot supply the specified plants in sizes, species cultivar and/or quantities indicated by Contract Documents.
    e. The nursery does not follow cultural practices or maintenance procedures suitable for healthy plant material.

C. Contractor's Preparation for Plant Selection

1. Make all pre-selection arrangements with and at nursery supply source(s) to insure a ready supply of materials, equipment, and manpower required for an efficient selection and tagging procedure.
2. Request visit of the Landscape Architect, together with the Owner as applicable, at least fourteen (14) days in advance of the Contractor's desired inspection date for each type plant material.
    a. Written request for plant material inspection shall be made at least 60 days prior to the expected and scheduled planting date.
3. Pay costs for the Landscape Architect's travel for each inspection/tagging trip. Anticipate travel arrangements for at least 2 persons with the Landscape Architect unless otherwise advised.
4. Be present, together with plant Installer's Supervisor and nursery representative for plant inspection and tagging at the nursery source and, at applicable times on-site.

D. Plant Material Inspection and Selection at Nursery

1. The Landscape Architect will inspect plant material and make selection prior to digging at place of growth for compliance with genus, species, variety, size and quality.

a. All trees will be inspected and selected at the nursery sources by the Landscape Architect for conformity to the specification requirements.
b. The Landscape Architect may only require inspection of representative samples of each species of shrub, perennial, and grasses.

2. Selected plants shall be tagged in the nursery as directed by the Landscape Architect. Seals shall be placed by the Landscape Architect on selected plants and not removed until the end of the Guaranty / Warranty period or at Substantial Completion as directed by the Landscape Architect.
3. Inspection and selection by the Landscape Architect shall not affect the right of inspection and rejection during delivery or during and after installation.
4. Photographs: Furnish photographs of the plant material at the Landscape Architect's request.
   a. Photographs (using digital camera) shall be taken at the nursery source. A scale figure or measuring device to indicate size shall be in each photograph.
      1) Tree photographs shall include images of the entire plant, and detail photographs showing the following: base of the tree, leaves, branching structure, form and habit.
      2) Shrub photographs shall include images of the entire plant, and detail photographs showing the following: base of the plant, leaves, branching structure, form and habit, root ball (for balled and burlap material), and/or roots (for boxed material).
   b. Each photograph taken shall be labeled with the botanical and common names, nursery name, location and date.
   c. Furnish the Landscape Architect digital disk and two (2) print copies, minimum 4" x 6" size, of all photographs within 5 days of the Landscape Architect's request.

E. Plant Material Inspection On-Site

1. Notify the Landscape Architect fourteen (14) days in advance of any delivery of plant materials to the site.
   a. Inspection by the Landscape Architect of stakeout for tree and shrub locations, perennials, grasses and plant massings must be complete prior to plant delivery.
2. The Landscape Architect will inspect plant material upon delivery to site or prior to installation.
   a. Allow time duration on-site, as approved by the Landscape Architect, for inspection and layout adjustment prior to installations.
   b. Arrange for adequate manpower and equipment on-site at the time of plant material inspections and installation to provide a complete staked layout and to unload, open, and handle plant material during inspection.
   c. Rejected plants shall be removed immediately from site.

2.2 PLANT MATERIAL

A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch (19 mm) in diameter; or with stem girdling roots are unacceptable.
2. 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.

B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Landscape Architect, with a proportionate increase in size of roots or balls.

C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

D. Labeling: Label each plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant.

E. If formal arrangements or consecutive order of plants is indicated on Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.

2.3 SUPPLEMENTS AND SOIL AMMENDMENTS

A. All amendments of soil shall be provided as part of Section 329115, “Planting Soils”. It is not anticipated that any amendments will be necessary at project site at time of planting.

2.4 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: triple shredded bark
2. Size Range: three inches (3") in length and one inch (1") in width.
3. Color: Natural.
4. Mulch contaminated with leaves, twigs, and/or debris shall not be acceptable. Only all natural mulch suitable as a top dressing of trees and shrubs derived from tree bark, not from wood waste products like sawdust, shall be acceptable.
5. Mulch shall be free of heavy metals, well-aerated, low salinity, moderate pH value.

2.5 TREE-STABILIZATION MATERIALS

A. Trunk-Stabilization Materials:

1. ¾” (20mm) wide, flat, woven polypropylene with a rounded weave and a lock stitch with a tensile strength of 900 lbs. Staked with a manufacturer-approved method.
   a. Arbor Tie as manufactured by DeepRoot Green Infrastructure, LLC or approved equal.

2.6 TREE-WATERING DEVICES

A. Slow-Release Watering Device: Standard product manufactured for drip irrigation of plants and emptying its water contents over an extended time period; manufactured from UV-light-stabilized nylon-reinforced polyethylene sheet, PVC, or HDPE plastic.
   1. Color: As selected by Architect from manufacturer's full range.

2.7 MISCELLANEOUS PRODUCTS

A. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.

B. Burlap: Non-synthetic, biodegradable.

C. Planter Drainage Gravel: Washed, sound crushed stone or gravel complying with ASTM D448 for Size No. 8.

D. Planter Filter Fabric: Nonwoven geotextile manufactured for separation applications and made of polypropylene, polyolefin, or polyester fibers or combination of them.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive plants, with Installer present, for compliance with requirements and conditions affecting installation and performance of the Work.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Verify that plants and vehicles loaded with plants can travel to planting locations with adequate overhead clearance.
3. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
4. Uniformly moisten excessively dry soil that is not workable or which is dusty.

B. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

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

3.2 PREPARATION

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

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Architect's acceptance of layout before excavating or planting. Make minor adjustments as required.

D. Lay out plants at locations directed by Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.

3.3 PLANTING AREA ESTABLISHMENT

A. General: Prepare planting area for soil placement and mix planting soil according to Section 329113 "Soil Preparation."

