**SECTION 024119**

**SELECTIVE DEMOLITION**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

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

B. Referenced Sections:
1. Section 076200 “Sheet Metal Flashing and Trim.”
2. Section 017419 “Construction Waste Management.”
3. Section 013233 “Photographic Documentation”

1.2 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.

1.3 INFORMATIONAL SUBMITTALS

A. Proposed Protection Measures: Submit report, including Drawings, that indicate 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 with starting and ending dates for each activity.

C. Predemolition photographs or video.

1.4 CLOSEOUT SUBMITTALS

A. Inventory of items that have been removed and salvaged.

1.5 FIELD CONDITIONS

A. Owner will occupy building throughout 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. Hazardous materials will be removed by Owner before start of the Work.
2. 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. Maintain fire-protection facilities in service during selective demolition operations.

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

1.6 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties.

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. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.

C. Inventory and record the condition of items to be removed and salvaged.

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. Owner will arrange to shut off indicated services/systems when requested by Contractor.
2. Arrange to shut off utilities with utility companies.
3. 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.
4. Disconnect, demolish, and remove fire-suppression systems, plumbing, electrical, and HVAC systems, equipment, and components indicated on Drawings to be removed.

    a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
    c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

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.

B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

C. Remove temporary barricades and protections where hazards no longer exist.

## 3.4 SELECTIVE DEMOLITION

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. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain. Comply with requirements in Section 07620 “Sheet Metal Flashing and Trim.”
2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
4. Maintain fire watch during and for at least 2 hours after flame-cutting operations.
5. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
6. Dispose of demolished items and materials promptly Comply with requirements in Section 017419 "Construction Waste Management and Disposal."

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. Sections of site access must be maintained at all times; coordinate operations with Owner.

C. 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 CLEANING

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.

C. 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.

END OF SECTION 024119

**SECTION 040323**

**HISTORIC BRICK UNIT MASONRY REPOINTING**

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes historic treatment work consisting of repointing brick masonry joints.

B. Related Sections:

1. Section 013500 "Special Project Procedures" for general historic treatment requirements.
2. Section 092400 “Cement Plastering” for finish surface treatment requirements.

1.2 DEFINITIONS

A. Low-Pressure Spray:

1. Pressure: 100 to 400 psi
2. Flow Rate: 4 to 6 gpm

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at McPherson Square Library, 601 E Indiana Ave, Philadelphia, PA 19134.
1. Review methods and procedures related to repointing historic brick masonry and sequencing with installation of new stormwater drainage and flashing components at drum base and flashing at chimney.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified, new mortar to be Type N and any required replacement brick is to match existing.

1.5 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic masonry repointing specialist. Experience in pointing or repointing only new or nonhistoric masonry is insufficient experience for masonry historic treatment work.

B. Mockups: Prepare mockups of historic treatment as part of regularly scheduled work to demonstrate aesthetic effects and to set quality standards for materials and execution. The work, upon approval from Architect, can be used toward completed work.

1. Repointing: Cut out out joints in two separate areas**, 1) approximately 24 inch height by the full width of chimney and 2) approximately 24 inch width by the full height of the drum [varies for each**] for each type of repointing required, and repoint each area. Work can be used toward completion if approved by Architect.

PART 2 - PRODUCTS

2.1 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type II; white [**or gray or both**] where required for color matching of mortar. Mortar color to match existing.

1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C114, color to match existing.

B. Hydrated Lime: ASTM C207, Type S.

C. Mortar Sand: ASTM C144 unless otherwise indicated.

1. Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.
2. Color: Natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color.
3. Provide sand with rounded edges.

D. Water: ASTM C270, potable.

2.2 MORTAR MIXES

A. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.

B. Do not use admixtures in mortar unless otherwise indicated.

C. Mixes: Mix mortar materials in the following proportions:
1. Pointing Mortar by Type: ASTM C270, Proportion Specification, [**Type N**] unless otherwise indicated; with cementitious material limited to portland cement and lime.**[ Mortar pigments not required. Each of these two surfaces is to be finished with stucco.**]

PART 3 - EXECUTION

3.1 PROTECTION

A. Prevent mortar from staining face of surrounding masonry and other surfaces.

B. Provide temporary rain drainage during work to direct water away from building.

3.2 MASONRY REPOINTING, GENERAL

A. Have repointing work performed only by qualified historic treatment specialist.

3.3 REPOINTING

A. Cut out and repoint joints to the following extent:

1. All joints at chimney and base of dome.
2. Joints at locations of the following defects:

    a. Holes and missing mortar.
    b. Cracks that can be penetrated 1/4 inch or more by a knife blade 0.027 inch thick.
    c. Cracks **1/16** inch(es) or more in width and of any depth.
    d. Hollow-sounding joints when tapped by metal object.
    e. Eroded surfaces 1/4 inch or more deep.
    f. Deterioration to point that mortar can be easily removed by hand, without tools.
    g. Joints filled with substances other than mortar.

B. Do not cut out and repoint joints where not required.

C. Cut out joints as follows, according to procedures demonstrated in approved mockup:

1. Remove mortar from joints to depth of 3/4" [**and**] [**not less than that required to expose sound, unweathered mortar**]. Do not remove unsound mortar more than [**2**] inches deep; if found to be the case, then consult Architect for direction.
2. Remove mortar from masonry surfaces within cut out joints to provide reveals with square backs and to expose masonry for contact with pointing mortar. Brush, vacuum, or flush joints to remove dirt and loose debris.
3. Do not spall edges of bricks or widen joints. Replace or patch damaged bricks as directed by Architect.

    a. Cut out mortar by hand with chisel and resilient mallet. Do not use power-operated grinders without Architect's written approval based on approved quality-control program.

D. Notify Architect of unforeseen detrimental conditions, including voids in mortar joints, cracks, loose masonry units, rotted wood, rusted metal, and other deteriorated items.

E. Pointing with Mortar:

1. Rinse joint surfaces with water to remove dust and mortar particles. Time rinsing application so, at time of pointing, joint surfaces are damp but free of standing water. If rinse water dries, dampen joint surfaces before pointing.
2. Apply pointing mortar first to areas where existing mortar was removed to depths greater than surrounding areas. Apply in layers 1/4 inch layers [not greater than 3/8 inch] until a uniform depth is formed. Fully compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.
3. After deep areas have been filled to same depth as remaining joints, point joints by placing mortar in 1/4 inch layers [not greater than 3/8 inch]. Fully compact each layer and allow it to become thumbprint hard before applying next layer. Where existing brick have worn or rounded edges, slightly recess finished mortar surface below face of masonry to avoid widened joint faces. Take care not to spread mortar beyond joint edges onto exposed masonry surfaces or to featheredge the mortar.

4. When mortar is thumbprint hard, tool joints to match original appearance of joints as demonstrated in approved mockup. Remove excess mortar from edge of joint by brushing.

5. Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.

6. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Remove mortar and repoint.

F. Where repointing work precedes cleaning of existing masonry, allow mortar to harden at least 30 days before beginning cleaning work.

## 3.4 FINAL CLEANING

A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water, applied by low-pressure spray.

1. Do not use metal scrapers or brushes.
2. Do not use acidic or alkaline cleaners.

END OF SECTION 040323

**SECTION 040326**

**HISTORIC TERRA COTTA UNIT REPAIR AND REPLACEMENT**

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes historic treatment work consisting of repairing historic terra cotta masonry.

B. Related Requirements:

1. Section 013510 "Special Project Procedures" for general historic treatment requirements.

2. Section 012300 “Alternates” listed under Alternate 3 (substitution).

1.2 UNIT PRICES

A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."

1.3 DEFINITIONS

A. Low-Pressure Spray:

1. Pressure: 100 to 400 psi.
2. Flow Rate: 4 to 6 gpm.

B. Rebuilding (Setting) Mortar: Mortar used to set and anchor masonry in a structure, distinct from pointing mortar installed after masonry is set in place.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
1. Review methods and procedures related to repairing and anchoring historic terra cotta masonry.
2. Confirm use of replacement material to be terra cotta. If other materials are to be considered then Contractor is to provide Product Data information, Unit Cost, and Schedule impact.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include plans, elevations, sections, and locations of masonry repair work on the structure.

2. Show full-size patterns with complete dimensions for new terra cotta units and their jointing, showing relationship of existing units to new units.
3. Indicate setting number of each new terra cotta unit and its location on the structure in annotated plans and elevations.
4. Show provisions for expansion joints or other sealant joints.
5. Show replacement and repair anchors. Include details of anchors within individual terra cotta units.
6. Clean area of terra cotta for accuracy of matching the patching compound and the mortar for pointing the joints.
7. Clean entirety of terra cotta cornice at completion of work, as noted in 3.6 FINAL CLEANING.

C. Samples: For each exposed product and for each color and texture specified.

## 1.6 INFORMATIONAL SUBMITTALS

A. Preconstruction Test Reports: For replacement terra cotta units.

## 1.7 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic terra cotta repair specialist. Experience installing standard unit masonry is insufficient experience for masonry historic treatment work.

1. Historic Treatment Worker Qualifications: When terra cotta units are being patched, assign at least one worker per crew who is trained and certified by manufacturer of patching compound to apply its products.

B. Terra Cotta Manufacturer Qualifications: A firm regularly engaged in manufacturing custom architectural terra cotta units for building restoration purposes, of same type and of similar size, complexity, and tolerances as those required for the Work.

C. Mockups: Prepare mockups of historic treatment to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation.

1. Terra Cotta Repair: Prepare sample areas for each type of terra cotta material and assembly indicated to have repair work performed. If not otherwise indicated, size each mockup not smaller than two adjacent whole units or approximately 48 inches in least dimension. Construct sample areas in locations in existing walls where directed by Architect unless otherwise indicated. Area is to be cleaned prior to matching patching compound and mortar for accuracy of color match at completion of work. Demonstrate quality of materials, workmanship, and blending with existing work. Include the following as a minimum:

a. Replacement: Two terra cotta units replaced.
b. Patching: Three small repair locations at least 4 inches square as directed for each type of terra cotta indicated to be patched, so as to leave no evidence of repair.

## 1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on terra cotta masonry as follows:

1. Replacement Terra Cotta: Test each proposed type of replacement masonry unit, according to sampling and testing methods in ASTM C67 for compressive strength, 24-hour cold-water absorption, five-hour boil absorption, saturation coefficient, and initial rate of absorption (suction).

## PART 2 - PRODUCTS

### 2.1 GENERAL

A. Source Limitations: Obtain each type of material from one source with resources to provide materials of consistent quality in appearance and physical properties.

B. For units that will be exposed in completed Work, use units with uniform texture and color, within accepted ranges for these characteristics.

C. Defective Units: Do not use units that contain chips, cracks, or other defects including dimensions that vary from specified dimensions by more than the stated tolerances.

### 2.2 MASONRY MATERIALS

A. Glazed Terra Cotta: New terra cotta units that match existing terra cotta units in physical properties, color, gloss, surface texture, thickness, profile, dimensions, and composition of surface glaze.

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

a. Boston Valley Terra Cotta.
b. Gladding, McBean; PABCO Clay Products, LLC; PABCO Building Products, LLC.

B. Field Documentation and Sampling:
1. Document and measure existing, in-place terra cotta units that will be replaced.
a. Identify and label units to be replaced.
b. Gather information and record data as necessary to accurately fabricate replacement units, including size and other variations of similar units.
2. Representative samples:
a. Remove existing damaged units, and salvage, for samples of existing finish and condition and for use in preparation of molds for fabrication.
b. Clean samples to allow for color match.
c. Pack, crate, and deliver samples to manufacturer’s plant.
d. Temporary protect openings to prevent moisture penetration into wall.

C. Design: Units shall be structurally sound with adequate provision for anchorage and setting.
1. Ornamental and specialty shapes:
a. Exposed faces: 1-1/2 inches minimum thick.
b. Webs: 1-1/4 inches minimum thick; thickness and spacing as required for structural support.
c. Beds: 4 inches minimum deep, match existing when deeper.
2. Provide hand holes. Coordinate hole sizes and locations with manufacturer and connection designer.

D. Terra Cotta: Match color, texture, shape, size, and profile of existing cleaned units.

1. Compressive Strength: minimum average compressive strength of 4,000 pounds per square inch.
2. Absorption: ASTM C67, 24-hour cold-water test; nine percent maximum.
3. Saturation Coefficient: ASTM C67; 0.68 maximum average with no more than one unit in five greater than or equal to 0.70.
4. Initial Rate of Absorption: ASTM C67; not less than 5 grams/minute/30 square inches or greater than 20 grams/minute/30 square inches. Individual units shall not vary by more than 15 percent.
5. Efflorescence: ASTM C67; rated “not effloresced.”
6. Crazing: ASTM C126; acceptable if microscopic crazing does not penetrate to bisque, when inspected at minimum magnification of 10X. If microscopic crazing penetrates to bisque, terra cotta is rejected unless:
   a. Crazed material passes glaze permeability test.
   b. Crazed material visually matches previously approved samples.
   c. Appearance is not considered visually objectionable.
7. Imperviousness: ASTM C126.
8. Resistance to Fading: ASTM C126, Chemical Resistance Test.

E. Fabrication:
1. Do not proceed with fabrication prior to approval of Shop Drawings and samples.
2. Duplicate existing units based on representative samples from building.
   a. Dimension units to achieve uniform joints, with existing minimum joint width of 1/4 inch.
   b. Allow for clay shrinkage during drying and firing and expected thermal and moisture expansion in service.
   c. Provide drips on projecting or overhanging units.
   d. Provide weep holes in bottoms of hung units and as appropriate overhanging portions of projecting units.
3. Construct molds and/or fabricate extrusion dies for new units.
4. Place clay into molds and/or extrude through die by best method for shapes, sizes, and complexity of terra cotta.
5. Verify that dimensions comply with approved Shop Drawings. Field cutting of units must be approved in advance by Engineer and demonstrated to Engineer prior to proceeding. Cutting process should not damage the glaze or reduce end walls or web thicknesses to less than 1 inch.
6. Tolerances:
   a. Face dimensions: Exposed face shall not vary more than 1/16 inch plus or minus from dimensions shown on approved Shop Drawings.
   b. Warpage: Exposed face of unit shall not vary from true plane more than stable, in-place, existing unit.
7. Paint or stamp unique identification marks and year of manufacture in appropriate location on back of units.

F. Finishes: ASTM C126.
1. Color, texture, and reflectivity of glazed and unglazed units to match approved samples.
2. Finished faces shall be free from inclusions, blisters, pinholes, crawling, shivering, staining, chipping, excessive crazing, or other imperfections which detract from appearance when viewed from distance of 10 feet.

G. Manufacturers Inspection Prior to Shipment
1. Inspect units prior to shipping. In addition to the fabrication issues listed above, units with the following defects should be rejected and a new unit should be fabricated by the manufacturer at no cost to the Owner. A clay slurry applied to internal defects is not an acceptable repair.
   a. Web cracks.

2.3 TERRA COTTA REPAIR MATERIALS

A. Proprietary Pre-Bagged Patching Mortar:
   1. Terra Cotta Patching Compound: Factory-mixed cementitious product that is custom manufactured for patching terra cotta masonry. Follow manufacturer's recommendations for preparation, including bonding agents and installation. Color to match existing.
      a. Cathedral Stone, Jahn M100, Terra Cotta Repair Mortar.
      b. Edison Coatings Inc., System 45, Restoration Mortar.
      c. Conproco Corporation, Matrix Stone Repair Mortar System.
   2. Use formulation that is vapor and water permeable (equal to or more than the terra cotta unit), exhibits low shrinkage, has lower modulus of elasticity than the terra cotta units being repaired, and develops high bond strength to all types of masonry.
   3. Use formulation having working qualities and retardation control to permit forming and sculpturing where necessary.
   4. Formulate patching compound used for patching terra cotta in colors and textures to match each unit being patched.

B. Coating for Patches and Glaze Spalls: Factory-formulated; internally plasticized, smooth finished.
   1. Use one of the following or approved equal:
      a. Aquathane UA210 Type E by Edison Coatings, Inc. Clear primer #240 should be used on existing glaze edges to be coated. Thin Fill 45 may be required to fill shallow bisque spalls and match the existing surface texture/finish. Primers and finish coating to be recommended by manufacturer.
      b. The Terra Cotta Glaze Repair System, as distributed by Cathedral Stone® Products, Inc. Primers and finish coating to be recommended by manufacturer.
      c. Terra Color and Terracotta Finish paint systems by Conproco. Matrix (MIMIC). Primers and finish coating to be recommended by manufacturer for job specific use.

C. Accessory Repair Materials:
   1. Anchors and Washers: Type 304 stainless steel, thickness and diameter shown on drawings.
   2. Helical Anchors:
      a. Minimum allowable anchor pullout capacity: 500 pounds per anchor.
      b. Use one of the following or approved alternate:
         1) DryFix ties by Helifix Inc.
         2) Spira-Lok ties by Hohmann & Barnard, Inc.
   3. Adhesive:
      a. HIT-HY 270 hybrid adhesive by Hilti, Inc.
      b. AC100+ Gold vinylester injection adhesive by DeWalt.

2.4 TERRA COTTA ANCHORAGE

A. Anchorage of new terra cotta units to match anchorage of existing terra cotta units. If any corroded structural members are found to be the cause of destabilized terra cotta units, the Contractor shall notify the Architect and Engineer of Record.

2.5 MORTAR MIXES
   1. Mortar: Type N,; Section 04 05 01

## PART 3 - EXECUTION

### 3.1 PROTECTION

A. Prevent mortar from staining face of surrounding masonry and other surfaces.

B. Remove gutters and downspouts and associated hardware adjacent to immediate work area, and store during masonry repair work. Reinstall when repairs are complete.

1. Provide temporary rain drainage during work to direct water away from building.

### 3.2 MASONRY REPAIR, GENERAL

A. Have repair work performed only by qualified historic treatment specialist.

### 3.3 TERRA COTTA REMOVAL AND REPLACEMENT

A. At locations indicated, remove terra cotta units that are damaged, spalled, or deteriorated. Carefully remove entire units from joint to joint, without damaging surrounding masonry, in a manner that permits replacement with full-size units.

B. Support and protect remaining masonry that was supported by removed units.

C. Maintain flashing, reinforcement, lintels, steel outriggers, and adjoining construction in an undamaged condition.

D. Notify Architect of unforeseen detrimental conditions, including voids, cracks, bulges, loose masonry units in existing backup, rotted wood, rusted metal, and other deteriorated items.

E. Clean masonry surrounding removal areas by removing mortar, dust, and loose particles in preparation for terra cotta replacement.

F. Install replacement units into bonding and coursing pattern of existing units.

1. Do not cut or grind glazed terra cotta.
2. If minor cutting of replacement brownstone terra cotta is required, use a motor-driven grinder or saw designed to cut masonry with clean, sharp, unchipped edges. Do not cut or grind more than 1/8 inches along any edge.
3. Maintain joint width for replacement units to match existing joints.
4. Use setting buttons or shims to set units accurately spaced with uniform joints.

G. Set replacement units in a full bed of rebuilding (setting) mortar. Replace existing, formed metal anchors with new terra cotta anchors of size and type indicated.

1. Embed anchors in mortar, and fill voids behind units with mortar.
2. Tool exposed mortar joints in repaired areas to match joints of surrounding existing terra cotta.
3. Rake out mortar used for setting terra cotta before mortar sets as indicated. Point at same time as repointing of surrounding area.
4. When mortar is hard enough to support units, remove shims and other devices interfering with pointing of joints.

H. Curing: Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.

1. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

## 3.4 TERRA COTTA PATCHING

A. Patch the following terra cotta units unless another type of repair or replacement is indicated:

1. Units indicated to be patched.
2. Units with holes.
3. Units with chipped edges or corners. Patch chipped edges or corners measuring more than 3/4 inch in least dimension.
4. Units with small areas of deep deterioration. Patch deep deteriorations measuring more than 3/4 inch in least dimension and more than 1/4 inch deep.

B. Patching Terra Cotta:

1. Remove deteriorated material as determined by sounding gently with a small hammer. Carefully remove additional material so patch does not have feathered edges but has square or slightly undercut edges on area to be patched and is at least 1/4 inches thick, but not less than recommended in writing by patching compound manufacturer.
2. Mask adjacent mortar joint or rake out for repointing if patch extends to edge of unit.
3. Mix patching compound in individual batches to match each unit being patched. Combine one or more colors of patching compound, as needed, to produce exact match.
4. Rinse surface to be patched and leave damp, but without standing water.
5. Brush-coat surfaces with slurry coat of patching compound according to manufacturer's written instructions.
6. Place patching compound in layers as recommended in writing by patching compound manufacturer, but not less than 1/4 inch or more than 2 inches thick. Roughen surface of each layer to provide a key for next layer.
7. Do not apply patching compound over mortar joints. If patching compound bridges mortar joints, cut out joints after patching compound hardens.
8. Trowel, scrape, or carve surface of patch to match texture, details, and surrounding surface plane or contour of the unit. Shape and finish surface before or after curing, as determined by testing, to best match existing terra cotta.
9. Keep each layer damp for 72 hours or until patching compound has set.
10. After final layer of patching compound has cured, apply terra cotta glaze to match existing according to manufacturer's written instructions. Apply two or more coats, as needed, to match glaze of adjacent terra cotta units.
11. Clean surface of terra cotta prior to matching the patching compound.

## 3.5 TERRA COTTA GLAZE REPAIR

A. Repair the glaze on the following terra cotta units that are otherwise sound unless another type of repair or replacement is indicated:

1. Units indicated to have glaze repaired.
2. Units with abraded or chipped glaze.
3. Units with spots or areas of shallow deterioration greater than glaze thickness and less up to 1/16 inch(es deep.

B. Application: After other repairs have cured, apply terra cotta glaze replacement according to manufacturer's written instructions. Apply two or more coats, as needed, to match glaze of adjacent terra cotta units. Do not apply glaze to joint surfaces between units or within joints that will be mortared or sealed.

## 3.6 FINAL CLEANING

A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water, applied by low-pressure spray.

1. Do not use metal scrapers or brushes.
2. Do not use acidic or alkaline cleaners.

END OF SECTION 040326

**SECTION 040501**

**MASONRY MORTAR**

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Supply and preparation of mortar for brick masonry and terra cotta

B. Related Sections:
   1. Section 04 03 26 – Historic Terra Cotta Unit Repair and Replacement

1.2 DEFINITIONS

A. Existing mortar: Mortar present in existing construction.

B. Cement-lime mortar: A mortar containing only portland cement, lime, and sand with strictly no additives, except for pigments to produce a desired color.

C. Preblended cement-lime mortar: A factory-blended product containing only portland cement and lime with strictly no additives, except for pigments to produce a desired color. Sand may be included in the factory preblended product, depending on the regional customs and availability.

D. Repointing: Process of raking out mortar joint to specified depth and replacing mortar.

1.3 SUBMITTALS

A. Product Data: Supplier's literature indicating compliance with specified requirements. Include Safety Data Sheets (SDS) for information only:
   1. Pigments: Product name and type, and name of manufacturer.
   2. Preblended Mortar: Types and volumetric proportions of ingredients.

B. Certificates: Indicating compliance with specified requirements.
   1. Portland Cement: Product name and type, and name of manufacturer.
   2. Hydrated Lime: Product name and type, and name of manufacturer.

C. Test Reports: For aggregates, indicating type, gradation, impurities, and source.

D. Masonry Qualification Data:
   1. Evidence that existing company has a minimum of ten years of continuous experience in masonry work with cement-lime mortar.
      a. List at least five representative projects of similar scope and size, including:
         1) Project name
         2) Owner's name
         3) Owner Representative's name and current contact information
         4) Description of the masonry work performed
         5) Project supervisor's name
         6) Total cost of masonry work
         7) Completion date
      b. Supervisory personnel/foreman must have not less than five years' experience in supervising this type of work and must commit to be present at all times. Do not change supervisory personnel during the course of the Project except for reasons

beyond the control of Subcontractor; inform Engineer in advance of any changes. Supervisory personnel must be fluent in English. Provide the following:
1) Name(s) of supervisory personnel
2) Their resumes of experience

c. Employ masons with a minimum of two years' experience in similar work. Fully supervise apprentices with experienced masons.

E. Test Agency Qualification Data: Provide agency name and documentation of accreditation.

1.4 QUALITY ASSURANCE

A. Mockup Requirements for Repointing

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Site in original containers and packaging with seals unbroken, labeled with manufacturer's name, product brand name and type, date of manufacture, lot number, directions for storing, and complete manufacturer's written instructions.

B. Store and handle materials in accordance with manufacturer's written instructions, safety requirements, and all applicable laws and regulations. Store materials in original, undamaged containers in clean, dry, location on raised platforms and protected from weather, within temperature range required by manufacturer. Protect stored materials from direct sunlight and sources of ignition. Manufacturer's standard packaging alone is not considered adequate weather protection.

C. Keep materials dry and do not allow materials to be exposed to moisture during transportation, storage, or handling. Discard any cementitious materials that have been exposed to moisture to their detriment.

D. Locate materials in a secure location approved by Owner's Representative.

E. Limit stored materials on structures so as to preclude damage to materials and structures.

F. Conspicuously mark damaged containers, containers with contaminated materials, damaged materials, and materials that cannot be used within stated shelf life and remove from Site as soon as possible. Replace discarded materials in a timely manner at no cost to Owner.

G. Maintain copies of all applicable SDS, to be available for ready reference on Site.

PART 2 PRODUCTS

2.1 MATERIALS

A. Cement-Lime Mortar formulated to match existing mortar and to produce color indicated.
1. Portland Cement: ASTM C150, Type I or II. Provide ordinary (gray) or white cement as required to produce mortar color indicated.
a. Type III may be used for cold-weather construction with Engineer's written approval.
2. Hydrated Lime: ASTM C207, Type S.
3. Aggregate: ASTM C144, washed aggregate consisting of natural sand or crushed stone. Aggregate must not contain more than fifty parts per million of chloride ions and must be free of organic contaminates.
a. Small-Aggregate Mortar: For use in joints less than 1/4 inch wide: use aggregate graded with 100 percent passing a number 16 sieve.

b. Colored-Mortar Aggregate: Natural sand or crushed stone of color necessary to produce required mortar color.

4. Pigment: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortar. Pigment is not to exceed ten percent of portland cement by weight; pigment containing carbon black is not exceed two percent of portland cement by weight.
   a. Use one of the following or approved equal:
      1) Bayferrox iron oxide pigments by Lanxess Corporation
      2) True Tone Sweet 16 Mortar Colors by Davis Colors, Inc
      3) SGS Mortar Colors by Solomon Colors, Inc
5. Water: Clean and potable; free from deleterious amounts of acids, alkalis, or organic materials.

B. Admixtures: Do not use admixtures without Engineer's prior written approval, including:
1. Calcium chloride or admixtures containing calcium chloride
2. Air-entraining admixtures or material containing air-entraining admixtures
3. Antifreeze compounds
4. Pozzolans, including naturally derived and artificially derived, such as fly ash

C. Do not substitute masonry cement or mortar cement for the above materials.

2.2 MORTAR MIXES

A. Cement-Lime Mortar: ASTM C270; by minimum property values as follows:
1. Mortar Type:
   a. Type N: 750 psi compressive strength; 75 percent water retention; 14 percent maximum air content, or 12 percent maximum air content with structural reinforcement.
2. Aggregate: Not less than 2-1/4 times and not more than 3 times the sum of the volumes of portland cement and hydrated lime.

B. Preblended Cement-Lime Mortar: ASTM C270. A factory packaged dry blend of portland cement, lime, and sand may be used in lieu of site-mixed mortar. Preblended cement-lime mortar may not contain any other ingredients, except pigment, if required.
1. Use one of the following or approved equal:
   a. SPEC MIX Portland Lime and Sand N; Color by SPEC MIX.
   b. Mortamix Rainbow Custom Color Cement-Lime Type N by Holcim, Inc.
   c. Eaglebond Portland and Lime Type N by Lafarge North America, Inc.
   d. Custom Color Portland/Lime Cement Type N by Lehigh Hanson, Heidelberg Cement Group.

C. Color: Match color of mortar to existing adjacent mortar joints, unless specified otherwise.

2.3 SUBMITTALS

A. Mortar Mix Samples

1. Contractor shall prepare a minimum of **3** mortar samples based upon on-site mortar analysis of the terra cotta units

B. Sample Pointing

1. Point three sample joint installations in an area selected by the Architect for approval of color and joint profile. Mortar color should match the color of the existing mortar. Joint profile should match existing sample joints on the building selected by the Architect. If none of the installations are approved, rake out joints and repoint as instructed.

PART 3 EXECUTION

3.1 PRE-BLENDED MORTAR MIXING

A. Develop mixing operations so that quality control is assured.

B. Designate one or two individuals to mix mortar. Fully instruct these individuals on mixing procedures. No other persons shall mix mortar without prior notification to Engineer.

C. Mix materials in appropriate drum-type batch machine mixer to uniform consistency as recommended by manufacturer.
   1. Mix mortar for three to five minutes after materials are in mixer.
      a. Dry preblended mortar may require a longer mixing period to overcome the water affinity of oven dry sand and subsequent workability loss in the mortar.
   2. Provide sufficient number of mixers, including reserve mixers, so that mortar placement operations will proceed uninterrupted.
   3. Hand-mixing is permitted upon prior written approval of Engineer.

3.2 REPOINTING MORTAR MIXING

A. Pre-hydrate mortar:
   1. Thoroughly mix ingredients except water.
   2. Continue mixing, adding only enough water to produce damp workable mix which will retain its form when pressed into ball.
   3. Maintain mortar in dampened condition for 1 to 1-1/2 hours.

B. Add sufficient water to bring mortar to proper consistency; that is, somewhat drier than conventional masonry mortars.

3.3 MORTAR INSTALLATION LIMITATIONS

A. If mortar begins to stiffen, it may be retempered with water as frequently as needed to restore consistency.

B. Discard mortar not placed within 2-1/2 hours after initial mixing.

3.4 REPOINTING

A. Cut out and repoint joints to the following extent:

   1. All joints in areas indicated.
   2. Joints indicated as sealant-filled joints. Seal skyward facing joints (terra cotta at pediments, cornice, rake, dome drum, and side entrance) with sealant.

B. Do not cut out and repoint joints where not required.

C. Cut out joints as follows, according to procedures demonstrated in approved mockup:

   1. Remove mortar from joints to depth of not less than 3/4 inch and not less than that required to expose sound, unweathered mortar. Do not remove unsound mortar more than one and a half inches deep; consult Architect for direction.

2. Remove mortar from masonry surfaces within joints to provide reveals with square backs and to expose masonry for contact with pointing mortar. Brush, vacuum, or flush joints to remove dirt and loose debris.
3. Do not spall edges of masonry units or widen joints. Replace or patch damaged masonry units as directed by Architect.

    a. Cut out mortar by hand with chisel and resilient mallet. Do not use power-operated grinders without Architect's written approval based on approved quality-control program.
    b. Cut out center of mortar bed joints using angle grinders with diamond-impregnated metal blades. Remove remaining mortar in bed joints and mortar in head joints by hand with chisel and resilient mallet. Strictly adhere to approved quality-control program.

D. Notify Architect of unforeseen detrimental conditions, including voids in mortar joints, cracks, loose stone, rotted wood, rusted metal, and other deteriorated items.

E. Pointing with Mortar:

1. Rinse joint surfaces with water to remove dust and mortar particles. Time rinsing application so, at time of pointing, joint surfaces are damp but free of standing water. If rinse water dries, dampen joint surfaces before pointing.
2. Apply pointing mortar first to areas where existing mortar was removed to depths greater than surrounding areas. Apply in layers not greater than 3/8 inch until a uniform depth is formed. Fully compact each layer thoroughly, and allow it to become thumbprint hard before applying next layer.
3. After deep areas have been filled to same depth as remaining joints, point joints by placing mortar in layers not greater than 1/4 inch. Fully compact each layer, and allow it to become thumbprint hard before applying next layer. Where existing masonry unit has worn or rounded edges, slightly recess finished mortar surface below face of masonry unit to avoid widened joint faces. Take care not to spread mortar beyond joint edges onto exposed masonry unit surfaces or to featheredge the mortar.
4. When mortar is thumbprint hard, tool joints to match original appearance of joints as demonstrated in approved mockup. Remove excess mortar from edge of joint by brushing.
5. Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.

    a. Acceptable curing methods include covering with wet burlap and plastic sheeting, periodic hand misting, and periodic mist spraying using system of pipes, mist heads, and timers.
    b. Adjust curing methods to ensure that pointing mortar is damp throughout its depth without eroding surface mortar.

6. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Remove mortar and repoint.

F. Where repointing work precedes cleaning of existing masonry unit, allow mortar to harden at least 30 days before beginning cleaning work.

END OF SECTION 04 05 01

**SECTION 0610053**

**MISCELLANEOUS ROUGH CARPENTRY**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Framing with dimension lumber.
2. Wood blocking, cants, and nailers.
3. Plywood backing panels.

1.2 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:

1. Preservative-treated wood.
2. Fire-retardant-treated wood.
3. Power-driven fasteners.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. Dress lumber, S4S, unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat all miscellaneous carpentry unless otherwise indicated:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, [furring,] [stripping,] and similar concealed members in contact with masonry or concrete.
3. Wood framing members that are less than 18 inches (460 mm) above the ground in crawlspaces or unexcavated areas.
4. Wood floor plates that are installed over concrete slabs-on-grade.

## 2.3 FIRE-RETARDANT-TREATED MATERIALS

A. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.
2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D3201 at 92 percent relative humidity. Use where exterior type is not indicated.

B. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.

C. Application: Treat all miscellaneous carpentry unless otherwise indicated.

1. Framing for raised platforms.
2. Concealed blocking.
3. Roof framing and blocking.
4. Wood cants, nailers, curbs, equipment support bases, blocking, and similar members in connection with roofing.
5. Plywood backing panels.

## 2.4 DIMENSION LUMBER FRAMING

A. Non-Load-Bearing Interior Partitions: Construction or No. 2grade of any species.

B. Other Framing: No. 2 grade of any of the following species:

1. Hem-fir (north); NLGA.
2. Southern pine; SPIB.
3. Douglas fir-larch; WCLIB or WWPA.
4. Southern pine or mixed southern pine; SPIB.
5. Spruce-pine-fir; NLGA.
6. Douglas fir-south; WWPA.
7. Hem-fir; WCLIB or WWPA.
8. Douglas fir-larch (north); NLGA.
9. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

## 2.5 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Rooftop equipment bases and support curbs.
4. Cants.

B. Dimension Lumber Items: Construction or No. 2 grade lumber of any species.

C. Concealed Boards: 15 percent maximum moisture content of any of the following species and grades:
1. Eastern softwoods, [No. 2] Common grade; NELMA.
2. Northern species, [No. 2] Common grade; NLGA.

## 2.6 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated.

## 2.7 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

B. Screws for Fastening to Metal Framing: ASTM C954, length as recommended by screw manufacturer for material being fastened.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

## 2.8 MISCELLANEOUS MATERIALS

A. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.

1. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

# PART 3 - EXECUTION

## 3.1 INSTALLATION, GENERAL

A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

B. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

C. Framing Standard: Comply with AF&PA's "Details for Conventional Wood Frame Construction," unless otherwise indicated.

D. Do not splice structural members between supports, unless otherwise indicated.

E. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

F. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.
2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.

## 3.2 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061053

**SECTION 061600**
**SHEATHING**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof sheathing.
2. Sheathing joint and penetration treatment.

B. Related Sections:
1. Section 075216 “SBS Modified Bituminous Membrane Roofing” for upper roof.
2. Section 07311 “Asphalt Shingles”
3. Section 07610 “Sheet Metal Roofing for Dome Gutter”

1.2 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product.

1.3 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated wood-blocking.
2. Wood-preservative-treated plywood.

1.4 QUALITY ASSURANCE

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

B. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: As tested according to ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 WOOD PANEL PRODUCTS

A. Emissions: Products shall meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Certified Wood: The following wood products shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001 and FSC STD-40-004.

1. Plywood.

2.3 PRESERVATIVE-TREATED PLYWOOD

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC3b for exterior construction not in contact with ground.

B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

C. Application: Treat all plywood applicable to roof framing unless otherwise indicated.

2.5 ROOF SHEATHING

A. Plywood Sheathing at SBS Roof Deck: Exterior, APA rated APA rated grade stamped for specific span. 19/32” thickness (to be verified in field to match demolished existing), C-C plugged veneer grade.
1. Plywood must be fitted flush to the skyward facing surface of roof sheathing.

B. Plywood Sheathing at Asphalt Shingle Roof Deck: Exterior, APA rated grade stamped for specific span, 19/32” thickness (to match existing).

PART 7 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.
2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in the ICC's International Residential Code for One- and Two-Family Dwellings.
3. ICC-ES evaluation report for fastener.

D. Coordinate roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

## 3.2 WOOD STRUCTURAL PANEL INSTALLATION

A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated

B. Fastening Methods: Fasten panels as indicated below:
   1. Wall and Roof Sheathing:
      a. Nail to wood framing.
      b. Space panels 1/8 inch (3 mm) apart at edges and ends.

END OF SECTION 061600

**SECTION 070150.19**

**PREPARATION FOR REROOFING**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Temporary protection from weather throughout construction.
2. Full tear off of SBS roofing, insulation and flashings at stair roof area.
   a. Removal of iron railing system for repair and painting.
   b. Removal of channel steel support system for repair and painting.
   c. Removal and replacement of one roof drain, underdeck clamp, related RWC connections, support, and insulation at pipe and drain bowl.
3. Full tear-off of entire asphalt fiberglass shingle roof system from the Main roof and Skirt roof areas.
4. Full tear off of copper gutter and dome roofing.
   a. Removal and replacement of deteriorated T & G roof decking, assume 1% max.
   b. Remove 100% of gutter substrate
5. All Roof Areas:
   a. Removal and replacement of deteriorated roof sheathing.
   b. Removal and replacement of deteriorated T & G roof decking.
   c. Removal of flashings and surface mounted counterflashings at drum and chimney.
6. Full removal of skylight/oculus glazing, sealant, fasteners and related materials.

1.2 ALLOWANCES

A. Allowance for removal of existing deteriorated wood roof deck, and replacement with new wood deck, is specified under Section 012100 "Allowances."
   1. Assume 5% remove and replace deteriorated deck. Refer to Structural Drawings.

1.3 UNIT PRICES

A. Additional deck replacement $ per board foot.

B. Sheathing per SF to match existing

1.4 PREINSTALLATION MEETINGS

A. Preliminary Roofing Conference: Before starting removal Work, conduct conference at McPherson Square Library. Notify Architect/Consultant 72-hours in advance.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Approved by warrantor of roofing system to provide a suitable substrate for roofing.
   1. Asphalt Shingles: Provide manufacturer's fifty-year warranty.

B. Basis of Design:
   1. Low Slope Stair Roof: Siplast SBS modified bituminous roofing system
   2. Steep Slope Main Roof and Skirt Areas: Certainteed Grand Manor asphalt fiberglass shingle
   3. Dome Roof: Copper Dome Standing Seam Cladding. Basis of Design: Revere.

1.6 FIELD CONDITIONS

A. Existing Roofing System:
   1. Dome Roof and Gutter: Standing Seam Copper.
   2. Oculus Skylight: The skylight will be removed and replaced in its entirety during this project. Refer to Section 086200 "Unit Skylight."
   3. Main Rood and Dome Skirt Roof Areas: Asphalt Fiberglass Shingles over felt (assumed) underlayment.
   4. Stair Roof: SBS-Modified Bituminous Roofing over +/- 2" insulation.

B. Owner **will** occupy portions, the entire desk and floor space immediately below the vaulted ceiling and skylight, throughout the construction period.

   1. Daily library operations will begin daily at 10:00 am. Schedule noisy operations to be largely complete before 10:00 am daily.
   2. Safely erect work platform covering the front desk at the main entrance. This work to be completed before 10:00 am, daily.
      a. Coordinate platform erection with library staff. Protect flooring and wall finishes from construction damage.
      b. Scaffolding to provide interior lighting beneath the platform, sufficient to meet the needs of the desk workers, staff, and general public.
      c. Assure platform is sufficiently covered (dust proof) to prevent dust from entering the desk, book, and reading areas.
         1) Note the platform will provide double purpose and provide a work platform for the plaster repairs and painting.
         2) The oculus skylight will be replaced during this project above this platform.
   3. Conduct reroofing so Owner's operations are not disrupted.
   4. Provide Owner a weekly updated 2-week "Look Ahead" schedule at the end of the first work day of each week.
   5. Provide Owner with not less than **72** hours' written notice of activities that may affect Owner's operations i.e., nailing of shingles and copper cleats, pans, flashings, sheets, demolition of roofing materials and replacement of wood deck etc.
   6. Coordinate work activities daily with Owner so Owner has adequate advance notice to place protective dust and water-leakage covers over sensitive equipment and furnishings, shut down HVAC and fire-alarm or -detection equipment if needed, and evacuate occupants from below work area.
   7. Provide interior protection, in addition described above, as required for dust and debris control.
   8. Before working over structurally impaired areas of deck, notify Owner to evacuate occupants from below affected area.

a. Verify that occupants below work area have been evacuated before proceeding with work over impaired deck area.

C. Protect building to be reroofed, adjacent buildings, walkways, site improvements, exterior plantings, and landscaping from damage or soiling from reroofing operations.

D. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.

E. Provide and maintain construction scaffolding.
1. Provide limited access scaffolding protection 12’ above grade.

F. Provide and maintain construction fencing for laydown and debris removal.
1. No dumpsters allowed on site
2. Clean site free of construction debris daily.
3. Remove debris from roof daily.

G. Conditions existing at time of inspection for bidding will be maintained by Owner as far as practical.
1. Contractor is responsible for verification of existing conditions.

H. Limit construction loads on existing roof areas to remain, and existing roof areas scheduled to be reroofed for uniformly distributed loads. See Structural documents.

I. Weather Limitations: Proceed with reroofing preparation only when existing and forecasted weather conditions permit Work to proceed without water entering existing roofing system or building.

1. Remove only as much roofing in one day as can be made watertight in the same day.

1.7 WARRANTY
1. Copper Dome and Gutter: Provide Contractors five-year workmanship and waterproof warranty.
2. Asphalt Shingles: Provide manufacturer’s fifty-year shingle warranty.

PART 2 - PRODUCTS

2.1 AUXILIARY REROOFING MATERIALS

A. General: Use auxiliary reroofing preparation materials manufactured by roofing system manufacturer and included in the system warranty, for intended use and compatible with components of new roofing system. Selected materials shall not damage adjacent surfaces.

PART 3 - EXECUTION

3.1 PREPARATION

A. Build a dust containment room at the base of the attic access chase. Prevent demolition work dust from spreading throughout basement area.

B. Seal or isolate windows that may be exposed to airborne substances created in removal of existing materials.
   1. Roll seams on self-adhering underlayments
   2. Provide sealants and other materials required to assure of maintaining a watertight roof throughout construction.

C. Complete roof deck openings, insulation removal/replacement work, provide access for abatement work (by others), and infilling the deck opening areas prior to completing roof shingle replacement work, before/in conjunction with roof replacement.

D. Testing of existing roof drains by others to verify that there are no blockages or restrictions.

   1. Test drains after completion of roofing and provide a report on the findings.

   2. Removal and replacement of one existing roof drain including pipe and connections to the existing rainwater conductors and insulation of drain bowls and piping.

E. During removal operations, have sufficient and suitable materials on-site to facilitate rapid installation of temporary protection in the event of unexpected rain.

F. Maintain roof drains in functioning condition to ensure roof drainage at end of each workday.

   1. Prevent debris from entering or blocking roof drains and conductors.

      a. Use roof-drain plugs specifically designed for this purpose.
      b. Remove roof-drain plugs at end of each workday, when no work is taking place, or when rain is forecast.

   2. If roof drains are temporarily blocked or unserviceable due to roofing system removal or partial installation of new roofing system, provide alternative drainage method to remove water and eliminate ponding.

      a. Do not permit water to enter into or under existing roofing system components.

## 3.2 ROOF TEAR-OFF

A. Notify Owner each day of extent of roof tear-off proposed for that day, and expected time of completion of noisy work.

B. Lower removed roofing materials to ground and onto lower roof levels, using dust-tight chutes or other acceptable means of removing materials from roof areas.

C. Full Roof Tear-off: **Remove** existing roofing and other roofing system components down to the existing wood roof deck.

   1. Remove asphalt fiberglass shingles and underlayments.
   2. Remove SBS roofing, insulation, base flashings and counter flashings.
   3. Remove flashings at pipes, railing brackets and other penetrations.
   4. Remove scupper and infill masonry.
   5. Remove roof drain, and provide new roof drain indicated on drawings on Stair Roof Area
   6. Remove and replace deteriorated deck and/or sheathing.
   7. Saw cut reglets and coordinate roofing, flashing and sheet metal requirements with masonry.

8. Nail in and/or remove fasteners from deck.
9. Provide gutter blocking and substrate at base of dome

3.3 DECK PREPARATION

A. Inspect deck after tear-off of roofing system.

B. If broken or loose fasteners that secure deck panels to one another or to structure are observed, or if deck appears or feels inadequately attached, immediately notify Architect.

1. Do not proceed with installation until directed by Architect.

C. If deck surface is unsuitable for receiving new roofing or if structural integrity of deck is suspect, immediately notify Architect.

1. Do not proceed with installation until directed by Architect.

D. Provide additional deck securement as indicated on Drawings.

E. Remove deteriorated deck and/or sheathing and replace with roof sheathing as directed by Architect.

1. Include up to 5% in base bid. Contractor to document such replacement. See Structural and Division 061600.

3.4 ROOF SUBSTRATE PREPARATION

1. Cover roof deck with High Temperature Self-Adhering Underlayment (HTSAU), roll seams and secure with cap nails.
   a. Remove cap nails as copper roofing progresses
2. Provide primers and self-adhering underlayment
   a. Roll end laps and side laps with steel roller

3.5 BASE FLASHING REMOVAL

A. Remove existing base flashings.
1. Clean substrates of contaminants, such as asphalt felts, sheet materials, metal flashing dirt, debris and foreign materials from parapets.

2. Complete all masonry work above roof while existing shingle roofing is in place.

3. If built-in metal counterflashings are exposed during flashing removal. Immediately contact Architect/Consultant for direction.

END OF SECTION 070150.19

**SECTION 072100**

**THERMAL INSULATION**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Mineral-wool batt insulation.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:
1. Basis of Design: JM Mineral Wool TempControl Batt Insulation, R-30, Product Data.

PART 2 - PRODUCTS

2.1 MINERAL-WOOL BATT INSULATION

A. Mineral-Wool Batt Insulation, Unfaced: ASTM C665, Type I (blankets without membrane facing); consisting of fibers; passing ASTM E136 for combustion characteristics, for installation at cross-gable roof attic space.

1. Basis of Design:
Johns Manville:
JM Mineral Wool TempControl Batt Insulation
7 ¼" thickness
23 ½ width
R-30

2. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.

3. Smoke-Developed Index: Not more than 50 when tested in accordance with ASTM E84.

4. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

2.2 ACCESSORIES

A. Insulation for Miscellaneous Voids:

1. Glass-Fiber Insulation: ASTM C764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E84.
2. Spray Polyurethane Foam Insulation: ASTM C1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.

3. Polyurethane Pour-In-Place Insulation: Closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84, specifically formulated for pour-in-place applications.

B. Insulation Anchors, Spindles, and Standoffs: As recommended by manufacturer.

C. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Install insulation with manufacturer's R-value label exposed after insulation is installed.

D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

E. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

### 3.2 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. For wood-framed construction, install blankets according to ASTM C1320 and as follows:

B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft.
2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

END OF SECTION 072100

**SECTION 072600**
**VAPOR RETARDERS**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Polyethylene vapor retarders.

B. Related Requirements:

1. Section 075216 “SBS Modified Bituminous Membrane Roofing.”

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

PART 2 - PRODUCTS

2.1 POLYETHYLENE VAPOR RETARDERS

A. Polyethylene Film: ASTM D 4397, 6 mils (0.15 mm) thick minimum, with maximum permeance rating of 0.13 perm (7.5 ng/Pa x s x sq. m).
1. Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

PART 3 - EXECUTION

3.1 INSTALLATION OF VAPOR RETARDERS ON FRAMING

A. Polyethylene Film: Loosely lay polyethylene-film vapor retarder in a single layer over area to receive vapor retarder, side and end lapping each sheet a minimum of 2 inches (50 mm) and 6 inches (150 mm) respectively. Continuously seal side and end laps with tape.

B. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives, vapor retarder fasteners, or other anchorage system as recommended by manufacturer. Extend vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.

C. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into roofing system.

D. Seal vertical joints in vapor retarders over framing by lapping no fewer than two studs and sealing with vapor-retarder tape according to vapor-retarder manufacturer's written instructions. Locate all joints over framing members or other solid substrates.

E. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.

F. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

END OF SECTION 072600

**SECTION 073113**

**ASPHALT SHINGLES**

1.1 SUMMARY

A. Section Includes:

1. Glass-fiber-reinforced asphalt shingles.
2. Underlayment materials.
3. Metal flashing and trim.

B. Related requirements:
1. Section 070150.19 “Preparation for Reroofing”
2. Section 076100 “Sheet Metal Roofing”

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Asphalt shingles.
2. Underlayment materials.
3. Asphalt roofing cement.
4. Elastomeric flashing sealant.

B. Shop Drawings: For metal flashing and trim.

C. Samples: For each exposed product and for each color and blend specified.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Research reports for synthetic underlayment.

C. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An authorized installer who is trained and approved by manufacturer.