B. Placing Planting Soil: Place in accordance with Section 329113 “Soil Preparation.”

C. Before planting, obtain Landscape Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 EXCAVATION FOR TREES AND SHRUBS

A. Planting Pits and Trenches: Excavate circular planting pits.

1. Excavate planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are unacceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
2. Excavate approximately three times as wide as ball diameter for balled and burlapped stock.
3. Excavate at least 12 inches (300 mm) wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
4. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
5. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
6. Maintain angles of repose of adjacent materials to ensure stability. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
7. Maintain supervision of excavations during working hours.
8. Keep excavations covered or otherwise protected when unattended by Installer's personnel.
9. If drain tile is indicated on Drawings or required under planting areas, excavate to top of porous backfill over tile.

B. Backfill Soil: Subsoil and topsoil removed from excavations may be used as backfill soil unless otherwise indicated.

C. Obstructions: Notify Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.

1. Hardpan Layer: Drill 6-inch- (150-mm-) diameter holes, 24 inches (600 mm) apart, into free-draining strata or to a depth of 10 feet (3 m), whichever is less, and backfill with free-draining material.

D. Drainage: Notify Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.

E. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

3.5 TREE, SHRUB, AND VINE PLANTING

A. Inspection: At time of planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.

B. Roots: Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.

C. Balled and Burlapped Stock: Set each plant plumb and in center of planting pit or trench with root flare 2 inches (50 mm) aboveadjacent finish grades.

1. Backfill: Planting soil
2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root

balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.

3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.

4. Continue backfilling process. Water again after placing and tamping final layer of soil.

D. Balled and Potted and Container-Grown Stock: Set each plant plumb and in center of planting pit or trench with root flare 2 inches (50 mm) above adjacent finish grades.

1. Backfill: Planting soil
2. Carefully remove root ball from container without damaging root ball or plant.
3. Container-grown rootball shall be scarified and roots loosened prior to installation with a soil knife or similar tool to alleviate pot bound root systems.
4. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.

5. Continue backfilling process. Water again after placing and tamping final layer of soil.

3.6 MECHANIZED TREE-SPADE PLANTING

A. Trees may be planted with an approved mechanized tree spade at the designated locations. Do not use tree spade to move trees larger than the maximum size allowed for a similar field-grown, balled-and-burlapped root-ball diameter according to ANSI Z60.1, or larger than manufacturer's maximum size recommendation for the tree spade being used, whichever is smaller.

B. Use the same tree spade to excavate the planting hole as will be used to extract and transport the tree.

C. When extracting the tree, center the trunk within the tree spade and move tree with a solid ball of earth.

D. Cut exposed roots cleanly during transplanting operations.

E. Plant trees following procedures in "Tree, Shrub, and Vine Planting" Article.

F. Where possible, orient the tree in the same direction as in its original location.

3.7 TREE, SHRUB, AND VINE PRUNING

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

B. Prune, thin, and shape trees, shrubs, and vines as directed by Architect.

C. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.

D. Do not apply pruning paint to wounds.

3.8 TREE STABILIZATION

A. Trunk Stabilization by arbor tie: Install trunk stabilization as follows unless otherwise indicated:
   1. Secure arbor tie around newly planted tree in accordance with manufacturer's tying instructions. The tying technique shall provide a secure, girdle free attachment to the tree, which will expand as the tree grows.
   2. No anchors or nails shall be used on the tree itself.
   3. Secure long end of arbor tie to the eye of the stake or anchor. Add tension to the arbor tie by driving the stake or anchor into the ground outside of the planting hole at a 45 degree angle to the tree trunk.
   4. When driving the stake or anchor into the ground, ensure eye opening is not buried. Final stake placement shall ensure eye opening is even to the soil level.
   5. A minimum of 3 anchor points shall be evenly spaced around each tree.
   6. Trunk stabilization shall be removed 1 year after installation.

3.9 PLACING SOIL IN PLANTERS

A. Place a layer of drainage gravel at least 4 inches (100 mm) thick in bottom of planter. Cover bottom with filter fabric and wrap filter fabric 6 inches (150 mm) up on all sides. Duct tape along the entire top edge of the filter fabric, to secure the filter fabric against the sides during the soil-filling process.

B. Fill planter with planting soil. Place soil in lightly compacted layers to an elevation of 1-1/2 inches (38 mm) below top of planter, allowing natural settlement.

3.10 GROUND COVER AND PLANT PLANTING

A. Set out and space ground cover and plants other than trees, shrubs, and vines [as indicated on Drawings in even rows with triangular spacing.

B. Use planting soil for backfill.

C. Dig holes large enough to allow spreading of roots.

D. For rooted cutting plants supplied in flats, plant each in a manner that minimally disturbs the root system but to a depth not less than two nodes.

E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.11 PLANTING AREA MULCHING

A. Mulch backfilled surfaces of planting areas and other areas indicated.

   1. Trees and Treelike Shrubs in Turf Areas: Apply organic mulch ring of 2-inch (50-mm) average thickness, with 24-inch (600-mm) radius around trunks or stems. Do not place mulch within 3 inches (75 mm) of trunks or stems.

2. Organic Mulch in Planting Areas: Apply 2-inch (50-mm) average thickness of organic mulch extending 12 inches (300 mm) beyond edge of individual planting pit or trench and over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 3 inches (75 mm) of trunks or stems.

3.12 INSTALLATION OF SLOW-RELEASE WATERING DEVICE

A. Provide one device for each tree.

B. Place device on top of the mulch at base of tree stem and fill with water according to manufacturer's written instructions.

3.13 PLANT MAINTENANCE

A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.

B. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.

C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices when possible to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.14 PESTICIDE APPLICATION

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

B. Pre-Emergent Herbicides (Selective and Nonselective): Apply to tree, shrub, and ground-cover areas according to manufacturer's written recommendations. Do not apply to seeded areas.

C. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.15 CLEANUP AND PROTECTION

A. Clean pavements and keep work areas clean and neat during landscape work. Remove all debris from site.

B. Provide temporary protection, as specified and as needed to protect drainage system, restrict traffic, to permit growth to develop, to protect completed work, and to ensure work is without damage or deterioration at time of final acceptance. Remove and replace damaged landscape work prior to acceptance.

C. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

3.16 DISPOSAL

A. Excess Planting Soil Mixture and Materials: Excess materials are the property of the Owner; however, the Contractor shall remove the excess planting soil mixture and materials from the site, if so requested by the Owner, at no additional cost to the Owner. Coordinate with work in Section 329115 Planting Soils.

B. Tags: Remove all identification labels, nursery stakes, tie tape, wire, burlap, seals, tags and other debris from plant material, planting areas, and Project site at final acceptance of the project.

3.17 ADJUSTING AND CLEANING

A. Maintain the site in an orderly condition during the progress of Work. Continuously and promptly remove excess and waste materials and keep paved areas, planted areas, stairs, walks and decking clear. Store materials and equipment where approved by the Owner's Representative.

B. Promptly remove soil and debris created by planting work from paved areas. Clean wheels of vehicles before leaving soil areas of site to avoid tracking soil onto surfaces of adjacent deck areas, adjoining roads, walks, or other paved areas.

C. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

D. After installation and before Final Completion, remove nursery tags, nursery stakes, tie tape, non-identifying labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

E. Immediately remove rejected materials from the property. Promptly remove equipment, surplus material, and debris and trash resulting from operations under this Contract upon completion and prior to initial acceptance of Work. Leave the site in a neat, orderly condition, "broom clean".

F. Disposal: Legally dispose of waste material off Owner's property.

3.18 REPAIR AND REPLACEMENT

A. General: Repair or replace existing or new trees and other plants that are damaged by construction operations, in a manner approved by Landscape Architect.

1. Submit details of proposed pruning and repairs.
2. Perform repairs of damaged trunks, branches, and roots within 24 hours, if approved.
3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect.

B. Remove and replace trees that are more than 25 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Architect determines are incapable of restoring to normal growth pattern.

1. Provide new trees of same size as those being replaced for each tree.
2. Species of Replacement Trees: Same species being replaced or as otherwise selected by Landscape Architect.

3.19 CLEANING AND PROTECTION

A. During planting, keep adjacent paving and construction clean and work area in an orderly condition. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

C. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

D. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

E. At time of Substantial Completion, verify that tree-watering devices are in good working order and leave them in place. Replace improperly functioning devices.

3.20 MAINTENANCE SERVICE

A. In accordance with Section 329650 “Landscape Maintenance Period.”

END OF SECTION 329300

SECTION 329600

TRANSPLANTING

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 transplanting non-nursery-grown trees by tree spade

B. Related Requirements:

1. Section 015639 "Temporary Tree and Plant Protection" for protecting, trimming, pruning, repairing, and replacing existing trees to remain that interfere with, or are affected by, execution of the Work.
2. Section 329300 "Plants" for new trees from nursery-grown sources.

1.3 DEFINITIONS

A. General: See definitions in ANSI A300 (Part 6) and in ANSI Z60.1 pertaining to field-grown trees, except as otherwise defined in this Section.

B. Caliper: Diameter of a trunk as measured by a diameter tapeat a height 6 inches (150 mm) above the root flair for trees up to, and including, 4-inch (100-mm) size at this height; and as measured at a height of 12 inches (300 mm) above the root flair for trees larger than 4-inch (100-mm) size.

C. Caliper (DBH): Diameter breast height; diameter of a trunk as measured by a diameter tape [or] [the average of the smallest and largest diameters] at a height 54 inches (1372 mm) above the ground line[for trees with caliper of 8 inches (200 mm) or greater as measured at a height of 12 inches (300 mm) above the root flair].

D. Root-Ball Depth: Measured from bottom of trunk flare to the bottom of root ball.

E. Root-Ball Width: Measured horizontally across the root ball with an approximately circular form or the least dimension for non-round root balls, not necessarily centered on the tree trunk, but within tolerance according to ANSI Z60.1.

F. Root Flare: Also called "trunk flare." The area at the base of the tree's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site

1. Review methods and procedures related to transplanting work include, but are not limited to, the following:

    a. Construction schedule. Verify availability of materials, personnel, equipment, and unimpeded access needed to make progress and avoid delays.
    b. Tree and plant protection.
    c. Tree maintenance.
    d. Arborist's responsibilities.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Verification: For each of the following:

1. Weed-control barriers.
2. Proprietary Root-Ball-Stabilization Device: One unit.
3. Slow-Release Watering Device: One unit of each size required.

C. Pruning Schedule: Written schedule prepared by arborist detailing scope and extent of pruning each tree in preparation for and subsequent to transplanting.

1. Species and size of plant.
2. Location on site plan. Include unique identifier for each.
3. Reason for pruning.
4. Seasonal limitations on pruning.
5. Preparatory Pruning: Time schedule and description of preparatory pruning to be performed.

    a. Indicate time in months preceding the extraction of the tree.
    b. Indicate diameter of root ball and depth of root pruning for each tree.

6. Description of root and crown pruning during and subsequent to transplanting.
7. Description of maintenance following pruning.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified tree-service firm and arborist.

B. Certification: From arborist, certifying that transplanted trees have been protected during construction and that trees were promptly and properly treated and repaired when damaged.

C. Maintenance Recommendations: From arborist, recommended procedures to be established by Owner for care and protection of trees after completing the Work.

1. Submit before completing the Work.

D. Existing Conditions: Documentation of existing trees indicated to be transplanted, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.

1. Use sufficiently detailed color photographs or video recordings. Color shall accurately depict hue condition of foliage and bark.
2. Include drawings and notations to indicate specific wounds and damage conditions of each tree designated to be transplanted.

E. Tree-Transplanting Program: Submit before work begins.

F. Sample Warranties: For special warranties.

G. Tree-maintenance reports.

1.7 QUALITY ASSURANCE

A. Tree-Service Firm Qualifications: An experienced landscaping contractor or tree-moving firm that has successfully completed transplanting work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of the Work.