1.7 WARRANTY

A. Materials Warranty: Manufacturer agrees to repair or replace asphalt shingles that fail within specified warranty period. Basis of Design: Certainteed Grand Manor

1. Materials Warranty Period: 50 years from date of Substantial Completion, prorated, with 10-year non prorated
2. Wind-Speed Warranty Period: Asphalt shingles will resist blow-off or damage caused by wind speeds of up to 110 mph (49 m/s) for 15 years from date of Substantial Completion.
3. Algae-Resistance Warranty Period: Asphalt shingles will not discolor for 30 years from date of Substantial Completion.
4. Workmanship Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Exterior Fire-Test Exposure: Provide asphalt shingles and related roofing materials identical to those of assemblies tested for Class A fire resistance in accordance with ASTM E108 or UL 790 by Underwriters Laboratories or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.

B. Wind Resistance: Provide asphalt shingles that comply with requirements of ASTM D3161/D3161M, Class F, and with ASTM D7158/D7158M, Class H.

2.2 GLASS-FIBER-REINFORCED ASPHALT SHINGLES

A. Impact-Resistant, Laminated-Strip Asphalt Shingles: ASTM D3462/D3462M, laminated, multi-ply overlay construction; glass-fiber reinforced, mineral-granule surfaced, and self-sealing; with impact resistance complying with UL 2218, Class 4.

1. Certainteed Grand Manor
2. Butt Edge: Straight cut.
3. Strip Size: Manufacturer's standard.
4. Algae Resistance: Granules resist algae discoloration.
5. Color and Blends: As selected by Architect from manufacturer's full range color and blends.

B. Hip and Ridge Shingles: Manufacturer's standard units to match asphalt shingles.

C. Non-woven polyester ridge vent. Ridge Vent product not intended for ventilation, intended for architectural reveal.

## 2.3 UNDERLAYMENT MATERIALS

A. Self-Adhering, Polymer-Modified Bitumen Sheet: ASTM D1970/D1970M, minimum 50-mil- thick sheet; glass-fiber-mat-reinforced, polymer-modified asphalt; with slip-resistant top surface and release backing; cold applied.[ Provide primer for adjoining metal surfaces to receive underlayment.]
   1. Manufacturer: Basis of Design Henry self-adhering underlayment
      a. Product: Henry Blueskin® Tile & Metal (RF200TM)

B. Roofing Nails: EG Wire Nails, minimum 0.120-inch- (3-mm-) diameter, sharp-pointed, with a 3/8- to 7/16-inch- (10- to 11-mm-) diameter flat head of sufficient length to penetrate 1 1/2" (but not less than 1 1/4") into solid wood decking or extend at least 1/8 inch through sheathing less than 3/4 inch thick.

   1. Copper nails are in contact with metal flashing, use nails made from same metal as ZT copper flashing.

C. Underlayment Nails: Aluminum, stainless steel, or hot-dip galvanized-steel wire nails with low-profile metal or plastic caps, 1-inch minimum diameter.

   1. Provide with minimum 0.0134-inch- (0.34-mm-) thick metal cap or 0.035-inch- (0.89-mm-) thick plastic cap; and with minimum 0.083-inch- (2.11-mm-) thick ring shank or 0.091-inch- (2.31-mm-) thick smooth shank of length to penetrate at least 3/4 inch (19 mm) into roof sheathing or to penetrate through roof sheathing less than 3/4 inch (19 mm) thick.

## 2.4 METAL FLASHING AND TRIM

A. Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."

   1. Sheet Metal: ZT Copper 16 oz. sq. ft. at dome drum and chimney
      a. step flashing 4” x 4” x 12”
      b. reglet counter flashing: 4” face
   2. Sheet Metal: ZT Copper 28 oz sq ft at cricket and valley flashing

B. Fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of the item unless otherwise indicated on Drawings.

   1. Vent-Pipe Flashings: Red Copper 16 oz. sq. ft.

# PART 3 - EXECUTION

## 3.1 INSTALLATION OF UNDERLAYMENT MATERIALS

A. Comply with asphalt shingle and underlayment manufacturers' written installation instructions and with recommendations in NRCA's "The NRCA Roofing Manual: Steep-Slope Roof Systems" applicable to products and applications indicated unless more stringent requirements are specified in this Section or indicated on Drawings.

B. Self-Adhering, Polymer-Modified Bitumen Sheet: Install, wrinkle free, on roof deck in locations indicated on Drawings.

1. Comply with low-temperature installation restrictions of underlayment manufacturer.
2. Install lapped in direction that sheds water.

    a. Lap sides not less than 4 inches (102 mm).
    b. Lap ends not less than 6 inches (152 mm), staggered 24 inches (610 mm) between succeeding courses.
    c. Roll laps with roller.

3. Prime masonry, and metal surfaces to receive self-adhering sheet.
4. Cover underlayment within seven days.

## 3.2 INSTALLATION OF METAL FLASHING AND TRIM

A. Install metal flashings and trim to comply with requirements in Section 076200 "Sheet Metal Flashing and Trim" and 07610 “Sheet Metal Roofing.”

1. Install metal flashings in accordance with recommendations in NRCA's "NRCA Guidelines for Asphalt Shingle Roof Systems."
2. Bed flanges of metal flashings using asphalt roofing cement or elastomeric flashing sealant.

B. Pipe Flashings: Prefabricate soldered copper flashing around pipe penetrations and asphalt shingles. Pipe flashing flange to extend 12” upslope from centerline of pipe.

## 3.3 INSTALLATION OF ASPHALT SHINGLES

A. Verify that all carpentry repairs and surface preparations are complete and properly fastened to roof deck and gutter brackets are installed and secured to the rafter.

B. Install asphalt shingles in accordance with manufacturer's written instructions and recommendations in NRCA's "NRCA Guidelines for Asphalt Shingle Roof Systems."

C. Install starter strip along lowest roof edge consisting of an asphalt shingle strip with self-sealing strip at eave.

D. Install first and remaining courses of laminated asphalt shingles stair-stepping diagonally across roof deck with manufacturer's recommended offset pattern at succeeding courses, maintaining uniform exposure.

E. Fasten asphalt shingle strips with a minimum of six roofing nails, but not less than the number indicated in manufacturer's written instructions for roof slope and design wind speed indicated on Drawings and for warranty requirements specified in this Section.

1. Locate fasteners in accordance with manufacturer's written instructions.

2. Assure that all nails are securely seated and hammered if needed to seat all unseated nails, prior to placing the next course of shingles.
3. When ambient temperature during installation is below 50 deg F, hand seal self-sealing asphalt shingles by applying asphalt roofing cement spots between course overlaps after nailing the upper course.

F. Hip and Ridge Shingles: Provide shingle manufacturer's ridge cap shingles to be set over polyethylene ridge vent.
   1. Maintain exposure of cap shingles as published by roofing-shingle manufacturer. Lap cap shingles at ridges to shed water away from direction of prevailing winds.

   2. Fasten with roofing nails of sufficient length to penetrate sheathing.

END OF SECTION 073113

**SECTION 075216**
**STYRENE-BUTADIENE-STYRENE (SBS) MODIFIED BITUMINOUS MEMBRANE ROOFING**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Styrene-butadiene-styrene (SBS)-modified bituminous membrane roofing system
2. PMMA-based fluid-applied flashing systems at roof drain and perimeter walls
3. Roof insulation

B. Related Sections:

1. Section 061600 “Sheathing” for sheathing and coverboard
2. Section 076200 “Sheet Metal Flashing and Trim”

1.2 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" apply to work of this Section.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Roofing Conference:

1. Work of this section will be reviewed as part of the overall preconstruction meeting.
2. Coordinate Stair Roof removal and replacement work with removal and replacement of the wrought iron railing system.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

1. Submit evidence of meeting performance requirements. Basis of Design: Siplast three-part system.

1.5 INFORMATIONAL SUBMITTALS

A. Research/Evaluation Reports: For components of membrane roofing system, from ICC-ES.

B. Sample Warranties: For manufacturer's special warranties.
1. 20-year manufacturer’s warranty.

C. Qualification Data: For Installer and manufacturer.

## 1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system to include in maintenance manuals.

B. Inspection Report and Punchlist: Contractor and roofing system manufacturer's post-installation punchlist of open items. Copy of roofing system manufacturer's inspection report of completed roofing installation.

## 1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by membrane roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty. Qualified installer must have held such approval or license for a minimum of five years.

B. Manufacturer Qualifications: A qualified manufacturer that has FM Global approval for roofing system identical to that used for this Project.

C. Acceptable Products: Obtain components for membrane roofing system approved by membrane roofing manufacturer. Provide secondary or accessory products which are acceptable to the manufacturer of the primary roofing products.

D. Project Acceptance: Submit a completed manufacturer's application for roof guarantee form along with shop drawings of the roofs showing all dimensions, penetrations, and details. The form shall contain all the technical information applicable to the project including deck types, roof slopes, base sheet and/or insulation assemblies (with method of attachment, and fastener type), and manufacturer's membrane assembly proposed for installation. The project must receive approval, through this process, prior to shipment of materials to the project site.

## 1.8 PERFORMANCE REQUIREMENTS

A. General: Provide installed roofing membrane and base flashings that remain watertight; do not permit the passage of water; and resist specified uplift pressures, thermally induced movement, and exposure to weather without failure.

B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.

C. Energy Performance: Provide roofing system with initial Solar Reflectance Index not less than 78 when calculated according to ASTM E 1980 based on testing identical products by a qualified testing agency.
   1. Philadelphia Energy Code: Minimum R-Value 30.

D. Roofing System Design: Provide membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE/SEI 7.

   1. Corner Uplift Pressure: 50.6 lbf/sq. ft. (kPa/sq. m)>.

E. FYI wood decks fail FM testing. They also do not qualify for a ROOF-NAV rating.

1.9 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

PART 2 - PRODUCTS

2.1 MULTI-PLY SBS-MODIFIED BITUMEN ROOFING SYSTEM

A. Source Limitations: Obtain components including roof insulation, fasteners, perimeter metal flashing and edge systems, for roofing system from same manufacturer as membrane roofing or manufacturer approved by membrane roofing manufacturer.

B. Roofing Membrane Assembly Description: A cold-applied, roof membrane assembly consisting of two plies of a prefabricated, reinforced, homogeneous Styrene-Butadiene-Styrene (SBS) block copolymer modified asphalt membrane, applied over a prepared substrate. Reinforcement mats shall be impregnated/saturated and coated each side with SBS modified bitumen blend.

C. Manufacturers: Basis of Design system Siplast; Paradiene 20/30 roof system.

1. Provide basis of design product, Siplast or equal product by one of the following:

a. Siplast; 20 – 30 SBS roof system.

D. Roofing Membrane Base and Stripping Ply: Roofing Membrane Sheet: ASTM D 6163, Grade S, Type I, SBS-modified asphalt sheet (reinforced with glass fibers) or

E. Granule-Surfaced Roofing Cap Sheet/ Finish Ply: ASTM D 6163, Grade G, Type I, SBS-modified asphalt sheet (reinforced with glass fibers) or ASTM D 6164/D 6164M, Grade G, Type I, SBS-modified asphalt sheet (reinforced with polyester fabric) granule surfaced; suitable for application method specified.

1. Basis of Design: Siplast; Paradiene 30.

a. Top Ply Surfacing: Ceramic granule finish, Bright White (BW) color.

2. Provide basis of design product, or equal product listed below:

a. Siplast; Paradiene 30

2.2 PMMA BASE FLASHING MATERIALS

A. Backer Sheet: ASTM D 6163, Grade S, Type I or II, SBS-modified asphalt sheet (reinforced with glass fibers) or ASTM D 6163/D 6163M, Grade S, Type I or II, SBS-modified asphalt sheet (reinforced with polyester fabric; smooth surfaced; suitable for application method specified.

1.

B. Liquid Applied Flashing: A liquid and fabric reinforced flashing system created with a stitchbonded polyester scrim and a two-component, moisture cured, elastomeric, liquid applied flashing material, consisting of an asphalt extended urethane base material and an activator.

1. Basis of Design: Siplast; Parapro 123 Flashing System.

a. Surface Finish: finish, smooth,,. white.

2. Provide basis of design product, or equal product listed below:

a. Siplast: ParaPro 123.Flashing System.

C. Fleece for Membrane Reinforcement: a non-woven, 110 g/m$^2$, needle-punched polyester fabric reinforcement as provided by the membrane system manufacturer.

## 2.3 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing.

B. Asphalt Primer: ASTM D 41/D 41M.

C. Cold-Applied Adhesive: Roofing system manufacturer's standard asphalt-based, one- or two-part, asbestos-free, cold-applied adhesive specially formulated for compatibility and use with roofing membrane and base flashings, conforming to ASTM D4479.

D. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required by roofing system manufacturer for application.

E. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roofing components to substrate; tested by manufacturer for required pullout strength, and acceptable to roofing system manufacturer.

F. Roofing Granules: Ceramic-coated roofing granules, No. 11 screen size with 100 percent passing No. 8 (2.36-mm) sieve and 98 percent of mass retained on No. 40 (0.425-mm) sieve, color to match roofing.

## 2.4 INSULATION SUBSTRATE BOARD

1. High Density Gypsum: HD Gypsum ½” thick.
   a. Secure to deck as necessary.

## 2.5 ROOF INSULATION

A. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2 closed cell, rigid polyisocyanurate foam core material, integrally laminated between glass fiber facers. Insulation to be provided by roofing membrane manufacturer as part of a complete roofing system.

1. Minimum “R-value” R-30 in accordance with Philadelphia Energy Code.

2. Provide in two layers of 2.6”.

a. First layer secured with screws and insulation plates at the rate of 1 fastener per 2 square feet of roof area.

B. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to provide positive slope to drain.

2.6 INSULATION COVER BOARD

1. High Density Gypsum: HD Gypsum ½" thick.
   a. Set in urethane foam adhesive

2.7 INSULATION ACCESSORIES

A. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.
   1. Base layer: 1 fastener per 2 sq ft

B. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer.
   1. Siplast Para Stik

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Comply with roofing system manufacturer's written instructions.

B. Substrate- Preparations: Prevent roofing asphalt and adhesives from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction. Verify that all roof deck repairs/replacement work is complete.

C. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:

   1. Verify that roof drains are securely clamped in place.
   2. Verify that scupper is infilled.
   3. Verify that masonry work at parapet is complete.
   4. Verify that railing fastener hardware is approved by EoR.
   5. Asphaltic Primer: Prime metal and masonry surfaces to be flashed with a uniform coating of the specified asphalt primer.

3.2 INSULATION INSTALLATION

A. Coordinate installing substrate board roofing system components so insulation is not exposed to precipitation or left exposed at the end of the work day.

B. Install insulation in two layers of 2.6" each.

C. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.

1. Cut and fit insulation within parapet and rising.

D. Mechanically Fastened Insulation: Install each layer of insulation and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.

1. Fasten insulation to resist uplift pressure at corners.

2. Adhere second layer of insulation in urethane adhesive.

E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.

## 3.3 ROOFING MEMBRANE INSTALLATION

A. Install roofing membrane system according to roofing system manufacturer's written instructions and applicable recommendations of ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing."

B. Coordinate installing roofing system so insulation and other components of the roofing membrane system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.
1. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system.

C. Where roof slope exceeds 3/4 inch per 12 inches (1:18) install roofing membrane sheets parallel with slope.

## 3.4 BASE PLY INSTALLATION

A. Install (1) one ply of base ply membrane shingled uniformly to achieve one ply throughout over the prepared substrate. Shingle in proper direction to shed water on each large area of roofing.

B. Lap ply sheet ends eight inches. Stagger end laps twelve inches minimum.

C. Extend plies two inches beyond top edges of cants at wall and projection bases.

D. Set base ply in adhesive at manufacturer’s suggested rate.

E. Install base flashing ply to all perimeter and projection details.

## 3.5 TOP PLY - MODIFIED MEMBRANE APPLICATION

A. The modified membrane shall then by solidly bonded to the base ply with specified adhesive at the manufacturer’s specified rate.

B. The roll must push a puddle of asphalt in front of it with asphalt slightly visible at all side laps. Care should be taken to eliminate air entrapment under the membrane.

C. Apply pressure to all seams to ensure that the laps are solidly bonded to substrate.

D. Subsequent rolls of modified shall be installed across the roof as above with a minimum of 4” side laps and 8” end laps. The end laps shall be staggered. The modified membrane shall be laid in the same direction as the underlayers but the laps shall not coincide with the laps of the base layers.

E. Apply asphalt no more than five feet ahead of each roll being embedded.

F. Extend membrane 2” beyond top edge of all cants in a full troweling of the specified asphalt cement as shown on the drawings.

## 3.6 FLASHING AND STRIPPING INSTALLATION

A. Extend base flashing up walls or parapets a minimum of 8 inches (200 mm) above roofing membrane and 4 inches (100 mm) onto field of roofing membrane.

B. Mechanically fasten top of base flashing securely at terminations and perimeter of roofing.

C. Install the PMMA flashing system.

D. The entire base ply sheet of flashing membrane must be solidly adhered to the substrate.

E. Seal all vertical laps of flashing membrane with a three-course application of PMMA Flashing and fleece.

## 3.7 FIELD QUALITY CONTROL

A. A roof inspection is required by manufacturer before warranty issue.
   1. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Architect.

B. Repair or remove and replace components of roofing system where test results or inspections indicate that they do not comply with specified requirements.

C. Final Inspection: Hold a meeting at the completion of the project, attended by all parties that were present at the pre-job conference. A punch list of items required for completion shall be compiled by the Contractor and the manufacturer's representative. Complete, sign, and mail the punch list form to the manufacturer's headquarters.

D. PROTECTING AND CLEANING

E. Protect roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

F. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

G. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

H. Uncured resin is considered a hazardous material. Unused resin must be catalyzed and cured prior to disposal.

I. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

END OF SECTION 075216

**SECTION 076100**

**SHEET METAL ROOFING**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Custom-fabricated sheet metal roofing.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood deck and substrate repairs if not specified in this Section.
2. Section 084513 “Structured Polycarbonate Panel Assemblies" for prefabricated octagonal oculus designed to OSHA safety requirements.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each of the following:

1. Roofing sheet metal.
2. Underlayment materials.
3. Rosin sized paper.
4. Fasteners.
5. Sealant tape.
6. Elastomeric sealant.
7. Butyl sealant.

B. Shop Drawings:

1. Include plans, elevations, sections, faux rib details, and various cleat and attachment details.
2. Detail fabrication and panel installation layouts, expansion joint locations, points of fixity, and keyed details. Distinguish between shop- and field-assembled Work.
3. Include details for forming, including seams and dimensions.
4. Include details for joining and securing, including layout and spacing of fasteners, cleats, and other attachments. Include pattern of seams.
5. Include details of expansion joints, including showing direction of expansion and contraction from points of fixity.
6. Include details of roof penetrations.
7. Include details of hip and rib conditions, including folding of standing seams at skylight curb, corners, termination and counter flashing.
8. Include details of special conditions including removable and replaceable gutter system.

9. Include details of connections to adjoining work at skylight, gutter and skirt transition.

C. Samples: For each exposed product and for each color and texture specified, 6 inches long by 6 inches wide.

D. Contractor to provide mockup of skirt/gutter/dome transition. Dimensions to be 36” wide by full height of skirt including gutter up to and including transition to dome.

E. Delegated Design of Lightning Arrestor System: Contractor to determine need for a lightning arrestor system to mitigate potential conductivity of roof assembly including existing deck surface, new gutter substrate, skirt framing and blocking for skylight frame attachment components and systems attaching to copper sheet metal roofing.

Local Vendor: Warren Lightning Rod Co, Collingswood, NJ

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved.

B. Evaluation Reports: For self-adhering, high-temperature sheet underlayment, from ICC-ES.
1. Provide Submittal Product Data sheets for gutters and shingles.
2. Cast iron fasteners and epoxy fasteners, see structural.

C. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing sheet metals and accessories to include in maintenance manuals.

B. Special warranties. 5-year contractor watertight warranty for copper dome and gutter waterproofing.

1.6 WARRANTY

A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal roofing that shows evidence of deterioration of factory-applied finishes within specified warranty period. 20-year aluminum finish warranty.

1. Exposed Panel Finish: Mill

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Sheet metal roofing system, including, but not limited to, metal roof panels, cleats, anchors and fasteners, sheet metal flashing integral with sheet metal roofing, custom sloped gutter panels, faux rib **battens**, underlayment, and accessories, is to comply with

requirements without failure due to defective manufacture, fabrication, or installation, or due to other defects in construction. Sheet metal roofing is to remain watertight.

B. Sheet Metal Roofing Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or indicated on Drawings.

C. Copper Roofing Standard: Comply with CDA's "Copper in Architecture Handbook." Conform to dimensions and profiles shown unless more stringent requirements are specified or indicated on Drawings.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F (67 deg C), ambient; material surfaces temperature change.

## 2.2 ROOFING SHEET METALS

a. Batten Caps: Nominal 0.028 inch thick.

B. Copper Sheet: ASTM B370 cold-rolled copper sheet, H00 temper.
1. Weight (Thickness): 20 oz./sq. ft. unless otherwise indicated.

a. Faux Rib (Batten) Caps: 24 oz./sq. ft. thick.

## 2.3 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet Underlayment: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.

1. WR Grace
2. Thermal Stability: ASTM D1970/D1970M; stable after testing at 240 deg F or higher.
3. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F or lower.

B. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. minimum.

## 2.4 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners [**solder**], protective coatings, sealants, and other miscellaneous items as required for complete roofing system and as recommended by primary sheet metal manufacturer unless otherwise indicated.

B. Wood Blocking: Lumber according to requirements for nailers for roofing in Section 061000 "Rough Carpentry."

C. Fasteners: Wood screws, annular-threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.

1. General:
   a. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws, gasketed; with hex-washer head.
   b. Blind Fasteners: High-strength aluminum or stainless steel rivets suitable for metal being fastened.

2. Fasteners for Painted Aluminum: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.
3. Fasteners for Aluminum Extrusions: As provided, specified by skylight manufacturer, or Series 300 stainless steel.
4. Fasteners for Copper Sheet: Copper, hardware bronze, or passivated Series 300 stainless steel.
5. Copper Fasteners for cleats: Copper wire nails, or passivated Series 300 stainless steel.
6. Fasteners for Stainless Steel Sheet: Series 300 stainless steel.

D. Solder:
1. For Copper: ASTM B32, [Grade Sn50, 50 percent tin and 50 percent lead]
2. For Stainless Steel: ASTM B32, [Grade Sn96], with acid flux of type recommended by stainless steel sheet manufacturer.

E. Elastomeric Sealant: ASTM C920, elastomeric [polyurethane] [polyurethane-silicone] polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal roofing and remain watertight.

Retain "Butyl Sealant" Paragraph below for expansion joints with limited movement.

F. Butyl Sealant where open gutter meets valley: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

G. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D1187.

H. Underlayment Adhesive:

## 2.5 ACCESSORIES

A. Sheet Metal Accessories: Provide components required for complete sheet metal roofing assembly, including trim, cladding, gutters, counter flashing, Faux Rib covers, hips and corner units, clips, flashings, sealants, gaskets, fillers, metal closures, closure strips, and similar items. Match material and finish of sheet metal roofing unless otherwise indicated.

1. Cleats: Intermittent and continuous attachment devices for mechanically seaming into joints and formed from the following materials and thicknesses unless otherwise indicated:
   a. Copper Roofing Starter Cleats: 32-oz./sq. ft.
   b. Faux Rib Batten Cover Cleats: 32-oz./sq. ft.
   c. Faux Rib Batten Covers: 28-oz./sq. ft.
   d. Transition flashings: 24-oz./sq. ft. copper sheet.
   e. Copper Roofing Seam Cleats: 20-oz./sq. ft. standing seam starter
   f. Flashing and Counter Flashings and cleats: Minimum 20-oz./ sq. ft.
   g. ZT Copper (step and counter flashing and open downspout): Minimum 20-oz

2. Expansion-Type Cleats: Cleats of a design that allows longitudinal movement of roof panels without stressing panel seams; of same material as other cleats.
3. Backing Plates: Plates at roofing splices, fabricated from material recommended by SMACNA's "Architectural Sheet Metal Manual."
4. Flashing and Trim: Formed from same material and with same finish as sheet metal roofing, minimum 20-oz./ sq. ft.

B. Skylight Curb Capping: Fabricated from same material and finish as sheet metal roofing, minimum thickness matching the sheet metal roofing.
1. Fabricate curb and sub-framing to withstand indicated loads of size and height indicated.
2. Coordinate dimensions with skylight frame information and Shop Drawings.

## 2.6 FABRICATION

A. Custom-Fabricated Sheet Metal Roofing: Comply with details shown and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions (panel width and seam height), geometry, metal thickness, and other characteristics of installation. Fabricate sheet metal roofing and accessories in shop to greatest extent possible.
1. Standing-Seam Roofing: Form standing-seam panels with finished seam height of 1 inch

B. Form exposed sheet metal work to fit substrates with little oil canning; free of buckling and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
1. Lay out sheet metal roofing to conform with the curved surface of the dome in a manner to reduce and/or eliminate oil canning of the copper sheets.
2. Lay out sheet metal roofing, so transverse seams, if required, are made in direction of flow, with higher panels overlapping lower panels.
3. Offset transverse seams from each other 50% of panel length matching seam elevations on alternating panels. Provide a visually balanced seam pattern.
4. Fold and cleat eaves and transverse seams in shop to the greatest extent possible.
5. Form and fabricate sheets, seams, strips, cleats, valleys, ridges, edge treatments, integral flashings, and other components of metal roofing to profiles, patterns, and drainage arrangements indicated on Drawings and as required for leakproof construction.

C. Replaceable Built-In Gutters: Fabricate to cross section indicated, with minimally riveted and soldered joints, complete with expansion seams, spill-out scupper, custom receiver and counterflashing with soldered blind hold down cleats, and other special accessories as required.

1. Fabricate octagonal corner sections with minimum 24” long sections in both directions.
2. Fabricate custom gutter in lengths as long as possible. Slope gutters toward spill-out scupper beginning 180 degrees opposite the scupper.
3. Fabricate expansion joints in gutter pans, formed with positive shingling in the direction of flow, gutters unless otherwise indicated. Corners are assumed fixed locations.
4. Fabricate gutters with built-in expansion joints.

D. Expansion Provisions: Fabricate sheet metal roofing to allow for expansion in running work sufficient to prevent leakage, damage, and deterioration of the Work.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints upslope from corners and only where indicated on Drawings.

E. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to SMACNA's "Architectural Sheet Metal Manual."
   1. Use only with written approval as this is not a preferred detail. Review with Architect and Consultant prior to assembling.

F. Sheet Metal Accessories: Custom fabricate flashings and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item required. Obtain field measurements for accurate fit before shop fabrication.

   1. Form exposed sheet metal accessories without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
   2. Seams: Tin edges (of gutter pans) to be seamed, form seams, and solder.
   3. Fabricate cleats and attachment devices of sizes recommended by SMACNA's "Architectural Sheet Metal Manual" for application, but not less than thickness of metal being secured.
      a. Standing seam starter strip to be 32-oz. copper

G. Do not use graphite pencils to mark metal surfaces.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine roof assembly to verify that repairs are complete and that sheathing is secured to the rafters. Verify sheathing and T&G decking to extent possible that joints are tight and that tops of fasteners are concealed in the T&G and/or flush with surface, and that infill installation is within flatness tolerances required for finished roofing installation.

B. Verify that High temperature Self-Adhering Underlayments (HT-SAU) water-resistant barriers have been installed over sheathing substrate to prevent water penetration.

### 3.2 PREPARATION

A. Lay out panel arrangement, before installation of sheet metal roofing.

   1. Custom taper each gutter pan to fit slope and provide an even streetside gutter leg.
   2. Space fasteners not more than 18 inches o.c.

### 3.3 UNDERLAYMENT INSTALLATION

A. Self-Adhering High-Temperature Sheet Underlayment:

   1. Install self-adhering high-temperature sheet underlayment, wrinkle free.
   2. Prime substrate if recommended by underlayment manufacturer.
   3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.
   4. Apply in diagonal shingle fashion to shed water, with end laps of not less than 6 inches between courses. Provide continuous sheets covering from skylight blocking at top, covering dome and lapping onto gutter HT-SAU.

5. Overlap side edges not less than 3-1/2 inches.
6. Roll laps and edges with roller.
7. Cover underlayment within 14 days of installation.
8. Install self-adhering high-temperature underlayment at the following locations:
   a. Hips and ridges for a distance on each side, 3 inches
   b. Around dome corners, lapping 3” each direction.
   c. Below entire area of integral gutters, including; over skirt blocking, entire gutter pan area and upslope onto dome roof deck 18” minimum.
   d. Entire dome roof deck, turn up onto, and cover blocking. Trim even with (interior) blocking.

B. Install slip sheet, wrinkle free, over underlayment before installing sheet metal roofing and related flashing.

1. Install rosin underlayment just ahead of standing seam panel.

2. Install in shingle fashion, with lapped joints of not less than 4 inches.

C. Install gutter and/or roofing panels and flashings to cover slip sheet according to requirements in Section 076200 "Sheet Metal Flashing and Trim."

## 3.4 INSTALLATION, GENERAL

A. Install sheet metal roofing to comply with details shown and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to installation characteristics required unless otherwise indicated on Drawings.

1. Install cleats, fasteners, solder, separators, sealants, and other miscellaneous items as required for complete roofing and gutter system.
2. Install sheet metal roofing true to vertical line, and slopes. Provide uniform, neat seams with minimum oil canning and/or wrinkles.
3. Anchor sheet metal roofing and other components of the Work securely in place, with provisions for thermal and structural movement.
4. Do not field cut sheet metal roofing by torch.
5. Provide sheet metal cleats and flashings at locations identified on the contract drawings, but not in quantities published in the SMACNA manual.
6. Flash and seal sheet metal roofing with counter flashings and secure with blind soldered cleats.
7. Provide soldered caps at nails and solder over rivets and/or exposed fasteners.
8. Locate and space fastenings not greater than 18” o. c.
9. Install faux hip covers at corners (8) and center elevation locations (8) as sheet metal roofing work proceeds to avoid damaging panels.
10. Lap metal flashing over sheet metal roofing to direct moisture to run over and off roofing.
11. Do not use graphite pencils to mark metal surfaces.

B. Fasteners: Use fastener sizes that penetrate wood blocking and/or deck not less than 1-1/4 inches (32 mm) for nails and wood screws or substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

C. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating, by applying self-adhering sheet underlayment to each contact surface, or by other permanent separation as recommended in SMACNA's "Architectural Sheet Metal Manual."

1. Do not allow sheet metal roofing to contact wood, ferrous metal, or cementitious construction.

D. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

E. Skirt Transition Flashing:

1. Custom taper gutter pans to fit slope and provide an even streetside gutter leg.

## 3.5 CUSTOM-FABRICATED SHEET METAL ROOFING INSTALLATION

A. Install sheet metal roofing system with lines and corners of exposed units true and accurate.
1. Fold over panel seams and gently peen flat at transition to hip and skylight blocking.
2. Turn roof pans and folded seams up onto skylight blocking and peen gently into transition.
3. Do not cause metal fatigue by over peening.
4. Form exposed faces flat and free of buckles, excessive waves, and avoidable tool marks, considering metal temper and reflectivity.
5. Provide uniform, neat hand folded seams with no exposure of solder, welds, and/or sealant.
6. Fold back sheet metal to form hem on concealed side of exposed edges of flashings, unless otherwise indicated.
7. Pre-tin seams to be soldered.

B. Install cleats to hold sheet metal roofing panels in position.

1. Attach each cleat with at least two fasteners to prevent rotation.
2. Space cleats not more than 16 inches o.c.
3. Bend tabs over fastener head.
4. Provide expansion-type cleats for roof panels that exceed 20 feet in length.

C. Seal expansion joints as approved and required for watertight construction.

1. Use sealant-filled joints only where identified in the gutter and skylight only.

a. Embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant.
b. Form joints to completely conceal sealant.
c. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way.
d. Adjust setting proportionately for installation at higher ambient temperatures.
e. Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).

2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

D. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter.

1. Pre-tin edges of gutter pans to be soldered, with solder to a width of 1-1/2 inches; however, reduce pre-tinning where pre-tinned surface would show in completed Work.
2. Do not use torches for soldering.
3. Heat surfaces to receive solder, and flow solder into joint.

a. Fill joint completely.
b. Completely remove flux and spatter from exposed surfaces.

4. Copper Soldering: Tin edges of uncoated sheets, using solder for copper.

E. Rivets: Rivet joints in aluminum where necessary for strength. Copper rivets at copper seam fully soldered.

F. Standing-Seam Roofing:
Lock panels to hips with concealed cleats, form and roll hip corners, and crimp tight.

3.6 CUSTOM FABRICATED BUILT-IN GUTTER

1. Attach gutter pan to skirt blocking with 2” cleats, 16” o.c., fastened to blocking using 2 nails per 2” cleat.
2. Attach standing-seam metal panels to substrate with double-fastened cleats spaced at 16 inches o.c.
3. Install panels reaching from eave to ridge skylight blocking and fold finished seam turning up onto skylight blocking, before moving to adjacent panels.

a. If transverse joints are required, stagger joints in adjacent panels at one even elevation.

4. Lock standing seams by folding over twice, so cleat and panel edges are completely engaged.
5. Lock each panel to panel below with sealed transverse seam. Use only where panel lengths in excess of 10-feet are required.
6. Loose-lock panels at eave edges to continuous heavy cleat at roof to gutter transition.
7. Lock panels to dome, above gutter, on standing seam starter strip.

8. **Fold over seams** at hips and skylight blocking.

G. Custom Batten Hip and Custom Mid Elevation Ribs:

1. Secure Faux Batten Hip Covers in place with cleats secured through hip standing seam.
2. Mid Elevation Faux Ribs Hold cleats to substrate with intermittent cleats as detailed on the contract drawings. Pre tin pan in cleat area and solder cleats to roof pan.
3. Hook each faux rib cover onto cleats.
4. Form ribs to fit close to roof and fabricate end caps riveted in place.
5. Loose-lock panels at eave to continuous cleat at top of gutters.

H. Custom Replaceable Built-In Gutters:

1. Install self-adhering, high-temperature sheet underlayment inside built-in gutter and covering dome and blocking as indicated on drawings and here-in.
2. Fabricate spill-out scupper and place into open spout at skirt.
   a. Pre tin and solder scupper seams and deck flange at gutter interface.
3. Fabricate tapered gutter pans to fit onto substrate and allow ¼” both dome side and streetside for thermal movement, and the low, downslope pan end fits neatly into the previously installed pan without bowing and lap 1-1/2” onto pre tinned pan.
4. Place custom gutter segments into gutter framing covering HT-SAU and rosin, beginning at spill-out scupper and lapping onto the scupper spill-out pre tinned flange, 1-1/2”.
5. Secure gutter segments to blocking at skirt with 2 nails, through 2” cleats, 16” o. c.
6. Back leg upstand of gutter to be 12” up the dome and secured with 2 nails, through 2” cleats, 2 per each of 8 gutter segments and/or as necessary and to allow thermal movement.
7. Solder assembled gutter seams before the end of each work day.

8. Protect open gutter from damage and weather until standing seam roofing above is complete. Remove debris promptly.
9. Slope gutters to drainage point.
10. Provide fully soldered, watertight gutter system.

## 3.6 ACCESSORY INSTALLATION

A. Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion.

1. Coordinate installation with flashings and other components.
2. Install components required for complete sheet metal roofing assembly, including gutters, trim, flashings, sealants, skylight counter flashing, fillers, metal closures, closure strips, and similar items.
3. Install accessories integral to sheet metal roofing that are specified in Section 076200 "Sheet Metal Flashing and Trim" to comply with that Section's requirements.

B. Flashing and Trim: Comply with performance requirements and SMACNA's "Architectural Sheet Metal Manual."

1. Provide concealed fasteners where possible, and install units true to line, levels, and slopes.
2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.
3. Install flashing and trim as required to seal against weather and to provide finished appearance, including, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers.
4. Install continuous strip of self-adhering underlayment at edge of continuous flashing overlapping self-adhering underlayment, where "continuous seal strip" is indicated in SMACNA's "Architectural Sheet Metal Manual" and on Drawings.
5. Install exposed flashing and trim without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
6. Install sheet metal flashing and trim to fit substrates, and to result in waterproof and weather-resistant performance.
7. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.
    a. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, and filled with butyl sealant concealed within joints.
    b. Use lapped expansion joints only where indicated on Drawings.

C. Pipe Flashing: Form flashing around pipe penetration and sheet metal roofing. Fasten and seal to sheet metal roofing as recommended in SMACNA's "Architectural Sheet Metal Manual."

D. Skylight Curb: Install flashing around panned panel tops where curb meet sheet metal roofing.

## 3.7 CLEANING

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. On completion of sheet metal roofing installation, clean finished surfaces as recommended by sheet metal roofing manufacturer.

C. Clean and neutralize flux materials with sodium bicarbonate and water. Agitate without scratching panel finish. Clean off excess solder.

D. Clean off excess sealants.

3.8 PROTECTION

A. Remove temporary protective coverings and strippable films as sheet metal roofing is installed unless otherwise indicated in manufacturer's written installation instructions.

B. Prohibit traffic of any kind on installed sheet metal roofing.

C. Maintain sheet metal roofing in clean condition during construction.

D. Replace sheet metal roofing components that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Architect.

E. Protect gutter from construction traffic

END OF SECTION 076100

**SECTION 076200**

**SHEET METAL FLASHING AND TRIM**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Reglet counterflashing.
2. Formed roof-drainage sheet metal fabrications.
3. Formed low-slope roof sheet metal fabrications.
4. Formed steep-slope roof sheet metal fabrications.
5. Gutters, Scupper and Downspouts

1.2 RELATED SECTIONS

1. Section 07311 “Asphalt Shingles”
2. Section 07610 “Sheet Metal Roofing”
3. Section 09240 “Cement Plastering”

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each of the following

1. Underlayment materials.
2. Elastomeric sealant.
3. Butyl sealant.
4. Solder.

B. Shop Drawings: For sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
8. Include details of roof-penetration flashing.

9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, flashings, and counterflashings.
10. Include details of special conditions.
11. Include details of connections to adjoining work.

C. Samples: For each exposed product and for each color and texture specified, long by actual width. Provide color options for preliminary color selection and a final selection based on review of physical samples.
1. Half Round Gutter 12 inches long by 8” wide
2. Copper sheet: 2 of each gauge, 2” x 4”
   a. Copper: 32 oz., 28 oz., 24 oz., 20 oz.
   b. ZT coated copper: 16 oz., and 20 oz.
3. Powder-coated steel downspout and gutter

## 1.5 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Gutter Bracket

## 1.6 CLOSEOUT SUBMITTALS

A. Special warranty.

## 1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

## 1.8 WARRANTY

# PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, are to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim are not to rattle, leak, or loosen, and are to remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual: Architectural Metal Flashing, and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. Sheet Metal Standard for Copper: Comply with CDA's "Copper in Architecture Handbook." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

2.2 SHEET METALS

A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Copper Sheet: ASTM B370, cold-rolled copper sheet, H00 or H01 temper.

1. Revere
2. Nonpatinated, Exposed Finish: Mill.

C. Powder-coated Steel upper section of downspout: Standard construction shall be12 gauge 0.1094” thick Stainless Steel, ASTM A 240/A 240M, Type 304. as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.

1. Manufacturers: Piedmont Downspout Adapters by Piedmont Pipe Construction, Inc. (1.877.489.0911) 7907 Commerce Drive, Denver, North Carolina, 28037 www.piedmontpipe.com

2. Color: Powder Coat: A 2-5 mil UV resistant polyurethane finish coating shall be electrostatic applied to the chemically prepared metal surfaces at a temperature not below 250 degrees.
   a. Color Options: One of 15 standard powder coat colors to be selected by Architect.

D. ZT Copper Sheet (ASTM B370). Cold-rolled: 20 oz per sf ZT copper sheet. Mill finish.

2.3 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet Underlayment: Minimum 30 mils (0.76 mm) thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer in accordance with underlayment manufacturer's written instructions.

1. Approved Maufacturers:
   a. WR Grace
   b. GAF

B. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F (29 deg C) or lower.

C. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. minimum.

2.4 MISCELLANEOUS MATERIALS

A. Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.

    a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
    b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.

2. Fasteners for Copper Sheet: Copper, hardware bronze or passivated Series 300 stainless steel.
3. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
4. Fasteners for Stainless Steel Sheet: Series 300 stainless steel.

C. Solder:

1. For Copper: ASTM B32, Grade Sn50, 50 percent tin and 50 percent lead.

D. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

E. Elastomeric Sealant: ASTM C920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

F. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

G. Bituminous Coating: Cold-applied asphalt emulsion in accordance with ASTM D1187/D1187M.

H. Asphalt Roofing Cement: ASTM D4586, asbestos free, of consistency required for application.

I. Reglet Counter Flashing: Shop formed from specified materials, gauge and finish.
1. Material: Copper, 20 oz./sq. ft. Aluminum, 0.040 inch thick.

## 2.5 FABRICATION, GENERAL

A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.

1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
2. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
4. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances:

1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
2. Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified.

C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.

E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

F. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard and by FM Global Property Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.

G. Seams:

1. Fabricate nonmoving copper seams with flat-lapped seams. Tin edges to be seamed, form seams, and solder.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.

## 2.6 ROOF-DRAINAGE SHEET METAL FABRICATIONS

A. Hanging Gutters:
1. Furnish custom gutter brackets.

2. Fabricate 8” half-round, powder-coated steel to cross section required, complete with end pieces, outlet tubes, and other accessories as required.
3. Fabricate in maximum manageable lengths.
4. Fabricate expansion joints, expansion-joint covers and gutter accessories from same metal as gutters.
5. Shop fabricate interior and exterior corners.
6. Fabricate from the following materials:
    a. Steel shall be 12 gauge 0.1094” thick Stainless Steel, ASTM A 240/A 240M, Type 304 Powder-coated finish. Touch up paint to match custom finish.
    b. ZT Copper Sheet. Cold-rolled: 20 oz per sf ZT Copper Sheet. Mill finish. See Section 07610 “Sheet Metal Roofing”

B. Built-in Gutters:

1. Fabricate to cross section required, with riveted and soldered joints, complete with end pieces, outlet tubes, and other special accessories as required.

2. Fabricate in minimum 24-inch-long sections. Fabricate expansion joints and accessories from same metal as gutters unless otherwise indicated.
3. Fabricate gutters with built-in expansion joints.
4. Fabricate from the following materials:

   a. Copper: 24 oz./sq. ft. .

   b. Mill finish.

C. Scuppers: Fabricate and field form spill-out scupper at low point of replaceable built-in gutter. Cut and shape copper sheet of same gauge as built-in gutter.
   a. Copper: 24 **oz./sq. ft. .**
   b. Mill finish.

D. Half-round Gutter: Fabricate open-face at skirt, and rectangular downspouts to dimensions indicated as approved on Shop Drawings, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors. Shop fabricate elbows.

1. Hanger Style: Custom Bracket.
2. Fabricate from the following materials:
   a. 3/16” x 1-1/2” powder-coated steel bar, to match gutters.

E. Downspouts: Fabricate rectangular 3” x 4” shop-formed downspouts, where shown on elevation drawings complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors. Shop fabricate elbows.

1. Hanger Style: Custom Bracket., painted to match downspout.
2. Fabricate from the following materials:
   a. 1/8” x 2” Powder-coated steel bar

F. Splash Pan below open-face downspout at valley: Fabricate to dimensions and shape required and from the following materials:

1. ZT Copper: 20 oz./sq. ft.

## 2.7 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Built-in Metal Flashings at Drum: Shop fabricate interior and exterior corners**.** Fabricate from the following materials:

1. Copper Fabric Flashing: 5-oz./sq. ft.

B. Step Flashing: Fabricate from the following materials:
1. ZT Copper: 20 oz./sq. ft.

C. Roof-Penetration Flashing: Fabricate from the following materials:

1. ZT Copper: 20 oz./sq. ft.

2.8 STEEP-SLOPE ROOF SHEET METAL FABRICATIONS

A. Apron, Step, Cricket, and Backer Flashing: Fabricate from the following materials:
   1. ZT Copper: 20 oz./sq. ft.

B. Reglet Counterflashing: Fabricate from the following materials:

   1. ZT Copper: 20 oz./sq. ft.

C. Valley Flashing: Fabricate from the following materials:

   1. ZT Copper: 28 oz./sq. ft.

D. Step Flashings: Fabricate from the following materials:

   1. ZT Copper: 20 oz./sq. ft.

PART 3 - EXECUTION

3.1 INSTALLATION OF UNDERLAYMENT

A. Self-Adhering, High-Temperature Sheet Underlayment:

   1. Install self-adhering, high-temperature sheet underlayment; wrinkle free.
   2. Prime substrate if recommended by underlayment manufacturer.
   3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.
   4. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses.
   5. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller.
   6. Roll laps and edges with roller.
   7. Cover underlayment within 14 days.

B. Install slip sheet, wrinkle free, **over underlayment** before installing sheet metal flashing and trim.

   1. Install in shingle fashion to shed water.
   2. Lapp joints not less than 4 inches.

3.2 INSTALLATION, GENERAL

A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.

   1. Install fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
   2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder and sealant.
   3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.

4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
5. Install continuous cleats with fasteners spaced not more than 12 inches o.c.
6. Space individual cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
7. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
8. Do not field cut sheet metal flashing and trim by torch.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.
1. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws but into substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as required for watertight construction.

1. Use sealant-filled joints unless otherwise indicated.

a. Embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant.
b. Form joints to completely conceal sealant.
c. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way.
d. Adjust setting proportionately for installation at higher ambient temperatures.

1) Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).

2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter.

1. Pretin edges of sheets with solder to width of 1-1/2 inches; however, reduce pretinning where pretinned surface would show in completed Work.
2. Do not solder aluminum sheet.
3. Do not pretin zinc-tin alloy-coated copper.
4. Do not use torches for soldering.
5. Heat surfaces to receive solder, and flow solder into joint.

a. Fill joint completely.
b. Completely remove flux and spatter from exposed surfaces.

6. Copper Soldering: Tin edges of uncoated sheets, using solder for copper.

H. Rivets: Rivet joints in aluminum where necessary for strength.

## 3.3 INSTALLATION OF ROOF-DRAINAGE SYSTEM

A. Install sheet metal roof-drainage items to produce complete roof-drainage system in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.

B. Hanging Gutters:

1. Join sections with rivets and sealed with sealant.
2. Provide for thermal expansion.
3. Attach gutters at eave or fascia to firmly anchor them in position.
4. Provide end closures and seal watertight with sealant.
5. Slope to downspouts.
6. Install gutter with expansion joints at locations indicated on Drawings, but not exceeding, 50 feet apart. Install expansion-joint caps.

C. Built-in Gutters:

1. Join sections with rivets and soldered joints.
2. Provide for thermal expansion.
3. Slope to downspouts.
4. Provide end closures and seal watertight with sealant.
5. Install underlayment layer in built-in gutter trough and extend to drip edge at eaves and under underlayment on roof sheathing.

    a. Lap sides minimum of 2 inches over underlying course.
    b. Lap ends minimum of 4 inches.
    c. Stagger end laps between succeeding courses at least 72 inches.
    d. Fasten with roofing nails.
    e. Install slip sheet over underlayment.

D. Scuppers:

1. Extend open outlet scupper through perimeter blocking and 6-inches into open (ZT) gutter at skirt.
2. Cut and form “picture frame” and fold onto shingled skirt 4” to provide a watertight scupper and gutter system.
3. Secure formed parts and/or tack solder in place.
4. Solder all seams to provide a finished watertight scupper and gutter system.
5. Fabricate “picture frame” flashing extending minimum 4” onto shingles at sides and 6” onto shingles secured with blind (concealed) cleats.

E. Downspouts:

1. Join sections with 1-1/2-inch telescoping joints.
2. Provide hangers with fasteners of matching gauge designed to hold downspouts securely to walls.
3. Locate hangers at top and bottom and at approximately 60 inches o.c.
4. Connect aluminum upper downspouts to extended height cast iron boot connected to underground fitting to the drainage system.
5. Provide mortar wash at powder-coated steel/cast iron and cast iron to cast iron joints.

F. Splash Pans:

1. Install where open downspout discharges into valley.
2. Secure with strap anchors to masonry wall.

## 3.4 INSTALLATION OF ROOF FLASHINGS

A. Pipe Flashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches over base flashing. Install stainless steel draw band and tighten.

B. Counterflashing: Coordinate installation of counterflashing with installation of base flashing.
1. A. Insert counterflashing into reglets at rising exterior wall and window sill conditions and fit tightly to base flashing.

   B install Counterflashing at base and step flashing at dome drum
2. Extend counterflashing 4 inches over base flashing.
3. Lap counterflashing joints minimum of 4 inches.
4. Secure reglet counterflashings using lead wedges 8” o.c. Provide approved sealant at reglet.

C. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Turn flashing down into pipe opening 1 ½”.

## 3.5 INSTALLATION OF WALL FLASHINGS

A. Install sheet metal wall flashing to intercept and exclude penetrating moisture in accordance with cited sheet metal standard unless otherwise indicated.

## 3.6 INSTALLATION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-) offset of adjoining faces and of alignment of matching profiles.

## 3.7 CLEANING

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials with sodium bicarbonate and water. Clean off excess solder.

C. Clean off excess sealants.

## 3.8 PROTECTION

A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Architect.

END OF SECTION 076200

**SECTION 077100**

**ROOF SPECIALTIES**

1.1 SUMMARY

A. Section Includes:
1. Roof-edge drainage systems.

1.2 ACTION SUBMITTALS

A. Product Data: For the cast iron downspout and cast iron boot.

B. Shop Drawings: For roof specialties.

1. Include plans, elevations, joint locations. Distinguish between factory and field-assembled work.

C. Samples: For each type of roof specialty and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing specialties to include in maintenance manuals.