1. Arborist Qualifications: Certified Arborist as certified by ISA

B. Tree-Transplanting Program: Prepare a written plan by arborist for transplanting trees for the whole Project, including each phase or process, tree maintenance, and protection of surrounding materials during operations. Describe in detail the materials, methods, and equipment to be used for each phase of the transplanting work.

1. Include transplanting times appropriate for each species at the Project location unless otherwise indicated on Drawings or directed by arborist.
2. Include a transplanting schedule for each species to be transplanted, coordinated with the Project schedule.
3. Include site plans clearly marked to show tree-moving routes from extraction to planting locations. Indicate proposed equipment, weight, and turning radii.
4. Show details of temporary protective barriers where needed.
5. Include diagrams showing clearances to utility lines and other encumbrances along route.
6. Include care and maintenance provisions and eventual removal of tree stabilization.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or trees.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery with appropriate certificates.

C. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees in such a manner as to destroy their natural shape.

D. Completely cover foliage when transporting trees while they are in foliage.

E. Handle trees by root ball. Do not drop trees.

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

1.9 FIELD CONDITIONS

A. Field Measurements: Verify final grade elevations and final locations of trees and construction contiguous with trees by field measurements before proceeding with transplanting work. Perform transplanting only after finish grades are established.

B. Seasonal Restrictions: Transplant trees during the following in-season periods:

1. Spring Season: April 15 to June 30. Perennials and warm season grasses may be planted during this time after the last frost and before ambient temperatures rise above 80 deg. F.

2. Summer Season: July 1 through September 14. Planting during this season must receive approval by Owner and Horticultural Consultant one month in advance, prior to commencing. Approval to plant under such conditions shall not relieve Contractor from guarantee and maintenance provisions of these specifications. All watering for plants must be performed daily by Contractor and at no additional cost to the Contract.

3. Fall Planting Season: September 15 –October 31. Perennials may be planted during this time before the first frost and after ambient temperatures fall below 80 deg. F.

4. Dormant Planting Season: November 1 to February 28. Trees and shrubs may be planted during this time as long as the ground is not frozen.

C. Weather Limitations: Proceed with transplanting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Do not transplant during excessively wet or frozen conditions. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

D. Coordination with Turf Areas (Lawns): Perform transplanting before planting turf areas unless otherwise indicated.

1. When transplanting after planting turf areas, protect turf areas, and promptly repair damage caused by transplanting operations.

E. Coordination with Planting Beds: Perform transplanting before planting bedded areas unless otherwise indicated.

1. When transplanting after planting bedded areas, protect bedding plants, and promptly repair damage caused by transplanting operations.

1.10 WARRANTY

A. Installer's Special Warranty: Tree-service firm agrees to repair or replace trees and related materials that fail within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Death and unsatisfactory growth except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner, or incidents that are beyond Contractor's control.

b. Death and unsatisfactory growth is defined as more than 25 percent dead or in an unhealthy condition or failure to meet general performance requirements at end of warranty period.
c. Structural failures including trees falling or blowing over.
d. Faulty performance of materials and devices related to tree plantings including tree stabilization and watering devices.

2. Warranty Periods from Date of Substantial Completion

a. Trees: 12 months.

3. Include the following remedial actions as a minimum:

a. Remove dead trees and trees with unsatisfactory growth at end of warranty period; replace when directed.
b. A limit of one replacement of each tree will be required except for losses or replacements due to failure to comply with requirements.
c. Replace materials and devices related to tree plantings.
d. Provide extended warranty for period equal to original warranty period, for replaced trees.

1.11 MAINTENANCE SERVICE

A. Initial Maintenance Service: Provide tree maintenance by skilled employees of tree-service firm and as required in Part 3. Begin maintenance immediately after preparatory pruning and continue until plantings are healthy and well established but for not less than maintenance period below.

1. Maintenance Period: 12 months from date of Substantial Completion

B. Continuing Maintenance Proposal: From tree-service firm to Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Transplanted trees shall be healthy and resume vigorous growth within one year of transplanting without dieback due to defective extracting, handling, planting, maintenance, or other defects in the Work.

2.2 PLANTING MATERIALS

A. Backfill Soil: Planting soil of suitable moisture content and granular texture for placing and compacting in planting pit around tree, and free of stones, roots, plants, sod, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth.
1. Planting Soil: Planting soil as specified in Section 329113 "Soil Preparation."

2.3 TREE-STABILIZATION MATERIALS

A. Trunk-Stabilization Materials:

1. Upright and Guy Stakes: Rough-sawn, sound, new hardwood free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal (38-by-38-mm actual) by length indicated, pointed at one end.

B. Root-Ball-Stabilization Materials:

1. Upright Stakes and Horizontal Hold-Down: Rough-sawn, sound, new hardwood or softwood, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal (38-by-38-mm actual) by length indicated; stakes pointed at one end.
2. Wood Screws: Hot-dip galvanized or stainless steel.

2.4 WATERING DEVICES

A. Slow-Release Watering Device: Standard product manufactured for drip-irrigation of plants and emptying its water contents over a period of [2 to 9] <Insert number or range> hours; manufactured from UV-light stabilized nylon-reinforced polyethylene sheet, PVC, or HDPE plastic.

2.5 MISCELLANEOUS PRODUCTS

A. Organic Mulch: as specified in Section 329300 "Plants."

B. Burlap: Non-synthetic, biodegradable.

C. Pesticides: Pesticide registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended in writing by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

1. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
2. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

PART 3 - EXECUTION

3.1 TREE-TRANSPLANTING SPECIALIST

A. Tree-Transplanting Specialist Firms: Subject to compliance with requirements, have tree transplanting performed by one of the following firms:

1. The Davey Tree Expert Company. 131 E Church Rd, King of Prussia, PA, 19406. (610) 750-8262

2. Or approved equal.

3.2 EXAMINATION

A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross transplanting areas.

B. For the record, prepare written report, endorsed by arborist, listing conditions detrimental to transplanting work and tree protection and health.

C. Proceed with transplanting only after unsatisfactory conditions have been corrected.

3.3 PREPARATION

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

B. Utility Locator Service: Notify PAOne Call for area where Project is located before beginning excavation.

C. Locate and clearly identify trees for transplanting. Flag each tree at 54 inches (1372 mm) above the ground.

D. Lay out individual transplant locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Architect's acceptance of layout before transplanting. Make minor adjustments as required.

E. Apply antidesiccant to trees uniformly, using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during extracting, handling, and transportation.

1. If deciduous trees are moved in full leaf, spray with antidesiccant before extracting and again two weeks after transplanting.

F. Wrap trees with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during extracting, handling, and transporting.

3.4 PREPARATORY PRUNING

A. Root Pruning: Perform preparatory root pruning under direction of arborist as far in advance of extracting each tree as the Project Schedule allows.

1. Dig exploratory pits or trench by hand around perimeter of tree at indicated root-ball width to determine locations of main lateral roots.
2. Dig trench with tree spade around perimeter of tree at indicated root-ball width to the depth of the root system. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
3. Root-Ball Width: Minimum 9 inches of root-ball diameter, or least dimension for non-round root balls, for each inch of tree caliper being transplanted.
4. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking.
5. Use narrow-tine spading forks to comb soil to expose roots with minimal damage to root system.
6. Cut exposed roots manually with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
7. Do not paint or apply sealants on cut root ends.
8. Backfill trench with excavated soil.

B. Crown Pruning (Tip Pruning):

1. Do not perform preparatory crown pruning (tip pruning).
2. Perform preparatory crown pruning as directed by arborist. Follow procedures as specified in "Crown Pruning" Article.

3.5 EXCAVATION AND PLANTING EQUIPMENT

A. Tree Spade: Track-mounted mechanized tree mover; sized according to manufacturer's size recommendation for each tree being transplanted.

3.6 EXCAVATING PLANTING PITS

A. General: Excavate under supervision of the arborist.

1. Excavate planting pits or trenches with sides sloping. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil. Scarify sides of planting pit smeared or smoothed during excavation.
2. Excavate approximately two times as wide as root ball.
3. Keep excavations covered or otherwise protected until replanting trees.

B. Subsoil and topsoil removed from excavations may be used as planting soil.

C. Obstructions: Notify Architect if unexpected rock or obstructions detrimental to trees are encountered in excavations.

1. Hardpan Layer: Drill 6-inch- (150-mm-) diameter holes, 24 inches (600 mm) apart, into free-draining strata or to a depth of 10 feet (3 m), whichever is less, and backfill with free-draining material.

D. Seepage: Notify Architect if subsoil conditions evidence unexpected water seepage into tree-planting pits.

E. Drainage: Fill planting pit or trench with 6 inches of water and time the infiltration rate of the soil. If the drainage rate is less than 0.25 inch per hour, notify Architect to determine need for subsurface drainage.

F. Saline or Sodic Soils: Completely fill excavations with water and allow to percolate away before positioning trees.

3.7 EXTRACTING TREES

A. General: Extract trees under supervision of the arborist.

B. Orientation Marking: Mark the north side of each tree with non-permanent paint before extracting.

C. Root-Ball Width: Minimum 10 inches of root-ball diameter, or least dimension for non-round root balls, for each inch (25 mm) of tree caliper being transplanted.

1. Out-of-Season Planting: If planting before or after the in-season period for tree, provide a minimum root-ball diameter of 12 inches for each inch (25 mm) of tree caliper being transplanted.

D. Root-Ball Depth: As determined by the arborist for each species and size of tree and for site conditions at original and planting locations.

E. Digging:

1. Dig and clear a pit by hand or with tree spade to the depth of the root system. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
2. Use narrow-tine spading forks to comb soil to expose roots with minimal damage to root system.

3. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking.
4. Cut exposed roots manually with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not paint or apply sealants on cut root ends.
5. Construct box tight against root system sides and bottom as pit is dug. Brace and support box to prevent breaking of root ball.
6. Temporarily support and protect exposed roots from damage until they are permanently redirected and covered with soil. Cover roots with burlap and keep them moist until planted.

F. Extracting with Tree Spade: Use the same tree spade to extract the tree as will be used to transport and plant the tree.

1. Do not use tree spade to move trees larger than the manufacturer's maximum size recommendation for the tree spade being used.
2. When extracting the tree, center the trunk within the tree spade and move tree with a solid ball of earth.

3.8 PLANTING

A. Planting Standard: Perform planting according to ANSI A300 (Part 6) unless otherwise indicated.

B. Before planting, verify that root flare is visible at top of root ball. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.

C. Ensure that root flare is visible after planting.

D. Remove injured roots by cutting cleanly; do not break. Do not paint or apply sealants on cut root ends.

E. Orientation: Position the tree so that its north side, marked before extracting, is facing north in its new location.

F. Set tree plumb and in center of planting pit with top of root flare 1 inch above adjacent finish grades.

1. Use specified backfill soil for backfill.
2. If area under the tree was initially dug too deep, add backfill to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
3. After placing some backfill around root ball to stabilize plant, begin backfilling.
4. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
5. Redirect exposed root ends downward in backfill areas where possible. Hand-expose roots as required to bend and redirect them without breaking. If encountered immediately adjacent to location of new construction and redirection is not practical, cut roots approximately 3 inches (75 mm) back from new construction and as required for root pruning.
6. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended by arborist. Place tablets beside the root ball about 1 inch (25 mm) from root tips; do not place tablets in bottom of the hole.
7. Continue backfilling process. Water again after placing and tamping final layer of soil.

G. Planting with Tree Spade: Use the same tree spade for planting as was used to extract and transport the tree. Do not use tree spade for trees larger than the manufacturer's maximum size recommendation for the tree spade being used.