1.5 WARRANTY

1. Finish Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 Basis of Design:

A. Rain Water Conductor
1. Cast Iron Boot
Basis of Design: Neenah Foundry R-4929-011, Offset, no clean-out trap
Material: Cast Gray Iron ASTM A-48, Class 35B
Finish: Factory Finish. Painted to match exterior.
Weight: 95#
Quantity: One section of downspout boot at each location

2. Cast Iron Downspout Extension

Basis of Design: Neenah Foundry R-4929-EXT
Material: Cast Gray Iron ASTM A-48, Class 35B
Finish: Factory Finish. Painted to match exterior.
Weight: 76#
Quantity: Two sleeved sections of downspout extensions at each location, to reach 10’-0” above finished grade.

3. Upper downspout and 8” dia hanging gutter see Section 076200 “Sheet Metal Flashing and Trim”

B. Shop Drawings: For roof specialties noting connections between rain water conductors and connection to roof-edge drainage system.

## 2.2 ROOF-EDGE DRAINAGE SYSTEMS

A. Gutters: See Section 07620 “Sheet Metal Flashing and Trim”

B. Downspouts: Size to match existing downspouts.

## 2.3 MISCELLANEOUS MATERIALS

A. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:

1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
2. Fasteners for Aluminum: Aluminum or Series 300 stainless steel.

# PART 3 - EXECUTION

## 3.1 INSTALLATION, GENERAL

A. Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, underlayments, sealants, and other miscellaneous items as required to complete roof-specialty systems.

1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
2. Provide uniform, neat seams with minimum exposure of solder and sealant.
3. Install roof specialties to fit substrates and to result in weathertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
4. Torch cutting of roof specialties is not permitted.
5. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of [uncoated aluminum] [and] [stainless steel] roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.

C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.

1. Space movement joints as indicated by manufacturer.
2. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.

D. Fastener Sizes: Use fasteners of sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.

E. Seal concealed joints with butyl sealant as required by roofing-specialty manufacturer.

F. Seal joints as required for weathertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F.

G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches (38 mm); however, reduce pre-tinning where pre-tinned surface would show in completed Work. Tin edges of uncoated copper sheets using solder for copper. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

## 3.2 INSTALLATION OF ROOF-EDGE DRAINAGE SYSTEMS

A. Install components to produce a complete roof-edge drainage system according to manufacturer's written instructions.

B. Downspouts: Join sections with manufacturer's standard telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls and 1 inch away from walls; locate fasteners at top and bottom per manufacturer design.
1. Connect downspouts to underground drainage system indicated.

## 3.3 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as roof specialties are installed.

END OF SECTION 077100

**SECTION 079200**
**JOINT SEALANTS**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nonstaining silicone joint sealants.
2. Latex joint sealants.
3. Joint sealant backing materials including cylindrical sealant backing and secondary seals.

1.2 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product.

B. Joint-Sealant Schedule: Including application and location, manufacturer and product name, formulation, color.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Sample warranties.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

1.5 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

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

B. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

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

1.6 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (5 deg C).
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.
5. Where joint sealants are not compatible with specified and installed metal surfaces.

PART 2 - PRODUCTS

2.1 NONSTAINING SILICONE JOINT SEALANTS

A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C 1248.

B. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.

1. Product: Dowsil 790 series or Equivalent. Subject to compliance with requirements:

a. Pecora Corporation.
b. Tremco Incorporated.

2.2 LATEX JOINT SEALANTS

A. Butyl-Rubber-Based Joint Sealant: ASTM C 1311.

1. Products: Subject to compliance with requirements, provide one of the following:
a. Bostik, Inc.; Chem-Calk 300.
b. Pecora Corporation; BC-158.
c. Tremco Incorporated; Tremco Butyl Sealant.

2.3 JOINT SEALANT BACKING

A. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), Type O (open-cell material), Type B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. EMSEAL.
b. BASF Corporation-Construction Systems.
c. Construction Foam Products; a Division of Nomaco, Inc.

## 2.4 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

# PART 3 - EXECUTION

## 3.1 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove laitance and form-release agents from concrete.
2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces.

## 3.2 INSTALLATION OF JOINT SEALANTS

A. General: Comply with ASTM C 1193 and joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated. Use tooling

agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.

1. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.

## 3.3 FIELD QUALITY CONTROL

A. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

## 3.4 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

   a. Flashing in masonry.
   b. Fasteners through masonry, locations as noted on Drawings.
   c. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, nonstaining, nonsag, Class 50. Dowsil 790 Series
3. Joint-Sealant Color: As selected by Architect from manufacturer's standard range.

B. Joint-Sealant Application: Concealed mastics.

1. Joint Locations:
   a. Concealed joints in roof specialties.
   b. Other joints as indicated on Drawings.

2. Joint Sealant: Butyl-rubber based.
3. Joint-Sealant Color: As selected by Architect from manufacturer's standard range.

END OF SECTION 079200

**SECTION 084513**

**Structured Polycarbonate Panel Assemblies**

PART 1 - GENERAL

1.20 SUMMARY

A Section includes requirements for translucent skylight system as specified

1. Trained and factory authorized labor and supervision to complete the entire panel installation.

2. Requirements for a translucent octagonal skylight system as specified herein.

3. Unit Polycarbonate Panel Skylight Assembly.

4. All anchors, brackets, and hardware attachments necessary to complete the specified structural assembly, weatherability, and water-tightness performance requirements.

5. All flashing up to but not penetrating adjoining work are also required as part of the system and shall be included. Tubular daylighting devices.

1.21 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. 06100 Rough Carpentry

B. 07610 Sheet Metal Roofing

C. 07620 Flashing and Sheet Metal

1.22 QUALITY ASSURANCE

A. The glazing panels must be International Council Evaluation Service Inc (ICC-ES)

B. Materials and products shall be manufactured by a company manufacturing polycarbonate skylights for a period of at least ten (10) years.

C. Erection shall be by a factory-approved certified installer who has been in the business of erecting similar material for at least five (5) consecutive years

1.23 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.24 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Manufacturer’s product literature including OSHA compliance.

B. Shop Drawings:

   1. Include plans, elevations, sections, mounting, and attachment details and methods of structural support.

   2. Substrate Preparation: verify standing seam roofing and cap flashing are installed and all seams are soldered.

   3. Verify self-adhering underlayment is in place separating the dissimilar materials.

C. Submittal: For glazing assemblies indicated to comply with performance requirements and design criteria.

D. Samples: For each exposed product and for each color and finish specified.
   Test reports required are:

   1. Insulation U-Value for Center of Glazing (NFRC 100).
   2. Insulation U-Value for System(NFRC 100 and 700 Certification).
   3. Concentrated Loading: No damage w a load of 600 lbf (813.5 Nm) over 1 sq. Ft.
   4. ICC Evaluation Service Report (ICC-ESR)  IBC Building Code.
   5.

1.25 SHOP DRAWINGS:
   1. Submit Shop drawings and color samples

1.26 CLOSEOUT SUBMITTALS

A. Maintenance data.

B. Include analysis data signed and sealed by a professional engineer licensed in the state of the project’s location

1.27 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of products that fail in materials or workmanship within specified warranty period. Provide a single source curtain wall system manufacturer warranty against defective materials and fabrication. Submit manufacturer’s written warranty agreeing to repair failures in materials within one (1) year.
   1. Provide a lifetime warranty for both interior and exterior glazing covering:
   2. Provide a ten (10) warranty on the interior glazing covering:
   3. Provide a ten (10) year warranty on the exterior glazing covering:

PART 2 - PRODUCTS

.1 MANUFACTURER

A Basis of design

1. The design and performance criteria of this job are based on the QuadSpan™ Polycarbonate Skylights + Roof Assemblies as manufactured by Kingspan Light + Air | Architectural Daylighting
2. The design and performance criteria of this job are based on the QuadSpan™ Polycarbonate Skylights + Roof Assemblies as manufactured by Kingspan Light + Air | Architectural Daylighting
3. Locally Represented by Dave Coffey CBG Assoc. dcoffeycbg@comcast.net

B. Approved Manufacturers

1. Other manufacturers may bid this project per the specification.
2. Listing manufacturers names in this specification does not constitute approval

2.2 TRANSLUCENT SKYLIGHT PERFORMANCE AND APPEARANCE

A Thermal and Solar Performance

1. To ensure Energy Code compliance, product U-Values must be listed in the NFRC Product Directory and have a Certified Product Directory (CPD) number.
   a. Basis of Design CPD Number. 2.75 In System: Reference NFRC website code KLA-M-2
2. Solar Heat Gain Coefficient (SHGC) _____ per NFRC Calorimeter. Maximum .19
3. Basis of Design CPD Number. 2.75 In System: NFRC website code KLA-M-

B. Haze measurement minimum of 90% per ASTM D-1003.

1. Standard exterior glazing color White Matte
2. Standard interior glazing color: White Matte
3. Translucent Glazing Joint System

C. Translucent Glazing Joint System

1. Water penetration: no water penetration of the glazing joint connection length at test pressure of 6.24 PSF OPTIONAL: 15 PSF per ASTM E-331.
2. Air Infiltration: pass requirements at 1.57 PSF and 6.24 PSF per ASTM E-283.
3. Free movement of the glazing shall be allowed to occur without damage to the weather tightness of the completed system.
4. The glazing joint shall comply with the deflection limitation of IBC Table 1604.3 for exterior walls with flexible finishes – L/120 per ASTM E-330.

D Flammability

1. Exterior Glazing
2. Class CC1 fire rating classification per ASTM D-635. Square foot and separation limitations provided in IBC Table 2607.4, any light transmitting plastic of a CC2 fire classification rating is specifically dis-allowed.
3. Class A interior flame spread per ASTM E-84
4. Self-ignition temperature of 970F ° per ASTM 1929.

2. Interior Glazing

a Class CC1 fire rating classification per ASTM D-635. Square foot and separation limitations provided in IBC Table 2607.4, any light transmitting plastic of a CC2 fire classification rating is specifically dis-allowed.Class A interior flame spread per ASTM E-84

b Self-ignition temperature of 970F ° per ASTM 1929.

3 Roof Construction Fire Classification:

a. System shall be tested and approved as a Class C Roof Assembly: Class B, Class A as defined in IBC Chapter 15 and tested per ASTM E 108 or UL 790.

3 PART 3EXECUTION

3.1 EXAMINATION

A Installer shall examine area of installation to verify readiness of site conditions. Notify the general contractor about any defects requiring correction. Do not work until conditions are satisfactory.

3.2 INSTALLATION

A Install components in strict accordance with manufacturer's instructions on approved shop drawings. Use proper fasteners, caulking and hardware for material attachments as specified.

3.3 CLEANING

A Follow manufacturer's instructions when washing down exposed panel surfaces using a solution of mild detergent in warm water that is applied with soft, cleaning wiping cloths. Always test a small area before applying to an entire area.

3.4 FIELD QUALITY CONTROL

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

B After completion of installation and nominal curing of sealant and glazing compounds, but before installation of interior finishes, test for water leaks in accordance with AAMA 501.2.

C Perform test for total area of each installed product.

D Work will be considered defective if it does not pass tests and inspections.

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

F Prepare test and inspection reports.

END OF SECTION 084513

**SECTION 090320**

**HISTORIC TREATMENT OF PLASTER**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Removal and replacement of historic interior gypsum plaster at dome interior.

B. Related Requirements:

1. Section 013500 “Special Project Procedures” for general historic treatment requirements.
2. Section 099123 "Interior Painting" for paint removal, surface preparation for refinishing, and refinishing of historic plaster surfaces.

1.2 ALTERNATES

A. Work of this Section is an Alternate (Add) specified in Section 012300 “Alternates”

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
1. Review methods and procedures related to historic treatment of plaster and fire protection.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic plastering specialist with expertise in matching and performing the types of historic plasterwork repairs required. Experience only in installing and repairing new plasterwork, veneer plaster, or gypsum board is insufficient experience for historic treatment work.

B. Mockups: Prepare mockups of historic treatment processes for each type of plaster repair and reconstruction work to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation.

1. Number and Size: One wall surface of at least or approximately 48 inches (1200 mm) in least dimension to represent surfaces and conditions for application of each type of plaster repair and reconstruction under same conditions as the completed Work. Include at least the following:

a. Repair 3 linear ft. (1 m) of plaster cracks.

## PART 2 - PRODUCTS

### 2.1 GYPSUM PLASTER MATERIALS

A. Gypsum Materials:

1. Lightweight Gypsum Ready-Mixed Plaster: ASTM C 28/C 28M, with mill-mixed perlite aggregate.
2. Gypsum Neat Plaster: ASTM C 28/C 28M for use with job-mixed aggregates.
3. Gypsum Wood-Fibered Plaster: ASTM C 28/C 28M.
4. High-Strength Gypsum Neat Plaster: ASTM C 28/C 28M; with a minimum, average, dry compressive strength of 2800 psi (19 MPa) per ASTM C 472 for a mix of 100 lb (45 kg) of plaster and 2 cu. ft. (0.06 cu. m) of sand.
5. Gypsum Gaging Plaster. ASTM C 28/C 28M.
6. High-Strength Gypsum Gaging Plaster: ASTM C 28/C 28M; with a minimum, average, dry compressive strength of 5000 psi (34 MPa) per ASTM C 472 for a neat mix.
7. Gypsum Ready-Mixed Finish Plaster: ASTM C 28/C 28M; manufacturer's standard, mill-mixed, gaged, interior finish.

### 2.2 BASE-COAT PLASTER MATERIALS

A. Base-Coat Plasters, General: ASTM C 28/C 28M.

B. Gypsum Neat Plaster: For use with job-mixed aggregates.

1. Products: Subject to compliance with requirements, provide one of the following:

a. USG Corporation: Red Top Gypsum Plaster.

### 2.3 FINISH-COAT PLASTER MATERIALS

A. Gypsum Ready-Mixed Finish Plaster: Manufacturer's standard, mill-mixed, gaged, interior finish.

1. Products: Subject to compliance with requirements, provide one of the following:

a. USG Corporation; Red Top Finish Plaster.

B. Aggregates: Two-Component Gypsum Veneer Plaster: ASTM C 587, with separate formulations; one for base-coat application and one for finish-coat application over substrates.

1. Base Coat:

a. USG Corporation; Imperial Veneer Base Coat.

2. Smooth Finish Coat:

a. USG Corporation; Imperial Veneer Finish Plaster.

3. Aggregate for Base-Coat Plasters: ASTM C 35, sand.

C. Bonding Compound: ASTM C 631: OCTOWELD or approved equal.

D. Consolidation Material: ACRYL-60 or approved equal.

E. Reinforcing Mesh: BASF; Senergy fiberglass reinforcing mesh or approved equal.

2.4 LATH

A. Metal Lath:

1. Expanded-Metal Lath: ASTM C 847, cold-rolled carbon-steel sheet, ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized zinc coated.

a. Diamond-Mesh Lath: Self-furring, 2.5 lb/sq. yd. (1.4 kg/sq. m).

2.5 MISCELLANEOUS MATERIALS

A. Water for Mixing and Finishing Plaster: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.

B. Fasteners for Attaching Lath to Substrates:

1. For Gypsum Plaster: ASTM C 841.

C. Wire Ties: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, not less than 0.0475-inch (1.21-mm) diameter, unless otherwise indicated.

PART 3 - EXECUTION

3.1 HISTORIC TREATMENT OF PLASTER, GENERAL

A. General: In treating historic plaster, disturb it as minimally as possible and as follows unless otherwise indicated:

1. Dismantle loose, damaged, or deteriorated plaster, lath, and support systems that cannot be repaired.
2. Cleanly cut out sections of plaster and wall substrate only as required to provide plumbing work.
3. Verify that substrate surface conditions are suitable for repairs.
4. Provide lath, furring, and support systems for plaster included in the work of this Section.
5. Leave repaired plasterwork in proper condition for painting or applying other finishes as indicated.
6. Install temporary protective measures to protect historic surfaces that shall be treated later.

B. Illumination: Perform plastering work with adequate, uniform illumination that does not distort the flatness or curvature of surfaces.

## 3.2 PLASTER REMOVAL AND REPLACEMENT, GENERAL

A. Remove plaster to the limits indicated. Carefully dismantle areas along straight edges that lie over supports, without damaging surrounding plasterwork.

B. Maintain lath and supporting members in an undamaged condition so far as practicable. Dismantle damaged lath and supports that cannot be repaired or re-secured and replace with new work of same type.

C. Do not deviate more than plus or minus 1/8 inch in 10 feet (3 mm in 3 m) from a true plane in finished plaster surfaces, as measured by a 10-foot (3-m) straightedge placed on surface.

D. Clean substrate surfaces to remove grease, waxes, oils, waterborne staining, debris, and other foreign matter and deposits that could impair bond with repair material.

E. Wet masonry bases before plaster application. Keep substrate damp to the touch but without visible water droplets.

F. Wet remaining plaster abutting the replacement plaster before installing new plasterwork.

G. Finish plaster flush with original finish.

H. Provide plaster surfaces that are ready to receive field-applied finishes indicated.

## 3.3 FLAT GYPSUM-PLASTER REMOVAL AND REPLACEMENT

A. General: Dismantle deteriorated plaster to existing sound plaster at locations indicated on Drawings. Use replacement plaster mixes of gypsum, lime, and aggregate; and application according to ASTM C 842 unless otherwise indicated.

B. Bonding Compound: Apply on unit masonry or plaster bases.

C. Gypsum-Plaster Base Coats:
   1. Base Coats over Expanded-Metal Lath: Gypsum neat plaster with job-mixed sand for scratch and brown coats.
   2. Base Coats over Unit Masonry: Gypsum neat plaster with job-mixed sand.

D. Gypsum-Plaster Finish Coats:

   1. Finish-Coat Mix for Smooth-Troweled Finishes: High-strength gypsum gaging plaster.

E. Gypsum-Plaster Finishes: Match finish(es) of adjacent surfaces.

   1. Provide float finish unless otherwise indicated.

## 3.4 REMOVING AND INSTALLING LATH AND ACCESSORIES

A. General: Dismantle existing plaster as necessary to expose metal lath, wire ties, and support system, back to firm substrates and supports. Repair with new materials, well secured to existing lath in good condition and to building structure.

1. Cutting: Cut lath so it can be taken out completely from one support to the next. Cut to avoid cracking surrounding plaster.
2. Cut out existing base-coat plaster beyond the edges of the new lath to permit new plaster to extend onto the old lath. Then step subsequent plaster coats to permit new plaster to extend over the old material.
3. Fasten new lath to support system and to good existing lath. Wire tie at least every 6 inches (150 mm).
4. Install new lath according to ASTM C 841 for gypsum plaster.

B. Metal Lath: Install according to ASTM C 841 for gypsum plaster.

END OF SECTION 090320

**SECTION 092400**

**CEMENT PLASTERING**

PART 1 -

1. Exterior base-coat cement plaster.
2. Exterior cement plaster finish coats.
3. Accessories.

1.2 RELATED SECTIONS

1. Section 040323 “Historic Brick Unit Masonry Repointing”

1.3 ACTION SUBMITTALS

A. Product data.

B. Samples: Provide a range of color samples for preliminary selection. Provide physical samples for final selection by Architect.

PART 2 - PRODUCTS

2.1 BASE-COAT CEMENT PLASTER

A. Base-Coat Mixes for Use over Brick Masonry Units: Single base (scratch) coat for two-coat plasterwork on low-absorption plaster bases as follows:

1. Basis of Design: Sakrete Scratch and Brown Coat

   Portland Cement Mix: For cementitious material, mix 1 part portland cement and 0 to 3/4 part lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.

2.2 CEMENT PLASTER FINISH COATS

A. Ready-Mixed Finish-Coat Plaster: Mill-mixed portland cement, aggregates, coloring agents, and proprietary ingredients.

1. Basis of Design: Sakrete Finish Coat Stucco, to match existing
2. Color: To match existing. Selected by Architect.

2.3 ACCESSORIES

A. General: Comply with ASTM C1063, and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.

2.4 PLASTER MATERIALS

A. Portland Cement: ASTM C150/C150M, [**Type I**]

1. Color for Finish Coats: [**to match existing**]

2.5 MISCELLANEOUS MATERIALS

A. Bonding Compound: ASTM C932.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Prepare smooth, solid substrates for plaster according to ASTM C926.

3.2 APPLICATION OF BASE-COAT CEMENT PLASTER

A. General: Comply with ASTM C926.

3.3 APPLICATION OF CEMENT PLASTER FINISH COATS

A. Plaster Finish Coats: Apply to provide a match to existing stucco finish.

END OF SECTION 092400

**SECTION 099113**

**EXTERIOR PAINTING**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Primers.
2. Finish coatings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product used on Security Fence at Side Entrance Roof.

B. Samples: For each finish and for each color and texture required.

1.3 QUALITY ASSURANCE

A. Mockups: Apply mockup on a 2 LF section of security fence.

1. Final approval of color selections will be based on mockup.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner. Approved mockups may remain in place and become part of completed work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide the product listed in the paint schedules Rustoleum.

2.2 PAINT PRODUCTS, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by topcoat manufacturer for use in paint system and on substrate indicated.

B. Colors: As selected from manufacturer's standard color range, to match existing adjacent substrates in color, sheen, and finish.
   1. Provide manufacturer's standard color selections from which Architect will select one field color (security fence)

2.3 PRIMERS

A. Alkyd Metal Primer: Corrosion-resistant, solvent-based, alkyd primer formulated for use on prepared ferrous metals subject to industrial and light marine environments.

1. Basis of Design: Rustoleum Professional High Performance 7400 DTM Alkyd Enamel Primer

2.4 FINISH COATINGS

A. Quick-Drying Alkyd Enamel, Semigloss: Solvent-based, alkyd or modified-alkyd enamel formulated for quick-drying capabilities and for use on exterior, primed, metal and dimensionally stable wood surfaces.

1. Basis of Design: Rustoleum High Performance 7400 RocAlkyd Enamel
   Gloss Level: Manufacturer's standard semigloss finish

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify suitability of substrates, including surface conditions and compatibility, with finishes and primers.

B. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems specified in this Section.

3.3 INSTALLATION

A. Apply paints in accordance with manufacturer's written instructions.

B. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 CLEANING AND PROTECTION

A. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

B. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

C. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 EXTERIOR PAINTING SCHEDULE

A. Iron Substrates at Security Fence:

1. Alkyd System:

a. Prime Coat: Rustoleum Professional High Performance 7400 DTM Alkyd Enamel Primer
b. Intermediate Coat: Rustoleum High Performance 7400 RocAlkyd Enamel
c. Topcoat: Rustoleum High Performance 7400 RocAlkyd Enamel

END OF SECTION 099113

**SECTION 099123**

**INTERIOR PAINTING**

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes surface preparation and the application of paint systems on the following interior substrates based on scope of work outlined in Alternate 1:

1. Metals.
2. Wood.
3. Removing existing painted plaster which may contain lead based on its age.
4. Repairing loose plaster substrates.
5. Plain painting of historic surfaces, including gypsum plaster.

B. Related Sections:
1. Section 090320 “Historic Treatment of Plaster.”

1.2 SUBMITTALS

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

B. Samples: For each finish and for each color and texture required.

C. Interior Environment Submittals:

1. Product Data: For paints and coatings, indicating VOC content.
2. Laboratory Test Reports: For paints and coatings, indicating compliance with requirements for low-emitting materials.

1.3 QUALITY ASSURANCE

A. Mockups: Apply mockup on (1) one plaster repair section to verify color and finish selected to match existing adjacent finishes and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner. Approved mockups may remain in place and become part of the Work.

B. Lead Based Paint: The areas to be prepared for repainting may contain paint from the early twentieth century. Based on coatings of similar age, there will be lead in the existing paint when encountered:

1. Take all necessary actions and precautions to assure safety of the public, property and the environment, and workers in scraping, sanding, removing and disposing of any existing paint;
2. Comply with applicable health, safety and environmental regulations of the government agencies having jurisdiction.
3. Retain one or both subparagraphs below if additional requirements are necessary; include information about conference.
4. Review methods and procedures related to historic treatment of painting.
5. Review of the contractor's compliance with the OSHA lead regulations, including:

    a. Provide evidence of compliance with OSHA *Lead Standard – Construction Industry* (CFR 1926.62) and *Respiratory Protection Standard* (CFR 1910.134) and Contractor's Respiratory Protection Program, including records of training.
    b. A copy of the Contractor's Lead Exposure Assessment Protocol.
    c. A description of each activity in which lead is emitted including the equipment used, materials involved, control procedures, crew size, job responsibilities, operating procedures and maintenance protocols.
    d. A description of the specific means employed to achieve compliance, including engineering, administrative, and work practice controls.
    e. A copy of the Contractor's Personal Protective Equipment selection criteria.
    f. Records of lead hazard training as required by the *Lead Standard*.

C. Historic Treatment Specialist Qualifications: A qualified historic painting specialist with expertise in matching and touching up existing painting. Experience only in new painting work is insufficient experience for historic treatment work.

## 1.4 PREPARATORY CLEANING MATERIALS

A. Water: Potable.

B. Hot Water: Water heated to a temperature of 140 to 160 deg F (60 to 71 deg C).

C. Detergent Solution: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent that contains no ammonia, 5 quarts (5 L) of 5 percent sodium hypochlorite bleach, and 15 quarts (15 L) of warm water for every 5 gal. (20 L) of solution required.

D. Mildewcide: Commercial proprietary mildewcide or a job-mixed solution prepared by mixing 1/3 cup (80 mL) of household detergent that contains no ammonia, 1 quart (1 L) of 5 percent sodium hypochlorite bleach, and 3 quarts (3 L) of warm water.

E. Rust Remover: Manufacturer's standard phosphoric acid-based gel formulation, also called "naval jelly," for removing corrosion from iron and steel.

## 1.5 PAINT REMOVERS

A. Alkaline Paste Paint Remover: Manufacturer's standard alkaline paste or gel formulation for removing paint from masonry, stone, wood, plaster, or metal as required to suit Project; and containing no methylene chloride.

B. Low-Odor, Solvent-Type Paste Paint Remover: Manufacturer's standard low-odor, water-rinsable, solvent-type paste, gel, or foamed emulsion formulation for removing paint from

masonry, stone, wood, plaster, or metal as required to suit Project; and containing no methanol or methylene chloride.

## PART 2 - PRODUCTS

### 2.1 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. Transition Coat: Paint manufacturer's recommended coating for use where a residual existing coating is incompatible with the paint system.

C. VOC Content: For field applications that are inside the weatherproofing system, paints and coatings shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 50 g/L.
3. Primers, Sealers, and Undercoaters: 100 g/L.
4. Rust-Preventive Coatings: 100 g/L.
5. Zinc-Rich Industrial Maintenance Primers: 100 g/L.

D. Low-Emitting Materials: For field applications that are inside the weatherproofing system, 90 percent of paints and coatings shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

E. Colors: As selected from manufacturer’s standard color range, to match existing adjacent substrates in color, sheen, and finish.
1. Provide one field color (interior ceiling at dome).

### 2.2 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide the product listed in the paint schedules The Sherwin-Williams Company; or an approved equal product by one of the following manufacturers:
a. Benjamin Moore & Company

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Plaster: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

E. Alkalinity: Do not begin application of coatings unless surface alkalinity is within range recommended in writing by paint manufacturer. Conduct alkali testing with litmus paper on exposed plaster, cementitious, and masonry surfaces.

3.2 PREPARATION AND APPLICATION

A. Comply with manufacturer's written instructions and recommendations.

B. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.

C. Prepare surfaces to be painted according to the Surface-Preparation Schedule and with manufacturer's written instructions for each substrate condition.

D. Apply a transition coat over incompatible existing coatings.

E. Blending Plain Painted Surfaces: When painting new substrates patched into existing surfaces or touching up missing or damaged finishes, apply coating system specified for the specific substrate. Apply final finish coat over entire surface from edge to edge and corner to corner.

F. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

G. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

## 3.3 HISTORIC TREATMENT OF PAINTING, GENERAL

A. Execution of the Work: In treating historic items, disturb them as minimally as possible and as follows:

1. Remove failed coatings and corrosion and repaint.
2. Verify that substrate surface conditions are suitable for painting.
3. Allow other trades to repair items in place and retain as much original material as possible before repainting.
4. Install temporary protective measures to protect historic painted surfaces that shall be treated later.

B. Mechanical Abrasion: Where mechanical abrasion is needed for the work, use only the gentlest mechanical methods, such as scraping and lightly hand sanding, that will not abrade softer substrates, reducing clarity of detail. Do not use abrasive methods such as rotary sanding, rotary wire brushing, or power tools except as indicated as part of the historic treatment program and as approved by Architect.

C. Heat Processes: Do not use torches, heat guns, or heat plates.

## 3.4 PREPARATORY CLEANING

A. General: Use only the gentlest, appropriate method necessary to clean surfaces in preparation for painting. Clean all surfaces, corners, contours, and interstices.

B. Detergent Cleaning: Wash surfaces by hand using clean rags, sponges, and bristle brushes. Scrub surface with detergent solution and bristle brush until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet. Rinse with water applied by clean rags or sponges.

C. Solvent Cleaning: Use solvent cleaning to remove oil, grease, smoke, tar, and asphalt from painted or unpainted surfaces before other preparation work. Wipe surfaces with solvent using clean rags and sponges. If necessary, spot-solvent cleaning may be employed just prior to commencement of paint application, provided enough time is allowed for complete evaporation. Use clean solvent and clean rags for the final wash to ensure that all foreign materials have been removed. Do not use solvents, including primer thinner and turpentine, that leave residue.

D. Mildew: Clean off existing mildew, algae, moss, plant material, loose paint, grease, dirt, and other debris by scrubbing with bristle brush or sponge and detergent solution. Scrub mildewed areas with mildewcide. Rinse with water applied by clean rags or sponges.

E. Chemical Rust Removal:

1. Remove loose rust scale with approved abrasives for ferrous-metal cleaning.
2. Apply rust remover with brushes or as recommended in writing by manufacturer.
3. Allow rust remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing. Do not allow extended dwell time.
4. Wipe off residue with mineral spirits and either steel wool or soft rags, or clean with method recommended in writing by manufacturer to remove residue.
5. Dry immediately with clean, soft cloths. Follow direction of grain in metal.
6. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.

F. Mechanical Rust Removal:

1. Remove rust with approved abrasives for ferrous-metal cleaning. Clean to bright metal.
2. Wipe off residue with mineral spirits and either steel wool or soft rags.
3. Dry immediately with clean, soft cloths. Follow direction of grain in metal.
4. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.

## 3.5 PAINT REMOVAL

A. General: Remove paint where indicated. Where cleaning methods have been attempted and further removal of the paint is required because of incompatible or unsatisfactory surfaces for repainting, remove paint to extent required by conditions.

1. Brushes: Use brushes that are resistant to chemicals being used.

a. Metal Substrates: If using wire brushes on metal, use brushes of same metal composition as metal being treated.

B. Paint Removal with Hand Tools: Remove paint manually using hand-held scrapers, wire brushes, sandpaper, and metallic wool as appropriate for the substrate material. Do not use other methods except as indicated as part of the historic treatment program and as approved by Architect.

C. Paint Removal with Alkaline Paste Paint Remover:

1. Remove loose and peeling paint using scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply paint remover to dry, painted surface with brushes.
3. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
4. Use mechanical methods recommended in writing by manufacturer to remove chemicals and paint residue.
5. Repeat process if necessary to remove all paint.

D. Paint Removal with Low-Odor, Solvent-Type Paste Paint Remover:

1. Remove loose and peeling paint using scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply thick coating of paint remover to dry, painted surface with natural-fiber cleaning brush, deep-nap roller, or large paintbrush. Apply in one or two coats according to manufacturer's written instructions.
3. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
4. Use mechanical methods recommended in writing by manufacturer to remove chemicals and paint residue.
5. Repeat process if necessary to remove all paint.

## 3.6 SUBSTRATE REPAIR

A. General: Repair substrate surface defects that are inconsistent with the surface appearance of adjacent materials and finishes in accordance with Alternate 1 and in the case that work at exterior dome and oculus minimally effects surfaces at the interior

B. Gypsum-Plaster and Gypsum-Board Substrates:

1. Repair defects including dents and chips in size and all holes and cracks by filling with gypsum-plaster patching compound and sanding smooth. Remove protruding fasteners.
2. Rout out surface cracks to remove loose, unsound material; fill with patching compound and sand smooth.

C. Metal Substrate:

1. Preparation: Treat repair locations by wire-brushing and solvent cleaning. Use chemical or mechanical rust removal method to clean off rust.
2. Defects in Metal Surfaces: Repair non-load-bearing defects in existing metal surfaces, including dents and gouges more than 1/16 inch (6 mm) deep or 1/2 inch (13 mm) across and all holes and cracks by filling with metal patching compound and sanding smooth. Remove burrs and protruding fasteners.
3. Priming: Prime iron and steel surfaces immediately after repair to prevent flash rusting. Stripe paint corners, crevices, bolts, welds, and sharp edges. Apply two coats to surfaces that are inaccessible after completion of the Work.

## 3.7 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

C. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

## 3.8 PAINTING SCHEDULE

A. Gypsum Plaster Substrates, Dome Ceiling: Contractor to verify existing sheen. Color to match adjacent surfaces at dome.

1. Institutional Latex System:

a. Primer: ProMar 200 Primer
b. 1st coat: ProMar 200 Interior Latex, eggshell.
c. 2nd coat: ProMar 200 Interior Latex, eggshell.

END OF SECTION 099123

SECTION 310000

EARTHWORK

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. The work under this Section shall include all labor, material, equipment and all else necessary for cutting, proof rolling, filling and grading to required lines, dimensions, contours and elevations for proposed improvements as hereinafter specified and/or as otherwise required for the proper and timely completion of this Contract. Work under this Section includes, but is not limited to, subgrade preparation, excavating, backfilling, and compaction for structures and foundations, pavements, sidewalks, landscaping areas, and utilities. The contractor shall pay for and coordinate the services of a geotechnical engineer and testing agency to perform quality control of the earthwork.

B. Scarifying, compaction, moisture content conditioning and control, and removal of unsuitable material to ensure proper preparation of areas for the proposed improvements.

C. Undertake any special construction procedures for the project as shown in the drawings and described by these specifications for preparation of pavement areas.

1.2 RELATED DOCUMENTS

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

1.3 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM), latest edition
   1. C 33 Concrete Aggregates
   2. D 698 Laboratory Compaction Characteristics of Soil Using Standard Effort
   3. D 1556 Density and Unit Weight of Soils in Place by the Sand-Cone Method
   4. D 1557 Laboratory Compaction Characteristics of Soil Using Modified Effort
   5. D 2167 Density and Unit Weight of Soil in Place by Rubber Balloon Method
   6. D 2216 Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
   7. D 2487 Classification of Soils for Engineering Purposes (Unified Soil Classification System)
   8. D 2937 Density of Soil in Place by the Drive-Cylinder Method
   9. D 3740 Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
   10. D 4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils
   11. D 4254 Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
   12. D 6938 In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

B. American Association of State Highway and Transportation Officials (AASHTO), latest edition
   1. T 88 Particle Size Analysis of Soils

C. Associated General Contractors of America
   1. Manual of Accident Prevention in Construction

1.4 QUALITY ASSURANCE

A. A geotechnical engineer familiar with the project requirements, selected and paid by the Owner, may be retained to perform construction inspection on site based on density testing, visual observation, and judgement. This inspection will not relieve the Contractor from his responsibility to complete the work in accordance with the drawings and specifications.

B. Visual field confirmation and density testing of subgrade preparation and fill placement procedures shall be performed by the field geotechnical engineer as part of the construction testing requirements. The Contractor shall be informed as soon as possible of the test results.

C. The geotechnical engineer shall prepare field reports that indicate compaction test location, elevation data, testing results and acceptability. The Owner, engineer, and Contractor shall be provided with written copies of the results within 24 hours of time test was performed.

D. All costs related to reinspection due to failures shall be paid for by the Contractor at no additional expense to Owner. The Owner reserves the right to direct any inspection that is deemed necessary. Contractor shall provide free access to site for inspection activities.

1.5 SUBMITTALS

A. Testing Agency Qualifications: Provide a statement of qualifications of the geotechnical engineer and testing agency that will perform the quality control tasks required in Article 3.08.
   1. The geotechnical engineer shall be an experienced inspector working under the direction of the professional engineer licensed to practice in the Commonwealth of Pennsylvania who is experienced in providing engineering services related to earthwork.
   2. The testing agency shall be an independent laboratory having a minimum of three (3) years' experience in conducting the testing indicated herein.
   3. The testing laboratory shall meet the requirements of ASTM D 3740.

B. Material Test Reports: Shall be provided from the testing agency indicating and interpreting test results for compliance on the following:
   1. Classification according to ASTM D 2487 of each on-site or borrow soil material proposed for fill and backfill.
   2. Laboratory compaction curve according to ASTM D 1557 698 for each on-site or borrow soil material proposed for fill and backfill; provide for each material type and for every 5,000 cubic yards of each material.
   3. Material Gradation Tests.
   4. Electrical Resistivity and pH tests for sand used for water pipe bedding and backfill.

C. Within 10 days after award of the contract, the Contractor shall submit to the Owner and engineer a schedule detailing the sequence, and time of completion of all phases of work under this section.

D. At least two weeks in advance of imported fill use, the Contractor shall submit the following laboratory test data to the geotechnical engineer for each type of imported soil/gravel material to be used as compacted fill.
   1. Moisture and Density Relationship: ASTM D1557;
   2. Particle-Size Analysis: ASTM D2487; and,
   3. Plasticity Index: ASTM D 4318.

E. Together with the above test data, the Contractor shall submit a 25-pound sample of each type of off site fill material in an air tight container for the approval of the geotechnical engineer.

F. Submit the name of each material supplier and specific type and source of each material. Any change in source or soil type throughout the job requires approval of the Owner and the engineer.

1.6 DEFINITIONS

A. Backfill: Soil materials used to fill an excavation.

B. Base Course: Layer placed between the subgrade and paving.

C. Bedding Course: Layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow: Approved soil materials imported from off-site for use as fill or backfill.

E. Classification: No consideration will be given to the nature of earthen materials, and all excavation required for this Project will be designated as unclassified.

F. Degree of Compaction: Degree of compaction required is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557 abbreviated hereinafter as percent laboratory maximum density. For granular material, relative density is determined in accordance with ASTM D 4254.

G. Excavation: Removal of material encountered down to subgrade elevations:
   1. Bulk Excavation: Excavation more than 10 feet in width.
   2. Overexcavation: Excavation of existing unsuitable material beyond limits shown on the Drawings for replacement with structural fill as directed by the Owner.
   3. Unauthorized Excavation: Excavation below subgrade elevations or beyond limits shown on the Drawings without direction by the Owner.

H. Hard Material: Weathered rock, dense consolidated deposits, or buried construction debris (i.e., demolished brick walls, concrete, etc.) which are not included in the definition of “rock” but which usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

I. Rock:
   1. General Excavation - Any material that cannot be excavated with a single-toothed ripper drawn by a crawler tractor having a minimum draw bar pull rated at not less than 71,000 lbs. (Caterpillar D9N or equivalent), and occupying an original volume of at least 2 cubic yards or more; and,
   2. Trench Excavation - Any material that cannot be excavated with a backhoe having a break out force rated at not less than 44,000 lbs. (Caterpillar 235D or equivalent), and occupying an original volume of at least 2 cubic yards.

J. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below base or topsoil materials.

K. Subbase: Material shown on the Drawings between the pavement base and subgrade.

L. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.7 REGULATORY COMPLIANCE

A. Codes and Standards: Perform earthwork complying with federal, state, and local regulations including the Occupational Safety and Health Act of 1970 as amended. Excavation and trenching are regulated by OSHA. The Contractor shall perform all excavation and trenching work in accordance with 29 CFR 1926 Subpart P.

B. Conform with Pennsylvania Act 287 and all amendments and other applicable regulations regarding notification of utility companies.

C. Any pumped water shall be discharged from the Site in accordance with federal, state and local codes and regulations. Comply with all Philadelphia Water Department permit requirements.

1.8 PROJECT CONDITIONS

A. Utility Identification: Notify PA One-Call System at 1-800-242-1776 at least 3 days prior to excavation.

B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Owner and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Notify the Owner not less than 72 hours in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without the Owner's written permission.

C. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

D. Existing improvements, adjacent property, and other facilities and trees and plants that are not to be removed shall be protected from injury or damage, which may result from Contractor's operation.

PART 2 - PRODUCTS

2.1 ON-SITE FILL

A. On-site excavated materials may be used as backfill provided they meet the following criteria:
   1. Suitable backfill materials include soil that complies with ASTM D 2487 soil classifications GW, GP, GM, SW, SP, and SM and having a maximum particle size of three (3) inches in any one dimension.
   2. Unsuitable backfill materials include any material having an excess of wood, timber, metal, rebar, organics, debris, or any other deleterious materials.

B. It is not permitted for excavated materials unsuitable for fill in their as-is state to be processed on-site to comply with suitable backfill requirements. Concrete, brick, asphalt debris is not permitted to be broken or crushed on site to meet the above particle size requirement.

C. The Contractor shall use the on-site soil judiciously to facilitate the construction schedule.

D. Prior to placement, on-site material to be used as fill shall not contain:
   1. Debris other than crushed concrete and brick meeting the above requirements.
   2. Timber or railroad ties.
   3. Other deleterious materials such as steel rails, rebar, trash, etc.

4. Hazardous material - Unsuitable and deleterious materials and debris shall be disposed of off-site in accordance with all applicable regulations.

E. Any bituminous concrete on the site shall be milled/removed prior to placing any fill and shall be reused only onsite immediately below the pavement stone base course.

2.2 OFF-SITE IMPORTED FILL

A. If necessary, off-site fill shall be obtained and provided by the Contractor;

B. Fill shall be clean, well graded granular soil which is non-expansive and non-collapsible and shall have less than 20% by weight passing the #200 sieve. The portion passing the #200 shall be non-plastic. Fill with less fines (less than #200) may be required on project specific basis and as required by geotechnical engineer. Likewise, fill with more than 20% fines may be acceptable on a project specific basis or as identified in the geotechnical engineering study;

C. Imported fill shall be free of all hazardous substances. Certification of compliance and, if requested, test results substantiating compliance shall be furnished to the Owner and geotechnical engineer by the Contractor not less than one week prior to its intended use;

D. The Owner reserves the right to test off-site fill material for conformance with these specifications; and,

E. The Contractor shall be responsible for all permits and regulatory requirements associated with off-site borrow sources.

2.3 STONE BACKFILL

A. In accordance with PennDOT Publication 408, Section 703 for AASHTO No. 57 Stone.

2.4 GEOTEXTILES

A. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
1. Survivability: Class 2; AASHTO M 288.
2. Survivability: As follows:
3. Grab Tensile Strength: 247 lbf; ASTM D 4632.
4. Sewn Seam Strength: 222 lbf; ASTM D 4632.
5. Tear Strength: 90 lbf; ASTM D 4533.
6. Puncture Strength: 90 lbf; ASTM D 4833.
7. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
8. Permittivity: 0.02 per second, minimum; ASTM D 4491.
9. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

2.5 EQUIPMENT

A. Compactor for mass earthwork shall be minimum 10-ton static-drum weight vibratory roller or 10-ton static-drum weight sheep foot compactor as appropriate for the type of soil material at the site or other compactor approved by the geotechnical engineer.

B. Compactor for trenches and where access or maneuverability is limited, use a double drum walk- behind roller or vibratory plate compactor or "jumping jack" tampers.

C. Grading equipment including, but not limited to, Bulldozers, Skid-Steer Loaders, Excavators, and Backhoe Loaders shall be wide track or balloon tire machines rated with a ground pressure of 4 psi or less to limited soil compaction.

## PART 3 - EXECUTION

### 3.1 GENERAL

A. Prior to all work of this section, the Contractor shall become thoroughly familiar with the site, site conditions, and all portions of the work falling under this section.

B. The Contractor shall refer to the soil erosion and sediment control drawings for staging of earthwork operations and for erosion control measures to be implemented prior to commencement of earthwork.

C. Locate and identify existing utilities that are to remain and protect them from damage.

D. Notify utility companies to allow removal and/or relocation of any utilities that are in conflict with the proposed improvements.

E. Protect fences, structures, sidewalks, paving, curbs, etc. to remain from equipment and vehicular traffic.

F. Protect benchmarks, property corners and all other survey monuments from damage or displacement. If a marker needs to be removed/relocated it shall be referenced by a licensed land surveyor and replaced, as necessary, by the same at no additional cost to the Owner.

G. Remove from the site, material encountered in grading operations that, in opinion of Owner or geotechnical engineer, is unsuitable or undesirable for backfilling as per Article 2.01.

H. Identify required lines, levels, contours and datum to bring site grades to the proposed subgrade conditions inferred from the drawings.

I. Do not allow or cause any of the work performed or installed to be covered by work of this section prior to all inspections, tests and approvals.

J. Perform excavation using capable, well maintained equipment and methods acceptable to the Owner and regulatory authorities having jurisdiction.

K. When performing grading operations during periods of prolonged wet or dry weather, provide adequate measures for surface drainage and ground water control, and moisture control of soils (i.e., wetting or drying, scarify and discing) so as to place and compact the soil within the moisture content range three (3) percentage points of its optimum water content. Any disturbed areas should be proofrolled at the end of each day.

L. Sloping, shoring, bracing, and fencing shall be installed in accordance with Federal OSHA requirements as well as the requirements of all regulatory authorities having jurisdiction.

M. Allow no debris to accumulate on-site. Haul debris away from the site and dispose of at no cost to the Owner.

3.2 COMPACTION OF SUBGRADE SURFACES

A. In areas to receive fill and at the final cut subgrade, proof roll and compact the exposed ground surface following clearing and grubbing and any required excavation with a minimum of four (4) passes of an approved compactor and obtain at least the following density requirement:

| Location | Percent of Maximum Dry Density per ASTM D698 | Percent of Maximum Dry Density per ASTM D1557 |
|---|---|---|
| Foundation Support, Pavements, and Wall Backfill | 98% | 95% |
| Utility Trenches and Walkways | 95% | 93% |
| Non-structural | 85% | 82% |

B. The proof roll, truck and compactor equipment shall traverse the area at speed that permits the geotechnical engineer to comfortably walk alongside the equipment.

C. Any soft areas exhibiting excessive weaving or unsatisfactory material identified during excavation, fill placement, compaction and proof testing shall be removed, replaced with suitable fill, and compacted as specified above.

3.3 UNDERCUT EXCAVATION

A. When approved by the Owner and recommended by the geotechnical engineer, the Contractor may be required to remove natural soil materials in areas where fills are to be placed when determined to be undesirable in their location or condition. The Contractor shall be required to remove the undesirable material and backfill with approved material properly compacted.

B. At locations where unstable or unsuitable soil is shown on the drawings or identified within the geotechnical engineering study, the removal and replacement of such soil shall be as directed on the drawings or as directed by the geotechnical engineer and the Owner.

C. All material removed in the work of undercut excavation will be classified by the geotechnical engineer and Owner as either suitable for other use without excessive manipulation and utilized by the Contractor elsewhere in the work, or unsuitable for future use and manipulated as per Article 2.01.

D. The Contractor shall conduct undercut operations in such a way that the necessary measurements can be taken before any backfill is placed.

E. Backfill in undercut areas shall be placed as a continuous operation along with the undercutting operation. No backfill material shall be placed in water unless otherwise permitted by the geotechnical engineer.

3.4 EXCAVATION, FILL AND SUBGRADE PREPARATION

A. GENERAL
1. Refer to Sections 024116, Structure Demolition and 024119 Selective Demolition, for demolition information and requirements pertaining to below-grade utilities.
2. The Contractor shall cut or fill to the proposed subgrade elevations based on finished grades and the pavement thicknesses as shown on the drawings. Subgrade elevations shall be constructed to within 0 to minus ½ inch of the proposed grades specified.

B. EXCAVATION

1. Where existing grades are above proposed subgrade elevation, excavate materials to line and grade as shown in the drawings being careful not to over excavate beyond the elevations needed for building subgrades;
2. Excavate organic soils that do not provide adequate foundation support. Excavated on-site organic soils, which are unsuitable for fill may be used in landscaped areas and, if approved by the geotechnical engineer, as fill in parking area at least 5 feet below final elevation. Otherwise this material shall be disposed of as directed by Owner;
3. Excavated on-site soils, which meet the requirements of suitable fill may be used as fill; and,
4. Unsuitable material, such as wood and any other deleterious materials determined to be unsuitable by the geotechnical engineer for use as on-site fill, shall be disposed of as directed by Owner.

C. FOUNDATIONS
1. Building foundations shall bear on undisturbed soil having minimum bearing capacity of 2500 psf. Adjust bottom of footing elevations as required to bear on uniformly dense inorganic subgrade.
2. Concrete for foundations shall be poured on the same day subgrade approval is given by the Special Inspector.
3. All exterior footings shall be placed a minimum of 3'-0" below final grade. Footings shall be placed such that the line drawn between the lower edges of adjoining footings shall not have a slope steeper than 30 deg from the horizontal. Footings shall be stepped at a rate of 2 horizontal feet to one vertical foot.
4. Excavations for any purpose shall not remove lateral support from any footing or foundation without protecting the footing or foundation against settlement or lateral translation.

D. SPECIAL INSPECTIONS
1. Third party special inspections shall be performed for this project as follows, and in accordance with project specifications:

| | |
|---|---|
| Site soil conditions beneath shallow foundations | periodic inspections required |

2. The independent inspections agency shall perform inspections and submit reports to the Engineer of Record (EOR) within 72 hours of inspection. Any inadequacies found by the Inspector shall be reported to the EOR within 24 hours. The Contractor shall facilitate these inspections by scheduling the inspections to coordinate with the work being performed by their sub-contractors.