H. Slopes: When planting on slopes, set the tree so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.9 CROWN PRUNING

A. Prune branches as directed by arborist.

1. Prune to remove only injured, broken, dying, or dead branches. Do not prune for shape.
2. Do not remove or reduce living branches to compensate for root loss caused by cutting root system or to improve natural tree form.
3. Pruning Standards: Perform pruning according to ANSI A300 (Part 1).

B. Unless otherwise directed by arborist and acceptable to Architect, do not cut tree leaders.

C. Cut branches with sharp pruning instruments; do not break or chop.

D. Do not paint or apply sealants to wounds.

E. Provide subsequent maintenance during Contract period as recommended by arborist.

F. Chip removed branches and dispose of off-site

3.10 TREE STABILIZATION

A. Trunk Stabilization by Upright Staking and Tying: Install trunk stabilization as follows unless otherwise indicated on Drawings or directed by arborist.

1. Upright Staking and Tying: Stake only as required to prevent wind tip out. Use a minimum of two stakes of length required to penetrate at least 18 inches (450 mm) below bottom of backfilled excavation and to extend one-third of trunk height above grade. Set stakes vertical and space to avoid penetrating root balls or root masses.
2. Support trees with bands of flexible ties at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.
3. Support trees with two strands of tie wire, connected to the brass grommets of tree-tie webbing at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.

B. Trunk Stabilization by Staking and Guying: Install trunk stabilization as follows unless otherwise indicated on Drawings or directed by arborist.

1. Site-Fabricated Staking-and-Guying Method: Install no fewer than three guys spaced equally around tree.

    a. Securely attach guys to stakes 30 inches (760 mm) long, driven to grade. Adjust spacing to avoid penetrating root balls or root masses. Provide compression spring for each guy wire and tighten securely.
    b. For trees more than 6 inches (150 mm) in caliper anchor guys to wood deadmen buried at least 36 inches (900 mm) below grade. Provide compression spring for each guy wire and tighten securely.
    c. Support trees with bands of flexible ties at contact points with tree trunk and reaching to a compression spring. Allow enough slack to avoid rigid restraint of tree.

d. Support trees with guy cable or multiple strands of tie wire, connected to the brass grommets of tree-tie webbing at contact points with tree trunk and reaching to a compression spring. Allow enough slack to avoid rigid restraint of tree.
e. Attach flags to each guy wire, 30 inches (760 mm) above finish grade.
f. Paint compression springs with luminescent white paint.

2. Proprietary Staking and Guying Device: Install staking and guying system sized and positioned as recommended by manufacturer unless otherwise indicated and according to manufacturer's written instructions.

C. Root-Ball Stabilization: Install at- or below-grade stabilization system to secure each new planting by the root ball unless otherwise indicated on Drawings[or directed by arborist].

1. Wood Hold-Down Method: Place vertical stakes against side of root ball and drive them into subsoil; place horizontal wood hold-down stake across top of root ball and screw at each end to one of the vertical stakes.

a. Install stakes of length required to penetrate at least 18 inches below bottom of backfilled excavation. Saw stakes off at horizontal stake.
b. Install screws through horizontal hold-down and penetrating at least 1 inch (25 mm) into stakes. Predrill holes if necessary to prevent splitting wood.
c. Install second set of stakes on other side of root trunk for larger trees as indicated.

2. Proprietary Root-Ball-Stabilization Device: Install root-ball-stabilization system sized and positioned as recommended by manufacturer unless otherwise indicated and according to manufacturer's written instructions.

D. Palm Bracing: Install bracing system at three or more places equally spaced around perimeter of trunk to secure each palm until established unless otherwise indicated.

1. Site-Fabricated Palm-Bracing Method:

a. Place battens over padding and secure battens in place around trunk perimeter with at least two straps, tightened to prevent displacement. Ensure that straps do not contact trunk.
b. Place diagonal braces and cut to length. Secure upper ends of diagonal braces with galvanized nails into battens or into nail-attached blocks on battens. Do not drive nails, screws, or other securing devices into palm trunk; do not penetrate palm trunk in any fashion. Secure lower ends of diagonal braces with stakes driven into ground to prevent outward slippage of braces.

2. Proprietary Palm-Bracing Device: Install palm-bracing system sized and positioned as recommended by manufacturer unless otherwise indicated and according to manufacturer's written instructions.

3.11 MULCHING

A. Organic Mulch: Apply 2-inch average thickness of organic mulch extending 12 inches (300 mm) beyond edge of individual planting pit and finish level with adjacent finish grades. Do not place mulch within 3 inches of trunks or stems.

3.12 INSTALLING SLOW-RELEASE WATERING DEVICE

A. Provide one device for each tree.

B. Place device on top of the mulch at base of tree and fill with water according to manufacturer's written instructions.

3.13 TREE MAINTENANCE

A. Perform tree maintenance as recommended by arborist. Maintain arborist observation of transplanting work.

B. Maintain trees by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings. Treat as required to keep trees free of insects and disease.

C. From time of preparatory root pruning measure soil moisture adjacent to edge of each root ball weekly Record findings and weather conditions.

D. Fill areas of soil subsidence with backfill soil. Replenish mulch materials damaged or lost in areas of subsidence.

E. Apply treatments as required to keep tree materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

F. Pesticide Application: Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written instructions. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

1. Pre-Emergent Herbicides (Selective and Non-Selective): Apply in accordance with manufacturer's written instructions. Do not apply to seeded areas.
2. Post-Emergent Herbicides (Selective and Non-Selective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written instructions.

G. Reports: Have arborist prepare yearly inspection reports.

3.14 REPAIR AND REPLACEMENT

A. General: Repair or replace transplanted trees and other plants indicated to remain or be relocated that are damaged by construction operations, in a manner recommended by the arborist and approved by Architect.

1. Submit details of proposed pruning and repairs.
2. Perform repairs of damaged trunks, branches, and roots within 24 hours according to arborist's written instructions.
3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect.

B. Remove and replace trees that are more than 25 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Architect determines are incapable of restoring to normal growth pattern.