E. SUBGRADE PREPARATION FOR FILL
1. Existing grades below proposed grades and thus requiring fill shall be leveled prior to fill placement. The Contractor shall remove existing lawn and top soil in these areas prior to placement of any fill; and,
2. All existing grades to receive fill areas shall be proof rolled and compacted per Article 3.02.
3. Loose/Soft and unstable subgrade resulting from excessive moisture may be aerated and dried in-place. Following adequate drying time, the subgrade is to be densified in-place. Subgrade that cannot be aerated, dried, and densified in place shall be removed as described in Article 3.03.

F. FILL PLACEMENT
1. Rock or processed suitable debris pieces larger than six inches (6 inches) across shall not be part of fill;
2. Reduce soil clod size to a maximum of 2 inches before placement. Do not place frozen fill material;

3. No fill material shall be placed in areas of standing water, in areas of frozen or thawing ground, or in areas that have not been approved by the geotechnical engineer;
4. No fill materials shall be placed during unfavorable weather conditions. When work is interrupted by heavy rains, fill operations shall not be resumed until all saturated surficial soils are returned to a satisfactory moisture content as determined by the geotechnical engineer;
5. Fill lift surfaces shall be made smooth and free from ruts or indentations at the end of any work day when precipitation is forecast to prevent saturation of surficial fill material. Fill surfaces shall be graded to drain and sealed with a smooth drum roller at the completion of each work day;
6. The fill shall be placed in uniform loose lifts not exceeding 8-inches thick and compacted with at least 4 coverages of a 10-ton static-drum weight roller;
7. Each lift shall be compacted to the minimum densities listed in Article 3.02 as appropriate for the project and as specified in the geotechnical engineering study;
8. The Contractor shall adjust the water content by aeration or adding water to achieve the required density. Assist drying by discing, harrowing or pulverizing until moisture content is reduced to achieve proper compaction and facilitate the construction schedule;
9. Wet, saturated material shall be air dried as necessary to achieve the field densities specified in this Section. Removal and replacement shall not occur without prior approval or Owner. Removal and replacement shall be used if necessary to facilitate the construction schedule;
10. Remove areas of finished subgrade found to have insufficient compaction density of depth necessary and replace with suitable compacted fill as approved by the Owner or Owners representative. Surface of subgrade after compaction shall be hard, uniform, smooth, stable, and true to grade and cross section; and,
11. Fill placed on slopes greater than 1 vertical to 3 horizontal shall have each lift benched onto the slope at least 3 feet.

## 3.5 PROOFROLLING

A. The work covered by this subsection consists of furnishing and operating, proofrolling equipment at the direction of the Owner's representative and/or geotechnical engineer.

B. Proofrolling shall be under the observation of the Owner's representative and/or the geotechnical engineer as described herein and under the following schedule:
   1. Immediately following the completion of excavation to proposed subgrades in cut areas, proofrolling shall be performed as specified; and,
   2. Immediately prior to and following stone base course placement, in pavement and building pad areas for final floor slab preparation, all subgrade and stone base areas shall be proofrolled. Any areas which deflect, rut or pump under the roller shall be undercut and replaced with compacted fill material or stone base course as directed by the geotechnical engineer and approved by the Owner.

C. Proofrolling shall be done with 1 pass of a fully loaded tandem dump truck equal to or exceeding 50,000 lbs., or other construction equipment if approved by the geotechnical engineer.

D. Construction methods shall be as follows:
   1. After the subgrade or stone base course has been completed within 0.50 foot of final grade, the subgrade or stone base course shall then be compacted and tested prior to commencement of proofrolling. The coverage areas and methods will be identified by the Owner's representative and/or geotechnical engineer. However, the roll shall be operated in a systematic manner so that the number of coverages over all areas to be proofrolled can be readily determined and recorded;

2. The equipment shall be operated at a speed that the geotechnical engineer can comfortably and slowly walk alongside the equipment;
3. If it becomes necessary to take corrective action, such as but not limited to underdrain installation, undercut and backfill of an unsuitable material, and aeration of excessively wet material in areas that have been proofrolled, see Article 3.03. These areas shall be proofrolled again following the completion of the necessary corrections. If the corrections are necessary due to the negligence of the Contractor or weather, the corrective work and additional proofrolling shall be performed by the Contractor at no cost to the Owner; and,
4. The Contractor shall protect all structural facilities on the project, such as but not limited to box culverts, pipe culverts, and utilities, from damage by the proofrolling equipment.

3.6 MAINTENANCE OF SUBGRADE

A. Finished subgrades shall be verified by the Contractor to ensure proper elevation and conditions for construction above subgrade.

B. Protect subgrade from excessive construction traffic and wheel loading including concrete and dump trucks.

C. Remove areas of finished subgrade judged to be unsatisfactory to the depth necessary and replace in a manner that will comply with compaction requirements by use of material equal to or better than the best subgrade material on site. Surface of subgrade after compaction shall be hard, uniform, smooth, stable, and true to grade and cross section.

3.7 FINISH ELEVATIONS AND LINES

A. For setting and establishing finish elevations and lines, secure the services of a licensed land surveyor acceptable to the Owner and engineer.

B. Provide elevation grade stakes and any other surveying necessary for the layout of the work. The Contractor shall conduct his work in such a manner that survey stakes will be protected as long as their need exists. Grade stakes, which are damaged or stolen, shall be replaced by the Contractor's surveyor at the Contractor's expense.

C. Graded areas shall be uniform, hard and smooth, free from rock, debris, or irregular surface changes. Any deviation shall not result in changes in drainage areas or ponding. All ground surfaces shall vary uniformly between indicated elevations. Finish drainage ditches shall be graded to allow for proper drainage without ponding and in a manner that will minimize the potential for erosion.

D. Correct all settlement and eroded areas for one year after date of project completion at no additional expense to Owner. Bring paved and landscaped areas to proper elevation. Replant or replace any grass, shrubs, bushes, or other vegetation disturbed by construction using corrective measures.

3.8 FIELD QUALITY CONTROL

A. The contractor shall coordinate all earthwork with the testing agency and geotechnical engineer to allow for inspection and testing. The geotechnical engineer shall provide full-time observation and testing of the compaction operations and provide documentation to the Owner.

B. Allow geotechnical engineer to inspect and test each subgrade and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.

C. The geotechnical engineer shall test compaction of soils in place according to ASTM D 1556, ASTM D 1557, ASTM D 2167, ASTM D 2922, ASTM D 2937, and ASTM D 4254 as applicable. Tests shall be performed at the following locations and frequencies:
   1. Paved Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2200 sq. ft. or less of paved areas or building slab, but in no case fewer than three tests.
   2. Trench Backfill: At each compacted initial and final backfill layer, at least one test for each 150 feet or less of trench, but no fewer than two tests.
   3. Structural Backfill: At each compacted initial and final backfill layer, at least one test for each 150 feet or less of trench, but no fewer than two tests.

D. When the geotechnical engineer reports that subgrades, fills or backfills have not achieved degree of compaction specified, recompact and retest until specified compaction is obtained.

3.9 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Comply with requirements specified in Section 017419 - Construction Waste Management and Disposal. Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off site to a regulated and permitted facility. Provide two copies of load manifest and permit from owner of the property where material is deposited.

END OF SECTION 310000

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SECTION 311000

SITE CLEARING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. The work under this Section shall include all labor, materials, and equipment necessary for Site Clearing as hereinafter specified and/or as otherwise required for the proper and timely completion of the Contract.

B. This Section includes the following:
   1. Removing surface debris.
   2. Removing designated paving; curbs; and existing features including, but not limited to inlets, pipes, and fencing.
   3. Removing designated trees, shrubs, and other plant life.
   4. Removing abandoned utilities.
   5. Excavating topsoil.

### 1.2 RELATED DOCUMENTS

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

### 1.3 MATERIALS OWNERSHIP

A. Except for materials indicated to be stockpiled or to remain Owner’s property, cleared materials shall become the Contractor’s property and shall be disposed of in accordance with all applicable regulations.

### 1.4 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

B. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner’s premises where indicated.

C. Notify utility locator service for area where Project is located prior to site clearing.

D. Contractor shall verify existing grades prior to performing work under this section. If existing grades are at variance with the drawings, notify the Owner and engineer to receive instructions prior to proceeding. No additional compensation will be considered resulting from grade variances once site clearing has commenced.

E. All benchmarks and monuments shall be protected during construction. If disturbed or destroyed, they shall be replaced in original position by a licensed surveyor at the Contractor’s expense.

F. Protect areas outside limits of disturbance from encroachment by construction personnel or equipment, regardless of property Ownership. Access shall be by specific, written permission or easement only.

## PART 2 - PRODUCTS

### 2.1 EQUIPMENT AND MATERIALS

A. The contractor shall provide and use all necessary equipment and materials to perform the work described herein.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Verify existing plant life designated to remain is tagged or identified.

### 3.2 PREPARATION

A. Call the Pennsylvania One Call System at 1-800-242-1776 not less than three working days before performing work.
   1. Request underground utilities to be located and marked within and surrounding construction areas.

B. Provide erosion control measures in accordance with Section 312500, Soil Erosion and Sediment Control, prior to any construction activity.

C. Limit of clearing is to be staked and verified by Owner or engineer prior to removal of any material.

D. All trees and shrubs not designated to remain within the area to be graded, whether shown or not on the drawings, shall be cut and the stumps shall be completely dug out. Burning on site is not permitted.

### 3.3 PROTECTION

A. The Contractor shall protect existing underground utilities from damage. The accuracy of the utilities shown on the plan as to line and grade is not guaranteed. Any damage caused by the Contractor to any utility shall be the responsibility of the contractor to correct.

B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted. If utilities are interrupted, arrange to provide temporary utility services.
   1. Notify Owner not less than 72 hours in advance of proposed utility interruptions.
   2. Do not proceed with utility interruption without Owner’s written permission.

C. All trees and vegetation to remain shall be barricaded and protected during the construction process in accordance with plans and specifications.

## 3.4 CLEARING AND GRUBBING

A. Clear areas required for access to site and excavation of Work.

B. Remove trees and shrubs indicated. Remove stumps and main root balls.

C. Clear undergrowth and deadwood, without disturbing subsoil.

D. Remove obstructions, objectionable material, rubbish, junk, trees, shrubs, grass, and other vegetation within the limit of disturbance to permit Work. Removal includes digging out stumps and obstructions and grubbing roots, unless otherwise specified.

E. 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 and compact each layer to a density equal to adjacent original ground as in accordance with Section 310000 - Earthwork.

## 3.5 REMOVAL

A. Remove debris, rock, and extracted plant life from site.

B. Partially remove paving and curbs. Neatly saw cut edges at right angles to the surface.

C. Remove abandoned utilities. Indicate removal termination point for underground utilities on Record Documents.

D. Continuously clean-up and remove waste materials from site. Do not allow materials to accumulate on site.

E. Do not burn or bury materials on site. Leave site in a clean condition.

F. Comply with requirements specified in Section 017419 - Construction Waste Management and Disposal. Legally dispose of waste off Owner’s property.

## 3.6 TOPSOIL EXCAVATION

A. Excavate topsoil from entire site within the limit of disturbance without mixing with foreign materials for use in finished grading.

B. Do not excavate wet topsoil.

C. Stockpile in area designated on site to depth not exceeding 20 feet and protect from erosion.

D. Remove excess topsoil not intended for reuse from site.

END OF SECTION 311000

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SECTION 312200

GRADING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Grading shall include all work necessary to bring the designated locations of the project area to the grades shown on the Drawings.

B. Grading shall include all Borrow Excavation, transporting, placement and compaction work required to provide the necessary material volumes to complete the designed grades for the project areas as shown in the Contract Drawings. Borrow Excavation work shall be comprised of two types of excavation:

1. Common Borrow Excavation. This refers to soil material salvaged within the limit of disturbance of the project. This shall include soil that will be excavated and/or stockpiled in order to complete the work depicted in the Contract Drawings.
2. Foreign Borrow Excavation. This refers to soil material required in addition to the material available from regrading operations, and will come from approved sources outside the limits of the project.

C. Finished grades to be landscaped or seeded shall include a minimum topsoil layer of six inches (6”) or as indicated on the Drawings. Finished grades to be otherwise surfaced shall allow sufficient elevation for the completed surface to produce the finished grades and elevations as shown on the Drawings.

1.2 REFERENCES

A. It is the Contractor's responsibility to be thoroughly familiar with the most recent revision or amendment to the following:

1. Philadelphia Water Department, Standard Details and Standard Specifications for Sewers.
2. Philadelphia Water Department, Standard Specifications for Excavation, Refilling, Grading, Landscaping, and Repaving (12-49).
3. Philadelphia Streets Department, Standard Specifications for Paving and Repaving.
4. Philadelphia Streets Department, Standard Construction Items.
5. PennDOT Publication 408, Section 201 – Clearing and Grubbing
6. PennDOT Publication 408, Section 205 – Borrow Excavation
7. PennDOT Publication 408, Section 206 – Embankment
8. PennDOT Publication 408, Section 802 – Topsoil Furnished and Placed

1.3 QUALITY ASSURANCE

A. The grading Contractor or subcontractor is subject to approval by the owner.

B. Any fill or topsoil sources, disposal areas, or temporary offsite storage locations shall be subject to review and approval by the owner.

C. An as-built survey of completed grades and elevations shall be completed by the Contractor. This survey will be deliverable to the owner, or as otherwise directed, prior to any landscaping installation or final surfacing (seeding, paving, etc.) operations.

PART 2 - PRODUCTS

2.1 FILL MATERIAL

A. Fill material (both Common Borrow Excavation and Foreign Borrow Excavation) shall conform to Publication 408 Specifications, Section 205.

B. All Foreign Borrow Excavation materials shall be free of seeds or live plant materials and all noxious or invasive plants and/or weeds. These materials shall be obtained from properly permitted and authorized sites. All Foreign Borrow Excavation materials shall also conform to the following:

1. More than 35% passing No. 200 Sieve.
2. Minimum dry mass density of 95 lb/ft3 determined by PTM No. 106, Method B.
3. Maximum liquid limit of 65, determined by AASHTO T89.
4. Plasticity index of not less than liquid limit minus 30 (for soils with liquid limits of 41 to 65), determined by AASHTO T90.

C. All fill materials shall be free from clay lumps, brush, litter, roots, stones 2 in. and larger, and other foreign materials.

2.2 TOPSOIL

A. Topsoil shall be acceptable friable loam that is reasonably free of subsoils, clay lumps, litter, roots or other plant materials, stones (2 in. and larger), and other foreign materials.

B. Topsoil may be produced onsite from existing appropriate soils by adding organic plant matter (mulch, shredded plants, etc) to constitute ten percent (10%), as determined according to AASHTO T194, and fully combined with the soil stockpile. Soils with clay content greater than thirty-five percent (35%) or sand content greater than seventy percent (70%) shall not be considered amendable to topsoil by this method.

C. Topsoil shall have a minimum sixty percent (60%) passing through the No. 10 (2 mm) sieve as defined by AASHTO T88.

PART 3 - EXECUTION

3.1 GRADING

A. Install all required Soil Erosion and Sedimentation Control measures as described in these Specifications or indicated on the Drawings. Phasing of Erosion and Sedimentation Control Measures shall follow the sequence provided, or barring provision of a specified sequence shall be installed as appropriate to the Work and as directed by the owner/Authorized Representative. At a minimum, downstream sediment protection, limit-of-disturbance fencing, and vehicle/tire cleaning shall be instituted prior to commencing any clearing or grading activities.

B. Perform all clearing and grubbing work in accordance with PennDOT Publication 408 Specifications, Section 201.3, Clearing and Grubbing – Construction and as specified in section 31 1000 – Site Clearing. Complete all clearing and grubbing (including stump removal) before starting other grading work.

C. In areas of fill, complete grading to within three feet (3’) of finished grade before excavating for and constructing sewers.

D. All grading work, except final grading where sewers are constructed in fill (see above), shall be completed within thirty (30) days of starting clearing and grubbing operations.

E. Place embankment over pipes and embankment around manholes in accordance with the Standard Details and Standard Specifications for Sewers.

3.2 PLACEMENT AND COMPACTION OF FILL AND BACKFILL

A. For general fill and backfilling, place materials in accordance with Section 206.3(b) (Embankment: Placement and Compaction) of PennDOT Publication 408.

B. Where fill materials are to be placed within six inches (6”) of the finished graded soil surface on areas that are to be revegetated, materials shall be compacted with a roller having a mass (weight) not over one-hundred-and-twenty pounds per foot width (120 lb/ft-width) of roller or by other acceptable methods as directed by Owner/Authorized Representative. Material shall not be placed in a wet or frozen condition.

3.3 PLACEMENT AND FINISH GRADING OF TOPSOIL

A. Loosen or scarify all areas to be covered by topsoil to a minimum depth of three inches (3”). Remove and dispose of any stones or other objectionable material encountered.

B. Place topsoil on the prepared areas, and (unless otherwise directed in the Drawings or by Owner/Authorized Representative) spread and compact to a uniform depth of six inches (6”) to produce the elevations and grades as shown on the Drawings.

C. Compact topsoil with a roller having a mass (weight) not over one-hundred-and-twenty pounds per foot width (120 lb/ft-width) of roller or by other acceptable methods as directed by Owner/Authorized Representative. A sheep foot roller may be used as appropriate.

D. Material shall not be placed or compacted in a wet or frozen condition.

3.4 AS-BUILT SURVEY

A. An as-built survey shall be completed by the Contractor and submitted to Owner/Authorized Representative for approval prior to commencing final surfacing operations, including paving or landscaping.

B. The survey shall identify spot elevations sufficient to show the grading in accordance with the Drawings (or as modified by Owner/Authorized Representative). Spot elevations provided on the Drawings shall be duplicated as a minimum number of survey points for the as-built.

C. Survey of as-built elevations and grades may be included in (or include) as-built dimensions and elevations for other infrastructure constructed under this Contract.

D. Survey underground stormwater management basins in accordance with latest PWD as-built survey guidelines.

END OF SECTION 312200

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SECTION 312316.13

TRENCHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Excavating trenches for utilities from 5 feet outside building to utility service.
2. Compacted fill from top of utility bedding to subgrade elevations.
3. Backfilling and compaction.

1.2 RELATED DOCUMENTS

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

B. Related Sections:
1. Section 310000 - Earthwork.
2. Section 311000 - Site Clearing.
3. Section 334009 - Connections To Existing Structures
4. Section 334201 - Stormwater Gravity Piping and Inlets

C. American Association of State Highway and Transportation Officials:
1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

D. ASTM International:
1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3).
2. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
3. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3).
4. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
5. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
6. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

1.3 DEFINITIONS

A. Utility: Any buried pipe, duct, conduit, or cable.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with City of Philadelphia standard.

B. Maintain one copy of document on site.

1.5 QUALIFICATIONS

A. Prepare excavation protection plan under direct supervision of Professional Engineer experienced in design of this Work and licensed in the City of Philadelphia.

1.6 RELATED DOCUMENTS

A. Verify field measurements prior to fabrication.

1.7 COORDINATION

A. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 LINES AND GRADES

A. Lay pipes to lines and grades indicated on Drawings.
   1. Architect/Engineer reserves right to make changes in lines, grades, and depths of utilities when changes are required for Project conditions.

B. Use laser-beam instrument with qualified operator to establish lines and grades.

3.2 PREPARATION

A. Contact the Pennsylvania One Call System, Inc at 8-1-1 or 1-800-242-1776 not less than three, but no more than ten business days before performing Work. A business day is any day except Saturday, Sunday, or legal holiday prescribed by statute in the law. A business day begins at 12:00:00 am and end at 11:59:59 pm.
   1. Request underground utilities to be located and marked within and surrounding construction areas.

B. Identify required lines, levels, contours, and datum locations.

C. Protect plant life, lawns, and other features remaining as portion of final landscaping.

D. Protect benchmarks, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

E. Maintain and protect above and below grade utilities indicated to remain.

F. Establish temporary traffic control and detours when trenching is performed in public right-of-way. Obtain all necessary permits to perform work within the public right-of-way. Relocate controls and reroute traffic as required during progress of Work.

3.3 TRENCHING

A. Excavate subsoil required for utilities to utility service.

B. Remove lumped subsoil, boulders, and rock up of 1/6 cu. yd., measured by volume. Remove larger material as specified in Section 310000.

C. Perform excavation within 24 inches of existing utility service in accordance with utility company's requirements.

D. Do not advance open trench more than 200 feet ahead of installed pipe.

E. Cut trenches sufficiently wide to enable installation and allow inspection. Remove water or materials that interfere with Work.

F. Excavate bottom of trenches maximum 2 feet wider than outside diameter of pipe.

G. Excavate trenches to depth indicated on Drawings. Provide uniform and continuous bearing and support for bedding material and utilities.

H. Do not interfere with 45 degree bearing splay of foundations.

I. When Project conditions permit, slope side walls of excavation starting 2 feet above top of pipe. Slope excavation at a maximum slope of 2 horizontal to 1 vertical. When side walls cannot be sloped, provide sheeting and shoring to protect excavation as specified in this section.

J. When subsurface materials at bottom of trench are loose or soft, excavate to greater depth as directed by Architect/Engineer until suitable material is encountered.

K. Cut out soft areas of subgrade not capable of compaction in place. Backfill with clean sand or sand and gravel with a maximum gravel size of 1.5-inches and compact to density equal to or greater than requirements for subsequent backfill material.

L. Correct areas over excavated areas with compacted backfill as specified for authorized excavation or replace with fill concrete as directed by Architect/Engineer.

M. Stockpile subsoil in area designated on site to depth not exceeding 20 feet and protect from erosion.

3.4 SHEETING AND SHORING

A. Sheet, shore, and brace excavations to prevent danger to persons, structures and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.

B. Support trenches more than 5 feet deep excavated through unstable, loose, or soft material. Provide sheeting, shoring, bracing, or other protection to maintain stability of excavation.

C. Design sheeting and shoring to be left in place as part of the completed Work, cut off minimum 18 inches below finished grade.

D. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.

E. Repair damage to new and existing Work from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

3.5 BACKFILLING

A. Backfill trenches to contours and elevations with unfrozen fill materials.

B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.

C. Place fill material in continuous layers and compact in accordance with Section 310000 - Earthwork.

D. Employ placement method that does not disturb or damage utilities in trench.

E. Maintain optimum moisture content of fill materials to attain required compaction density.

F. Do not leave more than 50 feet of trench open at end of working day.

G. Protect open trench to prevent danger to the public.

3.6 TOLERANCES

A. Top Surface of Backfilling: Plus or minus 1 inch from required elevations.

3.7 FIELD QUALITY CONTROL

A. Perform laboratory material tests in accordance with ASTM D1557.

B. Perform in place compaction tests in accordance with the following:
1. Density Tests: ASTM D1556.
2. Moisture Tests: ASTM D3017.

C. When tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest.

3.8 PROTECTION OF FINISHED WORK

A. Reshape and re-compact fills subjected to vehicular traffic during construction.

END OF SECTION 312316.13

SECTION 31 23 50

SAWCUTTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section includes the saw-cutting 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 the 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 31 23 50

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SECTION 312500

EROSION AND SEDIMENTATION CONTROLS

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. Stone and Concrete Block Inlet Protection;
   3. Compost filter sock;
   4. Temporary seeding and mulching;
   5. Rock Construction Entrance;
   6. Pumped Water Filter Bag;
   7. Compost Sock Washout Station; and,
   8. Maintenance and repair of erosion and sediment control measures.

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.

B. Related Sections:
   1. Section 310000 - Earthwork
   2. Section 311000 - Site Clearing
   3. Section 321216 - Asphalt Paving
   4. Section 321600 - Concrete Sidewalks

1.3 REFERENCES

A. Pennsylvania Department of Environmental Protection, Erosion and Sediment Pollution Control Program Manual (most recent version).

B. Commonwealth of Pennsylvania, Department of Transportation (PennDOT)
   1. Bulletin No. 15: Approved Construction Materials.
   2. Publication 408/2020 Specifications.

1.4 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.

1.5 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.

1.6 PRE-INSTALLATION MEETING

A. Convene a minimum seven (7) days prior to commencing Work of this Section.

PART 2 - PRODUCTS

2.1 FILTER BAG INLET PROTECTION

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 D4884 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 compost filter sock as described below and manufactured from recycled synthetic fibers.

2.2 STONE AND CONCRETE BLOCK INLET PROTECTION

A. In accordance with PennDOT Publication 408, Section 860.2(b).

B. Inlet protection in roadway is not to include stone or berms.

2.3 COMPOST FILTER SOCK

A. Compost filter socks shall be a three-dimensional tubular sediment control listed in PennDOT Bulletin 15, or approved equal.

2.4 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.

2.5 ROCK CONSTRUCTION ENTRANCE

A. Rock Construction Entrance shall be in accordance with PennDOT Publication 408, Section 849.

B. Accumulated materials shall be cleaned daily and as necessary and disposed of in accordance with all applicable regulations.

2.6 PUMPED WATER FILTER BAG

A. Pumped water filter bags shall be provided in accordance with PennDOT Publication 408, Section 855.

2.7 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 or PennDOT Publication 408 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 EXAMINATION

A. Verify compacted subgrade is acceptable and ready to support devices and imposed loads.

3.3 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.

3.4 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. Grates of Highway grate and Open Mouth Grate Inlets shall be protected using inlet filter bags as specified herein.

E. Mouth of 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.

3.5 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. Stockpile slopes shall be 2:1 or flatter.

3.6 SITE STABILIZATION

A. Incorporate erosion control devices indicated on the Drawings into the Project at the earliest practicable time.

B. Construct, stabilize and activate erosion controls before site disturbance within tributary areas of those controls.

C. Stabilize and disturbed area of affected erosion control devices on which activity has ceased and which will remain exposed for more than 20 days.
   1. During non-germinating periods, apply mulch at recommended rates.
   2. Stabilize disturbed areas which are not at finished grade and which will be disturbed within one year in accordance with temporary seeding as specified on the Drawings.
   3. Stabilize disturbed areas which are either at finished grade or will not be disturbed within one year in accordance with Section 329200 - Lawn and Meadow.

3.7 CLEANING

A. When sediment accumulation in sedimentation structures has reached a point one-third depth of sediment structure or device, remove and dispose of sediment.

B. Do not damage structure or device during cleaning operations.

C. Do not permit sediment to erode into construction or site areas or natural waterways.

D. Clean channels when depth of sediment reaches approximately on half channel depth

3.8 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.).

END OF SECTION 312500

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SECTION 31 50 00

EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work under this Section shall include all labor, on-site materials, and equipment necessary for the excavation of trench and grading as hereinafter specified and/or as otherwise required for the proper and timely completion of this Contract.

1.2 RULES AND REGULATIONS

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

1. ASTM C131 Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angles Machine
2. ASTM C136 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
3. ASTM C535 Standard Test Method for Resistance to Degradation of Large-Size Aggregate by Abrasion and Impact in the Los Angeles Machine
4. ASTM D653 Standard Terminology Relating to Soil, Rock, and Contained Fluids
5. ASTM D1140 Standard Test Methods for Determining the Amount of Material Finer than 75-µm (No. 200) Sieve in Soils by Washing
6. ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3))
7. ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
8. ASTM D2487 Standard Practice for Classification of Soils for Engineering Purposes
9. ASTM D6938 Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
10. ASTM D4253 Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
11. ASTM D4254 Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
12. ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
13. AASHTO T180 Standard Method of Test for Moisture-Density Relations of Soils Using 4.54-kg (10-lb) Rammer and 457-mm (18-in.) Drop

1.3 SUBMITTALS

A. Samples

1. Furnish and deliver samples of fill and backfill materials as selected by the Engineer.

1.4 PERFORMANCE REQUIREMENTS

A. If any hazardous waste materials are discovered on the site, the Contractor shall cease operations in that area until authorized to resume. The Contractor shall notify the Engineer of such material and cooperate with any outside agency or specialist that may be called in to determine the extent of the hazard and methods of its disposition.

B. Tolerances:

1. Construct finished sub-grades to plus 0 inches minus ½ inch of the elevation indicated.

2. Construct finished grade of slopes not steeper than 3H:1V to plus or minus 1/2 inch and on slopes steeper than 3H:1V to plus or minus 2 inches. Slopes shall not encroach upon roadbeds.
3. Maintain the moisture content of fill material as it is being placed within plus or minus 3 percent of the optimum, moisture content of the material as determined by the laboratory test herein specified.
4. Protect all existing and new construction including utilities, finishes and equipment from water, damage, weakening or other disturbance.

1.5 DEFINITIONS

A. Earthwork Terminology used in this Section and not defined herein shall be interpreted in accordance with the definitions given in ASTM D653.

1. Sub-grade: Sub-grade is the lowest elevation of excavation and the highest elevation if embankment required to accommodate the indicated construction.
2. Backfill: Soil or soil-rock material used to refill excavations and to refill excavated spaces around building walls.
3. Imported Material: Soil or granular material which is hauled in from off-site areas.
4. Unsuitable Material: Excavated material or material below the natural ground surface in embankment areas or below sub-grade elevation in excavated areas, which is unsuitable for its planned use.
5. Relative Compaction: The ratio, expressed as a percentage, of the in-place place dry density of fill material as compacted in the field to the maximum dry density of the same material as determined by laboratory test ASTM D1557, Method D.
6. Optimum Moisture Content: The water content at which a soil can be compacted to a maximum dry unit weight by a given compactive effort.
7. Relative Density: Refer to ASTM D4253 and ASTM D4254.
8. Excavation: Excavation is the removing of all materials encountered within the Contract Limits, regardless of the nature of the material encountered and the method by which it is removed, for grading, sub-grading for roadways or paved areas and other structures not specified elsewhere in these specifications. All excavation is unclassified and no additional compensation will be made for rock.

1.6 PROJECT CONDITIONS

A. Protection

1. Provide the necessary barricades, signs, lights, etc. to prevent accidents, to avoid all hazards and to protect the public, the work and property at all times, including Saturdays, Sundays, and holidays.
2. Be responsible for any and all damages which may arise or occur to any party whatsoever by reason of neglect in providing proper lights, guards, barriers or any other safeguards to prevent damage to property, life and limb.
3. Prior to any excavation the Contractor, with the cooperation of the Owner of the respective existing utility or its agents shall locate and paint the location of all water services, gas services, gas mains, water mains, sanitary sewers, telephone raceways or conduits and drains, within five (5) feet of the proposed excavations.
4. In case water, gas pipes, conduits, or other utilities are broken in the prosecution of the work, the Contractor shall stop work and give immediate notice to the proper authorities and shall be responsible for any damage to persons or property caused by such breaks. Failure to give prompt notice to the authorities shall deem the Contractor responsible for any damages legal or otherwise caused by the interruption or loss of utility service.

B. Parking and Storage

1. Parking of vehicles and storage of materials shall be confined to designated areas approved by the Owner.

C. Dust Control

1. During the progress or work, the Contractor shall conduct his operation and maintain the area of his activities so as to minimize the creation and dispersion of dust.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Unfavorable Weather Conditions

1. Excavating, filling, backfilling, and grading work shall not be performed during weather conditions which might damage the condition of existing ground, in-progress work, or completed work. When the work is interrupted by rain, excavating, filling, backfilling and grading work shall not resume until the site is suitable for the work.
2. Sub-grade shall be free from mud, snow, ice, and deleterious material when work is resumed.

PART 2 - PRODUCTS

2.1 FILL AND BACKFILL

A. Material suitable for use as fill and backfill shall be an inert, non-expansive soil, free from organic matter and of such quality that it will compact thoroughly without the presence of voids. Excavated on-site soil will be considered suitable for fill and backfill.

B. Suitable excavated material shall be conditioned for reuse and properly stockpiled for later filling and backfilling operations. Conditioning shall consist of spreading material in layers not to exceed 8 inches and raking free of debris and rubble. Rocks exceeding four inches in largest dimension and deleterious material shall be moved from the site and disposed of.

PART 3 - EXECUTION

3.1 EXISTING UTILITIES

A. Verify on site the location and depth (elevation) of all existing utilities and services before performing any excavation work. Excavation within 3 feet of a utility line shall be performed by hand.

3.2 EXCAVATION

A. General

1. Excavation consists of the removal and on-site placement or disposal of whatever material is encountered when establishing required sub-grade elevations.
2. Excavation shall be made to the grades as shown on the Contract Drawings.
3. Where excavation grades are not shown on the Contract drawings, excavation shall be made as required to accommodate the installation of all facilities.

B. Cold Weather Protection

1. Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degrees Fahrenheit.

C. Stability of Excavations

1. Sloped sides of excavation shall comply with state and local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.
2. Maintain sides and slopes of excavations in a safe condition until completion of backfilling.

D. Shoring and Bracing

1. Provide materials for shoring and bracing, such as sheet piling, uprights, stringers and cross-braces, in good serviceable condition.
2. Establish requirements for trench shoring and bracing to comply with local Codes and authorities having jurisdiction.
3. Maintain shoring and bracing excavations regardless of the time period excavations will be open. Carry down shoring and bracing as excavation progresses.

E. Material Storage

1. Stockpile suitable excavated materials where directed, as required for fill.
2. Locate and retain soil materials away from edge of excavation.

3.3 BACKFILL

A. Backfill excavation as promptly as work permits, but not until waterproofing membrane is applied and is ready to be backfilled, if applicable.

B. Placement and Compaction

1. Place backfill materials in layers not more than 4” in loose depth for materials by hand-operated tampers.
2. Place backfill and fill materials evenly adjacent to structures, to required elevations. Take care to prevent wedging action of backfill against structures by carrying the material uniformly around structure to approximately same elevation in each life.

3.4 GRADING

A. Grade areas adjacent to building lines to drain away from structures and to prevent ponding. Finish below the required sub-grade elevations.

3.5 CLEAN-UP

A. Upon completion of the work of this section, place in stockpile areas all excess excavated material, rubbish, trash and debris resulting from operations. Leave the site in a neat and orderly condition.

END OF SECTION 31 50 00

SECTION 321116

SUBBASE COURSE

PART 1 - GENERAL

1.1 SUMMARY

A. This item consists of the preparation of the subgrade and the construction of a layer of aggregate for driveways, footways/sidewalks, and roadway pavement of the depth indicated, to the lines and grades shown on the drawings, or as directed by the engineer.

B. Section Includes:
1. Aggregate subbase.
2. Aggregate base course.

C. Related Sections:
1. 310000 - Earthwork
2. 321600 - Concrete Sidewalk

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.

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials:
1. AASHTO M288 - Standard Specification for Geotextile Specification for Highway Applications.

B. ASTM International:
1. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
2. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
3. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
4. ASTM D2940 - Standard Specification for Graded Aggregate Material for Bases or Subbases for Highways or Airports.
5. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

1.4 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Product Data:
1. Submit data for geotextile fabric.

C. Samples: Submit, in air-tight containers, 10 lb. sample of each type of aggregate fill to testing laboratory.

D. Materials Source: Submit name of aggregate materials suppliers.

E. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

A. Furnish each aggregate material from single source throughout the Work.

B. Perform Work according to Pennsylvania Department of Transportation standards.

C. Maintain one copy of each document on site.

PART 2 - PRODUCTS

2.1 AGGREGATE MATERIALS

A. Subbase Aggregate:
   1. No. 2A Stone Aggregate in accordance with PennDOT Publication 408, Section 703.

B. Base Course Aggregate:
   1. No. 2A Stone Aggregate in accordance with PennDOT Publication 408, Section 703.

2.2 ACCESSORIES

A. Geotextile Fabric:
   1. Class 4, Type C Woven Geotextile Fabric in accordance with PennDOT Publication 408, Section 735.

PART 3 - EXECUTION

3.1 GENERAL

A. Subbase material shall not be placed on soft, muddy or frozen areas, nor until all irregularities in the prepared areas, including soft areas in the foundation, have been satisfactorily corrected. The subgrade shall be compacted to not less than one hundred percent (100%) of the determined dry weight density.

B. Unstable subbase conditions, including soft foundation areas which develop ahead of the base and paving operations shall be satisfactorily corrected by scarifying, reshaping, and compacting, or by replacement as required.

3.2 PLACEMENT

A. Install geotextile fabric over subgrade as indicated on the plans an in accordance with manufacturer’s instructions.
   1. Lap ends and edges minimum 6 inches.
   2. Anchor fabric to subgrade when required to prevent displacement until aggregate is installed.

B. Place aggregate in equal thickness layers over prepared substrate to total compacted thickness indicated on Drawings.
   1. Maximum Layer Compacted Thickness: 6 inches

2. Minimum Layer Compacted Thickness: 3 inches

C. Level and contour surfaces to elevations, profiles, and gradients indicated.

D. Add small quantities of fine aggregate to course aggregate when required to assist compaction.

E. Maintain optimum moisture content of fill materials to attain specified compaction density.

F. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

G. When constructed in part width, the extension of the subbase construction shall not proceed to its full width until the existing edge of the subbase is trimmed and all foreign and deleterious material is removed from the remaining prepared area.

3.3 COMPACTION

A. The uniformly spread material shall be compacted by means of approved equipment to not less than one hundred percent (100%) of the maximum dry weight density (PENNSYLVANIA TEST METHODS (PTM) No. 106, Method B) as determined by PTM No. 112, or PTM No. 402. When the material is too coarse to satisfactorily use these methods, compaction will be determined by the Engineer based on non-movement of the material under the specified compaction equipment. Compaction shall progress gradually from the sides to the center with each succeeding pass uniformly overlapping the previous pass, and shall continue until the entire area is satisfactorily shaped and compacted to the required lines and grades. One (1) density determination shall be made for each three thousand (3,000) square yards or less, on each layer of completed subbase.

3.4 DEPTH TEST

A. The depth of the finished subbase will be determined by cutting or digging holes to the full depth of the completed subbase. One depth measurement shall be made for each three thousand (3,000) square yards, or less, of the completed subbase. Any section in which the subbase is one half inch (1/2”) or more deficient in specified depth shall be scarified to a depth of at least three inches (3”), blended with the necessary additional material, and then recompacted to the specified density and depth or otherwise satisfactorily corrected.

B. All test holes shall be cut or dug, backfilled with similar material, and satisfactorily compacted by and at the expense of the Contractor. This operation shall be under the direct supervision of the inspector who will check the depth for record purposes.

3.5 MAINTENANCE OF TRAFFIC

A. No traffic shall be allowed on the completed subbase other than necessary local traffic and that developing from the operation of essential construction equipment, unless otherwise directed by the Engineer. Any defects which may develop in the construction of the subbase or any damage caused by the operation of local or job traffic is the responsibility of the Contractor and shall be immediately repaired or replaced at the expense of the Contractor.

B. The competed subbase shall be uniformly moistened immediately prior to the construction of the base course and/or pavement, except when a hot-mix bituminous base course is to be placed.

C. Completed subbase which has been subjected to hauling or exposed to the elements for periods in excess of one-hundred-twenty (120) calendar days will require re-testing of the

material and re-approval by the Engineer before construction of the base course or pavement may proceed. Subbase so used or exposed, not meeting the requirements herein specified shall be reconstructed or replaced as directed by the Engineer at the expense of the Contractor.

END OF SECTION 321116

SECTION 321216

ASPHALT PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes all labor, equipment, and materials necessary for the installation and testing of Warm Mix Asphalt Superpave Wearing Course, Warm Mix Asphalt Superpave Binder Course, and Warm Mix Asphalt Superpave Binder Course of specified depths.

B. Section Includes:
   1. Asphalt paving base course, binder course, and wearing course.

C. For bituminous asphalt paving in public right-of-way. Refer to the City of Philadelphia, Department of Streets, Standard Construction Items for materials, equipment, installation, and testing requirements.

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.

B. Related Sections:
   1. Section 310000 - Earthwork
   2. Section 321116 - Subbase Course

1.3 REFERENCES

A. The most current version of the publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.
   1. Pennsylvania Department of Transportation (PennDOT), Publication 408/2020
   2. PennDOT Bulletin No. 15: Qualified Products List for Construction
   3. Asphalt Institute (AI): “The Asphalt Handbook”
   4. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM):
      a. ASTM D 692 - Coarse Aggregate for Bituminous Paving Mixtures
      b. ASTM D 979 - Sampling Bituminous Paving Mixtures
      c. ASTM D 1073 - Fine Aggregate for Asphalt Paving Mixtures
      d. ASTM D 1188 - Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples
      e. ASTM D 2041 - Theoretical Maximum Specific Gravity and Density of Asphalt Mixtures
      f. ASTM D 2726 - Bulk Specific Gravity and Density of Non-Absorptive Compacted Asphalt Mixtures
      g. ASTM D 2950 - Density of Bituminous Concrete in Place by Nuclear Methods
      h. ASTM D 3549 - Thickness or Height of Compacted Asphalt Mixture Specimens
      i. ASTM D 3666 - Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials

B. The Contractor is required to have one copy of the latest edition of each of the following publications available for review in the job-site construction office at all times while performing the

work described in this Section. The Contractor is to comply with each of the following unless more stringent requirements are indicated on the Drawings or within these specifications.

1. City of Philadelphia, Department of Streets: Standard Construction Items, except that measurement and payment sections do not apply.
2. Publication 408: Specifications, except that measurement and payment sections do not apply.

1.4 SUBMITTALS

A. Product Data: For each product specified. Include technical data and tested physical and performance properties.

B. Job-Mix Design: Certification, by PennDOT and other authorities having jurisdiction, of approval of each job mix proposed for the Work.

C. Qualification Data: For firms and persons specified in the “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.

D. Material Test Reports: Test Reports shall be from the approved testing agency. Indicate and interpret test results for compliance of materials with requirements indicated.

E. Material Certificates: Certificates signed by manufacturers certifying that each material complies with the requirements.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who has completed warm-mix asphalt paving similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Manufacturer Qualifications: Engage a firm experienced in manufacturing warm-mix asphalt similar to that indicated for this project and with a record of successful in-service performance.

1. Firm shall be a registered and approved paving mix manufacturer listed in PennDOT Bulletin No. 15.

C. Testing Agency Qualifications: Demonstrate to the Owner's satisfaction, based on Owner’s evaluation of criteria conforming to ASTM D 3666, that the independent testing agency has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work.

D. Obtain materials from the same source throughout the project.

E. Pre-construction conference: Conduct conference at the project site to comply with the requirements of Division 1 sections and to review the methods and procedures related to asphalt paving including but not limited to the following:

1. Review proposed sources of paving materials, including capabilities and location of plant that will manufacturer warm-mix asphalt.
2. Review condition of substrate and preparatory work performed by other trades.
3. Review requirements for protecting paving work, including restriction of traffic during installation period for remainder of construction period.
4. Review and finalize construction schedule for paving and related work. Verify availability of materials, paving installer’s personnel, and equipment required to execute the work without delays.

5. Review inspection and testing requirements, governing regulations, and proposed installation procedures.
6. Review forecasted weather conditions and procedures for coping with unfavorable conditions.

1.6 REGULATORY REQUIREMENTS

A. Contractor shall obtain all necessary City of Philadelphia Streets Department road opening permits and approvals, and City of Philadelphia Department of Licenses and Inspections permits and approvals, upon the Contractor receiving Notice to Proceed and prior to proceeding with the Work.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if substrate is wet or excessively damp or if the following conditions are not met:
1. Asphalt Base Course: Minimum air or surface temperature of 35 deg F at time of placement in accordance with PennDOT Publication 408, Section 313.3(b).
2. Asphalt Wearing Course: Minimum air or surface temperature of 40 deg F at time of placement in accordance with PennDOT Publication 408, Section 413.3(b).

PART 2 - PRODUCTS

2.1 AGGREGATES

A. Aggregates shall be in accordance with the latest version of PennDOT Publication 408, Section 413.2(b). Provide aggregate from sources listed in PennDOT Bulletin 14.

2.2 ASPHALT MATERIALS

A. Asphalt Cement: PG-64-22 emulsion in accordance with PennDOT Publication 408, Section 413.2(a)1.
1. Water: Potable
2. Mix designs shall contain a maximum of 15% reclaimed asphalt pavement.

B. AUXILIARY MATERIALS
1. Herbicide: Commercial chemical for weed control, registered by Environmental Protection Agency (EPA) and PADEP. Provide granular, liquid, or wettable powder form.
2. Sand: Type B in accordance with PennDOT Publication 408, Section 703.
3. Joint Sealant: ASTM D 3405 or AASHTO M 301, hot applied, single component, polymer-modified bituminous sealant.
4. Geotextile: Class 4, Type A Non-Woven Needle Punched Geotextile Fabric in accordance with PennDOT Publication 408, Section 735.

C. MIXES
1. Warm-mix Asphalt: Provide dense, hot-laid, warm mix asphalt plant mixes approved by PennDOT and complying with the following requirements:
a. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
b. Superpave Base Course: Superpave Asphalt Mixture Design, WMA Base Course, PG 64-22, 3 to <10 Million ESALs, 25 mm Mix, in accordance with PennDOT Publication 408, Section 313.

c. Superpave Binder Course: Superpave Asphalt Mixture Design, WMA Binder Course, PG 64-22, 3 to < 10 Million ESALs, 19 mm Mix, in accordance with PennDOT Publication 408, Section 413.
d. Superpave Wearing Course: Superpave Asphalt Mixture Design, WMA Wearing Course, PG 64-22, 3 to < 10 Million ESALs, 9.5 mm Mix, in accordance with PennDOT Publication 408, Section 413.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to support paving and imposed loads.

B. Refer to Section 321116 for subbase preparation requirements. Refer to Section 321136 for Concrete Base Course Preparation.

C. Verify gradients and elevations of subbase or base are correct.

D. Asphalt paving courses shall be installed in accordance with PennDOT Publication 408, Section 413.

E. Protect adjacent work and structures from splashing of paving materials.

3.2 CONDITIONING OF EXISTING SURFACE

A. The vertical surface of curbs, structures, gutters, and existing paving in contact with bituminous mixtures, shall be painted with a uniform coating of bituminous material of the class and type designated for the surface course.

3.3 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subbase or base is ready to receive paving.
1. Sweep loose granular particles from surface of unbound-aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course.

B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted aggregate base before applying paving materials.
1. Apply herbicide only if absolutely necessary. Owner approval in writing is required prior to any herbicide application. Herbicide application must comply with all federal, state and local regulations.

C. Adjust elevation of existing utility structure tops to remain, including but not limited to manholes, inlet grates, valve boxes, etc. to final grades. Depending on the type of utility structure, adjustment shall be accomplished by the installation of factory-fabricated adjustment rings, installation of additional masonry courses under existing manhole castings or inlet tops, or resetting structures. Coordinate with utility owners prior to disturbing existing underground utilities to remain.

D. At existing curbs to remain, mill existing pavement as required to maintain existing curb reveal unless otherwise noted on the Drawings.

3.4 DEMOLITION

A. Saw cut and notch existing paving as indicated on Drawings.

B. Clean existing paving to remove foreign material, excess joint sealant and crack filler from paving surface.

C. Repair surface defects in existing paving to provide uniform surface to receive new paving.

3.5 WARM-MIX ASPHALT PLACING

A. Machine place warm-mix asphalt mix on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and compacted thickness as indicated on the Drawings.
   1. Place warm-mix asphalt base course in a single lift and thickness indicated on the Drawings or within these specifications.
   2. Place warm-mix asphalt binder course in a single lift and thickness indicated on the Drawings or within these specifications.
   3. Place warm-mix asphalt wearing surface course in single lift and thickness indicated on the Drawings or within these specifications.
   4. Spread mix at minimum temperature as indicated in PennDOT Publication 408, Section 413.
   5. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes, unless otherwise indicated on the Drawings or within these specifications.

B. Place paving in consecutive strips not less than 10 feet wide, except where infill edge strips of a lesser width are required. After the first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete asphalt binder course for a section before placing asphalt wearing 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 warm-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.6 JOINTS

A. Construct joints to ensure continuous bond between adjoining paving sections. Construct joints free of depressions with same texture and smoothness as other sections of warm-mix asphalt course.
   1. Clean contact surfaces and apply tack coat.
   2. Offset longitudinal joints in successive courses a minimum of 6 inches, however, the joint at the top layer shall be at the centerline of the roadway for 2-lane roads, and at the lane lines for roads with more than two lanes.
   3. Offset transverse joints in successive courses a minimum of 24 inches.
   4. Construct transverse joints by bulkhead method or sawed vertical face method as described in AI's "The Asphalt Handbook".
   5. Compact joints as soon as warm-mix asphalt will bear roller weight without excessive displacement.
   6. Compact asphalt at joints to a density within 2 percent of specified course density.

B. Apply bituminous material of the class and type designated for the surface course where new pavement meets existing bituminous pavement, and where bituminous pavement meets curbs and utility structures. Apply sealant in layer thickness that provides for curing and will not cause

tracking or lifting of sealant to other surfaces. Apply a fine sand covering temporarily over sealant during curing period.

## 3.7 PAVEMENT COMPACTION

A. When the subgrade is exposed proof roll according to the requirements shown. Densify to a stable subgrade. If the Owner determines that the subgrade cannot be densified to a stable condition, then the Owner may direct the Contractor to remove additional subgrade material to the depth required for a stable condition. The Contractor shall then replace unstable subgrade material with 2A stone compacted in 6-inch loose lifts.

B. Begin new pavement compaction as soon as placed warm-mix paving will bear roller weight without excessive displacement. Compact warm-mix paving with hot, hand tampers, or vibratory-plate compactors in areas inaccessible to rollers.
   1. Complete compaction before mix temperature cools to 185 F.

C. Breakdown Rolling: Accomplish breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Repair surfaces by loosening displaced material, filling with warm-mix asphalt, and rerolling to required elevations.

D. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling, while warm-mix asphalt is still hot enough to achieve specified density. Continue rolling until warm-mix asphalt course has been uniformly compacted to the following density:
   1. Density: not less than 95 percent of the density requirements established by the Marshall method at the time of approval of the mix design.

E. Finish Rolling: Finish roll paved surfaces to remove roller marks while warm-mix asphalt is still warm.

F. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while still hot, with back of rake or smooth iron. Compact thoroughly using tamper or other satisfactory method.