1. Provide new trees of same size as those being replaced for each tree of 6 inches or smaller in caliper size.
2. Provide two new tree(s) of 6-inch caliper size for each tree being replaced that measures more than 4 inches in caliper size.
3. Species of Replacement Trees: Species selected by Architect

3.15 CLEANUP AND PROTECTION

A. During transplanting, keep adjacent paving and construction clean and work area in an orderly condition.

B. Protect trees from damage due to transplanting operations and operations of other contractors and trades. Maintain protection during transplanting and maintenance periods. Treat, repair, or replace damaged plantings.

C. After planting and before Substantial Completion remove tags, markings, tie tape, labels, wire, burlap, and other debris from transplanted trees, planting areas, and Project site.

3.16 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Except for materials indicated to be recycled, remove surplus soil, excess excavated material, waste materials, displaced plants, trash, and debris, and legally dispose of them off Owner's property.

B. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.

1. Except for materials indicated to be retained on Owner's property or recycled, remove excess excavated material, waste materials, displaced plants, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 329600

SECTION 331417 - SITE WATER SERVICE UTILITY LATERALS

PART 1 - **G**ENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe and fittings for 1-inch water service connections.
2. Corporation stop assemblies.
3. Curb stop assemblies.
4. Backflow preventers.
5. Hot Box with Heater.
6. Meter setting equipment.
7. Meter boxes.
8. Trenching, bedding, and cover.

1.2 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials:

1. AASHTO T 180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. American Society of Mechanical Engineers:

1. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
2. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

C. ASTM International:

1. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.
2. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
3. ASTM C891 - Standard Practice for Installation of Underground Precast Concrete Utility Structures.
4. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3).
5. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3).
6. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
7. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
8. ASTM D2466 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
9. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets.
10. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

D. American Welding Society:

1. AWS A5.8/A5.8M - Specification for Filler Metals for Brazing and Braze Welding.

E. American Water Works Association:

1. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service.
2. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances.
3. AWWA C651 - Disinfecting Water Mains
4. AWWA C800 - Underground Service Line Valves and Fittings.

5. AWWA C901 - Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. (13 mm) Through 3 In. (76 mm), for Water Service.
6. AWWA M6 - Water Meters - Selection, Installation, Testing, and Maintenance.

1.3 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit manufacturer information regarding pipe materials, pipe fittings, corporation stop assemblies, curb stop assemblies, meter setting equipment, meter pits, service saddles, backflow preventers, hot box with heater, and accessories.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

F. Qualifications Statement:

1. Submit qualifications for manufacturer.

G. Contractor is responsible for obtaining a plumbing permit from the Philadelphia Department of Licenses and Inspections for the plumbing work outlined in the contract documents. All associated fees are the responsibility of the contractor.

1.4 CLOSEOUT SUBMITTALS

A. Section 017000 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations of piping mains, curb stops, connections, thrust restraints, pressure-pipe centerline elevations, and gravity-pipe invert elevations.

C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.5 QUALITY ASSURANCE

A. Perform Work according to city, state, and federal standards.

B. Maintain copies of each standard affecting Work of this Section on Site.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.

B. A licensed master plumber shall oversee all plumbing work. The master plumber must have an active license, be current on all City of Philadelphia taxes, and have current insurance on file with the Philadelphia Department of Licenses and Inspections.

1.7 QUALITY ASSURANCE

A. Perform Work in accordance with City of Philadelphia standards.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

C. Store materials according to manufacturer instructions.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

PART 2 - PRODUCTS

2.3 WATER PIPING AND FITTINGS

A. Copper Tubing:

1. Comply with ASTM B88.
2. Type: L annealed.
3. Fittings: Cast copper; ASME B16.18 or wrought copper; ASME B16.22.
4. Joints: Compression connection or BCuP silver braze; AWS A5.8.

2.4 CURB STOP ASSEMBLIES

A. Manufacturers:

1. Furnish materials according to City of Philadelphia standards.

B. Curb Stops:

1. Body: Brass or red brass alloy.
2. Comply with ASTM B62.
3. Valve Type: Plug.
4. Sealing: Positive pressure.

C. Curb Boxes and Covers:

1. Body: Cast iron.
2. Type:
    a. Furnish Buffalo type curb boxes or approved equal.
    b. Furnish Roundway curb stops or approved equal, fitted for flared connections on both sides.
3. Base: Minneapolis or arch pattern.
4. Lid:
    a. Inscription: WATER.
    b. Plug: Pentagonal.

2.5 BACKFLOW PREVENTERS

A. Furnish materials according to City of Philadelphia standards.

B. Reduced-pressure backflow preventers: Furnish backflow preventer outlined in the list of approved backflow prevention assemblies from the City of Philadelphia.

2.6 METER PIT

A. Furnish materials according to City of Philadelphia standards.

2.7 HOT BOX WITH HEATER

A. Material of fabrication shall be 5052-H32 marine grade aluminum (.050/18 gauge), mill finish and shall meet ASTM B209.
B. Insulation shall be 1.5" (9.0 "R" value) minimum thickness polyisocyanurate foam laminated to a glass fiber reinforced facer (each side). The insulation shall have the following properties:
   1. Dimensional stability-less than 2% linear change, ASTM D-2126;
   2. Compressive strength-20psi, ASTM D-1621;
   3. Water absorption-less than 1% by volume, ASTM C-209;
   4. Moisture vapor transmission-less than one (1) perm, ASTM E-96;
   5. Product density-nominal 2.0 lbs. Per cubic foot, ASTM D-1622;
   6. Flame spread=25, ASTM E-84;
   7. Service temperature= -1000f to +2500f maximum.
   8. The insulation shall be of uniform thickness.
C. Roof & Walls:
   1. The roof and walls of the enclosure shall be constructed of 5052-H32 (.050/18 gauge) marine grade aluminum, mill finish, ASTM B209 outside with insulation 1 1/2" (9.0 "R" value) thick in the walls and roof.
   2. The enclosure shall be completely removable for access for testing and maintenance.
   3. The complete assembly shall be protected by being inside the enclosure.
   4. Clear opening drain panel area shall be 7"W x 5 1/4"H.
   5. Drain flap shall have a stainless steel hinge and a stainless steel light strength spring as a positive means of closure so that it will not be activated by wind.
   6. The drain flap shall be constructed of the same materials that is used in the walls and roof of the enclosure.
D. Heating Equipment:
   1. Heating equipment shall be furnished and designed by the manufacturer of the enclosure to maintain an interior temperature of +40 degrees F with an outside temperature of -30 degrees F. Install heating equipment as per manufacturer's instructions and governing local and national codes.
E. Mounting Hardware
   1. Mounting hardware shall be furnished and shall be constructed of 5052-H32 aluminum.
   2. All masonry fasteners shall be metal hit anchors.
   3. All necessary drill bits shall be furnished.
   4. All mounting brackets shall be on the inside of the enclosure. The enclosure shall be mounted in such a way that removal will be by removal of lockable stainless steel rod only.