G. Repairs: Remove newly paved areas that are defective or contaminated with foreign materials. Remove paving course over areas affected and replace with fresh, warm-mix asphalt. Compact by rolling to specified density and surface smoothness.

H. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

I. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

## 3.8 INSTALLATION TOLERANCES

A. Thickness: Compact each course to produce the thickness indicated on the Drawings within the following tolerances:
   1. Base Course: Plus or minus ¼ inch
   2. Binder Course: Plus or minus ¼ inch
   3. Wearing Surface Course: Plus ¼ inch, no minus.

B. Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10 foot straightedge applied transversely or longitudinally to paved areas:
   1. Base Course: ¼ inch.
   2. Binder Course: ¼ inch
   3. Wearing Surface Course: 1/8 inch.
   4. Crowned Surfaces: Test with crowned template centered at right angle to crown. Maximum allowable variance from template is 0.25 inch.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: As part of this contract, the Contractor shall engage a qualified independent testing agency meeting the requirements of paragraph 1.06 to perform field inspections and test and to prepare test reports.
   1. Testing agency shall conduct and interpret tests and state in each report whether tested Work complies with or deviates from specified requirements.

B. Additional testing, at Contractor's sole expense, will be performed to determine compliance of corrected Work with specified requirements.

C. Thickness: In-place compacted thickness of warm-mix asphalt courses will be determined according to ASTM D3549.

D. Surface Smoothness: Finished surface of warm-mix asphalt will be tested for compliance with smoothness tolerances.

E. In-Place Density: Samples of uncompacted paving mixtures and compacted pavement will be secured by the testing agency according to ASTM D 979.
   1. Reference laboratory density shall be determined by averaging results from 4 samples of warm-mix asphalt-paving mixture delivered daily to site and compacted according to job-mix specifications.
   2. Reference maximum theoretical density shall be determined by averaging results from 4 samples of warm-mix asphalt paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
   3. In-place density of compacted pavement shall be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.
   4. One core sample shall be taken for every 1000 sq. yd. or less of installed pavement, but no case will fewer than 3 cores be taken.
      a. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.
      b. The Contractor shall fill all holes from which cores were taken. Restore and seal the surface to conditions similar to the adjacent areas.

F. Remove and replace or install additional warm-mix asphalt, at the Contractor’s sole expense, where test results or measurements indicate that it does not comply with specified requirements.

3.10 CLEANUP

A. Remove bituminous material from utility structure frames and covers. Open and reset utility manhole covers and inlet grates to ensure castings are not sealed shut.

B. Clean up debris and unused material, and remove from the site. Dispose of all material in accordance with local, state, and federal regulations. Do not dump material in manholes or inlets.

END OF SECTION 321216

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SECTION 321600

CONCRETE SIDEWALKS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section includes all labor, equipment, and materials necessary for the installation of the following as specified on the Drawings:
   1. Sidewalk pavement on an aggregate subbase.

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.

B. Related Sections:
   1. Section 310000 - Earthwork
   2. Section 321116 - Subbase Course

1.3 REFERENCES

A. The most current version of the publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.
   1. Pennsylvania Department of Transportation (PennDOT), Publication 408/2020
   2. PennDOT Bulletin No. 14: Aggregate Producers
   3. PennDOT Bulletin No. 15: Qualified Products List for Construction

1.4 PREINSTALLATION MEETINGS

A. Convene minimum one week prior to commencing Work of this Section.

1.5 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Product Data:
   1. Submit required information regarding concrete materials, joint filler, admixtures, and curing compounds.
   2. Mix Design:
      a. Submit concrete mix design for each concrete strength prior to commencement of Work.
      b. Submit separate designs if admixtures are required for hot- and cold-weather concrete Work.
      c. Identify mix ingredients and proportions, including admixtures.
   3. Identify chloride content of admixtures and whether or not chloride was added during manufacture.

C. Manufacturer’s Certificate: Certify that products meet or exceed specified requirements.

D. Source Quality-Control Submittals: Indicate results of factory tests and inspections.

E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

F. Qualifications Statement:
   1. Submit qualifications for manufacturer and installer.

1.6 QUALITY ASSURANCE

A. Perform Work according to PennDOT Publication 408, Section 704.

B. Obtain cementitious materials from same source throughout.

C. Maintain copies of each standard affecting Work of this Section on Site.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.

B. Installer: Company specializing in performing Work of this Section with minimum three years' experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store materials according with manufacturer's instructions.

C. 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

2.1 AGGREGATE SUBBASE

A. As specified in Section 321116 - Subbase Course

2.2 SIDEWALK

A. Concrete: Class A, in accordance with PennDOT Publication 408, Section 704.

B. Cure: PennDOT Publication 408, Section 711.2(a).

C. Joint Material: PennDOT Publication 408, Section 705.1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that compacted subgrade is dry and ready to support paving and imposed loads.

B. Verify that gradients and elevations of subgrade are as indicated on Drawings.

3.2 SIDEWALK

A. In accordance with PennDOT Publication 408, Section 676.3. The thickness of the sidewalk paving and aggregate shall be as defined in the construction plans.

END OF SECTION 321600

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SECTION 329000

PLANTINGS AND SEEDING

## PART 1 - GENERAL

### 1.1 SCOPE OF WORK

A. The work of this Section includes furnishing all labor, materials, equipment and incidentals required to complete all planting related landscaping work indicated on the Drawings and as specified herein, including but not necessarily limited to the following;

1. Excavation for plantings.
2. Furnishing and installing plant materials as shown on the Drawings, including shrubs, trees, and perennials.
3. Mulch, fertilize, stake, and prune all plants and trees.
4. Watering all specified plants.
5. Final cleanup and all other work required to complete the job in accordance with the Drawings and Specifications.
6. Preparation of as-planted sketch plans.
7. Maintenance of all specified plants and trees for an 8-week maintenance period.
8. Monthly planting status reporting of completed planted and maintenance activities.
9. Provision of “As Planted” record drawings.
10. Plant and tree warranties.

### 1.2 REFERENCE STANDARDS

A. American Association of Nurserymen (AAN)

B. ANSI Z60.1 - American Standard for Nursery Stock, most current edition

C. ANSI A 300 - Standard Practices for Tree, Shrub, and other Woody Plant Maintenance, most current edition and parts.

D. Soil Science Society of America (SSSA) Methods of Soil Analysis, Parts 1, 2, 3 & 4

E. American Society of Agronomy (ASA)

F. Other Agencies

1. American Society of Testing and Materials (ASTM)
   a. ASTM A 641/A 641M - Galvanized-steel wire
   b. ASTM B 221, Alloy 6063-T6, Aluminum Edging
   c. ASTM D5539-94 – Standard Specification for Seed Started Mix
2. Association of Official Agricultural Chemists (AOAC)
3. Woods End Research Laboratory, Solvita compost maturity index test.
4. International Society of Arboriculture (ISA)
5. PWD GSI Landscape Design Guidebook recommended plant list (Fall Update)
6. Philadelphia Parks and Recreation (PP&R - previously Fairmount Park Commission) Recommended Street Tree List
7. PP&R Contractor Guidelines.
8. USDA Rules and Regulations under the Federal Seed Act
9. Philadelphia Streets Department, Standard Construction Items.
10. Pennsylvania Department of Transportation, Form 408 Specifications.

G. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.3 SUBMITTALS

A. Submit complete product data for all materials furnished under this Section. One set of complete submittals is required per planting season. Any changes to materials require resubmittal. Unless otherwise noted below, all submittals must be received at least three (3) months prior to the start of the upcoming planting season.

B. Submit qualifications of crew, equipment, and suppliers using the Landscaping Qualifications Form in Appendix F. Qualifications must conform to the requirements detailed in Section 1.06, Contractor Qualifications, below.

C. Samples, testing and certifications of all materials shall be submitted for inspection and acceptance upon Owner's request. None of the landscaping materials shall be delivered to the site until samples and test results are approved by Owner/Authorized Representative, however such approval does not constitute final acceptance.

1. Mulch: Submit [1-quart] 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.

D. Submit a schedule for planting at least three (3) months prior to the start of the upcoming planting season. Schedule shall conform to planting seasons as defined in these Specifications and take into account allotted days for completion of the Work in the Contract; any extensions of the time allotment to be made for accommodation of planting seasons may be made at the sole discretion of a Project Manager.

E. Submit a proposed list of plant species with botanical and common names, variety, size, quantity, and source of plant materials in the varieties, sizes, and quantities indicated on the Drawings at least three (3) months prior to the start of the upcoming planting season. Sources of planting materials must be confirmed by the Contractor and written documentation of plant availability in accordance with the submitted planting schedule shall be provided by the supplier(s).

F. Plant Substitutions for plants not available locally should be ordered from nurseries located out of the state. Substitutions may be permitted only after substantiated written confirmation and documentation is submitted that a specified plant is either not obtainable or is not recommended for the location as shown on the landscaping plan. Substitutions should be drawn from the recommended plant list included in the PWD GSI Landscape Design Guidebook.

G. The Contractor must provide to a Project Manager each of their plant supplier's shipping lists for review and approval after ordering, but prior to supplier's shipping any plant material. Only specified plant species will be accepted. No cultivated varieties (cultivars) are acceptable.

H. The Contractor shall be required to submit status reports to Owner/Authorized Representative on a monthly basis during planting and maintenance activities. Photographic documentation as detailed in Section 01110 (Photographic Documentation) shall be provided as part of each status report. A template for the Project Status Report is appended to these Specifications.

I. Submit Monthly Project Status Reports using the template in Appendix D. Project Status Reports shall list detail all planting, maintenance activities, and upcoming site work. Photographic

documentation shall be included with the Monthly Project Status Report in accordance with Section 01110 (Photographic Documentation) of these Specifications. Project Status Reports shall be submitted within one (1) week of the end of each month.

J. Sketch plans, photographs, and written documentation of all plant installations, including initial planting and any plant replacements during the eight (8)-week maintenance period shall be submitted for approval within one (1) week of provisional acceptance subsequent to the maintenance period.

1. Sketch plans must include a revised schedule with species (botanical name) and cultivars and final quantities along with a revised planting plan.
2. Landscape sketch plans may be a markup of the original landscaping plan. Changes to the original landscaping plan shall be clearly noted and shown in red.
3. All sketches shall be labeled “As Planted”, dated, and shall contain the name or initials of the Designer.

## 1.4 CONTRACTOR QUALIFICATIONS

A. Crew Requirements: Crews shall consist of a minimum of two workers. One (1) landscape foreperson shall be present at all times during execution of the work. The foreperson shall direct all work performed under the following sections. Notify the Department of the name and phone number of crew member with credentials outlined below, along with a contact phone number, at least five (5) business days in advance of the first day of the specified activity.

1. The foreperson shall have experience with at least five (5) landscape installations of similar scope and complexity and shall have a minimum of three (3) years of experience in successful completion of similar landscape installation work. The Vendor must submit a resume of the foreperson(s) who will supervise the work crew(s).
2. All crew certification documentation should be readily available onsite so Owner/Authorized Representative can confirm certifications during site inspections.
3. Multiple certifications can be held by an individual crew member to satisfy the requirements set for in these Specifications.

B. Pesticide applications: No pesticides shall be applied unless approved in writing by the Owner. For pesticide applications, one (1) crew member must have certification as a Pest and Disease Applicator, Pennsylvania State licensed, certified commercial applicator, category: Ornamental and Shade Trees, Lawn and Turf. This crew member shall be required to be present during application of pest and disease control practices. The Vendor must submit the Pesticide and Disease Applicator’s License IDs for employees performing pest and disease control.

1. The Vendor must submit a resume of the employee(s) who will supervise the work crew(s).
2. All crew certification documentation should be readily available onsite so Owner/Authorized Representative can confirm certifications during site inspections.
3. Multiple certifications can be held by an individual crew member to satisfy the requirements set for in these Specifications.

## 1.5 QUALITY ASSURANCE

A. All plant materials shall be tagged and approved by the Owner prior to site delivery. The Contractor shall notify Owner/Authorized Representative of planting and tagging days a minimum of seven (7) days prior.

B. Each plant or same-species group of plants shipped to the job site must be clearly labeled with its scientific name and common name. The Contractor is responsible to check to see that the plants are correctly labeled. Owner/Authorized Representative will not accept improperly labeled

plants. The Contractor is prohibited to add, alter or remove labels. The Contractor will not be paid for material that is improperly labeled or for material on which the Contractor has altered or removed the labels.

1.6 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 ("root ball"), with a ball size not less than the 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 the 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 or stormwater soil.

H. Multi-stem trees: Trees that have shall have three or more main stems that arise from the ground from a single root crown or at a point just above the root crown.

I. 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.

J. 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.

K. Planting Area: Areas to be planted.

L. 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.

M. 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.

N. Plugs: A cylinder of medium in which a plant is grown. The term is generally used to describe seedlings and rooted cuttings which have been removed from the container but with the medium held intact by the roots.

O. 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.

P. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.

Q. Stormwater Soil: A planting soil mixture intended to provide water quality management by filtering stormwater runoff and provide sufficient infiltration for management of specified quantities of surface water flows.

R. Subgrade: Surface or elevation of subsoil remaining after completing excavation or backfill immediately beneath planting soil or lightweight fill material , that is integrated with Specified Soil or Growing Media by tilling in a layer of Transition Mix.

1.7 INSPECTION OF PLANT MATERIALS

A. Owner/Authorized Representative may observe plants and trees at supplier before delivery to site for compliance with requirements for genus, species, variety, size, and quality. Owner/Authorized Representative reserves the right to be present for inspection of plants at nursery and may attach their seal to each plant. The Contractor is responsible for paying any up charge for Owner/Authorized Representative to attach their seal to specific plants.

B. Owner/Authorized Representative shall be present at time of delivery to inspect plants and trees delivered to the site. A Project Manager retains the right to inspect or reject substandard plants or trees for size and condition of balls and root systems, insects, injuries, latent defects, and speciation, and to reject unsatisfactory or defective material at any time during progress of work. Rejected plants and trees must be removed immediately from the project site.

C. The Contractor shall stake the plant layout for approval by Owner/Authorized Representative. No plants or trees may be planted without on-site approval by Owner/Authorized Representative.

D. All trees shall be labeled by tree name (genus, species, and cultivar), and all labels securely attached to individual trees upon delivery to the jobsite.

1.8 DELIVERY, STORAGE AND HANDLING

A. The Contractor shall confine the storage of material and equipment to locations approved by Owner/Authorized Representative.

B. 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.

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. Accompany each delivery of bulk materials with appropriate certificates.

D. Materials shall not be dropped or dumped from vehicles. Materials shall be reviewed for compliance with specified requirements. Unacceptable materials shall be removed and disposed from the job site. Materials shall be stored in designated areas.

E. Deliver plants freshly dug. Do not prune trees and shrubs, except as directed by Owner/Authorized Representative. Protect bark, branches, and root system from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during delivery. Carefully handle all trees and shrubs during delivery to avoid mechanical damage. Handle all planting stock by the root ball. After delivery, set plants in a location protected from sun and wind. Provide adequate water to the root ball package during shipping and storage.

F. Roots of plants shall be adequately protected at all times from sun and from drying winds.

G. Plants which cannot be planted immediately upon delivery shall be set on the ground, out of direct sun if possible, and be well-protected with soil, mulch, or other acceptable material. Plant materials shall not be stored on site for more than two (2) days prior to planting. It is the Contractor's responsibility to keep plants watered and maintained upon delivery to site; give plants enough water so that the entire soil mass is wet and water is draining out the pot bottom. Secure plants from theft and vandalism.

H. No tree shall be planted if the root ball is cracked, broken, or dropped either before or during the planting process. No container plants will be accepted if the container is cracked or broken except upon special approval of Owner/Authorized Representative.

I. Deliver plants on day of installation after preparations for installation have been completed. A Project Manager shall be onsite to approve condition and speciation of delivered trees and plant layout.

1.9 PROJECT CONDITIONS

A. Restrictions: Planting shall only be performed during the periods within the seasons which are normal for such work as determined by weather and by locally acceptable practice and which are approved by Owner/Authorized Representative. No planting shall be performed between acceptable planting periods unless otherwise approved by Owner/Authorized Representative. The Contractor shall schedule his work to conform to these requirements. Planting close to the end of the season should be avoided if possible to maximize favorable planting conditions.

1. Spring Planting: March 15 – June 15.
2. Fall Planting: September 15 – December 15.

B. Weather Limitations: Proceed with planting activities 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 and according to manufacturer's written instructions. Owner/Authorized Representative reserves the right to postpone planting activities due to unfavorable weather conditions.

1. During periods of drought, irrigation shall be provided as approved by Owner/Authorized Representative. Water rates shall be equivalent to one inch (1") of rainfall per week.

C. Access over finished grade soils shall be restricted. If access is required across placed soils, Contractor shall be required to rework compacted soil areas prior to fine grading to the full depth of the placed soils as directed by Owner/Authorized Representative.

1.10 SITE ACCESS

A. For each of the different areas where the Contractor needs to gain access to perform his work, the Contractor shall make arrangements with the Owner in advance to access the site. These arrangements may require the construction of temporary roadways or bridges and the removal and replacement of existing structures.

1.11 EXISTING STRUCTURES AND PAVING

A. It is expected the Contractor will prepare their own preconstruction documentation in addition to the City's own photographs, to verify the original site conditions and the immediate vicinity of the project areas. The Contractor shall provide a set of preconstruction photographs to the Owner/Authorized Representative.

B. Any disturbed paving or curb, footway or driveway shall be restored according to any instructions provided by the Philadelphia Streets Department. All disturbed surfaces outside of the Streets Department restoration area shall be restored in kind.

1.12 MAINTENANCE SERVICE

A. Project Maintenance: Provide maintenance of planted areas by skilled employees of the landscape installer as defined under quality assurance above. Maintain as required in Part 3 herein. Begin maintenance immediately after plantings are installed and continue for an eight (8) week period.

1.13 INSPECTION FOR PLANTING CERTIFICATION

A. Planting certification for provisional approval shall be determined by Owner/Authorized Representative on a site by site basis. Certification shall verify that the plants are in healthy condition at the time of inspection, that the planting methodology appears correct, and that the plants should be expected to survive as installed by the Contractor. Certification shall be made by a designee of the Owner that has experience locally installing native plants of similar types used in the project. Individual plantings or entire areas or species may be rejected at this time for certification. Owner/Authorized Representative reserves the right to determine remediation required in the event of non-certified plantings, up to and including full replacement.

B. A Project Manager will perform inspection on a site by site basis at the end of the eight (8)-week maintenance period and upon the written request of the Contractor received at least ten (10) calendar days before the anticipated date of inspection.

C. At the end of the maintenance period, the Contractor shall be responsible for replacement planting for any plants that are missing, dead, not true to name or size as specified, or not in satisfactory growth, as determined by Owner/Authorized Representative. Any determination made by a Project Manager regarding plant replacement shall be final, and the Contractor shall be responsible for replacing the plantings in kind (unless otherwise directed) as soon as weather conditions permit during the next appropriate planting season at no additional cost to the City. The Contractor shall not be responsible for damage or plant mortality due to vandalism.

D. The Contractor shall prepare a list of items to be completed or corrected for review by Owner/Authorized Representative. Upon completion of the inspection, Owner/Authorized Representative shall amend the list of items to be completed or corrected. Corrective work shall be completed within two (2) weeks of receipt of the list of items needing correction or completion.

E. The eight (8)-week maintenance period must reoccur if any replacement of plants is required the time of inspection.

F. After all necessary corrective work has been completed and approved by Owner/Authorized Representative subsequent to required maintenance period(s), Owner/Authorized Representative shall certify in writing the planting certification and the one-year warranty period will commence.

G. Should approval of work be delayed after the end of the maintenance period(s) has elapsed, the Contractor shall continue maintenance activities until such approval is granted.

1.14 WARRANTY PERIOD AND REPLACEMENTS

A. The Contractor shall warranty that plant material is properly handled and installed. The Contractor shall be responsible for replacement planting required for a period of twelve (12) months after a planting is certified. At the end of the warranty period, plants that are missing, dead, not true to name or size as specified, or not in satisfactory growth, as determined by Owner/Authorized Representative, shall be replaced within the quantity limits set forth in section 1.16.D below. Any determination made by a Project Manager regarding plant replacement shall be final, and the Contractor shall be responsible for replacing the plantings in kind (unless otherwise directed) as soon as weather conditions permit during the next appropriate planting season at no additional cost to the City. The Contractor shall not be responsible for damage or plant mortality due to vandalism.

B. All replacement of plants and trees shall be conducted in accordance with the material and construction (including schedule) in these Specifications.

C. Replace any trees or shrubs that are more than twenty-five percent (25%) dead or in unhealthy condition at end of warranty period, as determined by Project Manager. Reseed herbaceous cover that is less than eighty-five percent (85%) alive at end of warranty period.

D. Plant replacements for all plants installed during a planting season, across all sites under the contract, shall be limited to the following quantities at the end of the warranty period:

1. 20% of trees
2. 20% of shrubs
3. 20% of herbaceous cover
4. Additional replacements may be required from installation to the end of the provisional maintenance period should plants not survive.

1.15 FINAL INSPECTION AND FINAL ACCEPTANCE

A. At the end of the warranty period, final inspection will be made by a Project Manager. Owner/Authorized Representative will request the Contractor to attend the site inspection at least ten (10) calendar days before the anticipated date of inspection.

B. Upon completion of the inspection, Owner/Authorized Representative shall provide a list of items to be completed or corrected. Corrective work shall be completed within two (2) weeks of receipt of items needing correction or completion.

C. After all necessary corrective work has been completed, a Project Manager will certify in writing the final acceptance of planting.

PART 2 - PRODUCTS

2.1 PLANT CONDITIONERS

A. Herbicide application is not permitted for school planting. All weeding shall be performed manually.

B. Water used in this work shall be furnished by the Contractor and shall be suitable for irrigation and free from ingredients harmful to plant life. Hose and other watering equipment required for the work shall be furnished by the Contractor.

C. The use of hydrogels (in soil mixes or directly applied to plant roots) is prohibited in any green stormwater infrastructure system.

2.2 PLANT MATERIALS

A. Furnish and install plants, and pre-tagged and approved trees, as shown on the Drawings and specified herein. Plants shall be nursery grown under climatic conditions similar to those in the locality of the project and shall conform to the variety and sizes indicated. Plant material not obtained from an approved source is prohibited.

B. Plants shall conform to the indicated botanical names and standards of size, culture and quality for the highest grades and standards as adopted by the ANSI Z60.1 - American Standard for Nursery Stock. All plants shall meet specified sizes and be provided as plugs, container grown, field potted, or field balled and burlapped materials as specified.

1. All single-stem trees must have a straight trunk, well–balanced crown, and intact leader. Branching height (height of the lowest living branch) must be one-third to one-half (⅓ - ½) of tree height. Shrubs must be multi-stemmed with a well-balanced crown.
2. Tree measurements should be taken with branches and trunks or canes in their normal position. Do not prune to obtain required sizes. Take height measurements from or near the top of the root flare for field-grown stock and container grown stock. Measure main body of tree for height and spread; do not measure branches or roots tip to tip. Take caliper measurements six inches (6”) above root flare for trees up to four-inch (4”) caliper size and 12 inches (12”) above the root flare for larger sizes.
3. All trees are to be a minimum of two inches (2”) caliper and balled and burlapped, or as specified in the landscaping drawings. Shrubs must be in a three (3) gallon container minimum and at least three to four feet (3-4’) feet tall, or as specified in the landscaping drawings.
4. All container grown materials shall be grown to specified size in a container and shall be healthy, vigorous, well rooted and established in the container in which they are growing. A container grown plant shall have a well-established root system reaching the sides of the containers to maintain a firm root ball, but shall not have excessive root growth encircling the inside of the container.
5. Plugs shall be cut into square or round plugs, strongly rooted, and capable of vigorous growth and development when planted; Plug Size: three (3) inches
6. Measure plant materials with stems, petioles, and foliage in their normal position. Plants shall be of sufficient dimensions to include most of the fibrous roots and conforming to the standards of the AAN and ANSI Z60.1.

C. Plants shall be freshly dug for delivery. No heeled in plants or plants from cold storage shall be accepted. All plants shall be sound, healthy, well branched, and free of disease or pests. Plants shall be free of physical damage such as bark abrasions, disfiguring knots, sunscald, or unhealed

cuts over three-quarters of an inch (¾"). Trees with multiple leaders shall not be accepted. Plants or trees with girdling root systems shall not be accepted.

D. Plants larger than those shown in the planting schedule on the Drawings may be used, if approved by a Project Manager, but use of such plants shall be at no additional cost to the Owner. If the use of larger plants is approved, the spread of roots or ball of earth shall be increased in proportion to the size of the plant as approved and in accordance with ANSI Z60.1.

E. All plants shall be grown on their own roots. Grafted materials are only acceptable if grafted at least twelve (12) months before use, unless otherwise specified.

F. Plant material not obtained from an approved source is prohibited

2.3 TREES

A. In accordance with the design plans.

2.4 SEEDING

A. Seeding on the site shall be one of the following design mixes:

1. Drought Defy "Diamond Quality Mix" as manufactured by Reed and Perrine, 396 Main Street, Tennent, NJ, 732-446-6363:
   a. 35% Titanium LS Tall Fescue
   b. 35% Raptor II Tall Fescue
   c. 20% GrandSlam II Perennial Rye
   d. 10% Zinger Kentucky Bluegrass
2. "Sports Turf Mix" as manufactured by The Turf Trade, 517 Franklinville Road Mullica Hill, NJ 08032, 856-478-6704:
   a. 40% Turbo Tall Fescue
   b. 40% Hemi or Bullseye Tall Fescue
   c. 10% Octane or Secretariate 2 Perennial Ryegrass
   d. 10% Fusion Perennial Ryegrass
3. "Advantage Mix" Tall Fescue/Rye Mix (80/20) as manufactured by Fisher and Son, 110 Summit Drive, Exton PA 19341, 1-800-262-2127:
   a. 50% Inferno Tall Fescue
   b. 30% Quest Tall Fescue
   c. 10% Revenge GLX Perennial Ryegrass
   d. 10% Replay Perennial Ryegrass

2.5 MULCH

A. Organic mulch shall be double-shredded well-composted, hardwood bark, aged six (6) months to one year. Size shall be a maximum width or length of two inches (2") and a minimum of a half inch (½") in width or length. Mulch shall be free of wood chips, stones or other undesirable matter. Mulch shall be natural hardwood color. Dyes shall not be permitted.

1. Source: The Contractor is reminded that mulch generally meeting these requirements is available for purchase from the Fairmount Park Organic Recycling Center, 3850 Ford Road, Philadelphia, (215) 685-0108.
2. Other supplier conforming to organic mulch requirements above.

2.6 WEED-FREE STRAW AND SALT HAY

A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

2.7 TREE WRAP

A. Contractor shall not use tree wrap on trees unless specifically directed by Owner/Authorized Representative. Where directed by Owner/Authorized Representative, tree wrap shall be a woven polypropylene fabric. When used, tree wrap shall be installed on each tree immediately after planting.

2.8 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 by length indicated, pointed at one end.
2. Wood Deadmen: Timbers measuring 8 inches in diameter and 48 inches long, treated with specified wood pressure-preservative treatment.
3. Flexible Ties: Wide rubber or elastic bands or straps of length required to reach stakes.
4. Guys and Tie Wires: ASTM A 641/A 641M, Class 1, galvanized-steel wire, two-strand, twisted, 0.106 inch (2.7 mm) in diameter.
5. Tree-Tie Webbing: UV-resistant polypropylene or nylon webbing with brass grommets.

2.9 EROSION CONTROL MATERIALS

A. Erosion-Control Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a 100% biodegradable mesh. Include manufacturer's recommended steel wire staples, six (6) inches long.

B. Erosion-Control Fiber Mesh: Biodegradable burlap or spun-coir mesh, a minimum of 0.92 lb./sq. yd., with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, six (6) inches long.

2.10 WATER

A. Water used in this work shall be furnished by the Contractor and shall be suitable for irrigation and free from ingredients harmful to plant life. Hose and other watering equipment required for the work shall be furnished by the Contractor.

B. The use of hydrogels (in soil mixes or directly applied to plant roots) is prohibited in any green stormwater infrastructure system.

PART 3 - EXECUTION

3.1 GENERAL

A. Planting, mulching and conditioning shall only be performed during those periods within the seasons which are normal for such work as determined by the weather and locally accepted practice, as approved by Owner/Authorized Representative and set forth in Section 1.10 herein.

B. Protect adjacent and adjoining structures, utilities, walks, pavements, fences and other facilities, trees, shrubs, mulched beds, plantings, and mulched areas from damage caused by planting operations. Any damages to infrastructure shall be repaired by the Contractor at no cost to Owner.

C. Schedules for planting shall be submitted to Owner/Authorized Representative for approval at least three (3) months prior to the start of the upcoming planting season. The Contractor shall notify Owner/Authorized Representative of plant tagging and planting days with a minimum of seven (7) days' notice. In the event of inclement weather, planting should occur when conditions permit. In the event of rain, specifically, planting should occur the following day.

D. The Contractor shall stake out locations of trees and secure approval of layout prior to planting.

3.2 EXAMINATION

A. Examine areas to receive plants for compliance with requirements and conditions affecting installation and performance of the Work.

1. The Contractor shall review details of existing subsurface infrastructure to ensure digging or staking does not damage existing infrastructure. Contractor is responsible for costs to repair any damage to subsurface infrastructure caused by planting or staking operations.
2. 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.
3. Verify that plants and vehicles loaded with plants can travel to planting locations with adequate overhead clearance.
4. Review details of subsurface infrastructure to ensure digging or staking does not interfere with other assets.
5. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
6. 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 Project Manager and replace with new stormwater soil.

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

3.3 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, other facilities, trees, shrubs, mulched beds, plantings, 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. All plants shall be installed at locations as shown on the Drawings. The Contractor shall stake out locations, outline areas, and obtain a Project Manager's approval of layout before excavating or planting. Make minor adjustments as required.

3.4 MINOR GRADING AND FILL

A. See Section 334003 for requirements of placement and grading of planting and stormwater soils.

B. The addition of soil may be required given the condition of the site as directed by Owner/Authorized Representative. Minor grading shall take place following the addition of soil, or as deemed necessary by Owner/Authorized Representative.

C. Protect newly graded soils from traffic, freezing and erosion. Keep soils free of trash, debris or construction materials from other work.

D. Repair and re-establish grades to specified tolerances where completed surfaces become eroded, rutted, settled, or over compacted due to subsequent construction operations or weather conditions.

E. Scarify or remove and replace material to a depth as directed by Owner/Authorized Representative.

F. Where settling occurs, before final acceptance, remove mulch and backfill with additional approved soil, compact to specified density.

G. Finished grades to be landscaped or seeded shall include a minimum stormwater layer of six inches (6”). Finished grades to be otherwise surfaced shall allow sufficient elevation for the completed surface to produce the finished grades and elevations as shown on the Drawings.

## 3.5 PLANTING OPERATIONS

A. Planting shall be done by experienced workmen familiar with planting procedures under the supervision of a qualified foreman.

B. The Contractor shall make all efforts to not destroy soil structure by excessive traffic, working, or compacting the soil throughout the planting operation. Utilize the smallest practicable piece of low ground pressure mechanical equipment in the adjacent areas.

C. To prevent potential for plant settlement, do not over-excavate prior to planting.

D. Stormwater soil shall be backfilled in lightly compacted layers of not more than nine inches (9”) and each layer watered sufficiently to settle before the next layer is put in place.

E. If more than two (2) days elapse following preparation of stormwater soil, then the Contractor shall be responsible for regrading and loosening areas before planting.

F. Plants which cannot be planted immediately upon delivery shall be set on the ground, out of direct sun when possible, and be well-protected with soil, mulch, or other acceptable material. Plant materials shall not be stored on site for more than two (2) days prior to planting. It is the Contractor’s responsibility to keep plants watered and maintained upon delivery to site; give plants enough water so that the entire soil mass is wet and water is draining out the pot bottom. Secure plants from theft and vandalism.

G. Owner/Authorized Representative reserves the right to reject a plant or group of plants at any time during the project.

## 3.6 EXCAVATION FOR TREES AND SHRUBS

A. Planting Pits and Trenches

1. Excavate circular planting pits with sides sloping inward at a 45-degree angle where possible, or as indicated in planting detail drawings. 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 planting stock where possible, or as indicated in tree planting detail drawings.
3. For bare root stock, excavate at least 12 inches wider than root spread or as indicated on the drawings, whichever is the greater dimension and deep enough to accommodate vertical roots.
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; the root flare must be visible for planted trees.
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: Topsoil, planting soil, or stormwater soil removed from excavations may be used as backfill soil unless otherwise indicated.

C. Obstructions: Notify Owner/Authorized Representative if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations

1. Hardpan Layer: Drill 6-inch-diameter holes, 24 inches apart, into free-draining strata or to a depth of 10 feet, whichever is less, and backfill with free-draining material.

D. Drainage:

1. Notify Project Manager/Contracting Officer if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.
2. Verify by testing that pits are free draining. If pits are not free draining notify Owner/Authorized Representative and submit alternative method of drainage for approval

## 3.7 INSTALLATION OF TREES AND CONTAINER SHRUBS

A. Remove all debris from the pit and tamp loose soil in the bottom of the pit by hand.

B. Do not handle the plant by the trunk, branches, leaves or stem.

C. Place the plant straight in the center of the planting pit, carrying the plant by the root mass.

D. Carefully cut and remove all of the wire baskets that are packaging the root system using the least amount of disturbance as possible.

E. Cut and remove all ropes around the burlapped ball. Remove all nails. Remove all burlap, wires, and/or other materials from the planting hole.

F. When planting container plants, scarify the sides and bottom of the root mass such that no roots continue to circle around the root mass. When possible, pull encircling roots away from root mass and position them in the soil around the planting hole such that they are being pulled away from the plant.

G. Backfill planting pit with soil and tamp firmly to fill all voids and air pockets. Do not over compact soil (backfilled soil should have a maximum bulk density of 1.5g/cm3). Make sure plant remains straight during backfilling/tamping procedure.

H. The top of the root mass of the trees/shrubs should be flush with, or slightly elevated (no more than 1/8th its height) above the final grade. Do not cover stem with soil or mulch.

I. When planting on a slope, plant “out-of-the-hill” by raising the grade around the planted hole so it is flat at the surface. Do not plant “into-the-hill” by lowering the grade and do not leave the grade at an angle.

J. Water plants thoroughly at their bases immediately after planting to saturate backfill. Watering shall occur of a sufficient quantity to saturate the backfill and shall be applied slowly enough to sink into the soil avoiding runoff.

K. Install slow-release watering bags on all trees such as Treegator or equivalent with at least 15 gallon capacity. Fill watering bags during maintenance.

L. A layer of mulch should be placed around each tree and shrub installed as set forth in herein and as indicated in planting detail drawings.

M. The Contractor shall leave no open planting pits at the close of each day.

N. A woven polypropylene tree wrap shall be used to protect trees from deer damage if so directed by Owner/Authorized Representative. Tree wrap shall be installed on each tree immediately after planting.

O. Maintain protection of trees during installation and maintenance periods. Treat, repair or replace any damaged planting.

P. During planting, all areas shall be kept neat, clean and free of all trash and debris, and all reasonable precautions shall be taken to avoid damage to existing plants, turf, structures, and private property.

Q. Remove all tags, labels, strings and wire from the plant materials, unless otherwise directed by Owner/Authorized Representative.

R. Promptly remove soil debris created by work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks or other paved areas.

S. Final cleanup shall be the responsibility of the Contractor and consist of removing all trash and materials incidental to the project and disposing of them off-site.

T. When planting on side slopes, grade shall be raised to provide a level surface for planting.

## 3.8 PROTECTION OF TREES

A. Refer to section 015639 for Tree Protection requirements.

3.9 TREE REMOVAL

A. Refer to section 015639 for Tree Removal requirements.

3.10 TRIMMING AND PRUNING

A. Each plant shall be trimmed in accordance with AAN and ANSI Z60.1 standards to preserve the natural character of the plant and as directed by Owner/Authorized Representative.

B. Trimming and pruning shall be done with clean, sharp tools.

3.11 TREE STABILIZATION

A. Trunk Stabilization by Upright Staking and Tying: Install trunk stabilization as follows unless otherwise indicated:

1. Place stakes as low as possible, no higher than 2/3 the height of the tree.
2. Stake trees with two stakes for trees up to 12 feet high and 2-1/2 inches or less in caliper; three stakes for trees less than 14 feet high and up to 4 inches in caliper. Space stakes equally around trees.
3. Materials used to tie the tree to the stake should be flexible and allow for movement all the way down to the ground so that trunk taper develops correctly.
4. Support trees with bands of flexible ties at contact points with tree trunk. 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: Stake and guy trees more than 14 feet in height and more than 3 inches in caliper unless otherwise indicated. Install trunk stabilization as follows:

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 long, driven to grade. Adjust spacing to avoid penetrating root balls or root masses. Provide turnbuckle for each guy wire and tighten securely.
    b. For trees more than 6 inches in caliper, anchor guys to wood deadmen buried at least 36 inches below grade. Provide turnbuckle for each guy wire and tighten securely.
    c. Support trees with bands of flexible ties at contact points with tree trunk and reaching to turnbuckle. Allow enough slack to avoid rigid restraint of tree.
    d. Attach flags to each guy wire, 30 inches above finish grade.
    e. Paint turnbuckles with luminescent white pain

C. No staking shall be performed without full understanding of subsurface infrastructure locations.

3.12 INSTALLATION OF CONTAINER PLANTS

A. Install plants after stapled erosion control blanket is installed and approved by a Project Manager (where applicable). When stapled erosion control blanket is approved, dig a hole for each plug or plant that is about the same depth as the soil of the plug or potted plant. For plugs, a ‘dibble bar’ with the same diameter as the plug can be used to create the hole, when punched through the blanket. For container plants, the stapled erosion control blanket shall be cut in a circular hole shape to match the diameter of the container.

B. Remove the plants and soil from the pots and carefully break apart bound root balls. Position each plant in its hole so that the soil level of each plant is flush to the surrounding finished grade soil surface. After planting, fill soil in around the plant completely, firming the soil and ensuring there are no air pockets as plants are installed. When planted, cover the top of the potted soil mix with about ½-in of stormwater soil to match surrounding finished grades and help reduce wicking of moisture out of the potted soil mix. Water installed plants immediately after planting. Where specified on the Drawings, install mulch as directed.

C. When planting on a slope, plant “out-of-the-hill” by raising the grade around the planted hole so it is flat at the surface. Do not plant “into-the-hill” by lowering the grade and do not leave the grade at an angle.

3.13 GROUND COVER AND HERBACEOUS 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 stormwater soil for backfill.

C. Dig holes large enough to allow spreading of roots.

D. For plugs supplied in flats, plant each in a manner that minimally disturbs the root system.

1. Plant plugs in holes or furrows, spaced twelve (12) inches apart in triangular pattern unless otherwise indicated on drawings. On slopes, contour furrows to near level.

E. Work soil around roots to eliminate air pockets and maintain plant at finished grade.

F. Water thoroughly after planting, taking care not to wet plant foliage when sunny.

G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.14 PLANTING AREA MULCHING

A. Immediately after planting operations are completed, planting beds placed outside the infiltration areas and channels (areas covered in erosion control blankets) shall be covered with the specified mulch as indicated.

1. For Trees and Shrubs in Turf Areas: Apply organic mulch ring of 3-inch average thickness, with a 3-foot radius around trunks or stems. Do not place mulch within three inches (3”) of trunks or stems.
2. For Continuous Planting Areas: Apply 3-inch average thickness of organic mulch extending 12 inches beyond edge of individual planting and over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within three inches (3”) of trunks or stems and off of leaves or stems for container plants and plugs.

B. No mulch shall be placed in areas that will experience surface flows (channels, swales, etc.) or surface ponding of water (areas of basins, bumpouts, or other surface features that are designed for surface water detention). These areas that will be flooded shall only be covered with erosion control blankets and plantings or landscaping stone as specified.

## 3.15 WATERING

A. Trees shall be watered twice within the first twenty-four (24) hours of the time of planting and not less than twice per week until provisional acceptance. Trees shall be watered at the roots, to minimize wetting of the leaves. Water shall be released slowly to prevent runoff and in sufficient quantity to saturate the soils (approximately fifteen to twenty (15-20) gallons per watering). In the event of steady rainfall, frost, or yellowing of the leaves, watering may be temporarily reduced with the approval of Owner/Authorized Representative.

B. Plantings must be thoroughly watered twice within the first twenty four (24) hours of the time of planting and not less than twice per week until provisional acceptance. Plants shall be watered at the roots to minimize the wetting of the leaves. Overhead watering is permitted only during overcast weather. Water shall be released slowly to prevent runoff and in sufficient quantity to saturate the soils.

C. Suitable water for planting and maintenance will be the responsibility of the Contractor. The Contractor shall furnish his own hose and hose connections or other watering equipment.

D. See Table of Maintenance Tasks and Schedule for further watering requirements.

## 3.16 SITE RESTORATION

A. General

1. Restore all disturbed areas to the satisfaction of Owner/Authorized Representative.
2. Backfill all disturbed areas outside the Limits of Disturbance to original elevation and slope. Ensure stability of reconstructed slopes. On steep slopes, provide and arrange logs, large rocks or other devices to check erosion. Slope areas shall be seeded with the specified seed mix. The entire disturbed area of the slope shall be covered with erosion control blanket to prevent erosion. The fabric shall be pinned to the slope at 3-three foot (3') intervals.
3. Restore all disturbed trenches, rubble gutters, bridle paths, asphalt paths, cinder roads, stone walls, structures, utilities, sidewalks and other fixtures in kind, to original condition, and to the satisfaction of Owner/Authorized Representative.

## 3.17 MAINTENANCE

A. Maintenance for provisional acceptance shall begin immediately after planting is installed on a site by site basis. Contractor will begin a formalized cyclical maintenance program that will last until the end of the maintenance period of eight (8) weeks.

B. Proposed maintenance activities and schedule shall be coordinated with the Owner/Authorized Representative and shall be in accordance with the program submitted by the Contractor based on Table of Provisional Maintenance Tasks and Schedules below.

C. Plants shall be watered, mulched, weeded, pruned, and sprayed as described herein and otherwise maintained and protected during this period. Dead or damaged plants shall be replaced before the end of the provisional maintenance period. Maintenance activities are outlined in the table below.

D. Submit Monthly Project Status Reports using the template in Appendix B detailing the completed maintenance activities.

E. Site inspection for provisional approval shall take place at the end of the eight (8) week period. The Contractor shall coordinate the site inspection with the Owner/Authorized Representative ten (10) calendar days prior to the anticipated date of inspection. Should approval by the Owner/Authorized Representative be delayed until after the 8-week period has elapsed, the Contractor is responsible for continuing maintenance activities until such approval is granted.

F. Table of Provisional Maintenance Tasks and Schedules:

| Task | Description | Frequency |
|---|---|---|
| Remove trash, sediment and organic debris | Remove trash, sediment, and organic debris from all SMP surfaces and inlet gutters | Weekly |
| | Clean pretreatment devices; empty filter bags for inlets, domed rises or other structures. Sweep or vacuum at least five (5) ft. one either side of inlets or curb cuts. | Monthly |
| Remove non-target/invasive vegetation | Remove all non-target or invasive vegetation not part of the original planting manually. Weeds shall be disposed of offsite in an approved manner. | Monthly, from March to November |
| Water vegetation | Place and fill 15-20 gallon water bags such as Treegator® or equivalent on trees. Follow directions of manufacturer. Replace bags if they become damaged or missing. | Weekly |
| | Water shrubs and herbaceous plants at the base of the plant with a hose or ground-level irrigation system. Natural rainfall is not considered a watering as it will not provide the required depth of water. Each watering should slowly soak the entire depth of root system. | 3 times per week on dry days; no later than 3-4 hours from dusk. Watering with an overhead system is only permitted when weather is overcast. |
| | Water groundcover and plugs - do not allow soil to dry out. Provide a half-inch (0.5”) of water at each watering. | Daily, when there is no rainfall for first 6 weeks; twice weekly thereafter |
| Apply insecticides or other chemicals | Apply insecticides or other chemicals | As approved by Owner / Authorized Representative |

| | | |
|---|---|---|
| Prune trees and shrubs | Remove dead, damaged, or diseased wood | As needed during Provisional Maintenance period; should be completed prior to Final Owner/Authorized Representative Inspection and Walk-through |
| Replace tree stakes | Replace or amend tree stakes or tree protection | As needed during Provisional Maintenance period; should be completed prior to Final Owner/Authorized |

| | | |
|---|---|---|
| | | Representative Inspection and Walk-through |
| Apply mulch | Apply mulch to landscaped beds as needed to maintain three-inch (3”) depth; extending from the edge of the bed or pit to a radius of three inches (3”) from the stem of each plant. Mulch shall not touch the woody stem of a shrub or tree. When there is more than a one-inch (1”) drop from the edge of the pavement to the mulch, add mulch to reduce the gap to a minimum of a half-inch (0.5”) from the edge of the pavement. | As needed during Provisional Maintenance period; should be completed prior to Final Owner/Authorized Representative Inspection and Walk-through |
| Reset elevation of plants | Reset settled plants to proper grade and position | As needed during Provisional Maintenance period; should be completed prior to Final Owner/Authorized Representative Inspection and Walk-through |
| Replace dead or damaged plants | Replace plants that are more than 25% dead | As needed during Provisional Maintenance period; should be completed prior to Final Owner/Authorized Representative Inspection and Walk-through |

END OF SECTION 329000

SECTION 330561

CONCRETE MANHOLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Modular precast concrete manholes and structures with tongue-and-groove joints and masonry transition to cover frame, covers, anchorage, and accessories.
2. Bedding and cover materials.

B. Related Requirements:
1. Section 310000 - Earthwork.
2. Section 334201 - Stormwater Gravity Piping and Inlets

1.2 DEFINITIONS

A. Bedding: Specialized material placed under manhole prior to installation and subsequent backfill operations.

1.3 REFERENCE STANDARDS

A. American Association of State Highway Transportation Officials:
1. AASHTO M306 - Standard Specification for Drainage, Sewer, Utility, and Related Castings.

B. American Concrete Institute:
1. ACI 530/530.1 - Building Code Requirements and Specification for Masonry Structures.

C. ASTM International:
1. ASTM A48/A48M - Standard Specification for Gray Iron Castings.
2. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
3. ASTM C55 - Standard Specification for Concrete Building Brick.
4. ASTM C478 - Standard Specification for Circular Precast Reinforced Concrete Manhole Sections.
5. ASTM C497 - Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile.
6. ASTM C877 - Standard Specification for External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections.
7. ASTM C913 - Standard Specification for Precast Concrete Water and Wastewater Structures.
8. ASTM C923 - Standard Specification for Resilient Connectors between Reinforced Concrete Manhole Structures, Pipes, and Laterals.
9. ASTM C990 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
10. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
11. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

1.4 COORDINATION

A. Coordinate Work of this Section with connection to stormwater conveyance, site sanitary sewerage gravity piping, and trenching.

1.5 PREINSTALLATION MEETINGS

A. Convene minimum one week prior to commencing Work of this Section.

1.6 SUBMITTALS

A. Product Data: Submit manufacturer information for manhole covers, component construction, features, configuration, and dimensions.

B. Shop Drawings:
   1. Indicate structure locations and elevations.
   2. Indicate sizes and elevations of piping, conduit, penetrations, and rim elevation.

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. Source Quality-Control Submittals: Indicate results of factory tests and inspections.

F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.7 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of manholes and connections, and record invert elevations.

1.8 QUALITY ASSURANCE

A. Perform Work according to City of Philadelphia standards.

B. Maintain one copy of each standard affecting Work of this Section on Site.

1.9 QUALIFICATIONS

A. Manufacturer:
   1. Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.
   2. Listed on PennDOT Bulletin 15.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Handling: Comply with precast concrete manufacturer instructions for unloading and moving precast manholes and drainage structures.

C. Storage:
   1. Store materials according to manufacturer instructions.
   2. Store precast concrete manholes and drainage structures to prevent damage to Owner's property or other public or private property.
   3. Repair property damaged from materials storage.

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.

1.11 AMBIENT CONDITIONS

A. Cold Weather Requirements: Comply with ACI 530/530.1.

1.12 EXISTING CONDITIONS

A. Field Measurements:
   1. Verify field measurements prior to fabrication.
   2. Indicate field measurements on Shop Drawings.

1.13 WARRANTY

A. Furnish five-year manufacturer's warranty for concrete manholes.

PART 2 - PRODUCTS

2.1 CONCRETE AND MASONRY MANHOLES

A. Manufacturers:
   1. Furnish materials from a source listed in PennDOT Bulletin 15.

B. Manhole Sections:
   1. Materials:
      a. Reinforced Precast Concrete: Comply with ASTM C478.
      b. Gaskets: Comply with ASTM C923.
   2. Joints:
      a. Comply with ASTM C913.
      b. Maximum Leakage: 0.025 gal. per hour per foot of joint at 3 feet of head.

C. Mortar and Grout:
   1. Mortar:
      a. As specified in PennDOT Publication 408, Section 705.7(b).
   2. Grout: As specified in PennDOT Publication 408, Section 1001.2(d).

D. Reinforcement:
   1. As specified in PennDOT Publication 408, Section 709.

E. Clear Inside Dimensions:
   1. Diameter: 48 inches.

F. Design Depth:
   1. As indicated on Drawings.

G. Clear Cover Opening:
   1. Diameter: 26 inches.

H. Pipe Entry: Furnish openings as required.

I. Structure Joint Gaskets:
   1. Provide rubber gaskets per ASTM C443 or Neoprene gaskets per ASTM C361 as specified in PennDOT Publication 408, Section 705.5(b)3.

2.2 FRAMES AND COVERS

A. Manufacturers:
   1. Furnish materials from a source listed in PennDOT Bulletin 15.

B. Description:
   1. Material:
      a. Cast iron.
      b. Comply with AASHTO M105, Class 35B and AASHTO M306.
   2. Lid:
      a. Bearing Surface: Machined flat.
      b. Configuration: Removable.
      c. Security: None.
   3. Cover Design: Closed.
   4. Live-Load Rating: HS-25.
   5. Furnish sealing gasket.
   6. Cover: Molded with identifying name.
   7. Nominal Lid Size: 26 inches diameter.

2.3 GRADE ADJUSTMENT RINGS

A. Manufacturers:
   1. Furnish materials from a source listed in PennDOT Bulletin 15.

B. Riser Rings:
   1. Thickness of 2 to 12 Inches:
      a. Precast concrete.
      b. Comply with PennDOT Publication 408, Section 605.2(d).
      c. A maximum of two grade adjustment rings are permitted for grade adjustment. Total depth of rings is limited to 12” maximum.

2.4 MATERIALS

A. Cover and Bedding:
   1. Bedding: Construct manholes on a subbase constructed of compacted No. 2A coarse aggregate. Place in 4” layers to provide a 12” minimum depth.
   2. Cover: Backfill excavated spaces around the structure with acceptable embankment material.

2.5 ACCESSORIES

A. Steps: As specified in PennDOT Publication 408, Section 605(c) and from a manufacturer listed in PennDOT Bulletin 15.

B. Joint Sealant: Comply with ASTM C990.

C. Grout: Non-Shrink as specified PennDOT Publication 408, Section 1080.2(c).

2.6 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed assembly.

B. Certificate of Compliance:
   1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
   2. Specified shop tests are not required for Work performed by approved manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Verify that items provided by other Sections of Work are properly sized and located.

B. Verify that built-in items are in proper location and are ready for roughing into Work.

C. Verify that excavation base is ready to receive Work and excavations and that dimensions and elevations are as indicated on Drawings.

### 3.2 PREPARATION

A. Mark each precast structure by indentation or waterproof paint showing date of manufacture, manufacturer, and identifying symbols and numbers as indicated on Drawings to indicate its intended use.

B. Coordinate placement of inlet and outlet pipe or duct sleeves as required by other Sections.

C. Do not install manholes and structures where Site conditions induce loads exceeding structural capacity of manholes or structures.

D. Inspect precast concrete manholes and structures immediately prior to placement in excavation to verify that they are internally clean and free from damage; remove and replace damaged units.

### 3.3 INSTALLATION

A. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface structures or utilities in immediate or adjacent areas.

B. Correct over-excavation with coarse aggregate.

C. Remove large stones or other hard matter impeding consistent backfilling or compaction.

D. Protect manhole from damage or displacement while backfilling operation is in progress.

E. Excavating:
   1. As specified in Section 310000 – Earthwork and in indicated locations and depths.
   2. Provide clearance around sidewalls of manhole or structure for construction operations.
   3. If ground water is encountered, prevent accumulation of water in excavations; place manhole or structure in dry trench.
   4. Where possibility exists of watertight manhole or structure becoming buoyant in flooded excavation, anchor manhole or structure to avoid flotation as approved by Architect/Engineer.

F. Base and Alignment:
   1. Install manholes supported at proper grade and alignment on compacted crushed-stone bedding.

2. Grout base of shaft sections to achieve slope to exit piping, trowel smooth, and contour to form continuous drainage channel.
3. Form and place manhole or structure cylinders plumb and level, to correct dimensions and elevations.

G. Attachments:
1. As Work progresses, build fabricated metal items and steps.
2. Cut and fit for pipe.
3. Set cover frames and covers level to correct elevations without tipping.

H. Backfilling: As specified in Section 310000 - Earthwork.

I. Precast Concrete Manholes:
1. Lift precast components at lifting points designated by manufacturer.
2. When lowering manholes into excavations and joining pipe to units, take precautions to ensure that interior of pipeline and structure remains clean.
3. Assembly:
   a. Assemble multisection manholes and structures by lowering each section into excavation.
   b. Install rubber gasket joints between precast sections according to manufacturer recommendations.
   c. Lower, set level, and firmly position base section before placing additional sections.
4. Remove foreign materials from joint surfaces and verify that sealing materials are placed properly.
5. Maintain alignment between sections by using guide devices affixed to lower section.
6. Joint sealing materials may be installed on Site or at manufacturer's plant.
7. Verify that installed manholes meet required alignment and grade.
8. Remove knockouts or cut structure to receive piping without creating openings larger than required to receive pipe; fill annular spaces with mortar.
9. Cut pipe flush with interior of structure.
10. Shape inverts through manhole as indicated on Drawings.

J. Sanitary Manhole Drop Connections:
1. Concrete Encasement: Minimum 2 feet outside of manhole.
2. Form channel from pipe drop to sweep into main channel at maximum angle of 30 degrees.

K. Castings:
1. Set frame and cover 2 inches above finished grade for manholes and other structures with covers located within unpaved areas to allow area to be graded away from cover beginning 1 inch below top surface of frame.

## 3.4 ADJUSTING

A. Vertical Adjustment of Existing Manholes and Structures:
1. If required, adjust top elevation of existing manholes and structures to finished grades as indicated on Drawings.
2. Frames, Grates, and Covers:
   a. Remove frames, grates, and covers cleaned of mortar fragments.
   b. Reset to required elevation according to requirements specified for installation of castings.

END OF DOCUMENT 330561

SECTION 334009

CONNECTIONS TO EXISTING STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY OF WORK

A. The Work described in this Section shall include all materials, labor, equipment and incidentals required to make connections to structures from stormwater conduit piping as shown on the drawings. All orifice, underdrain, distribution, or other piping that connects to a structure shall have the connection constructed per these Specifications.

1.2 REFERENCES

A. ASTM C 109, Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-inch or 50 mm Cube Specimens).

B. ASTM D 638, Test Method for Tensile Properties of Plastics.

C. ASTM D 695, Test Method for Compressive Properties of Rigid Plastics.

1.3 SUBMITTALS

A. Before starting this work, submit for approval of Owner/Authorized Representative, manufacturer's literature describing Epoxy Mortar Gel and Epoxy Bonding Agent. Literature must address each requirement (e.g. Compressive Strength per ASTM C109) as specified.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. The following products are acceptable as Epoxy Mortar Gel, provided they continue to meet all requirements:

1. Meta Bond HM Gel, as manufactured by American Meta Seal Company, 509 Washington Avenue, Carlstadt, NJ 07072.
2. Sikadur 31 Hi-Mod Gel, as manufactured by Sika Corporation, Box 297, Lyndhurst, NJ 07071.
3. Thermal-Chem Mortar Resin Gel (Product No. 304), as manufactured by Thermal-Chem, Inc., 1400 Louis Avenue, Elkgrove, IL 60007.
4. Approved equivalent product.

B. The following products are acceptable as Epoxy Bonding Agent, provided they continue to meet all requirements.

1. Meta Bond HM, or Meta Bond HM Gel, as manufactured by American Meta Seal Company.
2. Sikastix 370, Sikadur Hi-Mod, or Sikadur 31 Hi-Mod Gel, as manufactured by Sika Corporation.
3. Thermal-Chem Mortar Resin (Product No. 3), or Thermal-Chem Mortar Resin Gel (Product No. 34), as manufactured by Thermal-Chem, Inc.
4. Approved equivalent product.

2.2 MATERIALS

A. Epoxy Mortar Gel shall:

1. Be a 100% solids formulation.
2. Have a Tensile Strength per ASTM D 638 not less than 3000 psi after 7 days at 73□F.
3. Have a Tensile Elongation per ASTM D 638 not over 7%.
4. Have a Compressive Strength per ASTM D 695 not less than 3000 psi after 24 hours at 73 degrees F, and not less than 6000 psi after 7 days at 73 degrees F.

B. Sand shall:

1. Be oven-dry silica sand.
2. Have at least 70% by weight pass #20 sieve.
3. Have not over 35% by weight pass #40 sieve.

C. Epoxy Bonding Agent shall meet the requirements for Epoxy Mortar Gel.

2.3 MIXES

A. Epoxy Mortar shall consist of Epoxy Mortar Gel and Sand mixed at a 1:1 ratio by loose volume.

PART 3 - EXECUTION

3.1 MAKING CONNECTION

A. Make hole(s) in existing structure as necessary to permit connection. Core through existing concrete structures and cut reinforcing as necessary. Remove all dirt, laitance, and other loose or undesirable material from mating surfaces. Check hole(s) for fit.

B. Comply fully with manufacturer’s instructions. Coat mating surfaces with Epoxy Bonding Agent and set pipe. Seal all openings with Epoxy Mortar. Support pipe securely to prevent movement and protect for at least 24 hours.

END OF SECTION 334009

SECTION 33 42 01

STORMWATER GRAVITY PIPING AND INLETS

PART 1 - GENERAL

1.1 SUMMARY OF WORK

A. This section includes all materials and appurtenant work necessary to furnish and install precast concrete inlet and trench drain structures, cast iron drainage pipe, and pipe connections to sewers.

1.2 REFERENCE STANDARDS

A. All sewer work in the public right-of-way under this contract shall be governed by, and done in accordance with the most recent revision or amendment to the Standard Specifications and Standard Details of the Philadelphia Water Department, including the following:

1. Standard Details and Standard Specifications for Sewers.
2. Standard Specifications for Excavation, Refilling, Grading, Landscaping and Repaving.
3. Standard Specifications for Masonry: Concrete.
4. Standard Specifications for Masonry: Stone and Brick.

B. The Standard Detail for Saddle Connection to RC Pipe Sewers is hereby modified so that the openings for the lateral connections shall be core drilled and rubber saddles shall be substituted in place of clay saddles. The 2000 psi concrete encasement around the saddle shall be extended to the cradle of sewer as shown in the Detail for Resilient Saddle Connection to RC Pipe Sewers affixed to the end of these specifications.

C. PennDOT Publication 72M, Roadway Construction Standards and PennDOT Publication 408, Section 605.

D. All materials and workmanship shall conform to the most recent revision or amendment to the following standards, except as modified by the Contract Documents:

1. ASTM A 74, Standard Specification for Cast Iron Soil Pipe and Fittings
2. ASTM C 94, Standard Specification for Ready-Mixed Concrete.
3. ASTM C 564, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
4. ASTM C 890, Standard Practice for Installation of Monolithic or Sectional Precast Concrete Water and Wastewater Structures.

1.3 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.

B. Certificates of Compliance: Before installation of any Precast Concrete Products, submit an acceptable Certificate of Compliance to Owner/Authorized Representative

C. Submit a list of materials to be provided for work under this Section including the name and address of the materials producer and the location from which the materials are to be obtained.

D. Submit certificates, signed by the materials producer, stating that materials meet or exceed the specified ASTM and ACI requirements

E. Submit detailed diagrams of all outflow structure depicting dimensions and materials used to construct the entire structure. Indicate knockout elevations and size for all pipe entering manhole structures or other concrete structures.

1.4 REGULATORY REQUIREMENTS

A. Traffic Control: Maintain access of and protection for vehicular and pedestrian traffic as required for construction activities in accordance with local regulations.

B. Contractor shall obtain all necessary City of Philadelphia Streets Department road opening permits and approvals, and City of Philadelphia Department of Licenses and Inspections permits and approvals, upon the Contractor receiving Notice to Proceed and prior to proceeding with the Work.

1.5 QUALITY ASSURANCE

A. All materials, methods of construction, and workmanship shall conform to applicable requirements of ASTM, PTM, PennDOT Standard Specifications and AASHTO Standards, unless otherwise specified.

PART 2 - PRODUCTS

2.1 BACKFILL

A. Ordinary Backfill Material may include all material excavated from the trench and free of objectionable matter, unless rejected by the Owner/Authorized Representative. The Contractor shall furnish any deficiency of Ordinary Backfill Material.

B. Furnish Select Backfill Material in accordance with PennDOT Publication 408 Specifications, Section 703.3, Select Granular Material-2RC (as amended). The use of slag as Select Backfill Material is hereby prohibited.

2.2 RUBBER SADDLES

A. Rubber Saddles for Lateral Connections to RC Pipe Sewers shall be manufactured from a blend of rubber that is laboratory tested and appropriate for sewer applications.

B. Pipe clamps and expansion rings shall be Type 304 Stainless Steel.

C. Rubber Saddles shall provide a watertight connection and be compatible with ASTM C-923.

2.3 GRAY (CAST) IRON DRAINAGE PIPE AND FITTINGS

A. All gray iron pipe shall be manufactured and tested in accordance with ASTM A 74 Standard specification for Cast Iron soil pipe and fittings.

B. Pipes shall have a nominal laying length of 5 feet and 10 feet for all size diameters.

C. Pipe shall conform to the Standard Specifications for Gray and Ductile Iron Pipe of PWD.

2.4 INLET GRATE AND FRAME

A. Area Drain: Provide Heavy Duty Inlet Frame and Grate Number 2815 manufactured by Campbell Foundry Company, R-3560 manufactured by Neenah Foundry, Inc., or approved alternative.

B. Trench Drain: Provide Standard Heavy Duty Trench Frame and Grate Number 4526A manufactured by Campbell Foundry Company, R-4990-DX manufactured by Neenah Foundry, Inc., or approved alternative.

2.5 PRECAST CONCRETE INLET BOX

A. Area Drain: Provide Precast Concrete Inlet Box Model 22 CB R manufactured by Oldcastle Infrastructure, Inc., a CRH Company, Precast Concrete Inlet manufactured by Altomare Precast, Inc., Precast Concrete Inlet manufactured by Atlantic Concrete Products, Inc., or approved alternative.

2.6 CAST-IN-PLACE CONCRETE TRENCH DRAIN

A. Concrete for trench drain to be in accordance with PennDOT Publication 408, Section 704 Class A Concrete.

2.7 INLET TRAP

A. Provide Standard Catch Basin Trap Number 2563 manufactured by Campbell Foundry Company, R-3711 manufactured by Neenah Foundry Inc., or approved alternative.

2.8 CONCRETE MIX

A. Concrete for sewer lateral connection to be in accordance with PennDOT Publication 408, Section 704 Class C Concrete.

PART 3 - EXECUTION

3.1 MAINTENANCE AND PROTECTION OF TRAFFIC DURING CONSTRUCTION

A. Maintain and protect traffic during construction as required elsewhere in these Contract Documents.

3.2 EXCAVATING

A. Excavate in accordance with the Standard Specifications for Excavation, Refilling, Grading, Landscaping, and Repaving. Excavation will not be classified, whether by type of material encountered, or by type of equipment required.

B. Use sheathing and shoring sufficient to avoid damage to or settlement of adjacent buildings, paving, and underground structures.

C. Protect from damage and provide adequate temporary support for all existing underground facilities, except those known to be abandoned. Repair any damage to existing underground facilities due to Contractor's operations without charge to the Owner.

D. Use of a Hydro-Hammer or similar equipment for breaking existing paving is hereby prohibited.

3.3 DEBRIS GRILLS

A. Take great care when breaking the sewer crown to prevent debris from being washed down the sewer.

B. At the end of each work day, cover the open end of the sewer with a metal debris grill to prevent debris from being washed down or thrown into the sewer during non-work hours. At the beginning of each work day, remove all accumulated debris before removing the debris grill.

C. Employ a rigid, portable metal debris grill which is sufficiently strong to withstand the impact of any debris which may be washed down stream or thrown against it. Openings shall be 3" x 3".

D. During working hours, prevent any debris, construction material, or equipment from being washed down the sewer. Remove any such material from the sewer without charge. Use debris grill during working hours when feasible.

3.4 TRENCH DRAINS

A. Construct cast-in-place concrete trench drain in accordance with trench drain frame and grate manufacturer's specifications.

3.5 INSTALLING

A. Install inlets in accordance with PennDOT Publication 408, Section 605.

B. Construct inlet connections in accordance with the 1985 Standard Details and Standard Specifications for Sewers, and the Contract Plans and Special Specifications.

C. All inlets shall be constructed to provide positive drainage. All associated pavement restoration shall be sloped inwards towards the inlet, and the inlet grate or throat as appropriate shall be slightly below the surrounding paving surface. No inlet may be constructed such that its function is restricted, and the Owner/Authorized Representative reserves the right to refuse payment on any inlet that does not provide positive drainage. This may include, but is not limited to, inlets that do not meet the minimum throat opening requirements of four inches (4") after final paving and surfacing is complete, or inlets whose grate is higher than the surrounding paving surface.

D. When connecting VCP laterals that do not require the use of a wye branch to RC Pipe, the openings shall be created with a core drill. The Standard Detail for Saddle Connections to RC Pipe Sewers within the 1985 Standard Details and Standard Specifications for Sewers shall be modified so that rubber saddles shall be substituted for clay saddles. The rubber saddles shall be expanded against the wall of the pipe to provide a watertight connection. The lateral pipe shall be secured within the saddle through the use of a stainless steel clamp. The 2000 psi concrete encasement shall be extended to the cradle of the sewer as shown in the Detail for Resilient Saddle Connection to RC Pipe Sewers affixed to the end of these specifications.

E. When connecting new VCP laterals to existing laterals, make joints with a 1:3 grout, making a full, closed joint between the pipes.

F. Seal all remaining openings with 9 inch thick brick masonry.

G. Do not make holes in RC Pipe for lifting. Use only padded slings to lift RC pipe sections. Take care not to damage pipe surface, bell, or spigot.

H. Inlet protection (permanent and temporary) shall be installed according to the manufacturer's specifications. Please see Section 312500 – Soil Erosion and Sediment Control for additional details.

3.6 BACKFILLING AND COMPACTING

A. Place and compact backfill in accordance with the Standard Specifications for Excavation, Refilling, Grading, Landscaping and Repaving, except as herein modified.

B. Do not place backfill around any structure requiring time to gain strength (e.g., masonry or concrete), until so directed by the Owner/Authorized Representative.

C. Place Ordinary Backfill up to three feet (3') below subgrade elevation in all sewer trenches and sewer manholes to be abandoned. Place Select Backfill Material-2RC for three feet (3') below subgrade elevation in all sewer trenches and sewer manholes to be abandoned.

D. Compact backfill around and to a depth of six inches (6") over pipes and fittings by hand tamping. Compact all other backfill in eight-inch (8") layers by mechanical tamping. Puddling is prohibited.

E. When backfill has been placed to three feet (3') below street surface or finish grade, cut off and remove sheathing and shoring (including soldier beams) two feet (2') below street surface or finish grade.

3.7 REPAVING

A. Restore all disturbed paving, curb, and grass areas as required elsewhere in the Contract Documents.

END OF SECTION 33 42 01

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**SECTION 072100**

**THERMAL INSULATION**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Mineral-wool batt insulation.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:
1. Basis of Design: JM Mineral Wool TempControl Batt Insulation, R-30, Product Data.

PART 2 - PRODUCTS

2.1 MINERAL-WOOL BATT INSULATION

A. Mineral-Wool Batt Insulation, Unfaced: ASTM C665, Type I (blankets without membrane facing); consisting of fibers; passing ASTM E136 for combustion characteristics, for installation at cross-gable roof attic space.

1. Basis of Design:
Johns Manville:
JM Mineral Wool TempControl Batt Insulation
7 ¼" thickness
23 ½ width
R-30

2. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.

3. Smoke-Developed Index: Not more than 50 when tested in accordance with ASTM E84.

4. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

2.2 ACCESSORIES

A. Insulation for Miscellaneous Voids:

1. Glass-Fiber Insulation: ASTM C764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E84.
2. Spray Polyurethane Foam Insulation: ASTM C1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.

3. Polyurethane Pour-In-Place Insulation: Closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84, specifically formulated for pour-in-place applications.

B. Insulation Anchors, Spindles, and Standoffs: As recommended by manufacturer.

C. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Install insulation with manufacturer's R-value label exposed after insulation is installed.

D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

E. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

### 3.2 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. For wood-framed construction, install blankets according to ASTM C1320 and as follows:

B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft.
2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

END OF SECTION 072100

**SECTION 072600**
**VAPOR RETARDERS**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Polyethylene vapor retarders.

B. Related Requirements:

1. Section 075216 “SBS Modified Bituminous Membrane Roofing.”

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

PART 2 - PRODUCTS

2.1 POLYETHYLENE VAPOR RETARDERS

A. Polyethylene Film: ASTM D 4397, 6 mils (0.15 mm) thick minimum, with maximum permeance rating of 0.13 perm (7.5 ng/Pa x s x sq. m).
1. Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

PART 3 - EXECUTION

3.1 INSTALLATION OF VAPOR RETARDERS ON FRAMING

A. Polyethylene Film: Loosely lay polyethylene-film vapor retarder in a single layer over area to receive vapor retarder, side and end lapping each sheet a minimum of 2 inches (50 mm) and 6 inches (150 mm) respectively. Continuously seal side and end laps with tape.

B. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives, vapor retarder fasteners, or other anchorage system as recommended by manufacturer. Extend vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.

C. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into roofing system.

D. Seal vertical joints in vapor retarders over framing by lapping no fewer than two studs and sealing with vapor-retarder tape according to vapor-retarder manufacturer's written instructions. Locate all joints over framing members or other solid substrates.

E. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.

F. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

END OF SECTION 072600

**SECTION 073113**

**ASPHALT SHINGLES**

1.1 SUMMARY

A. Section Includes:

1. Glass-fiber-reinforced asphalt shingles.
2. Underlayment materials.
3. Metal flashing and trim.

B. Related requirements:
1. Section 070150.19 “Preparation for Reroofing”
2. Section 076100 “Sheet Metal Roofing”

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Asphalt shingles.
2. Underlayment materials.
3. Asphalt roofing cement.
4. Elastomeric flashing sealant.

B. Shop Drawings: For metal flashing and trim.

C. Samples: For each exposed product and for each color and blend specified.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Research reports for synthetic underlayment.

C. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An authorized installer who is trained and approved by manufacturer.

1.7 WARRANTY

A. Materials Warranty: Manufacturer agrees to repair or replace asphalt shingles that fail within specified warranty period. Basis of Design: Certainteed Grand Manor

1. Materials Warranty Period: 50 years from date of Substantial Completion, prorated, with 10-year non prorated
2. Wind-Speed Warranty Period: Asphalt shingles will resist blow-off or damage caused by wind speeds of up to 110 mph (49 m/s) for 15 years from date of Substantial Completion.
3. Algae-Resistance Warranty Period: Asphalt shingles will not discolor for 30 years from date of Substantial Completion.
4. Workmanship Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Exterior Fire-Test Exposure: Provide asphalt shingles and related roofing materials identical to those of assemblies tested for Class A fire resistance in accordance with ASTM E108 or UL 790 by Underwriters Laboratories or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.

B. Wind Resistance: Provide asphalt shingles that comply with requirements of ASTM D3161/D3161M, Class F, and with ASTM D7158/D7158M, Class H.

2.2 GLASS-FIBER-REINFORCED ASPHALT SHINGLES

A. Impact-Resistant, Laminated-Strip Asphalt Shingles: ASTM D3462/D3462M, laminated, multi-ply overlay construction; glass-fiber reinforced, mineral-granule surfaced, and self-sealing; with impact resistance complying with UL 2218, Class 4.

1. Certainteed Grand Manor
2. Butt Edge: Straight cut.
3. Strip Size: Manufacturer's standard.
4. Algae Resistance: Granules resist algae discoloration.
5. Color and Blends: As selected by Architect from manufacturer's full range color and blends.

B. Hip and Ridge Shingles: Manufacturer's standard units to match asphalt shingles.

C. Non-woven polyester ridge vent. Ridge Vent product not intended for ventilation, intended for architectural reveal.

## 2.3 UNDERLAYMENT MATERIALS

A. Self-Adhering, Polymer-Modified Bitumen Sheet: ASTM D1970/D1970M, minimum 50-mil- thick sheet; glass-fiber-mat-reinforced, polymer-modified asphalt; with slip-resistant top surface and release backing; cold applied.[ Provide primer for adjoining metal surfaces to receive underlayment.]
   1. Manufacturer: Basis of Design Henry self-adhering underlayment
      a. Product: Henry Blueskin® Tile & Metal (RF200TM)

B. Roofing Nails: EG Wire Nails, minimum 0.120-inch- (3-mm-) diameter, sharp-pointed, with a 3/8- to 7/16-inch- (10- to 11-mm-) diameter flat head of sufficient length to penetrate 1 1/2" (but not less than 1 1/4") into solid wood decking or extend at least 1/8 inch through sheathing less than 3/4 inch thick.

   1. Copper nails are in contact with metal flashing, use nails made from same metal as ZT copper flashing.

C. Underlayment Nails: Aluminum, stainless steel, or hot-dip galvanized-steel wire nails with low-profile metal or plastic caps, 1-inch minimum diameter.

   1. Provide with minimum 0.0134-inch- (0.34-mm-) thick metal cap or 0.035-inch- (0.89-mm-) thick plastic cap; and with minimum 0.083-inch- (2.11-mm-) thick ring shank or 0.091-inch- (2.31-mm-) thick smooth shank of length to penetrate at least 3/4 inch (19 mm) into roof sheathing or to penetrate through roof sheathing less than 3/4 inch (19 mm) thick.

## 2.4 METAL FLASHING AND TRIM

A. Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."

   1. Sheet Metal: ZT Copper 16 oz. sq. ft. at dome drum and chimney
      a. step flashing 4” x 4” x 12”
      b. reglet counter flashing: 4” face
   2. Sheet Metal: ZT Copper 28 oz sq ft at cricket and valley flashing

B. Fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of the item unless otherwise indicated on Drawings.

   1. Vent-Pipe Flashings: Red Copper 16 oz. sq. ft.

# PART 3 - EXECUTION

## 3.1 INSTALLATION OF UNDERLAYMENT MATERIALS

A. Comply with asphalt shingle and underlayment manufacturers' written installation instructions and with recommendations in NRCA's "The NRCA Roofing Manual: Steep-Slope Roof Systems" applicable to products and applications indicated unless more stringent requirements are specified in this Section or indicated on Drawings.

B. Self-Adhering, Polymer-Modified Bitumen Sheet: Install, wrinkle free, on roof deck in locations indicated on Drawings.

1. Comply with low-temperature installation restrictions of underlayment manufacturer.
2. Install lapped in direction that sheds water.

    a. Lap sides not less than 4 inches (102 mm).
    b. Lap ends not less than 6 inches (152 mm), staggered 24 inches (610 mm) between succeeding courses.
    c. Roll laps with roller.

3. Prime masonry, and metal surfaces to receive self-adhering sheet.
4. Cover underlayment within seven days.

## 3.2 INSTALLATION OF METAL FLASHING AND TRIM

A. Install metal flashings and trim to comply with requirements in Section 076200 "Sheet Metal Flashing and Trim" and 07610 “Sheet Metal Roofing.”

1. Install metal flashings in accordance with recommendations in NRCA's "NRCA Guidelines for Asphalt Shingle Roof Systems."
2. Bed flanges of metal flashings using asphalt roofing cement or elastomeric flashing sealant.

B. Pipe Flashings: Prefabricate soldered copper flashing around pipe penetrations and asphalt shingles. Pipe flashing flange to extend 12” upslope from centerline of pipe.

## 3.3 INSTALLATION OF ASPHALT SHINGLES

A. Verify that all carpentry repairs and surface preparations are complete and properly fastened to roof deck and gutter brackets are installed and secured to the rafter.

B. Install asphalt shingles in accordance with manufacturer's written instructions and recommendations in NRCA's "NRCA Guidelines for Asphalt Shingle Roof Systems."

C. Install starter strip along lowest roof edge consisting of an asphalt shingle strip with self-sealing strip at eave.

D. Install first and remaining courses of laminated asphalt shingles stair-stepping diagonally across roof deck with manufacturer's recommended offset pattern at succeeding courses, maintaining uniform exposure.

E. Fasten asphalt shingle strips with a minimum of six roofing nails, but not less than the number indicated in manufacturer's written instructions for roof slope and design wind speed indicated on Drawings and for warranty requirements specified in this Section.

1. Locate fasteners in accordance with manufacturer's written instructions.

2. Assure that all nails are securely seated and hammered if needed to seat all unseated nails, prior to placing the next course of shingles.
3. When ambient temperature during installation is below 50 deg F, hand seal self-sealing asphalt shingles by applying asphalt roofing cement spots between course overlaps after nailing the upper course.

F. Hip and Ridge Shingles: Provide shingle manufacturer's ridge cap shingles to be set over polyethylene ridge vent.
   1. Maintain exposure of cap shingles as published by roofing-shingle manufacturer. Lap cap shingles at ridges to shed water away from direction of prevailing winds.

   2. Fasten with roofing nails of sufficient length to penetrate sheathing.

END OF SECTION 073113

**SECTION 075216**
**STYRENE-BUTADIENE-STYRENE (SBS) MODIFIED BITUMINOUS MEMBRANE ROOFING**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Styrene-butadiene-styrene (SBS)-modified bituminous membrane roofing system
2. PMMA-based fluid-applied flashing systems at roof drain and perimeter walls
3. Roof insulation

B. Related Sections:

1. Section 061600 “Sheathing” for sheathing and coverboard
2. Section 076200 “Sheet Metal Flashing and Trim”

1.2 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" apply to work of this Section.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Roofing Conference:

1. Work of this section will be reviewed as part of the overall preconstruction meeting.
2. Coordinate Stair Roof removal and replacement work with removal and replacement of the wrought iron railing system.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

1. Submit evidence of meeting performance requirements. Basis of Design: Siplast three-part system.

1.5 INFORMATIONAL SUBMITTALS

A. Research/Evaluation Reports: For components of membrane roofing system, from ICC-ES.

B. Sample Warranties: For manufacturer's special warranties.
1. 20-year manufacturer’s warranty.

C. Qualification Data: For Installer and manufacturer.

## 1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system to include in maintenance manuals.

B. Inspection Report and Punchlist: Contractor and roofing system manufacturer's post-installation punchlist of open items. Copy of roofing system manufacturer's inspection report of completed roofing installation.

## 1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by membrane roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty. Qualified installer must have held such approval or license for a minimum of five years.

B. Manufacturer Qualifications: A qualified manufacturer that has FM Global approval for roofing system identical to that used for this Project.

C. Acceptable Products: Obtain components for membrane roofing system approved by membrane roofing manufacturer. Provide secondary or accessory products which are acceptable to the manufacturer of the primary roofing products.

D. Project Acceptance: Submit a completed manufacturer's application for roof guarantee form along with shop drawings of the roofs showing all dimensions, penetrations, and details. The form shall contain all the technical information applicable to the project including deck types, roof slopes, base sheet and/or insulation assemblies (with method of attachment, and fastener type), and manufacturer's membrane assembly proposed for installation. The project must receive approval, through this process, prior to shipment of materials to the project site.

## 1.8 PERFORMANCE REQUIREMENTS

A. General: Provide installed roofing membrane and base flashings that remain watertight; do not permit the passage of water; and resist specified uplift pressures, thermally induced movement, and exposure to weather without failure.

B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.

C. Energy Performance: Provide roofing system with initial Solar Reflectance Index not less than 78 when calculated according to ASTM E 1980 based on testing identical products by a qualified testing agency.
   1. Philadelphia Energy Code: Minimum R-Value 30.

D. Roofing System Design: Provide membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE/SEI 7.

   1. Corner Uplift Pressure: 50.6 lbf/sq. ft. (kPa/sq. m)>.

E. FYI wood decks fail FM testing. They also do not qualify for a ROOF-NAV rating.

1.9 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

PART 2 - PRODUCTS

2.1 MULTI-PLY SBS-MODIFIED BITUMEN ROOFING SYSTEM

A. Source Limitations: Obtain components including roof insulation, fasteners, perimeter metal flashing and edge systems, for roofing system from same manufacturer as membrane roofing or manufacturer approved by membrane roofing manufacturer.

B. Roofing Membrane Assembly Description: A cold-applied, roof membrane assembly consisting of two plies of a prefabricated, reinforced, homogeneous Styrene-Butadiene-Styrene (SBS) block copolymer modified asphalt membrane, applied over a prepared substrate. Reinforcement mats shall be impregnated/saturated and coated each side with SBS modified bitumen blend.

C. Manufacturers: Basis of Design system Siplast; Paradiene 20/30 roof system.

1. Provide basis of design product, Siplast or equal product by one of the following:

a. Siplast; 20 – 30 SBS roof system.

D. Roofing Membrane Base and Stripping Ply: Roofing Membrane Sheet: ASTM D 6163, Grade S, Type I, SBS-modified asphalt sheet (reinforced with glass fibers) or

E. Granule-Surfaced Roofing Cap Sheet/ Finish Ply: ASTM D 6163, Grade G, Type I, SBS-modified asphalt sheet (reinforced with glass fibers) or ASTM D 6164/D 6164M, Grade G, Type I, SBS-modified asphalt sheet (reinforced with polyester fabric) granule surfaced; suitable for application method specified.

1. Basis of Design: Siplast; Paradiene 30.

a. Top Ply Surfacing: Ceramic granule finish, Bright White (BW) color.

2. Provide basis of design product, or equal product listed below:

a. Siplast; Paradiene 30

2.2 PMMA BASE FLASHING MATERIALS

A. Backer Sheet: ASTM D 6163, Grade S, Type I or II, SBS-modified asphalt sheet (reinforced with glass fibers) or ASTM D 6163/D 6163M, Grade S, Type I or II, SBS-modified asphalt sheet (reinforced with polyester fabric; smooth surfaced; suitable for application method specified.

1.

B. Liquid Applied Flashing: A liquid and fabric reinforced flashing system created with a stitchbonded polyester scrim and a two-component, moisture cured, elastomeric, liquid applied flashing material, consisting of an asphalt extended urethane base material and an activator.

1. Basis of Design: Siplast; Parapro 123 Flashing System.

a. Surface Finish: finish, smooth,,. white.

2. Provide basis of design product, or equal product listed below:

a. Siplast: ParaPro 123.Flashing System.

C. Fleece for Membrane Reinforcement: a non-woven, 110 g/m$^2$, needle-punched polyester fabric reinforcement as provided by the membrane system manufacturer.

## 2.3 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing.

B. Asphalt Primer: ASTM D 41/D 41M.

C. Cold-Applied Adhesive: Roofing system manufacturer's standard asphalt-based, one- or two-part, asbestos-free, cold-applied adhesive specially formulated for compatibility and use with roofing membrane and base flashings, conforming to ASTM D4479.

D. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required by roofing system manufacturer for application.

E. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roofing components to substrate; tested by manufacturer for required pullout strength, and acceptable to roofing system manufacturer.

F. Roofing Granules: Ceramic-coated roofing granules, No. 11 screen size with 100 percent passing No. 8 (2.36-mm) sieve and 98 percent of mass retained on No. 40 (0.425-mm) sieve, color to match roofing.

## 2.4 INSULATION SUBSTRATE BOARD

1. High Density Gypsum: HD Gypsum ½” thick.
   a. Secure to deck as necessary.

## 2.5 ROOF INSULATION

A. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2 closed cell, rigid polyisocyanurate foam core material, integrally laminated between glass fiber facers. Insulation to be provided by roofing membrane manufacturer as part of a complete roofing system.

1. Minimum “R-value” R-30 in accordance with Philadelphia Energy Code.

2. Provide in two layers of 2.6”.

a. First layer secured with screws and insulation plates at the rate of 1 fastener per 2 square feet of roof area.

B. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to provide positive slope to drain.

2.6 INSULATION COVER BOARD

1. High Density Gypsum: HD Gypsum ½" thick.
   a. Set in urethane foam adhesive

2.7 INSULATION ACCESSORIES

A. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.
   1. Base layer: 1 fastener per 2 sq ft

B. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer.
   1. Siplast Para Stik

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Comply with roofing system manufacturer's written instructions.

B. Substrate- Preparations: Prevent roofing asphalt and adhesives from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction. Verify that all roof deck repairs/replacement work is complete.

C. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:

   1. Verify that roof drains are securely clamped in place.
   2. Verify that scupper is infilled.
   3. Verify that masonry work at parapet is complete.
   4. Verify that railing fastener hardware is approved by EoR.
   5. Asphaltic Primer: Prime metal and masonry surfaces to be flashed with a uniform coating of the specified asphalt primer.

3.2 INSULATION INSTALLATION

A. Coordinate installing substrate board roofing system components so insulation is not exposed to precipitation or left exposed at the end of the work day.

B. Install insulation in two layers of 2.6" each.

C. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.

1. Cut and fit insulation within parapet and rising.

D. Mechanically Fastened Insulation: Install each layer of insulation and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.

1. Fasten insulation to resist uplift pressure at corners.

2. Adhere second layer of insulation in urethane adhesive.

E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.

## 3.3 ROOFING MEMBRANE INSTALLATION

A. Install roofing membrane system according to roofing system manufacturer's written instructions and applicable recommendations of ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing."

B. Coordinate installing roofing system so insulation and other components of the roofing membrane system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.
1. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system.

C. Where roof slope exceeds 3/4 inch per 12 inches (1:18) install roofing membrane sheets parallel with slope.

## 3.4 BASE PLY INSTALLATION

A. Install (1) one ply of base ply membrane shingled uniformly to achieve one ply throughout over the prepared substrate. Shingle in proper direction to shed water on each large area of roofing.

B. Lap ply sheet ends eight inches. Stagger end laps twelve inches minimum.

C. Extend plies two inches beyond top edges of cants at wall and projection bases.

D. Set base ply in adhesive at manufacturer’s suggested rate.

E. Install base flashing ply to all perimeter and projection details.

## 3.5 TOP PLY - MODIFIED MEMBRANE APPLICATION

A. The modified membrane shall then by solidly bonded to the base ply with specified adhesive at the manufacturer’s specified rate.

B. The roll must push a puddle of asphalt in front of it with asphalt slightly visible at all side laps. Care should be taken to eliminate air entrapment under the membrane.

C. Apply pressure to all seams to ensure that the laps are solidly bonded to substrate.

D. Subsequent rolls of modified shall be installed across the roof as above with a minimum of 4” side laps and 8” end laps. The end laps shall be staggered. The modified membrane shall be laid in the same direction as the underlayers but the laps shall not coincide with the laps of the base layers.

E. Apply asphalt no more than five feet ahead of each roll being embedded.

F. Extend membrane 2” beyond top edge of all cants in a full troweling of the specified asphalt cement as shown on the drawings.

## 3.6 FLASHING AND STRIPPING INSTALLATION

A. Extend base flashing up walls or parapets a minimum of 8 inches (200 mm) above roofing membrane and 4 inches (100 mm) onto field of roofing membrane.

B. Mechanically fasten top of base flashing securely at terminations and perimeter of roofing.

C. Install the PMMA flashing system.

D. The entire base ply sheet of flashing membrane must be solidly adhered to the substrate.

E. Seal all vertical laps of flashing membrane with a three-course application of PMMA Flashing and fleece.

## 3.7 FIELD QUALITY CONTROL

A. A roof inspection is required by manufacturer before warranty issue.
   1. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Architect.

B. Repair or remove and replace components of roofing system where test results or inspections indicate that they do not comply with specified requirements.

C. Final Inspection: Hold a meeting at the completion of the project, attended by all parties that were present at the pre-job conference. A punch list of items required for completion shall be compiled by the Contractor and the manufacturer's representative. Complete, sign, and mail the punch list form to the manufacturer's headquarters.

D. PROTECTING AND CLEANING

E. Protect roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

F. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

G. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

H. Uncured resin is considered a hazardous material. Unused resin must be catalyzed and cured prior to disposal.

I. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

END OF SECTION 075216

**SECTION 076100**

**SHEET METAL ROOFING**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Custom-fabricated sheet metal roofing.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood deck and substrate repairs if not specified in this Section.
2. Section 084513 “Structured Polycarbonate Panel Assemblies" for prefabricated octagonal oculus designed to OSHA safety requirements.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each of the following:

1. Roofing sheet metal.
2. Underlayment materials.
3. Rosin sized paper.
4. Fasteners.
5. Sealant tape.
6. Elastomeric sealant.
7. Butyl sealant.

B. Shop Drawings:

1. Include plans, elevations, sections, faux rib details, and various cleat and attachment details.
2. Detail fabrication and panel installation layouts, expansion joint locations, points of fixity, and keyed details. Distinguish between shop- and field-assembled Work.
3. Include details for forming, including seams and dimensions.
4. Include details for joining and securing, including layout and spacing of fasteners, cleats, and other attachments. Include pattern of seams.
5. Include details of expansion joints, including showing direction of expansion and contraction from points of fixity.
6. Include details of roof penetrations.
7. Include details of hip and rib conditions, including folding of standing seams at skylight curb, corners, termination and counter flashing.
8. Include details of special conditions including removable and replaceable gutter system.

9. Include details of connections to adjoining work at skylight, gutter and skirt transition.

C. Samples: For each exposed product and for each color and texture specified, 6 inches long by 6 inches wide.

D. Contractor to provide mockup of skirt/gutter/dome transition. Dimensions to be 36” wide by full height of skirt including gutter up to and including transition to dome.

E. Delegated Design of Lightning Arrestor System: Contractor to determine need for a lightning arrestor system to mitigate potential conductivity of roof assembly including existing deck surface, new gutter substrate, skirt framing and blocking for skylight frame attachment components and systems attaching to copper sheet metal roofing.

Local Vendor: Warren Lightning Rod Co, Collingswood, NJ

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved.

B. Evaluation Reports: For self-adhering, high-temperature sheet underlayment, from ICC-ES.
1. Provide Submittal Product Data sheets for gutters and shingles.
2. Cast iron fasteners and epoxy fasteners, see structural.

C. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing sheet metals and accessories to include in maintenance manuals.

B. Special warranties. 5-year contractor watertight warranty for copper dome and gutter waterproofing.

1.6 WARRANTY

A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal roofing that shows evidence of deterioration of factory-applied finishes within specified warranty period. 20-year aluminum finish warranty.

1. Exposed Panel Finish: Mill

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Sheet metal roofing system, including, but not limited to, metal roof panels, cleats, anchors and fasteners, sheet metal flashing integral with sheet metal roofing, custom sloped gutter panels, faux rib **battens**, underlayment, and accessories, is to comply with

requirements without failure due to defective manufacture, fabrication, or installation, or due to other defects in construction. Sheet metal roofing is to remain watertight.

B. Sheet Metal Roofing Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or indicated on Drawings.

C. Copper Roofing Standard: Comply with CDA's "Copper in Architecture Handbook." Conform to dimensions and profiles shown unless more stringent requirements are specified or indicated on Drawings.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F (67 deg C), ambient; material surfaces temperature change.

## 2.2 ROOFING SHEET METALS

a. Batten Caps: Nominal 0.028 inch thick.

B. Copper Sheet: ASTM B370 cold-rolled copper sheet, H00 temper.
1. Weight (Thickness): 20 oz./sq. ft. unless otherwise indicated.

a. Faux Rib (Batten) Caps: 24 oz./sq. ft. thick.

## 2.3 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet Underlayment: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.

1. WR Grace
2. Thermal Stability: ASTM D1970/D1970M; stable after testing at 240 deg F or higher.
3. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F or lower.

B. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. minimum.

## 2.4 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners [**solder**], protective coatings, sealants, and other miscellaneous items as required for complete roofing system and as recommended by primary sheet metal manufacturer unless otherwise indicated.

B. Wood Blocking: Lumber according to requirements for nailers for roofing in Section 061000 "Rough Carpentry."

C. Fasteners: Wood screws, annular-threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.

1. General:
   a. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws, gasketed; with hex-washer head.
   b. Blind Fasteners: High-strength aluminum or stainless steel rivets suitable for metal being fastened.

2. Fasteners for Painted Aluminum: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.
3. Fasteners for Aluminum Extrusions: As provided, specified by skylight manufacturer, or Series 300 stainless steel.
4. Fasteners for Copper Sheet: Copper, hardware bronze, or passivated Series 300 stainless steel.
5. Copper Fasteners for cleats: Copper wire nails, or passivated Series 300 stainless steel.
6. Fasteners for Stainless Steel Sheet: Series 300 stainless steel.

D. Solder:
1. For Copper: ASTM B32, [Grade Sn50, 50 percent tin and 50 percent lead]
2. For Stainless Steel: ASTM B32, [Grade Sn96], with acid flux of type recommended by stainless steel sheet manufacturer.

E. Elastomeric Sealant: ASTM C920, elastomeric [polyurethane] [polyurethane-silicone] polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal roofing and remain watertight.

Retain "Butyl Sealant" Paragraph below for expansion joints with limited movement.

F. Butyl Sealant where open gutter meets valley: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

G. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D1187.

H. Underlayment Adhesive:

## 2.5 ACCESSORIES

A. Sheet Metal Accessories: Provide components required for complete sheet metal roofing assembly, including trim, cladding, gutters, counter flashing, Faux Rib covers, hips and corner units, clips, flashings, sealants, gaskets, fillers, metal closures, closure strips, and similar items. Match material and finish of sheet metal roofing unless otherwise indicated.

1. Cleats: Intermittent and continuous attachment devices for mechanically seaming into joints and formed from the following materials and thicknesses unless otherwise indicated:
   a. Copper Roofing Starter Cleats: 32-oz./sq. ft.
   b. Faux Rib Batten Cover Cleats: 32-oz./sq. ft.
   c. Faux Rib Batten Covers: 28-oz./sq. ft.
   d. Transition flashings: 24-oz./sq. ft. copper sheet.
   e. Copper Roofing Seam Cleats: 20-oz./sq. ft. standing seam starter
   f. Flashing and Counter Flashings and cleats: Minimum 20-oz./ sq. ft.
   g. ZT Copper (step and counter flashing and open downspout): Minimum 20-oz

2. Expansion-Type Cleats: Cleats of a design that allows longitudinal movement of roof panels without stressing panel seams; of same material as other cleats.
3. Backing Plates: Plates at roofing splices, fabricated from material recommended by SMACNA's "Architectural Sheet Metal Manual."
4. Flashing and Trim: Formed from same material and with same finish as sheet metal roofing, minimum 20-oz./ sq. ft.

B. Skylight Curb Capping: Fabricated from same material and finish as sheet metal roofing, minimum thickness matching the sheet metal roofing.
1. Fabricate curb and sub-framing to withstand indicated loads of size and height indicated.
2. Coordinate dimensions with skylight frame information and Shop Drawings.

## 2.6 FABRICATION

A. Custom-Fabricated Sheet Metal Roofing: Comply with details shown and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions (panel width and seam height), geometry, metal thickness, and other characteristics of installation. Fabricate sheet metal roofing and accessories in shop to greatest extent possible.
1. Standing-Seam Roofing: Form standing-seam panels with finished seam height of 1 inch

B. Form exposed sheet metal work to fit substrates with little oil canning; free of buckling and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
1. Lay out sheet metal roofing to conform with the curved surface of the dome in a manner to reduce and/or eliminate oil canning of the copper sheets.
2. Lay out sheet metal roofing, so transverse seams, if required, are made in direction of flow, with higher panels overlapping lower panels.
3. Offset transverse seams from each other 50% of panel length matching seam elevations on alternating panels. Provide a visually balanced seam pattern.
4. Fold and cleat eaves and transverse seams in shop to the greatest extent possible.
5. Form and fabricate sheets, seams, strips, cleats, valleys, ridges, edge treatments, integral flashings, and other components of metal roofing to profiles, patterns, and drainage arrangements indicated on Drawings and as required for leakproof construction.

C. Replaceable Built-In Gutters: Fabricate to cross section indicated, with minimally riveted and soldered joints, complete with expansion seams, spill-out scupper, custom receiver and counterflashing with soldered blind hold down cleats, and other special accessories as required.

1. Fabricate octagonal corner sections with minimum 24” long sections in both directions.
2. Fabricate custom gutter in lengths as long as possible. Slope gutters toward spill-out scupper beginning 180 degrees opposite the scupper.
3. Fabricate expansion joints in gutter pans, formed with positive shingling in the direction of flow, gutters unless otherwise indicated. Corners are assumed fixed locations.
4. Fabricate gutters with built-in expansion joints.

D. Expansion Provisions: Fabricate sheet metal roofing to allow for expansion in running work sufficient to prevent leakage, damage, and deterioration of the Work.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints upslope from corners and only where indicated on Drawings.

E. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to SMACNA's "Architectural Sheet Metal Manual."
   1. Use only with written approval as this is not a preferred detail. Review with Architect and Consultant prior to assembling.

F. Sheet Metal Accessories: Custom fabricate flashings and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item required. Obtain field measurements for accurate fit before shop fabrication.

   1. Form exposed sheet metal accessories without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
   2. Seams: Tin edges (of gutter pans) to be seamed, form seams, and solder.
   3. Fabricate cleats and attachment devices of sizes recommended by SMACNA's "Architectural Sheet Metal Manual" for application, but not less than thickness of metal being secured.
      a. Standing seam starter strip to be 32-oz. copper

G. Do not use graphite pencils to mark metal surfaces.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine roof assembly to verify that repairs are complete and that sheathing is secured to the rafters. Verify sheathing and T&G decking to extent possible that joints are tight and that tops of fasteners are concealed in the T&G and/or flush with surface, and that infill installation is within flatness tolerances required for finished roofing installation.

B. Verify that High temperature Self-Adhering Underlayments (HT-SAU) water-resistant barriers have been installed over sheathing substrate to prevent water penetration.

### 3.2 PREPARATION

A. Lay out panel arrangement, before installation of sheet metal roofing.

   1. Custom taper each gutter pan to fit slope and provide an even streetside gutter leg.
   2. Space fasteners not more than 18 inches o.c.

### 3.3 UNDERLAYMENT INSTALLATION

A. Self-Adhering High-Temperature Sheet Underlayment:

   1. Install self-adhering high-temperature sheet underlayment, wrinkle free.
   2. Prime substrate if recommended by underlayment manufacturer.
   3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.
   4. Apply in diagonal shingle fashion to shed water, with end laps of not less than 6 inches between courses. Provide continuous sheets covering from skylight blocking at top, covering dome and lapping onto gutter HT-SAU.