2.8 WATER METER

A. Water meters are furnished and installed by Philadelphia Water. The cost is covered in the fee charged for a water permit.

2.9 METER SETTING EQUIPMENT

A. Furnish materials according to City of Philadelphia standards.

2.10 MATERIALS

A. Backfill

1. Furnish Sand Backfill for pipe zone in accordance with ASTM C 33 (fine aggregate) and the following:
   a. Gradation:
      1) Sieve Number 200 100 50 16 4
      2) Percent Passing 0-5 0-8 5-30 50-98 98-100
   b. pH: between 5.5 and 8.5.
   c. Electrical Resistivity: 10,000 ohm-centimeters, minimum.
   d. Character: clean, free from lumps of clay or other deleterious substances.
2. Ordinary Backfill Material may include all material excavated from the trench and free of objectionable matter, unless rejected by the Project Manager. The Contractor shall furnish any deficiency of Ordinary Backfill Material.
3. Furnish Select Backfill Material in accordance with the most recent revision or amendment to PennDOT Publication 408 Specifications, Section 703.2, Coarse Aggregate – 2A, or Section 703.3, Select Granular Material-2RC. The use of slag as Select Backfill Material is hereby prohibited.

PART 3 - EXECUTION

3.3 EXAMINATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify that building service connections and municipal utility water main sizes, locations, and inverts are as indicated on Drawings.

3.4 PREPARATION

A. Section 017000 - Execution and Closeout Requirements: Requirements for installation preparation.

B. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, and remove burrs.

C. Remove scale and dirt from inside and outside of piping before assembly.

D. Prepare pipe connections to equipment with flanges or unions.

3.5 INSTALLATION

A. Corporation Stop Assemblies:

1. Make connection for each different kind of water main, using suitable materials, equipment, and methods as approved by the Engineer.
2. Provide service clamps for mains constructed of materials other than cast iron or ductile iron.
3. Location:
   a. Screw corporation stops directly into tapped and threaded iron main at 10- and 2-o'clock positions along main's circumference.
   b. Locate and stagger corporation stops at least 12 inches apart longitudinally.
4. Use seals or other devices such that no leaks are present in mains at points of tapping.
5. Do not backfill and cover service connections until installation has been approved by the Engineer.

B. Bedding:

1. Excavate pipe trench as specified in City of Philadelphia Water Department Water Main Standard Details.
2. Placement:

a. Place bedding material as indicated on City of Philadelphia Water Department Water Main Standard Details.
b. Level fill materials in one continuous layer not exceeding 6 inches of compacted depth.
c. Compact to 95 percent maximum density.

3. Backfill around sides and to top of pipe with cover fill, tamp in place, and compact to 95 percent maximum density.

C. Pipe and Fittings:

1. Installation Standards: Install Work according to City of Philadelphia standards.

D. Curb Stop Assemblies:

1. Set curb stops on solid bearing.
2. Boxes:
   a. Center and plumb curb boxes over curb stops.
   b. Set box cover flush with finished grade.

E. Disinfection of Water Piping System: In accordance with the most recent amendment to the Standard Specifications and Standard Details of the Philadelphia Water Department and the Standard Specification for Disinfecting Water Mains, W-22 and AWWA C651.

F. Backflow Preventers:

1. Install backflow preventers where indicated on Drawings and according to manufacturer instructions.

2. Testing and Installation Requirements: Comply with City of Philadelphia requirements and plumbing codes.

G. Service Connections:

1. Install water service according to City of Philadelphia requirements and as indicated on Drawings.

H. Meter Pit

1. According to ASTM C891.
2. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface structures or utilities in immediate or adjacent areas.
3. While lowering vaults or chambers into excavations and joining pipe to units, take precautions to ensure that interiors of pipeline and structure remain clean.
4. Install vaults and chambers to elevation and alignment as indicated on Drawings.
5. Base and Alignment:
   a. Install vaults and chambers supported at proper grade and alignment on compacted crushed-stone bedding.
   b. Grout base of shaft to achieve slope to drain, trowel smooth, and contoured as indicated on Drawings.
6. Connect pipe to structure and seal watertight.
7. Frame and Cover:
   a. Set level, without tipping, to elevations as indicated on Drawings.
   b. Set cover 2 inches above finished grade for structures located within unpaved areas to allow area to be graded away from cover beginning 1 inch below top surface of frame.
   c. Touch up damaged galvanized coatings.

I. Hot Box with Heater

1. Enclosure shall be mounted on a concrete pad meeting the dimensions of the manufacturer’s recommendation.
2. Enclosure shall be assembled and mounted to concrete pad according to manufacturer's instructions.

3.6 TOLERANCES

A. Install pipe to indicated elevation to within tolerance of 5/8 inch.

3.7 FIELD QUALITY CONTROL

A. Section 017000 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.

B. Perform pressure test on water distribution system according to City of Philadelphia standards.

C. Compaction Testing for Bedding: Comply with ASTM D1557.

D. If tests indicate Work does not meet specified requirements, remove Work, replace, and retest.

END OF SECTION 331417

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