5. Overlap side edges not less than 3-1/2 inches.
6. Roll laps and edges with roller.
7. Cover underlayment within 14 days of installation.
8. Install self-adhering high-temperature underlayment at the following locations:
   a. Hips and ridges for a distance on each side, 3 inches
   b. Around dome corners, lapping 3” each direction.
   c. Below entire area of integral gutters, including; over skirt blocking, entire gutter pan area and upslope onto dome roof deck 18” minimum.
   d. Entire dome roof deck, turn up onto, and cover blocking. Trim even with (interior) blocking.

B. Install slip sheet, wrinkle free, over underlayment before installing sheet metal roofing and related flashing.

1. Install rosin underlayment just ahead of standing seam panel.

2. Install in shingle fashion, with lapped joints of not less than 4 inches.

C. Install gutter and/or roofing panels and flashings to cover slip sheet according to requirements in Section 076200 "Sheet Metal Flashing and Trim."

## 3.4 INSTALLATION, GENERAL

A. Install sheet metal roofing to comply with details shown and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to installation characteristics required unless otherwise indicated on Drawings.

1. Install cleats, fasteners, solder, separators, sealants, and other miscellaneous items as required for complete roofing and gutter system.
2. Install sheet metal roofing true to vertical line, and slopes. Provide uniform, neat seams with minimum oil canning and/or wrinkles.
3. Anchor sheet metal roofing and other components of the Work securely in place, with provisions for thermal and structural movement.
4. Do not field cut sheet metal roofing by torch.
5. Provide sheet metal cleats and flashings at locations identified on the contract drawings, but not in quantities published in the SMACNA manual.
6. Flash and seal sheet metal roofing with counter flashings and secure with blind soldered cleats.
7. Provide soldered caps at nails and solder over rivets and/or exposed fasteners.
8. Locate and space fastenings not greater than 18” o. c.
9. Install faux hip covers at corners (8) and center elevation locations (8) as sheet metal roofing work proceeds to avoid damaging panels.
10. Lap metal flashing over sheet metal roofing to direct moisture to run over and off roofing.
11. Do not use graphite pencils to mark metal surfaces.

B. Fasteners: Use fastener sizes that penetrate wood blocking and/or deck not less than 1-1/4 inches (32 mm) for nails and wood screws or substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

C. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating, by applying self-adhering sheet underlayment to each contact surface, or by other permanent separation as recommended in SMACNA's "Architectural Sheet Metal Manual."

1. Do not allow sheet metal roofing to contact wood, ferrous metal, or cementitious construction.

D. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

E. Skirt Transition Flashing:

1. Custom taper gutter pans to fit slope and provide an even streetside gutter leg.

## 3.5 CUSTOM-FABRICATED SHEET METAL ROOFING INSTALLATION

A. Install sheet metal roofing system with lines and corners of exposed units true and accurate.
1. Fold over panel seams and gently peen flat at transition to hip and skylight blocking.
2. Turn roof pans and folded seams up onto skylight blocking and peen gently into transition.
3. Do not cause metal fatigue by over peening.
4. Form exposed faces flat and free of buckles, excessive waves, and avoidable tool marks, considering metal temper and reflectivity.
5. Provide uniform, neat hand folded seams with no exposure of solder, welds, and/or sealant.
6. Fold back sheet metal to form hem on concealed side of exposed edges of flashings, unless otherwise indicated.
7. Pre-tin seams to be soldered.

B. Install cleats to hold sheet metal roofing panels in position.

1. Attach each cleat with at least two fasteners to prevent rotation.
2. Space cleats not more than 16 inches o.c.
3. Bend tabs over fastener head.
4. Provide expansion-type cleats for roof panels that exceed 20 feet in length.

C. Seal expansion joints as approved and required for watertight construction.

1. Use sealant-filled joints only where identified in the gutter and skylight only.

a. Embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant.
b. Form joints to completely conceal sealant.
c. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way.
d. Adjust setting proportionately for installation at higher ambient temperatures.
e. Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).

2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

D. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter.

1. Pre-tin edges of gutter pans to be soldered, with solder to a width of 1-1/2 inches; however, reduce pre-tinning where pre-tinned surface would show in completed Work.
2. Do not use torches for soldering.
3. Heat surfaces to receive solder, and flow solder into joint.

a. Fill joint completely.
b. Completely remove flux and spatter from exposed surfaces.

4. Copper Soldering: Tin edges of uncoated sheets, using solder for copper.

E. Rivets: Rivet joints in aluminum where necessary for strength. Copper rivets at copper seam fully soldered.

F. Standing-Seam Roofing:
Lock panels to hips with concealed cleats, form and roll hip corners, and crimp tight.

3.6 CUSTOM FABRICATED BUILT-IN GUTTER

1. Attach gutter pan to skirt blocking with 2” cleats, 16” o.c., fastened to blocking using 2 nails per 2” cleat.
2. Attach standing-seam metal panels to substrate with double-fastened cleats spaced at 16 inches o.c.
3. Install panels reaching from eave to ridge skylight blocking and fold finished seam turning up onto skylight blocking, before moving to adjacent panels.

a. If transverse joints are required, stagger joints in adjacent panels at one even elevation.

4. Lock standing seams by folding over twice, so cleat and panel edges are completely engaged.
5. Lock each panel to panel below with sealed transverse seam. Use only where panel lengths in excess of 10-feet are required.
6. Loose-lock panels at eave edges to continuous heavy cleat at roof to gutter transition.
7. Lock panels to dome, above gutter, on standing seam starter strip.

8. **Fold over seams** at hips and skylight blocking.

G. Custom Batten Hip and Custom Mid Elevation Ribs:

1. Secure Faux Batten Hip Covers in place with cleats secured through hip standing seam.
2. Mid Elevation Faux Ribs Hold cleats to substrate with intermittent cleats as detailed on the contract drawings. Pre tin pan in cleat area and solder cleats to roof pan.
3. Hook each faux rib cover onto cleats.
4. Form ribs to fit close to roof and fabricate end caps riveted in place.
5. Loose-lock panels at eave to continuous cleat at top of gutters.

H. Custom Replaceable Built-In Gutters:

1. Install self-adhering, high-temperature sheet underlayment inside built-in gutter and covering dome and blocking as indicated on drawings and here-in.
2. Fabricate spill-out scupper and place into open spout at skirt.
   a. Pre tin and solder scupper seams and deck flange at gutter interface.
3. Fabricate tapered gutter pans to fit onto substrate and allow ¼” both dome side and streetside for thermal movement, and the low, downslope pan end fits neatly into the previously installed pan without bowing and lap 1-1/2” onto pre tinned pan.
4. Place custom gutter segments into gutter framing covering HT-SAU and rosin, beginning at spill-out scupper and lapping onto the scupper spill-out pre tinned flange, 1-1/2”.
5. Secure gutter segments to blocking at skirt with 2 nails, through 2” cleats, 16” o. c.
6. Back leg upstand of gutter to be 12” up the dome and secured with 2 nails, through 2” cleats, 2 per each of 8 gutter segments and/or as necessary and to allow thermal movement.
7. Solder assembled gutter seams before the end of each work day.

8. Protect open gutter from damage and weather until standing seam roofing above is complete. Remove debris promptly.
9. Slope gutters to drainage point.
10. Provide fully soldered, watertight gutter system.

## 3.6 ACCESSORY INSTALLATION

A. Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion.

1. Coordinate installation with flashings and other components.
2. Install components required for complete sheet metal roofing assembly, including gutters, trim, flashings, sealants, skylight counter flashing, fillers, metal closures, closure strips, and similar items.
3. Install accessories integral to sheet metal roofing that are specified in Section 076200 "Sheet Metal Flashing and Trim" to comply with that Section's requirements.

B. Flashing and Trim: Comply with performance requirements and SMACNA's "Architectural Sheet Metal Manual."

1. Provide concealed fasteners where possible, and install units true to line, levels, and slopes.
2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.
3. Install flashing and trim as required to seal against weather and to provide finished appearance, including, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers.
4. Install continuous strip of self-adhering underlayment at edge of continuous flashing overlapping self-adhering underlayment, where "continuous seal strip" is indicated in SMACNA's "Architectural Sheet Metal Manual" and on Drawings.
5. Install exposed flashing and trim without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
6. Install sheet metal flashing and trim to fit substrates, and to result in waterproof and weather-resistant performance.
7. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.
    a. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, and filled with butyl sealant concealed within joints.
    b. Use lapped expansion joints only where indicated on Drawings.

C. Pipe Flashing: Form flashing around pipe penetration and sheet metal roofing. Fasten and seal to sheet metal roofing as recommended in SMACNA's "Architectural Sheet Metal Manual."

D. Skylight Curb: Install flashing around panned panel tops where curb meet sheet metal roofing.

## 3.7 CLEANING

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. On completion of sheet metal roofing installation, clean finished surfaces as recommended by sheet metal roofing manufacturer.

C. Clean and neutralize flux materials with sodium bicarbonate and water. Agitate without scratching panel finish. Clean off excess solder.

D. Clean off excess sealants.

3.8 PROTECTION

A. Remove temporary protective coverings and strippable films as sheet metal roofing is installed unless otherwise indicated in manufacturer's written installation instructions.

B. Prohibit traffic of any kind on installed sheet metal roofing.

C. Maintain sheet metal roofing in clean condition during construction.

D. Replace sheet metal roofing components that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Architect.

E. Protect gutter from construction traffic

END OF SECTION 076100

**SECTION 076200**

**SHEET METAL FLASHING AND TRIM**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Reglet counterflashing.
2. Formed roof-drainage sheet metal fabrications.
3. Formed low-slope roof sheet metal fabrications.
4. Formed steep-slope roof sheet metal fabrications.
5. Gutters, Scupper and Downspouts

1.2 RELATED SECTIONS

1. Section 07311 “Asphalt Shingles”
2. Section 07610 “Sheet Metal Roofing”
3. Section 09240 “Cement Plastering”

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each of the following

1. Underlayment materials.
2. Elastomeric sealant.
3. Butyl sealant.
4. Solder.

B. Shop Drawings: For sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
8. Include details of roof-penetration flashing.

9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, flashings, and counterflashings.
10. Include details of special conditions.
11. Include details of connections to adjoining work.

C. Samples: For each exposed product and for each color and texture specified, long by actual width. Provide color options for preliminary color selection and a final selection based on review of physical samples.
1. Half Round Gutter 12 inches long by 8” wide
2. Copper sheet: 2 of each gauge, 2” x 4”
   a. Copper: 32 oz., 28 oz., 24 oz., 20 oz.
   b. ZT coated copper: 16 oz., and 20 oz.
3. Powder-coated steel downspout and gutter

## 1.5 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Gutter Bracket

## 1.6 CLOSEOUT SUBMITTALS

A. Special warranty.

## 1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

## 1.8 WARRANTY

# PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, are to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim are not to rattle, leak, or loosen, and are to remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual: Architectural Metal Flashing, and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. Sheet Metal Standard for Copper: Comply with CDA's "Copper in Architecture Handbook." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

2.2 SHEET METALS

A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Copper Sheet: ASTM B370, cold-rolled copper sheet, H00 or H01 temper.

1. Revere
2. Nonpatinated, Exposed Finish: Mill.

C. Powder-coated Steel upper section of downspout: Standard construction shall be12 gauge 0.1094” thick Stainless Steel, ASTM A 240/A 240M, Type 304. as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.

1. Manufacturers: Piedmont Downspout Adapters by Piedmont Pipe Construction, Inc. (1.877.489.0911) 7907 Commerce Drive, Denver, North Carolina, 28037 www.piedmontpipe.com

2. Color: Powder Coat: A 2-5 mil UV resistant polyurethane finish coating shall be electrostatic applied to the chemically prepared metal surfaces at a temperature not below 250 degrees.
   a. Color Options: One of 15 standard powder coat colors to be selected by Architect.

D. ZT Copper Sheet (ASTM B370). Cold-rolled: 20 oz per sf ZT copper sheet. Mill finish.

2.3 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet Underlayment: Minimum 30 mils (0.76 mm) thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer in accordance with underlayment manufacturer's written instructions.

1. Approved Maufacturers:
   a. WR Grace
   b. GAF

B. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F (29 deg C) or lower.

C. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. minimum.

2.4 MISCELLANEOUS MATERIALS

A. Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.

    a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
    b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.

2. Fasteners for Copper Sheet: Copper, hardware bronze or passivated Series 300 stainless steel.
3. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
4. Fasteners for Stainless Steel Sheet: Series 300 stainless steel.

C. Solder:

1. For Copper: ASTM B32, Grade Sn50, 50 percent tin and 50 percent lead.

D. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

E. Elastomeric Sealant: ASTM C920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

F. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

G. Bituminous Coating: Cold-applied asphalt emulsion in accordance with ASTM D1187/D1187M.

H. Asphalt Roofing Cement: ASTM D4586, asbestos free, of consistency required for application.

I. Reglet Counter Flashing: Shop formed from specified materials, gauge and finish.
1. Material: Copper, 20 oz./sq. ft. Aluminum, 0.040 inch thick.

## 2.5 FABRICATION, GENERAL

A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.

1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
2. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
4. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances:

1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
2. Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified.

C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.

E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

F. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard and by FM Global Property Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.

G. Seams:

1. Fabricate nonmoving copper seams with flat-lapped seams. Tin edges to be seamed, form seams, and solder.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.

## 2.6 ROOF-DRAINAGE SHEET METAL FABRICATIONS

A. Hanging Gutters:
1. Furnish custom gutter brackets.

2. Fabricate 8” half-round, powder-coated steel to cross section required, complete with end pieces, outlet tubes, and other accessories as required.
3. Fabricate in maximum manageable lengths.
4. Fabricate expansion joints, expansion-joint covers and gutter accessories from same metal as gutters.
5. Shop fabricate interior and exterior corners.
6. Fabricate from the following materials:
    a. Steel shall be 12 gauge 0.1094” thick Stainless Steel, ASTM A 240/A 240M, Type 304 Powder-coated finish. Touch up paint to match custom finish.
    b. ZT Copper Sheet. Cold-rolled: 20 oz per sf ZT Copper Sheet. Mill finish. See Section 07610 “Sheet Metal Roofing”

B. Built-in Gutters:

1. Fabricate to cross section required, with riveted and soldered joints, complete with end pieces, outlet tubes, and other special accessories as required.

2. Fabricate in minimum 24-inch-long sections. Fabricate expansion joints and accessories from same metal as gutters unless otherwise indicated.
3. Fabricate gutters with built-in expansion joints.
4. Fabricate from the following materials:

   a. Copper: 24 oz./sq. ft. .

   b. Mill finish.

C. Scuppers: Fabricate and field form spill-out scupper at low point of replaceable built-in gutter. Cut and shape copper sheet of same gauge as built-in gutter.
   a. Copper: 24 **oz./sq. ft. .**
   b. Mill finish.

D. Half-round Gutter: Fabricate open-face at skirt, and rectangular downspouts to dimensions indicated as approved on Shop Drawings, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors. Shop fabricate elbows.

1. Hanger Style: Custom Bracket.
2. Fabricate from the following materials:
   a. 3/16” x 1-1/2” powder-coated steel bar, to match gutters.

E. Downspouts: Fabricate rectangular 3” x 4” shop-formed downspouts, where shown on elevation drawings complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors. Shop fabricate elbows.

1. Hanger Style: Custom Bracket., painted to match downspout.
2. Fabricate from the following materials:
   a. 1/8” x 2” Powder-coated steel bar

F. Splash Pan below open-face downspout at valley: Fabricate to dimensions and shape required and from the following materials:

1. ZT Copper: 20 oz./sq. ft.

## 2.7 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Built-in Metal Flashings at Drum: Shop fabricate interior and exterior corners**.** Fabricate from the following materials:

1. Copper Fabric Flashing: 5-oz./sq. ft.

B. Step Flashing: Fabricate from the following materials:
1. ZT Copper: 20 oz./sq. ft.

C. Roof-Penetration Flashing: Fabricate from the following materials:

1. ZT Copper: 20 oz./sq. ft.

2.8 STEEP-SLOPE ROOF SHEET METAL FABRICATIONS

A. Apron, Step, Cricket, and Backer Flashing: Fabricate from the following materials:
   1. ZT Copper: 20 oz./sq. ft.

B. Reglet Counterflashing: Fabricate from the following materials:

   1. ZT Copper: 20 oz./sq. ft.

C. Valley Flashing: Fabricate from the following materials:

   1. ZT Copper: 28 oz./sq. ft.

D. Step Flashings: Fabricate from the following materials:

   1. ZT Copper: 20 oz./sq. ft.

PART 3 - EXECUTION

3.1 INSTALLATION OF UNDERLAYMENT

A. Self-Adhering, High-Temperature Sheet Underlayment:

   1. Install self-adhering, high-temperature sheet underlayment; wrinkle free.
   2. Prime substrate if recommended by underlayment manufacturer.
   3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.
   4. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses.
   5. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller.
   6. Roll laps and edges with roller.
   7. Cover underlayment within 14 days.

B. Install slip sheet, wrinkle free, **over underlayment** before installing sheet metal flashing and trim.

   1. Install in shingle fashion to shed water.
   2. Lapp joints not less than 4 inches.

3.2 INSTALLATION, GENERAL

A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.

   1. Install fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
   2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder and sealant.
   3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.

4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
5. Install continuous cleats with fasteners spaced not more than 12 inches o.c.
6. Space individual cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
7. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
8. Do not field cut sheet metal flashing and trim by torch.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.
1. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws but into substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as required for watertight construction.

1. Use sealant-filled joints unless otherwise indicated.

a. Embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant.
b. Form joints to completely conceal sealant.
c. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way.
d. Adjust setting proportionately for installation at higher ambient temperatures.

1) Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).

2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter.

1. Pretin edges of sheets with solder to width of 1-1/2 inches; however, reduce pretinning where pretinned surface would show in completed Work.
2. Do not solder aluminum sheet.
3. Do not pretin zinc-tin alloy-coated copper.
4. Do not use torches for soldering.
5. Heat surfaces to receive solder, and flow solder into joint.

a. Fill joint completely.
b. Completely remove flux and spatter from exposed surfaces.

6. Copper Soldering: Tin edges of uncoated sheets, using solder for copper.

H. Rivets: Rivet joints in aluminum where necessary for strength.

## 3.3 INSTALLATION OF ROOF-DRAINAGE SYSTEM

A. Install sheet metal roof-drainage items to produce complete roof-drainage system in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.

B. Hanging Gutters:

1. Join sections with rivets and sealed with sealant.
2. Provide for thermal expansion.
3. Attach gutters at eave or fascia to firmly anchor them in position.
4. Provide end closures and seal watertight with sealant.
5. Slope to downspouts.
6. Install gutter with expansion joints at locations indicated on Drawings, but not exceeding, 50 feet apart. Install expansion-joint caps.

C. Built-in Gutters:

1. Join sections with rivets and soldered joints.
2. Provide for thermal expansion.
3. Slope to downspouts.
4. Provide end closures and seal watertight with sealant.
5. Install underlayment layer in built-in gutter trough and extend to drip edge at eaves and under underlayment on roof sheathing.

    a. Lap sides minimum of 2 inches over underlying course.
    b. Lap ends minimum of 4 inches.
    c. Stagger end laps between succeeding courses at least 72 inches.
    d. Fasten with roofing nails.
    e. Install slip sheet over underlayment.

D. Scuppers:

1. Extend open outlet scupper through perimeter blocking and 6-inches into open (ZT) gutter at skirt.
2. Cut and form “picture frame” and fold onto shingled skirt 4” to provide a watertight scupper and gutter system.
3. Secure formed parts and/or tack solder in place.
4. Solder all seams to provide a finished watertight scupper and gutter system.
5. Fabricate “picture frame” flashing extending minimum 4” onto shingles at sides and 6” onto shingles secured with blind (concealed) cleats.

E. Downspouts:

1. Join sections with 1-1/2-inch telescoping joints.
2. Provide hangers with fasteners of matching gauge designed to hold downspouts securely to walls.
3. Locate hangers at top and bottom and at approximately 60 inches o.c.
4. Connect aluminum upper downspouts to extended height cast iron boot connected to underground fitting to the drainage system.
5. Provide mortar wash at powder-coated steel/cast iron and cast iron to cast iron joints.

F. Splash Pans:

1. Install where open downspout discharges into valley.
2. Secure with strap anchors to masonry wall.

## 3.4 INSTALLATION OF ROOF FLASHINGS

A. Pipe Flashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches over base flashing. Install stainless steel draw band and tighten.

B. Counterflashing: Coordinate installation of counterflashing with installation of base flashing.
1. A. Insert counterflashing into reglets at rising exterior wall and window sill conditions and fit tightly to base flashing.

   B install Counterflashing at base and step flashing at dome drum
2. Extend counterflashing 4 inches over base flashing.
3. Lap counterflashing joints minimum of 4 inches.
4. Secure reglet counterflashings using lead wedges 8” o.c. Provide approved sealant at reglet.

C. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Turn flashing down into pipe opening 1 ½”.

## 3.5 INSTALLATION OF WALL FLASHINGS

A. Install sheet metal wall flashing to intercept and exclude penetrating moisture in accordance with cited sheet metal standard unless otherwise indicated.

## 3.6 INSTALLATION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-) offset of adjoining faces and of alignment of matching profiles.

## 3.7 CLEANING

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials with sodium bicarbonate and water. Clean off excess solder.

C. Clean off excess sealants.

## 3.8 PROTECTION

A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Architect.

END OF SECTION 076200

**SECTION 077100**

**ROOF SPECIALTIES**

1.1 SUMMARY

A. Section Includes:
1. Roof-edge drainage systems.

1.2 ACTION SUBMITTALS

A. Product Data: For the cast iron downspout and cast iron boot.

B. Shop Drawings: For roof specialties.

1. Include plans, elevations, joint locations. Distinguish between factory and field-assembled work.

C. Samples: For each type of roof specialty and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing specialties to include in maintenance manuals.

1.5 WARRANTY

1. Finish Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 Basis of Design:

A. Rain Water Conductor
1. Cast Iron Boot
Basis of Design: Neenah Foundry R-4929-011, Offset, no clean-out trap
Material: Cast Gray Iron ASTM A-48, Class 35B
Finish: Factory Finish. Painted to match exterior.
Weight: 95#
Quantity: One section of downspout boot at each location

2. Cast Iron Downspout Extension

Basis of Design: Neenah Foundry R-4929-EXT
Material: Cast Gray Iron ASTM A-48, Class 35B
Finish: Factory Finish. Painted to match exterior.
Weight: 76#
Quantity: Two sleeved sections of downspout extensions at each location, to reach 10’-0” above finished grade.

3. Upper downspout and 8” dia hanging gutter see Section 076200 “Sheet Metal Flashing and Trim”

B. Shop Drawings: For roof specialties noting connections between rain water conductors and connection to roof-edge drainage system.

## 2.2 ROOF-EDGE DRAINAGE SYSTEMS

A. Gutters: See Section 07620 “Sheet Metal Flashing and Trim”

B. Downspouts: Size to match existing downspouts.

## 2.3 MISCELLANEOUS MATERIALS

A. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:

1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
2. Fasteners for Aluminum: Aluminum or Series 300 stainless steel.

# PART 3 - EXECUTION

## 3.1 INSTALLATION, GENERAL

A. Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, underlayments, sealants, and other miscellaneous items as required to complete roof-specialty systems.

1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
2. Provide uniform, neat seams with minimum exposure of solder and sealant.
3. Install roof specialties to fit substrates and to result in weathertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
4. Torch cutting of roof specialties is not permitted.
5. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of [uncoated aluminum] [and] [stainless steel] roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.

C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.

1. Space movement joints as indicated by manufacturer.
2. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.

D. Fastener Sizes: Use fasteners of sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.

E. Seal concealed joints with butyl sealant as required by roofing-specialty manufacturer.

F. Seal joints as required for weathertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F.

G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches (38 mm); however, reduce pre-tinning where pre-tinned surface would show in completed Work. Tin edges of uncoated copper sheets using solder for copper. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

## 3.2 INSTALLATION OF ROOF-EDGE DRAINAGE SYSTEMS

A. Install components to produce a complete roof-edge drainage system according to manufacturer's written instructions.

B. Downspouts: Join sections with manufacturer's standard telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls and 1 inch away from walls; locate fasteners at top and bottom per manufacturer design.
1. Connect downspouts to underground drainage system indicated.

## 3.3 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as roof specialties are installed.

END OF SECTION 077100

**SECTION 079200**
**JOINT SEALANTS**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nonstaining silicone joint sealants.
2. Latex joint sealants.
3. Joint sealant backing materials including cylindrical sealant backing and secondary seals.

1.2 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product.

B. Joint-Sealant Schedule: Including application and location, manufacturer and product name, formulation, color.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Sample warranties.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

1.5 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

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

B. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

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

1.6 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (5 deg C).
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.
5. Where joint sealants are not compatible with specified and installed metal surfaces.

PART 2 - PRODUCTS

2.1 NONSTAINING SILICONE JOINT SEALANTS

A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C 1248.

B. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.

1. Product: Dowsil 790 series or Equivalent. Subject to compliance with requirements:

a. Pecora Corporation.
b. Tremco Incorporated.

2.2 LATEX JOINT SEALANTS

A. Butyl-Rubber-Based Joint Sealant: ASTM C 1311.

1. Products: Subject to compliance with requirements, provide one of the following:
a. Bostik, Inc.; Chem-Calk 300.
b. Pecora Corporation; BC-158.
c. Tremco Incorporated; Tremco Butyl Sealant.

2.3 JOINT SEALANT BACKING

A. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), Type O (open-cell material), Type B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. EMSEAL.
b. BASF Corporation-Construction Systems.
c. Construction Foam Products; a Division of Nomaco, Inc.

## 2.4 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

# PART 3 - EXECUTION

## 3.1 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove laitance and form-release agents from concrete.
2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces.

## 3.2 INSTALLATION OF JOINT SEALANTS

A. General: Comply with ASTM C 1193 and joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated. Use tooling

agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.

1. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.

## 3.3 FIELD QUALITY CONTROL

A. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

## 3.4 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

   a. Flashing in masonry.
   b. Fasteners through masonry, locations as noted on Drawings.
   c. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, nonstaining, nonsag, Class 50. Dowsil 790 Series
3. Joint-Sealant Color: As selected by Architect from manufacturer's standard range.

B. Joint-Sealant Application: Concealed mastics.

1. Joint Locations:
   a. Concealed joints in roof specialties.
   b. Other joints as indicated on Drawings.

2. Joint Sealant: Butyl-rubber based.
3. Joint-Sealant Color: As selected by Architect from manufacturer's standard range.

END OF SECTION 079200

**SECTION 084513**

**Structured Polycarbonate Panel Assemblies**

PART 1 - GENERAL

1.20 SUMMARY

A Section includes requirements for translucent skylight system as specified

1. Trained and factory authorized labor and supervision to complete the entire panel installation.

2. Requirements for a translucent octagonal skylight system as specified herein.

3. Unit Polycarbonate Panel Skylight Assembly.

4. All anchors, brackets, and hardware attachments necessary to complete the specified structural assembly, weatherability, and water-tightness performance requirements.

5. All flashing up to but not penetrating adjoining work are also required as part of the system and shall be included. Tubular daylighting devices.

1.21 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. 06100 Rough Carpentry

B. 07610 Sheet Metal Roofing

C. 07620 Flashing and Sheet Metal

1.22 QUALITY ASSURANCE

A. The glazing panels must be International Council Evaluation Service Inc (ICC-ES)

B. Materials and products shall be manufactured by a company manufacturing polycarbonate skylights for a period of at least ten (10) years.

C. Erection shall be by a factory-approved certified installer who has been in the business of erecting similar material for at least five (5) consecutive years

1.23 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.24 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Manufacturer’s product literature including OSHA compliance.

B. Shop Drawings:

   1. Include plans, elevations, sections, mounting, and attachment details and methods of structural support.

   2. Substrate Preparation: verify standing seam roofing and cap flashing are installed and all seams are soldered.

   3. Verify self-adhering underlayment is in place separating the dissimilar materials.

C. Submittal: For glazing assemblies indicated to comply with performance requirements and design criteria.

D. Samples: For each exposed product and for each color and finish specified.
   Test reports required are:

   1. Insulation U-Value for Center of Glazing (NFRC 100).
   2. Insulation U-Value for System(NFRC 100 and 700 Certification).
   3. Concentrated Loading: No damage w a load of 600 lbf (813.5 Nm) over 1 sq. Ft.
   4. ICC Evaluation Service Report (ICC-ESR)  IBC Building Code.
   5.

1.25 SHOP DRAWINGS:
   1. Submit Shop drawings and color samples

1.26 CLOSEOUT SUBMITTALS

A. Maintenance data.

B. Include analysis data signed and sealed by a professional engineer licensed in the state of the project’s location

1.27 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of products that fail in materials or workmanship within specified warranty period. Provide a single source curtain wall system manufacturer warranty against defective materials and fabrication. Submit manufacturer’s written warranty agreeing to repair failures in materials within one (1) year.
   1. Provide a lifetime warranty for both interior and exterior glazing covering:
   2. Provide a ten (10) warranty on the interior glazing covering:
   3. Provide a ten (10) year warranty on the exterior glazing covering:

PART 2 - PRODUCTS

.1 MANUFACTURER

A Basis of design

1. The design and performance criteria of this job are based on the QuadSpan™ Polycarbonate Skylights + Roof Assemblies as manufactured by Kingspan Light + Air | Architectural Daylighting
2. The design and performance criteria of this job are based on the QuadSpan™ Polycarbonate Skylights + Roof Assemblies as manufactured by Kingspan Light + Air | Architectural Daylighting
3. Locally Represented by Dave Coffey CBG Assoc. dcoffeycbg@comcast.net

B. Approved Manufacturers

1. Other manufacturers may bid this project per the specification.
2. Listing manufacturers names in this specification does not constitute approval

2.2 TRANSLUCENT SKYLIGHT PERFORMANCE AND APPEARANCE

A Thermal and Solar Performance

1. To ensure Energy Code compliance, product U-Values must be listed in the NFRC Product Directory and have a Certified Product Directory (CPD) number.
   a. Basis of Design CPD Number. 2.75 In System: Reference NFRC website code KLA-M-2
2. Solar Heat Gain Coefficient (SHGC) _____ per NFRC Calorimeter. Maximum .19
3. Basis of Design CPD Number. 2.75 In System: NFRC website code KLA-M-

B. Haze measurement minimum of 90% per ASTM D-1003.

1. Standard exterior glazing color White Matte
2. Standard interior glazing color: White Matte
3. Translucent Glazing Joint System

C. Translucent Glazing Joint System

1. Water penetration: no water penetration of the glazing joint connection length at test pressure of 6.24 PSF OPTIONAL: 15 PSF per ASTM E-331.
2. Air Infiltration: pass requirements at 1.57 PSF and 6.24 PSF per ASTM E-283.
3. Free movement of the glazing shall be allowed to occur without damage to the weather tightness of the completed system.
4. The glazing joint shall comply with the deflection limitation of IBC Table 1604.3 for exterior walls with flexible finishes – L/120 per ASTM E-330.

D Flammability

1. Exterior Glazing
2. Class CC1 fire rating classification per ASTM D-635. Square foot and separation limitations provided in IBC Table 2607.4, any light transmitting plastic of a CC2 fire classification rating is specifically dis-allowed.
3. Class A interior flame spread per ASTM E-84
4. Self-ignition temperature of 970F ° per ASTM 1929.

2. Interior Glazing

a Class CC1 fire rating classification per ASTM D-635. Square foot and separation limitations provided in IBC Table 2607.4, any light transmitting plastic of a CC2 fire classification rating is specifically dis-allowed.Class A interior flame spread per ASTM E-84

b Self-ignition temperature of 970F ° per ASTM 1929.

3 Roof Construction Fire Classification:

a. System shall be tested and approved as a Class C Roof Assembly: Class B, Class A as defined in IBC Chapter 15 and tested per ASTM E 108 or UL 790.

3 PART 3EXECUTION

3.1 EXAMINATION

A Installer shall examine area of installation to verify readiness of site conditions. Notify the general contractor about any defects requiring correction. Do not work until conditions are satisfactory.

3.2 INSTALLATION

A Install components in strict accordance with manufacturer's instructions on approved shop drawings. Use proper fasteners, caulking and hardware for material attachments as specified.

3.3 CLEANING

A Follow manufacturer's instructions when washing down exposed panel surfaces using a solution of mild detergent in warm water that is applied with soft, cleaning wiping cloths. Always test a small area before applying to an entire area.

3.4 FIELD QUALITY CONTROL

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

B After completion of installation and nominal curing of sealant and glazing compounds, but before installation of interior finishes, test for water leaks in accordance with AAMA 501.2.

C Perform test for total area of each installed product.

D Work will be considered defective if it does not pass tests and inspections.

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

F Prepare test and inspection reports.

END OF SECTION 084513

**SECTION 090320**

**HISTORIC TREATMENT OF PLASTER**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Removal and replacement of historic interior gypsum plaster at dome interior.

B. Related Requirements:

1. Section 013500 “Special Project Procedures” for general historic treatment requirements.
2. Section 099123 "Interior Painting" for paint removal, surface preparation for refinishing, and refinishing of historic plaster surfaces.

1.2 ALTERNATES

A. Work of this Section is an Alternate (Add) specified in Section 012300 “Alternates”

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
1. Review methods and procedures related to historic treatment of plaster and fire protection.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic plastering specialist with expertise in matching and performing the types of historic plasterwork repairs required. Experience only in installing and repairing new plasterwork, veneer plaster, or gypsum board is insufficient experience for historic treatment work.

B. Mockups: Prepare mockups of historic treatment processes for each type of plaster repair and reconstruction work to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation.

1. Number and Size: One wall surface of at least or approximately 48 inches (1200 mm) in least dimension to represent surfaces and conditions for application of each type of plaster repair and reconstruction under same conditions as the completed Work. Include at least the following:

a. Repair 3 linear ft. (1 m) of plaster cracks.

## PART 2 - PRODUCTS

### 2.1 GYPSUM PLASTER MATERIALS

A. Gypsum Materials:

1. Lightweight Gypsum Ready-Mixed Plaster: ASTM C 28/C 28M, with mill-mixed perlite aggregate.
2. Gypsum Neat Plaster: ASTM C 28/C 28M for use with job-mixed aggregates.
3. Gypsum Wood-Fibered Plaster: ASTM C 28/C 28M.
4. High-Strength Gypsum Neat Plaster: ASTM C 28/C 28M; with a minimum, average, dry compressive strength of 2800 psi (19 MPa) per ASTM C 472 for a mix of 100 lb (45 kg) of plaster and 2 cu. ft. (0.06 cu. m) of sand.
5. Gypsum Gaging Plaster. ASTM C 28/C 28M.
6. High-Strength Gypsum Gaging Plaster: ASTM C 28/C 28M; with a minimum, average, dry compressive strength of 5000 psi (34 MPa) per ASTM C 472 for a neat mix.
7. Gypsum Ready-Mixed Finish Plaster: ASTM C 28/C 28M; manufacturer's standard, mill-mixed, gaged, interior finish.

### 2.2 BASE-COAT PLASTER MATERIALS

A. Base-Coat Plasters, General: ASTM C 28/C 28M.

B. Gypsum Neat Plaster: For use with job-mixed aggregates.

1. Products: Subject to compliance with requirements, provide one of the following:

a. USG Corporation: Red Top Gypsum Plaster.

### 2.3 FINISH-COAT PLASTER MATERIALS

A. Gypsum Ready-Mixed Finish Plaster: Manufacturer's standard, mill-mixed, gaged, interior finish.

1. Products: Subject to compliance with requirements, provide one of the following:

a. USG Corporation; Red Top Finish Plaster.

B. Aggregates: Two-Component Gypsum Veneer Plaster: ASTM C 587, with separate formulations; one for base-coat application and one for finish-coat application over substrates.

1. Base Coat:

a. USG Corporation; Imperial Veneer Base Coat.

2. Smooth Finish Coat:

a. USG Corporation; Imperial Veneer Finish Plaster.

3. Aggregate for Base-Coat Plasters: ASTM C 35, sand.

C. Bonding Compound: ASTM C 631: OCTOWELD or approved equal.

D. Consolidation Material: ACRYL-60 or approved equal.

E. Reinforcing Mesh: BASF; Senergy fiberglass reinforcing mesh or approved equal.

2.4 LATH

A. Metal Lath:

1. Expanded-Metal Lath: ASTM C 847, cold-rolled carbon-steel sheet, ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized zinc coated.

a. Diamond-Mesh Lath: Self-furring, 2.5 lb/sq. yd. (1.4 kg/sq. m).

2.5 MISCELLANEOUS MATERIALS

A. Water for Mixing and Finishing Plaster: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.

B. Fasteners for Attaching Lath to Substrates:

1. For Gypsum Plaster: ASTM C 841.

C. Wire Ties: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, not less than 0.0475-inch (1.21-mm) diameter, unless otherwise indicated.

PART 3 - EXECUTION

3.1 HISTORIC TREATMENT OF PLASTER, GENERAL

A. General: In treating historic plaster, disturb it as minimally as possible and as follows unless otherwise indicated:

1. Dismantle loose, damaged, or deteriorated plaster, lath, and support systems that cannot be repaired.
2. Cleanly cut out sections of plaster and wall substrate only as required to provide plumbing work.
3. Verify that substrate surface conditions are suitable for repairs.
4. Provide lath, furring, and support systems for plaster included in the work of this Section.
5. Leave repaired plasterwork in proper condition for painting or applying other finishes as indicated.
6. Install temporary protective measures to protect historic surfaces that shall be treated later.

B. Illumination: Perform plastering work with adequate, uniform illumination that does not distort the flatness or curvature of surfaces.

## 3.2 PLASTER REMOVAL AND REPLACEMENT, GENERAL

A. Remove plaster to the limits indicated. Carefully dismantle areas along straight edges that lie over supports, without damaging surrounding plasterwork.

B. Maintain lath and supporting members in an undamaged condition so far as practicable. Dismantle damaged lath and supports that cannot be repaired or re-secured and replace with new work of same type.

C. Do not deviate more than plus or minus 1/8 inch in 10 feet (3 mm in 3 m) from a true plane in finished plaster surfaces, as measured by a 10-foot (3-m) straightedge placed on surface.

D. Clean substrate surfaces to remove grease, waxes, oils, waterborne staining, debris, and other foreign matter and deposits that could impair bond with repair material.

E. Wet masonry bases before plaster application. Keep substrate damp to the touch but without visible water droplets.

F. Wet remaining plaster abutting the replacement plaster before installing new plasterwork.

G. Finish plaster flush with original finish.

H. Provide plaster surfaces that are ready to receive field-applied finishes indicated.

## 3.3 FLAT GYPSUM-PLASTER REMOVAL AND REPLACEMENT

A. General: Dismantle deteriorated plaster to existing sound plaster at locations indicated on Drawings. Use replacement plaster mixes of gypsum, lime, and aggregate; and application according to ASTM C 842 unless otherwise indicated.

B. Bonding Compound: Apply on unit masonry or plaster bases.

C. Gypsum-Plaster Base Coats:
   1. Base Coats over Expanded-Metal Lath: Gypsum neat plaster with job-mixed sand for scratch and brown coats.
   2. Base Coats over Unit Masonry: Gypsum neat plaster with job-mixed sand.

D. Gypsum-Plaster Finish Coats:

   1. Finish-Coat Mix for Smooth-Troweled Finishes: High-strength gypsum gaging plaster.

E. Gypsum-Plaster Finishes: Match finish(es) of adjacent surfaces.

   1. Provide float finish unless otherwise indicated.

## 3.4 REMOVING AND INSTALLING LATH AND ACCESSORIES

A. General: Dismantle existing plaster as necessary to expose metal lath, wire ties, and support system, back to firm substrates and supports. Repair with new materials, well secured to existing lath in good condition and to building structure.

1. Cutting: Cut lath so it can be taken out completely from one support to the next. Cut to avoid cracking surrounding plaster.
2. Cut out existing base-coat plaster beyond the edges of the new lath to permit new plaster to extend onto the old lath. Then step subsequent plaster coats to permit new plaster to extend over the old material.
3. Fasten new lath to support system and to good existing lath. Wire tie at least every 6 inches (150 mm).
4. Install new lath according to ASTM C 841 for gypsum plaster.

B. Metal Lath: Install according to ASTM C 841 for gypsum plaster.

END OF SECTION 090320

**SECTION 092400**

**CEMENT PLASTERING**

PART 1 -

1. Exterior base-coat cement plaster.
2. Exterior cement plaster finish coats.
3. Accessories.

1.2 RELATED SECTIONS

1. Section 040323 “Historic Brick Unit Masonry Repointing”

1.3 ACTION SUBMITTALS

A. Product data.

B. Samples: Provide a range of color samples for preliminary selection. Provide physical samples for final selection by Architect.

PART 2 - PRODUCTS

2.1 BASE-COAT CEMENT PLASTER

A. Base-Coat Mixes for Use over Brick Masonry Units: Single base (scratch) coat for two-coat plasterwork on low-absorption plaster bases as follows:

1. Basis of Design: Sakrete Scratch and Brown Coat

   Portland Cement Mix: For cementitious material, mix 1 part portland cement and 0 to 3/4 part lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.

2.2 CEMENT PLASTER FINISH COATS

A. Ready-Mixed Finish-Coat Plaster: Mill-mixed portland cement, aggregates, coloring agents, and proprietary ingredients.

1. Basis of Design: Sakrete Finish Coat Stucco, to match existing
2. Color: To match existing. Selected by Architect.

2.3 ACCESSORIES

A. General: Comply with ASTM C1063, and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.

2.4 PLASTER MATERIALS

A. Portland Cement: ASTM C150/C150M, [**Type I**]

1. Color for Finish Coats: [**to match existing**]

2.5 MISCELLANEOUS MATERIALS

A. Bonding Compound: ASTM C932.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Prepare smooth, solid substrates for plaster according to ASTM C926.

3.2 APPLICATION OF BASE-COAT CEMENT PLASTER

A. General: Comply with ASTM C926.

3.3 APPLICATION OF CEMENT PLASTER FINISH COATS

A. Plaster Finish Coats: Apply to provide a match to existing stucco finish.

END OF SECTION 092400

**SECTION 099113**

**EXTERIOR PAINTING**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Primers.
2. Finish coatings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product used on Security Fence at Side Entrance Roof.

B. Samples: For each finish and for each color and texture required.

1.3 QUALITY ASSURANCE

A. Mockups: Apply mockup on a 2 LF section of security fence.

1. Final approval of color selections will be based on mockup.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner. Approved mockups may remain in place and become part of completed work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide the product listed in the paint schedules Rustoleum.

2.2 PAINT PRODUCTS, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by topcoat manufacturer for use in paint system and on substrate indicated.

B. Colors: As selected from manufacturer's standard color range, to match existing adjacent substrates in color, sheen, and finish.
   1. Provide manufacturer's standard color selections from which Architect will select one field color (security fence)

2.3 PRIMERS

A. Alkyd Metal Primer: Corrosion-resistant, solvent-based, alkyd primer formulated for use on prepared ferrous metals subject to industrial and light marine environments.

1. Basis of Design: Rustoleum Professional High Performance 7400 DTM Alkyd Enamel Primer

2.4 FINISH COATINGS

A. Quick-Drying Alkyd Enamel, Semigloss: Solvent-based, alkyd or modified-alkyd enamel formulated for quick-drying capabilities and for use on exterior, primed, metal and dimensionally stable wood surfaces.

1. Basis of Design: Rustoleum High Performance 7400 RocAlkyd Enamel
   Gloss Level: Manufacturer's standard semigloss finish

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify suitability of substrates, including surface conditions and compatibility, with finishes and primers.

B. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems specified in this Section.

3.3 INSTALLATION

A. Apply paints in accordance with manufacturer's written instructions.

B. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 CLEANING AND PROTECTION

A. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

B. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

C. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 EXTERIOR PAINTING SCHEDULE

A. Iron Substrates at Security Fence:

1. Alkyd System:

a. Prime Coat: Rustoleum Professional High Performance 7400 DTM Alkyd Enamel Primer
b. Intermediate Coat: Rustoleum High Performance 7400 RocAlkyd Enamel
c. Topcoat: Rustoleum High Performance 7400 RocAlkyd Enamel

END OF SECTION 099113

**SECTION 099123**

**INTERIOR PAINTING**

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes surface preparation and the application of paint systems on the following interior substrates based on scope of work outlined in Alternate 1:

1. Metals.
2. Wood.
3. Removing existing painted plaster which may contain lead based on its age.
4. Repairing loose plaster substrates.
5. Plain painting of historic surfaces, including gypsum plaster.

B. Related Sections:
1. Section 090320 “Historic Treatment of Plaster.”

1.2 SUBMITTALS

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

B. Samples: For each finish and for each color and texture required.

C. Interior Environment Submittals:

1. Product Data: For paints and coatings, indicating VOC content.
2. Laboratory Test Reports: For paints and coatings, indicating compliance with requirements for low-emitting materials.

1.3 QUALITY ASSURANCE

A. Mockups: Apply mockup on (1) one plaster repair section to verify color and finish selected to match existing adjacent finishes and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner. Approved mockups may remain in place and become part of the Work.

B. Lead Based Paint: The areas to be prepared for repainting may contain paint from the early twentieth century. Based on coatings of similar age, there will be lead in the existing paint when encountered:

1. Take all necessary actions and precautions to assure safety of the public, property and the environment, and workers in scraping, sanding, removing and disposing of any existing paint;
2. Comply with applicable health, safety and environmental regulations of the government agencies having jurisdiction.
3. Retain one or both subparagraphs below if additional requirements are necessary; include information about conference.
4. Review methods and procedures related to historic treatment of painting.
5. Review of the contractor's compliance with the OSHA lead regulations, including:

    a. Provide evidence of compliance with OSHA *Lead Standard – Construction Industry* (CFR 1926.62) and *Respiratory Protection Standard* (CFR 1910.134) and Contractor's Respiratory Protection Program, including records of training.
    b. A copy of the Contractor's Lead Exposure Assessment Protocol.
    c. A description of each activity in which lead is emitted including the equipment used, materials involved, control procedures, crew size, job responsibilities, operating procedures and maintenance protocols.
    d. A description of the specific means employed to achieve compliance, including engineering, administrative, and work practice controls.
    e. A copy of the Contractor's Personal Protective Equipment selection criteria.
    f. Records of lead hazard training as required by the *Lead Standard*.

C. Historic Treatment Specialist Qualifications: A qualified historic painting specialist with expertise in matching and touching up existing painting. Experience only in new painting work is insufficient experience for historic treatment work.

## 1.4 PREPARATORY CLEANING MATERIALS

A. Water: Potable.

B. Hot Water: Water heated to a temperature of 140 to 160 deg F (60 to 71 deg C).

C. Detergent Solution: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent that contains no ammonia, 5 quarts (5 L) of 5 percent sodium hypochlorite bleach, and 15 quarts (15 L) of warm water for every 5 gal. (20 L) of solution required.

D. Mildewcide: Commercial proprietary mildewcide or a job-mixed solution prepared by mixing 1/3 cup (80 mL) of household detergent that contains no ammonia, 1 quart (1 L) of 5 percent sodium hypochlorite bleach, and 3 quarts (3 L) of warm water.

E. Rust Remover: Manufacturer's standard phosphoric acid-based gel formulation, also called "naval jelly," for removing corrosion from iron and steel.

## 1.5 PAINT REMOVERS

A. Alkaline Paste Paint Remover: Manufacturer's standard alkaline paste or gel formulation for removing paint from masonry, stone, wood, plaster, or metal as required to suit Project; and containing no methylene chloride.

B. Low-Odor, Solvent-Type Paste Paint Remover: Manufacturer's standard low-odor, water-rinsable, solvent-type paste, gel, or foamed emulsion formulation for removing paint from

masonry, stone, wood, plaster, or metal as required to suit Project; and containing no methanol or methylene chloride.

## PART 2 - PRODUCTS

### 2.1 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. Transition Coat: Paint manufacturer's recommended coating for use where a residual existing coating is incompatible with the paint system.

C. VOC Content: For field applications that are inside the weatherproofing system, paints and coatings shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 50 g/L.
3. Primers, Sealers, and Undercoaters: 100 g/L.
4. Rust-Preventive Coatings: 100 g/L.
5. Zinc-Rich Industrial Maintenance Primers: 100 g/L.

D. Low-Emitting Materials: For field applications that are inside the weatherproofing system, 90 percent of paints and coatings shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

E. Colors: As selected from manufacturer’s standard color range, to match existing adjacent substrates in color, sheen, and finish.
1. Provide one field color (interior ceiling at dome).

### 2.2 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide the product listed in the paint schedules The Sherwin-Williams Company; or an approved equal product by one of the following manufacturers:
a. Benjamin Moore & Company

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Plaster: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

E. Alkalinity: Do not begin application of coatings unless surface alkalinity is within range recommended in writing by paint manufacturer. Conduct alkali testing with litmus paper on exposed plaster, cementitious, and masonry surfaces.

3.2 PREPARATION AND APPLICATION

A. Comply with manufacturer's written instructions and recommendations.

B. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.

C. Prepare surfaces to be painted according to the Surface-Preparation Schedule and with manufacturer's written instructions for each substrate condition.

D. Apply a transition coat over incompatible existing coatings.

E. Blending Plain Painted Surfaces: When painting new substrates patched into existing surfaces or touching up missing or damaged finishes, apply coating system specified for the specific substrate. Apply final finish coat over entire surface from edge to edge and corner to corner.

F. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

G. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

## 3.3 HISTORIC TREATMENT OF PAINTING, GENERAL

A. Execution of the Work: In treating historic items, disturb them as minimally as possible and as follows:

1. Remove failed coatings and corrosion and repaint.
2. Verify that substrate surface conditions are suitable for painting.
3. Allow other trades to repair items in place and retain as much original material as possible before repainting.
4. Install temporary protective measures to protect historic painted surfaces that shall be treated later.

B. Mechanical Abrasion: Where mechanical abrasion is needed for the work, use only the gentlest mechanical methods, such as scraping and lightly hand sanding, that will not abrade softer substrates, reducing clarity of detail. Do not use abrasive methods such as rotary sanding, rotary wire brushing, or power tools except as indicated as part of the historic treatment program and as approved by Architect.

C. Heat Processes: Do not use torches, heat guns, or heat plates.

## 3.4 PREPARATORY CLEANING

A. General: Use only the gentlest, appropriate method necessary to clean surfaces in preparation for painting. Clean all surfaces, corners, contours, and interstices.

B. Detergent Cleaning: Wash surfaces by hand using clean rags, sponges, and bristle brushes. Scrub surface with detergent solution and bristle brush until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet. Rinse with water applied by clean rags or sponges.

C. Solvent Cleaning: Use solvent cleaning to remove oil, grease, smoke, tar, and asphalt from painted or unpainted surfaces before other preparation work. Wipe surfaces with solvent using clean rags and sponges. If necessary, spot-solvent cleaning may be employed just prior to commencement of paint application, provided enough time is allowed for complete evaporation. Use clean solvent and clean rags for the final wash to ensure that all foreign materials have been removed. Do not use solvents, including primer thinner and turpentine, that leave residue.

D. Mildew: Clean off existing mildew, algae, moss, plant material, loose paint, grease, dirt, and other debris by scrubbing with bristle brush or sponge and detergent solution. Scrub mildewed areas with mildewcide. Rinse with water applied by clean rags or sponges.

E. Chemical Rust Removal:

1. Remove loose rust scale with approved abrasives for ferrous-metal cleaning.
2. Apply rust remover with brushes or as recommended in writing by manufacturer.
3. Allow rust remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing. Do not allow extended dwell time.
4. Wipe off residue with mineral spirits and either steel wool or soft rags, or clean with method recommended in writing by manufacturer to remove residue.
5. Dry immediately with clean, soft cloths. Follow direction of grain in metal.
6. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.

F. Mechanical Rust Removal:

1. Remove rust with approved abrasives for ferrous-metal cleaning. Clean to bright metal.
2. Wipe off residue with mineral spirits and either steel wool or soft rags.
3. Dry immediately with clean, soft cloths. Follow direction of grain in metal.
4. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.

## 3.5 PAINT REMOVAL

A. General: Remove paint where indicated. Where cleaning methods have been attempted and further removal of the paint is required because of incompatible or unsatisfactory surfaces for repainting, remove paint to extent required by conditions.

1. Brushes: Use brushes that are resistant to chemicals being used.

a. Metal Substrates: If using wire brushes on metal, use brushes of same metal composition as metal being treated.

B. Paint Removal with Hand Tools: Remove paint manually using hand-held scrapers, wire brushes, sandpaper, and metallic wool as appropriate for the substrate material. Do not use other methods except as indicated as part of the historic treatment program and as approved by Architect.

C. Paint Removal with Alkaline Paste Paint Remover:

1. Remove loose and peeling paint using scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply paint remover to dry, painted surface with brushes.
3. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
4. Use mechanical methods recommended in writing by manufacturer to remove chemicals and paint residue.
5. Repeat process if necessary to remove all paint.

D. Paint Removal with Low-Odor, Solvent-Type Paste Paint Remover:

1. Remove loose and peeling paint using scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply thick coating of paint remover to dry, painted surface with natural-fiber cleaning brush, deep-nap roller, or large paintbrush. Apply in one or two coats according to manufacturer's written instructions.
3. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
4. Use mechanical methods recommended in writing by manufacturer to remove chemicals and paint residue.
5. Repeat process if necessary to remove all paint.

## 3.6 SUBSTRATE REPAIR

A. General: Repair substrate surface defects that are inconsistent with the surface appearance of adjacent materials and finishes in accordance with Alternate 1 and in the case that work at exterior dome and oculus minimally effects surfaces at the interior

B. Gypsum-Plaster and Gypsum-Board Substrates:

1. Repair defects including dents and chips in size and all holes and cracks by filling with gypsum-plaster patching compound and sanding smooth. Remove protruding fasteners.
2. Rout out surface cracks to remove loose, unsound material; fill with patching compound and sand smooth.

C. Metal Substrate:

1. Preparation: Treat repair locations by wire-brushing and solvent cleaning. Use chemical or mechanical rust removal method to clean off rust.
2. Defects in Metal Surfaces: Repair non-load-bearing defects in existing metal surfaces, including dents and gouges more than 1/16 inch (6 mm) deep or 1/2 inch (13 mm) across and all holes and cracks by filling with metal patching compound and sanding smooth. Remove burrs and protruding fasteners.
3. Priming: Prime iron and steel surfaces immediately after repair to prevent flash rusting. Stripe paint corners, crevices, bolts, welds, and sharp edges. Apply two coats to surfaces that are inaccessible after completion of the Work.

## 3.7 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

C. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

## 3.8 PAINTING SCHEDULE

A. Gypsum Plaster Substrates, Dome Ceiling: Contractor to verify existing sheen. Color to match adjacent surfaces at dome.

1. Institutional Latex System:

a. Primer: ProMar 200 Primer
b. 1st coat: ProMar 200 Interior Latex, eggshell.
c. 2nd coat: ProMar 200 Interior Latex, eggshell.

END OF SECTION 099123

SECTION 310000

EARTHWORK

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. The work under this Section shall include all labor, material, equipment and all else necessary for cutting, proof rolling, filling and grading to required lines, dimensions, contours and elevations for proposed improvements as hereinafter specified and/or as otherwise required for the proper and timely completion of this Contract. Work under this Section includes, but is not limited to, subgrade preparation, excavating, backfilling, and compaction for structures and foundations, pavements, sidewalks, landscaping areas, and utilities. The contractor shall pay for and coordinate the services of a geotechnical engineer and testing agency to perform quality control of the earthwork.

B. Scarifying, compaction, moisture content conditioning and control, and removal of unsuitable material to ensure proper preparation of areas for the proposed improvements.

C. Undertake any special construction procedures for the project as shown in the drawings and described by these specifications for preparation of pavement areas.

1.2 RELATED DOCUMENTS

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

1.3 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM), latest edition
   1. C 33 Concrete Aggregates
   2. D 698 Laboratory Compaction Characteristics of Soil Using Standard Effort
   3. D 1556 Density and Unit Weight of Soils in Place by the Sand-Cone Method
   4. D 1557 Laboratory Compaction Characteristics of Soil Using Modified Effort
   5. D 2167 Density and Unit Weight of Soil in Place by Rubber Balloon Method
   6. D 2216 Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
   7. D 2487 Classification of Soils for Engineering Purposes (Unified Soil Classification System)
   8. D 2937 Density of Soil in Place by the Drive-Cylinder Method
   9. D 3740 Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
   10. D 4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils
   11. D 4254 Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
   12. D 6938 In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

B. American Association of State Highway and Transportation Officials (AASHTO), latest edition
   1. T 88 Particle Size Analysis of Soils

C. Associated General Contractors of America
   1. Manual of Accident Prevention in Construction

1.4 QUALITY ASSURANCE

A. A geotechnical engineer familiar with the project requirements, selected and paid by the Owner, may be retained to perform construction inspection on site based on density testing, visual observation, and judgement. This inspection will not relieve the Contractor from his responsibility to complete the work in accordance with the drawings and specifications.

B. Visual field confirmation and density testing of subgrade preparation and fill placement procedures shall be performed by the field geotechnical engineer as part of the construction testing requirements. The Contractor shall be informed as soon as possible of the test results.

C. The geotechnical engineer shall prepare field reports that indicate compaction test location, elevation data, testing results and acceptability. The Owner, engineer, and Contractor shall be provided with written copies of the results within 24 hours of time test was performed.

D. All costs related to reinspection due to failures shall be paid for by the Contractor at no additional expense to Owner. The Owner reserves the right to direct any inspection that is deemed necessary. Contractor shall provide free access to site for inspection activities.

1.5 SUBMITTALS

A. Testing Agency Qualifications: Provide a statement of qualifications of the geotechnical engineer and testing agency that will perform the quality control tasks required in Article 3.08.
   1. The geotechnical engineer shall be an experienced inspector working under the direction of the professional engineer licensed to practice in the Commonwealth of Pennsylvania who is experienced in providing engineering services related to earthwork.
   2. The testing agency shall be an independent laboratory having a minimum of three (3) years' experience in conducting the testing indicated herein.
   3. The testing laboratory shall meet the requirements of ASTM D 3740.

B. Material Test Reports: Shall be provided from the testing agency indicating and interpreting test results for compliance on the following:
   1. Classification according to ASTM D 2487 of each on-site or borrow soil material proposed for fill and backfill.
   2. Laboratory compaction curve according to ASTM D 1557 698 for each on-site or borrow soil material proposed for fill and backfill; provide for each material type and for every 5,000 cubic yards of each material.
   3. Material Gradation Tests.
   4. Electrical Resistivity and pH tests for sand used for water pipe bedding and backfill.

C. Within 10 days after award of the contract, the Contractor shall submit to the Owner and engineer a schedule detailing the sequence, and time of completion of all phases of work under this section.

D. At least two weeks in advance of imported fill use, the Contractor shall submit the following laboratory test data to the geotechnical engineer for each type of imported soil/gravel material to be used as compacted fill.
   1. Moisture and Density Relationship: ASTM D1557;
   2. Particle-Size Analysis: ASTM D2487; and,
   3. Plasticity Index: ASTM D 4318.

E. Together with the above test data, the Contractor shall submit a 25-pound sample of each type of off site fill material in an air tight container for the approval of the geotechnical engineer.

F. Submit the name of each material supplier and specific type and source of each material. Any change in source or soil type throughout the job requires approval of the Owner and the engineer.

1.6 DEFINITIONS

A. Backfill: Soil materials used to fill an excavation.

B. Base Course: Layer placed between the subgrade and paving.

C. Bedding Course: Layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow: Approved soil materials imported from off-site for use as fill or backfill.

E. Classification: No consideration will be given to the nature of earthen materials, and all excavation required for this Project will be designated as unclassified.

F. Degree of Compaction: Degree of compaction required is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557 abbreviated hereinafter as percent laboratory maximum density. For granular material, relative density is determined in accordance with ASTM D 4254.

G. Excavation: Removal of material encountered down to subgrade elevations:
   1. Bulk Excavation: Excavation more than 10 feet in width.
   2. Overexcavation: Excavation of existing unsuitable material beyond limits shown on the Drawings for replacement with structural fill as directed by the Owner.
   3. Unauthorized Excavation: Excavation below subgrade elevations or beyond limits shown on the Drawings without direction by the Owner.

H. Hard Material: Weathered rock, dense consolidated deposits, or buried construction debris (i.e., demolished brick walls, concrete, etc.) which are not included in the definition of “rock” but which usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

I. Rock:
   1. General Excavation - Any material that cannot be excavated with a single-toothed ripper drawn by a crawler tractor having a minimum draw bar pull rated at not less than 71,000 lbs. (Caterpillar D9N or equivalent), and occupying an original volume of at least 2 cubic yards or more; and,
   2. Trench Excavation - Any material that cannot be excavated with a backhoe having a break out force rated at not less than 44,000 lbs. (Caterpillar 235D or equivalent), and occupying an original volume of at least 2 cubic yards.

J. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below base or topsoil materials.

K. Subbase: Material shown on the Drawings between the pavement base and subgrade.

L. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.7 REGULATORY COMPLIANCE

A. Codes and Standards: Perform earthwork complying with federal, state, and local regulations including the Occupational Safety and Health Act of 1970 as amended. Excavation and trenching are regulated by OSHA. The Contractor shall perform all excavation and trenching work in accordance with 29 CFR 1926 Subpart P.

B. Conform with Pennsylvania Act 287 and all amendments and other applicable regulations regarding notification of utility companies.

C. Any pumped water shall be discharged from the Site in accordance with federal, state and local codes and regulations. Comply with all Philadelphia Water Department permit requirements.

1.8 PROJECT CONDITIONS

A. Utility Identification: Notify PA One-Call System at 1-800-242-1776 at least 3 days prior to excavation.

B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Owner and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Notify the Owner not less than 72 hours in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without the Owner's written permission.

C. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

D. Existing improvements, adjacent property, and other facilities and trees and plants that are not to be removed shall be protected from injury or damage, which may result from Contractor's operation.

PART 2 - PRODUCTS

2.1 ON-SITE FILL

A. On-site excavated materials may be used as backfill provided they meet the following criteria:
   1. Suitable backfill materials include soil that complies with ASTM D 2487 soil classifications GW, GP, GM, SW, SP, and SM and having a maximum particle size of three (3) inches in any one dimension.
   2. Unsuitable backfill materials include any material having an excess of wood, timber, metal, rebar, organics, debris, or any other deleterious materials.

B. It is not permitted for excavated materials unsuitable for fill in their as-is state to be processed on-site to comply with suitable backfill requirements. Concrete, brick, asphalt debris is not permitted to be broken or crushed on site to meet the above particle size requirement.

C. The Contractor shall use the on-site soil judiciously to facilitate the construction schedule.

D. Prior to placement, on-site material to be used as fill shall not contain:
   1. Debris other than crushed concrete and brick meeting the above requirements.
   2. Timber or railroad ties.
   3. Other deleterious materials such as steel rails, rebar, trash, etc.

4. Hazardous material - Unsuitable and deleterious materials and debris shall be disposed of off-site in accordance with all applicable regulations.

E. Any bituminous concrete on the site shall be milled/removed prior to placing any fill and shall be reused only onsite immediately below the pavement stone base course.

2.2 OFF-SITE IMPORTED FILL

A. If necessary, off-site fill shall be obtained and provided by the Contractor;

B. Fill shall be clean, well graded granular soil which is non-expansive and non-collapsible and shall have less than 20% by weight passing the #200 sieve. The portion passing the #200 shall be non-plastic. Fill with less fines (less than #200) may be required on project specific basis and as required by geotechnical engineer. Likewise, fill with more than 20% fines may be acceptable on a project specific basis or as identified in the geotechnical engineering study;

C. Imported fill shall be free of all hazardous substances. Certification of compliance and, if requested, test results substantiating compliance shall be furnished to the Owner and geotechnical engineer by the Contractor not less than one week prior to its intended use;

D. The Owner reserves the right to test off-site fill material for conformance with these specifications; and,

E. The Contractor shall be responsible for all permits and regulatory requirements associated with off-site borrow sources.

2.3 STONE BACKFILL

A. In accordance with PennDOT Publication 408, Section 703 for AASHTO No. 57 Stone.

2.4 GEOTEXTILES

A. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
1. Survivability: Class 2; AASHTO M 288.
2. Survivability: As follows:
3. Grab Tensile Strength: 247 lbf; ASTM D 4632.
4. Sewn Seam Strength: 222 lbf; ASTM D 4632.
5. Tear Strength: 90 lbf; ASTM D 4533.
6. Puncture Strength: 90 lbf; ASTM D 4833.
7. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
8. Permittivity: 0.02 per second, minimum; ASTM D 4491.
9. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

2.5 EQUIPMENT

A. Compactor for mass earthwork shall be minimum 10-ton static-drum weight vibratory roller or 10-ton static-drum weight sheep foot compactor as appropriate for the type of soil material at the site or other compactor approved by the geotechnical engineer.

B. Compactor for trenches and where access or maneuverability is limited, use a double drum walk- behind roller or vibratory plate compactor or "jumping jack" tampers.

C. Grading equipment including, but not limited to, Bulldozers, Skid-Steer Loaders, Excavators, and Backhoe Loaders shall be wide track or balloon tire machines rated with a ground pressure of 4 psi or less to limited soil compaction.

## PART 3 - EXECUTION

### 3.1 GENERAL

A. Prior to all work of this section, the Contractor shall become thoroughly familiar with the site, site conditions, and all portions of the work falling under this section.

B. The Contractor shall refer to the soil erosion and sediment control drawings for staging of earthwork operations and for erosion control measures to be implemented prior to commencement of earthwork.

C. Locate and identify existing utilities that are to remain and protect them from damage.

D. Notify utility companies to allow removal and/or relocation of any utilities that are in conflict with the proposed improvements.

E. Protect fences, structures, sidewalks, paving, curbs, etc. to remain from equipment and vehicular traffic.

F. Protect benchmarks, property corners and all other survey monuments from damage or displacement. If a marker needs to be removed/relocated it shall be referenced by a licensed land surveyor and replaced, as necessary, by the same at no additional cost to the Owner.

G. Remove from the site, material encountered in grading operations that, in opinion of Owner or geotechnical engineer, is unsuitable or undesirable for backfilling as per Article 2.01.

H. Identify required lines, levels, contours and datum to bring site grades to the proposed subgrade conditions inferred from the drawings.

I. Do not allow or cause any of the work performed or installed to be covered by work of this section prior to all inspections, tests and approvals.

J. Perform excavation using capable, well maintained equipment and methods acceptable to the Owner and regulatory authorities having jurisdiction.

K. When performing grading operations during periods of prolonged wet or dry weather, provide adequate measures for surface drainage and ground water control, and moisture control of soils (i.e., wetting or drying, scarify and discing) so as to place and compact the soil within the moisture content range three (3) percentage points of its optimum water content. Any disturbed areas should be proofrolled at the end of each day.

L. Sloping, shoring, bracing, and fencing shall be installed in accordance with Federal OSHA requirements as well as the requirements of all regulatory authorities having jurisdiction.

M. Allow no debris to accumulate on-site. Haul debris away from the site and dispose of at no cost to the Owner.

3.2 COMPACTION OF SUBGRADE SURFACES

A. In areas to receive fill and at the final cut subgrade, proof roll and compact the exposed ground surface following clearing and grubbing and any required excavation with a minimum of four (4) passes of an approved compactor and obtain at least the following density requirement:

| Location | Percent of Maximum Dry Density per ASTM D698 | Percent of Maximum Dry Density per ASTM D1557 |
|---|---|---|
| Foundation Support, Pavements, and Wall Backfill | 98% | 95% |
| Utility Trenches and Walkways | 95% | 93% |
| Non-structural | 85% | 82% |

B. The proof roll, truck and compactor equipment shall traverse the area at speed that permits the geotechnical engineer to comfortably walk alongside the equipment.

C. Any soft areas exhibiting excessive weaving or unsatisfactory material identified during excavation, fill placement, compaction and proof testing shall be removed, replaced with suitable fill, and compacted as specified above.

3.3 UNDERCUT EXCAVATION

A. When approved by the Owner and recommended by the geotechnical engineer, the Contractor may be required to remove natural soil materials in areas where fills are to be placed when determined to be undesirable in their location or condition. The Contractor shall be required to remove the undesirable material and backfill with approved material properly compacted.

B. At locations where unstable or unsuitable soil is shown on the drawings or identified within the geotechnical engineering study, the removal and replacement of such soil shall be as directed on the drawings or as directed by the geotechnical engineer and the Owner.

C. All material removed in the work of undercut excavation will be classified by the geotechnical engineer and Owner as either suitable for other use without excessive manipulation and utilized by the Contractor elsewhere in the work, or unsuitable for future use and manipulated as per Article 2.01.

D. The Contractor shall conduct undercut operations in such a way that the necessary measurements can be taken before any backfill is placed.

E. Backfill in undercut areas shall be placed as a continuous operation along with the undercutting operation. No backfill material shall be placed in water unless otherwise permitted by the geotechnical engineer.

3.4 EXCAVATION, FILL AND SUBGRADE PREPARATION

A. GENERAL
1. Refer to Sections 024116, Structure Demolition and 024119 Selective Demolition, for demolition information and requirements pertaining to below-grade utilities.
2. The Contractor shall cut or fill to the proposed subgrade elevations based on finished grades and the pavement thicknesses as shown on the drawings. Subgrade elevations shall be constructed to within 0 to minus ½ inch of the proposed grades specified.

B. EXCAVATION

1. Where existing grades are above proposed subgrade elevation, excavate materials to line and grade as shown in the drawings being careful not to over excavate beyond the elevations needed for building subgrades;
2. Excavate organic soils that do not provide adequate foundation support. Excavated on-site organic soils, which are unsuitable for fill may be used in landscaped areas and, if approved by the geotechnical engineer, as fill in parking area at least 5 feet below final elevation. Otherwise this material shall be disposed of as directed by Owner;
3. Excavated on-site soils, which meet the requirements of suitable fill may be used as fill; and,
4. Unsuitable material, such as wood and any other deleterious materials determined to be unsuitable by the geotechnical engineer for use as on-site fill, shall be disposed of as directed by Owner.

C. FOUNDATIONS
1. Building foundations shall bear on undisturbed soil having minimum bearing capacity of 2500 psf. Adjust bottom of footing elevations as required to bear on uniformly dense inorganic subgrade.
2. Concrete for foundations shall be poured on the same day subgrade approval is given by the Special Inspector.
3. All exterior footings shall be placed a minimum of 3'-0" below final grade. Footings shall be placed such that the line drawn between the lower edges of adjoining footings shall not have a slope steeper than 30 deg from the horizontal. Footings shall be stepped at a rate of 2 horizontal feet to one vertical foot.
4. Excavations for any purpose shall not remove lateral support from any footing or foundation without protecting the footing or foundation against settlement or lateral translation.

D. SPECIAL INSPECTIONS
1. Third party special inspections shall be performed for this project as follows, and in accordance with project specifications:

| | |
|---|---|
| Site soil conditions beneath shallow foundations | periodic inspections required |

2. The independent inspections agency shall perform inspections and submit reports to the Engineer of Record (EOR) within 72 hours of inspection. Any inadequacies found by the Inspector shall be reported to the EOR within 24 hours. The Contractor shall facilitate these inspections by scheduling the inspections to coordinate with the work being performed by their sub-contractors.

E. SUBGRADE PREPARATION FOR FILL
1. Existing grades below proposed grades and thus requiring fill shall be leveled prior to fill placement. The Contractor shall remove existing lawn and top soil in these areas prior to placement of any fill; and,
2. All existing grades to receive fill areas shall be proof rolled and compacted per Article 3.02.
3. Loose/Soft and unstable subgrade resulting from excessive moisture may be aerated and dried in-place. Following adequate drying time, the subgrade is to be densified in-place. Subgrade that cannot be aerated, dried, and densified in place shall be removed as described in Article 3.03.

F. FILL PLACEMENT
1. Rock or processed suitable debris pieces larger than six inches (6 inches) across shall not be part of fill;
2. Reduce soil clod size to a maximum of 2 inches before placement. Do not place frozen fill material;

3. No fill material shall be placed in areas of standing water, in areas of frozen or thawing ground, or in areas that have not been approved by the geotechnical engineer;
4. No fill materials shall be placed during unfavorable weather conditions. When work is interrupted by heavy rains, fill operations shall not be resumed until all saturated surficial soils are returned to a satisfactory moisture content as determined by the geotechnical engineer;
5. Fill lift surfaces shall be made smooth and free from ruts or indentations at the end of any work day when precipitation is forecast to prevent saturation of surficial fill material. Fill surfaces shall be graded to drain and sealed with a smooth drum roller at the completion of each work day;
6. The fill shall be placed in uniform loose lifts not exceeding 8-inches thick and compacted with at least 4 coverages of a 10-ton static-drum weight roller;
7. Each lift shall be compacted to the minimum densities listed in Article 3.02 as appropriate for the project and as specified in the geotechnical engineering study;
8. The Contractor shall adjust the water content by aeration or adding water to achieve the required density. Assist drying by discing, harrowing or pulverizing until moisture content is reduced to achieve proper compaction and facilitate the construction schedule;
9. Wet, saturated material shall be air dried as necessary to achieve the field densities specified in this Section. Removal and replacement shall not occur without prior approval or Owner. Removal and replacement shall be used if necessary to facilitate the construction schedule;
10. Remove areas of finished subgrade found to have insufficient compaction density of depth necessary and replace with suitable compacted fill as approved by the Owner or Owners representative. Surface of subgrade after compaction shall be hard, uniform, smooth, stable, and true to grade and cross section; and,
11. Fill placed on slopes greater than 1 vertical to 3 horizontal shall have each lift benched onto the slope at least 3 feet.

## 3.5 PROOFROLLING

A. The work covered by this subsection consists of furnishing and operating, proofrolling equipment at the direction of the Owner's representative and/or geotechnical engineer.

B. Proofrolling shall be under the observation of the Owner's representative and/or the geotechnical engineer as described herein and under the following schedule:
   1. Immediately following the completion of excavation to proposed subgrades in cut areas, proofrolling shall be performed as specified; and,
   2. Immediately prior to and following stone base course placement, in pavement and building pad areas for final floor slab preparation, all subgrade and stone base areas shall be proofrolled. Any areas which deflect, rut or pump under the roller shall be undercut and replaced with compacted fill material or stone base course as directed by the geotechnical engineer and approved by the Owner.

C. Proofrolling shall be done with 1 pass of a fully loaded tandem dump truck equal to or exceeding 50,000 lbs., or other construction equipment if approved by the geotechnical engineer.

D. Construction methods shall be as follows:
   1. After the subgrade or stone base course has been completed within 0.50 foot of final grade, the subgrade or stone base course shall then be compacted and tested prior to commencement of proofrolling. The coverage areas and methods will be identified by the Owner's representative and/or geotechnical engineer. However, the roll shall be operated in a systematic manner so that the number of coverages over all areas to be proofrolled can be readily determined and recorded;

2. The equipment shall be operated at a speed that the geotechnical engineer can comfortably and slowly walk alongside the equipment;
3. If it becomes necessary to take corrective action, such as but not limited to underdrain installation, undercut and backfill of an unsuitable material, and aeration of excessively wet material in areas that have been proofrolled, see Article 3.03. These areas shall be proofrolled again following the completion of the necessary corrections. If the corrections are necessary due to the negligence of the Contractor or weather, the corrective work and additional proofrolling shall be performed by the Contractor at no cost to the Owner; and,
4. The Contractor shall protect all structural facilities on the project, such as but not limited to box culverts, pipe culverts, and utilities, from damage by the proofrolling equipment.

3.6 MAINTENANCE OF SUBGRADE

A. Finished subgrades shall be verified by the Contractor to ensure proper elevation and conditions for construction above subgrade.

B. Protect subgrade from excessive construction traffic and wheel loading including concrete and dump trucks.

C. Remove areas of finished subgrade judged to be unsatisfactory to the depth necessary and replace in a manner that will comply with compaction requirements by use of material equal to or better than the best subgrade material on site. Surface of subgrade after compaction shall be hard, uniform, smooth, stable, and true to grade and cross section.

3.7 FINISH ELEVATIONS AND LINES

A. For setting and establishing finish elevations and lines, secure the services of a licensed land surveyor acceptable to the Owner and engineer.

B. Provide elevation grade stakes and any other surveying necessary for the layout of the work. The Contractor shall conduct his work in such a manner that survey stakes will be protected as long as their need exists. Grade stakes, which are damaged or stolen, shall be replaced by the Contractor's surveyor at the Contractor's expense.

C. Graded areas shall be uniform, hard and smooth, free from rock, debris, or irregular surface changes. Any deviation shall not result in changes in drainage areas or ponding. All ground surfaces shall vary uniformly between indicated elevations. Finish drainage ditches shall be graded to allow for proper drainage without ponding and in a manner that will minimize the potential for erosion.

D. Correct all settlement and eroded areas for one year after date of project completion at no additional expense to Owner. Bring paved and landscaped areas to proper elevation. Replant or replace any grass, shrubs, bushes, or other vegetation disturbed by construction using corrective measures.

3.8 FIELD QUALITY CONTROL

A. The contractor shall coordinate all earthwork with the testing agency and geotechnical engineer to allow for inspection and testing. The geotechnical engineer shall provide full-time observation and testing of the compaction operations and provide documentation to the Owner.

B. Allow geotechnical engineer to inspect and test each subgrade and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.

C. The geotechnical engineer shall test compaction of soils in place according to ASTM D 1556, ASTM D 1557, ASTM D 2167, ASTM D 2922, ASTM D 2937, and ASTM D 4254 as applicable. Tests shall be performed at the following locations and frequencies:
   1. Paved Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2200 sq. ft. or less of paved areas or building slab, but in no case fewer than three tests.
   2. Trench Backfill: At each compacted initial and final backfill layer, at least one test for each 150 feet or less of trench, but no fewer than two tests.
   3. Structural Backfill: At each compacted initial and final backfill layer, at least one test for each 150 feet or less of trench, but no fewer than two tests.

D. When the geotechnical engineer reports that subgrades, fills or backfills have not achieved degree of compaction specified, recompact and retest until specified compaction is obtained.

3.9 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Comply with requirements specified in Section 017419 - Construction Waste Management and Disposal. Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off site to a regulated and permitted facility. Provide two copies of load manifest and permit from owner of the property where material is deposited.

END OF SECTION 310000

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SECTION 311000

SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

A. The work under this Section shall include all labor, materials, and equipment necessary for Site Clearing as hereinafter specified and/or as otherwise required for the proper and timely completion of the Contract.

B. This Section includes the following:
1. Removing surface debris.
2. Removing designated paving; curbs; and existing features including, but not limited to inlets, pipes, and fencing.
3. Removing designated trees, shrubs, and other plant life.
4. Removing abandoned utilities.
5. Excavating topsoil.

1.2 RELATED DOCUMENTS

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

1.3 MATERIALS OWNERSHIP

A. Except for materials indicated to be stockpiled or to remain Owner's property, cleared materials shall become the Contractor's property and shall be disposed of in accordance with all applicable regulations.

1.4 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

B. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

C. Notify utility locator service for area where Project is located prior to site clearing.

D. Contractor shall verify existing grades prior to performing work under this section. If existing grades are at variance with the drawings, notify the Owner and engineer to receive instructions prior to proceeding. No additional compensation will be considered resulting from grade variances once site clearing has commenced.

E. All benchmarks and monuments shall be protected during construction. If disturbed or destroyed, they shall be replaced in original position by a licensed surveyor at the Contractor's expense.

F. Protect areas outside limits of disturbance from encroachment by construction personnel or equipment, regardless of property Ownership. Access shall be by specific, written permission or easement only.

## PART 2 - PRODUCTS

### 2.1 EQUIPMENT AND MATERIALS

A. The contractor shall provide and use all necessary equipment and materials to perform the work described herein.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Verify existing plant life designated to remain is tagged or identified.

### 3.2 PREPARATION

A. Call the Pennsylvania One Call System at 1-800-242-1776 not less than three working days before performing work.
   1. Request underground utilities to be located and marked within and surrounding construction areas.

B. Provide erosion control measures in accordance with Section 312500, Soil Erosion and Sediment Control, prior to any construction activity.

C. Limit of clearing is to be staked and verified by Owner or engineer prior to removal of any material.

D. All trees and shrubs not designated to remain within the area to be graded, whether shown or not on the drawings, shall be cut and the stumps shall be completely dug out. Burning on site is not permitted.

### 3.3 PROTECTION

A. The Contractor shall protect existing underground utilities from damage. The accuracy of the utilities shown on the plan as to line and grade is not guaranteed. Any damage caused by the Contractor to any utility shall be the responsibility of the contractor to correct.

B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted. If utilities are interrupted, arrange to provide temporary utility services.
   1. Notify Owner not less than 72 hours in advance of proposed utility interruptions.
   2. Do not proceed with utility interruption without Owner’s written permission.

C. All trees and vegetation to remain shall be barricaded and protected during the construction process in accordance with plans and specifications.

## 3.4 CLEARING AND GRUBBING

A. Clear areas required for access to site and excavation of Work.

B. Remove trees and shrubs indicated. Remove stumps and main root balls.

C. Clear undergrowth and deadwood, without disturbing subsoil.

D. Remove obstructions, objectionable material, rubbish, junk, trees, shrubs, grass, and other vegetation within the limit of disturbance to permit Work. Removal includes digging out stumps and obstructions and grubbing roots, unless otherwise specified.

E. 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 and compact each layer to a density equal to adjacent original ground as in accordance with Section 310000 - Earthwork.

## 3.5 REMOVAL

A. Remove debris, rock, and extracted plant life from site.

B. Partially remove paving and curbs. Neatly saw cut edges at right angles to the surface.

C. Remove abandoned utilities. Indicate removal termination point for underground utilities on Record Documents.

D. Continuously clean-up and remove waste materials from site. Do not allow materials to accumulate on site.

E. Do not burn or bury materials on site. Leave site in a clean condition.

F. Comply with requirements specified in Section 017419 - Construction Waste Management and Disposal. Legally dispose of waste off Owner’s property.

## 3.6 TOPSOIL EXCAVATION

A. Excavate topsoil from entire site within the limit of disturbance without mixing with foreign materials for use in finished grading.

B. Do not excavate wet topsoil.

C. Stockpile in area designated on site to depth not exceeding 20 feet and protect from erosion.

D. Remove excess topsoil not intended for reuse from site.

END OF SECTION 311000

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SECTION 312200

GRADING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Grading shall include all work necessary to bring the designated locations of the project area to the grades shown on the Drawings.

B. Grading shall include all Borrow Excavation, transporting, placement and compaction work required to provide the necessary material volumes to complete the designed grades for the project areas as shown in the Contract Drawings. Borrow Excavation work shall be comprised of two types of excavation:

1. Common Borrow Excavation. This refers to soil material salvaged within the limit of disturbance of the project. This shall include soil that will be excavated and/or stockpiled in order to complete the work depicted in the Contract Drawings.
2. Foreign Borrow Excavation. This refers to soil material required in addition to the material available from regrading operations, and will come from approved sources outside the limits of the project.

C. Finished grades to be landscaped or seeded shall include a minimum topsoil layer of six inches (6”) or as indicated on the Drawings. Finished grades to be otherwise surfaced shall allow sufficient elevation for the completed surface to produce the finished grades and elevations as shown on the Drawings.

1.2 REFERENCES

A. It is the Contractor's responsibility to be thoroughly familiar with the most recent revision or amendment to the following:

1. Philadelphia Water Department, Standard Details and Standard Specifications for Sewers.
2. Philadelphia Water Department, Standard Specifications for Excavation, Refilling, Grading, Landscaping, and Repaving (12-49).
3. Philadelphia Streets Department, Standard Specifications for Paving and Repaving.
4. Philadelphia Streets Department, Standard Construction Items.
5. PennDOT Publication 408, Section 201 – Clearing and Grubbing
6. PennDOT Publication 408, Section 205 – Borrow Excavation
7. PennDOT Publication 408, Section 206 – Embankment
8. PennDOT Publication 408, Section 802 – Topsoil Furnished and Placed

1.3 QUALITY ASSURANCE

A. The grading Contractor or subcontractor is subject to approval by the owner.

B. Any fill or topsoil sources, disposal areas, or temporary offsite storage locations shall be subject to review and approval by the owner.

C. An as-built survey of completed grades and elevations shall be completed by the Contractor. This survey will be deliverable to the owner, or as otherwise directed, prior to any landscaping installation or final surfacing (seeding, paving, etc.) operations.

PART 2 - PRODUCTS

2.1 FILL MATERIAL

A. Fill material (both Common Borrow Excavation and Foreign Borrow Excavation) shall conform to Publication 408 Specifications, Section 205.

B. All Foreign Borrow Excavation materials shall be free of seeds or live plant materials and all noxious or invasive plants and/or weeds. These materials shall be obtained from properly permitted and authorized sites. All Foreign Borrow Excavation materials shall also conform to the following:

1. More than 35% passing No. 200 Sieve.
2. Minimum dry mass density of 95 lb/ft3 determined by PTM No. 106, Method B.
3. Maximum liquid limit of 65, determined by AASHTO T89.
4. Plasticity index of not less than liquid limit minus 30 (for soils with liquid limits of 41 to 65), determined by AASHTO T90.

C. All fill materials shall be free from clay lumps, brush, litter, roots, stones 2 in. and larger, and other foreign materials.

2.2 TOPSOIL

A. Topsoil shall be acceptable friable loam that is reasonably free of subsoils, clay lumps, litter, roots or other plant materials, stones (2 in. and larger), and other foreign materials.

B. Topsoil may be produced onsite from existing appropriate soils by adding organic plant matter (mulch, shredded plants, etc) to constitute ten percent (10%), as determined according to AASHTO T194, and fully combined with the soil stockpile. Soils with clay content greater than thirty-five percent (35%) or sand content greater than seventy percent (70%) shall not be considered amendable to topsoil by this method.

C. Topsoil shall have a minimum sixty percent (60%) passing through the No. 10 (2 mm) sieve as defined by AASHTO T88.

PART 3 - EXECUTION

3.1 GRADING

A. Install all required Soil Erosion and Sedimentation Control measures as described in these Specifications or indicated on the Drawings. Phasing of Erosion and Sedimentation Control Measures shall follow the sequence provided, or barring provision of a specified sequence shall be installed as appropriate to the Work and as directed by the owner/Authorized Representative. At a minimum, downstream sediment protection, limit-of-disturbance fencing, and vehicle/tire cleaning shall be instituted prior to commencing any clearing or grading activities.

B. Perform all clearing and grubbing work in accordance with PennDOT Publication 408 Specifications, Section 201.3, Clearing and Grubbing – Construction and as specified in section 31 1000 – Site Clearing. Complete all clearing and grubbing (including stump removal) before starting other grading work.

C. In areas of fill, complete grading to within three feet (3') of finished grade before excavating for and constructing sewers.

D. All grading work, except final grading where sewers are constructed in fill (see above), shall be completed within thirty (30) days of starting clearing and grubbing operations.

E. Place embankment over pipes and embankment around manholes in accordance with the Standard Details and Standard Specifications for Sewers.

3.2 PLACEMENT AND COMPACTION OF FILL AND BACKFILL

A. For general fill and backfilling, place materials in accordance with Section 206.3(b) (Embankment: Placement and Compaction) of PennDOT Publication 408.

B. Where fill materials are to be placed within six inches (6”) of the finished graded soil surface on areas that are to be revegetated, materials shall be compacted with a roller having a mass (weight) not over one-hundred-and-twenty pounds per foot width (120 lb/ft-width) of roller or by other acceptable methods as directed by Owner/Authorized Representative. Material shall not be placed in a wet or frozen condition.

3.3 PLACEMENT AND FINISH GRADING OF TOPSOIL

A. Loosen or scarify all areas to be covered by topsoil to a minimum depth of three inches (3”). Remove and dispose of any stones or other objectionable material encountered.

B. Place topsoil on the prepared areas, and (unless otherwise directed in the Drawings or by Owner/Authorized Representative) spread and compact to a uniform depth of six inches (6”) to produce the elevations and grades as shown on the Drawings.

C. Compact topsoil with a roller having a mass (weight) not over one-hundred-and-twenty pounds per foot width (120 lb/ft-width) of roller or by other acceptable methods as directed by Owner/Authorized Representative. A sheep foot roller may be used as appropriate.

D. Material shall not be placed or compacted in a wet or frozen condition.

3.4 AS-BUILT SURVEY

A. An as-built survey shall be completed by the Contractor and submitted to Owner/Authorized Representative for approval prior to commencing final surfacing operations, including paving or landscaping.

B. The survey shall identify spot elevations sufficient to show the grading in accordance with the Drawings (or as modified by Owner/Authorized Representative). Spot elevations provided on the Drawings shall be duplicated as a minimum number of survey points for the as-built.

C. Survey of as-built elevations and grades may be included in (or include) as-built dimensions and elevations for other infrastructure constructed under this Contract.

D. Survey underground stormwater management basins in accordance with latest PWD as-built survey guidelines.

END OF SECTION 312200

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SECTION 312316.13

TRENCHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Excavating trenches for utilities from 5 feet outside building to utility service.
2. Compacted fill from top of utility bedding to subgrade elevations.
3. Backfilling and compaction.

1.2 RELATED DOCUMENTS

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

B. Related Sections:
1. Section 310000 - Earthwork.
2. Section 311000 - Site Clearing.
3. Section 334009 - Connections To Existing Structures
4. Section 334201 - Stormwater Gravity Piping and Inlets

C. American Association of State Highway and Transportation Officials:
1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

D. ASTM International:
1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3).
2. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
3. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3).
4. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
5. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
6. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

1.3 DEFINITIONS

A. Utility: Any buried pipe, duct, conduit, or cable.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with City of Philadelphia standard.

B. Maintain one copy of document on site.

1.5 QUALIFICATIONS

A. Prepare excavation protection plan under direct supervision of Professional Engineer experienced in design of this Work and licensed in the City of Philadelphia.

1.6 RELATED DOCUMENTS

A. Verify field measurements prior to fabrication.

1.7 COORDINATION

A. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 LINES AND GRADES

A. Lay pipes to lines and grades indicated on Drawings.
   1. Architect/Engineer reserves right to make changes in lines, grades, and depths of utilities when changes are required for Project conditions.

B. Use laser-beam instrument with qualified operator to establish lines and grades.

3.2 PREPARATION

A. Contact the Pennsylvania One Call System, Inc at 8-1-1 or 1-800-242-1776 not less than three, but no more than ten business days before performing Work. A business day is any day except Saturday, Sunday, or legal holiday prescribed by statute in the law. A business day begins at 12:00:00 am and end at 11:59:59 pm.
   1. Request underground utilities to be located and marked within and surrounding construction areas.

B. Identify required lines, levels, contours, and datum locations.

C. Protect plant life, lawns, and other features remaining as portion of final landscaping.

D. Protect benchmarks, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

E. Maintain and protect above and below grade utilities indicated to remain.

F. Establish temporary traffic control and detours when trenching is performed in public right-of-way. Obtain all necessary permits to perform work within the public right-of-way. Relocate controls and reroute traffic as required during progress of Work.

3.3 TRENCHING

A. Excavate subsoil required for utilities to utility service.

B. Remove lumped subsoil, boulders, and rock up of 1/6 cu. yd., measured by volume. Remove larger material as specified in Section 310000.

C. Perform excavation within 24 inches of existing utility service in accordance with utility company's requirements.

D. Do not advance open trench more than 200 feet ahead of installed pipe.

E. Cut trenches sufficiently wide to enable installation and allow inspection. Remove water or materials that interfere with Work.

F. Excavate bottom of trenches maximum 2 feet wider than outside diameter of pipe.

G. Excavate trenches to depth indicated on Drawings. Provide uniform and continuous bearing and support for bedding material and utilities.

H. Do not interfere with 45 degree bearing splay of foundations.

I. When Project conditions permit, slope side walls of excavation starting 2 feet above top of pipe. Slope excavation at a maximum slope of 2 horizontal to 1 vertical. When side walls cannot be sloped, provide sheeting and shoring to protect excavation as specified in this section.

J. When subsurface materials at bottom of trench are loose or soft, excavate to greater depth as directed by Architect/Engineer until suitable material is encountered.

K. Cut out soft areas of subgrade not capable of compaction in place. Backfill with clean sand or sand and gravel with a maximum gravel size of 1.5-inches and compact to density equal to or greater than requirements for subsequent backfill material.

L. Correct areas over excavated areas with compacted backfill as specified for authorized excavation or replace with fill concrete as directed by Architect/Engineer.

M. Stockpile subsoil in area designated on site to depth not exceeding 20 feet and protect from erosion.

3.4 SHEETING AND SHORING

A. Sheet, shore, and brace excavations to prevent danger to persons, structures and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.

B. Support trenches more than 5 feet deep excavated through unstable, loose, or soft material. Provide sheeting, shoring, bracing, or other protection to maintain stability of excavation.

C. Design sheeting and shoring to be left in place as part of the completed Work, cut off minimum 18 inches below finished grade.

D. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.

E. Repair damage to new and existing Work from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

3.5 BACKFILLING

A. Backfill trenches to contours and elevations with unfrozen fill materials.

B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.

C. Place fill material in continuous layers and compact in accordance with Section 310000 - Earthwork.

D. Employ placement method that does not disturb or damage utilities in trench.

E. Maintain optimum moisture content of fill materials to attain required compaction density.

F. Do not leave more than 50 feet of trench open at end of working day.

G. Protect open trench to prevent danger to the public.

3.6 TOLERANCES

A. Top Surface of Backfilling: Plus or minus 1 inch from required elevations.

3.7 FIELD QUALITY CONTROL

A. Perform laboratory material tests in accordance with ASTM D1557.

B. Perform in place compaction tests in accordance with the following:
   1. Density Tests: ASTM D1556.
   2. Moisture Tests: ASTM D3017.

C. When tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest.

3.8 PROTECTION OF FINISHED WORK

A. Reshape and re-compact fills subjected to vehicular traffic during construction.

END OF SECTION 312316.13

SECTION 31 23 50

SAWCUTTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section includes the saw-cutting 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 the 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 31 23 50

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SECTION 312500

EROSION AND SEDIMENTATION CONTROLS

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. Stone and Concrete Block Inlet Protection;
   3. Compost filter sock;
   4. Temporary seeding and mulching;
   5. Rock Construction Entrance;
   6. Pumped Water Filter Bag;
   7. Compost Sock Washout Station; and,
   8. Maintenance and repair of erosion and sediment control measures.

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.

B. Related Sections:
   1. Section 310000 - Earthwork
   2. Section 311000 - Site Clearing
   3. Section 321216 - Asphalt Paving
   4. Section 321600 - Concrete Sidewalks

1.3 REFERENCES

A. Pennsylvania Department of Environmental Protection, Erosion and Sediment Pollution Control Program Manual (most recent version).

B. Commonwealth of Pennsylvania, Department of Transportation (PennDOT)
   1. Bulletin No. 15: Approved Construction Materials.
   2. Publication 408/2020 Specifications.

1.4 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.

1.5 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.

1.6 PRE-INSTALLATION MEETING

A. Convene a minimum seven (7) days prior to commencing Work of this Section.

PART 2 - PRODUCTS

2.1 FILTER BAG INLET PROTECTION

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 D4884 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 compost filter sock as described below and manufactured from recycled synthetic fibers.

2.2 STONE AND CONCRETE BLOCK INLET PROTECTION

A. In accordance with PennDOT Publication 408, Section 860.2(b).

B. Inlet protection in roadway is not to include stone or berms.

2.3 COMPOST FILTER SOCK

A. Compost filter socks shall be a three-dimensional tubular sediment control listed in PennDOT Bulletin 15, or approved equal.

2.4 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.

2.5 ROCK CONSTRUCTION ENTRANCE

A. Rock Construction Entrance shall be in accordance with PennDOT Publication 408, Section 849.

B. Accumulated materials shall be cleaned daily and as necessary and disposed of in accordance with all applicable regulations.

2.6 PUMPED WATER FILTER BAG

A. Pumped water filter bags shall be provided in accordance with PennDOT Publication 408, Section 855.

2.7 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 or PennDOT Publication 408 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 EXAMINATION

A. Verify compacted subgrade is acceptable and ready to support devices and imposed loads.

3.3 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.

3.4 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. Grates of Highway grate and Open Mouth Grate Inlets shall be protected using inlet filter bags as specified herein.

E. Mouth of 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.

3.5 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. Stockpile slopes shall be 2:1 or flatter.

3.6 SITE STABILIZATION

A. Incorporate erosion control devices indicated on the Drawings into the Project at the earliest practicable time.

B. Construct, stabilize and activate erosion controls before site disturbance within tributary areas of those controls.

C. Stabilize and disturbed area of affected erosion control devices on which activity has ceased and which will remain exposed for more than 20 days.
   1. During non-germinating periods, apply mulch at recommended rates.
   2. Stabilize disturbed areas which are not at finished grade and which will be disturbed within one year in accordance with temporary seeding as specified on the Drawings.
   3. Stabilize disturbed areas which are either at finished grade or will not be disturbed within one year in accordance with Section 329200 - Lawn and Meadow.

3.7 CLEANING

A. When sediment accumulation in sedimentation structures has reached a point one-third depth of sediment structure or device, remove and dispose of sediment.

B. Do not damage structure or device during cleaning operations.

C. Do not permit sediment to erode into construction or site areas or natural waterways.

D. Clean channels when depth of sediment reaches approximately on half channel depth

3.8 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.).

END OF SECTION 312500

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SECTION 31 50 00

EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work under this Section shall include all labor, on-site materials, and equipment necessary for the excavation of trench and grading as hereinafter specified and/or as otherwise required for the proper and timely completion of this Contract.

1.2 RULES AND REGULATIONS

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

1. ASTM C131 Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angles Machine
2. ASTM C136 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
3. ASTM C535 Standard Test Method for Resistance to Degradation of Large-Size Aggregate by Abrasion and Impact in the Los Angeles Machine
4. ASTM D653 Standard Terminology Relating to Soil, Rock, and Contained Fluids
5. ASTM D1140 Standard Test Methods for Determining the Amount of Material Finer than 75-µm (No. 200) Sieve in Soils by Washing
6. ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3))
7. ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
8. ASTM D2487 Standard Practice for Classification of Soils for Engineering Purposes
9. ASTM D6938 Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
10. ASTM D4253 Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
11. ASTM D4254 Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
12. ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
13. AASHTO T180 Standard Method of Test for Moisture-Density Relations of Soils Using 4.54-kg (10-lb) Rammer and 457-mm (18-in.) Drop

1.3 SUBMITTALS

A. Samples

1. Furnish and deliver samples of fill and backfill materials as selected by the Engineer.

1.4 PERFORMANCE REQUIREMENTS

A. If any hazardous waste materials are discovered on the site, the Contractor shall cease operations in that area until authorized to resume. The Contractor shall notify the Engineer of such material and cooperate with any outside agency or specialist that may be called in to determine the extent of the hazard and methods of its disposition.

B. Tolerances:

1. Construct finished sub-grades to plus 0 inches minus ½ inch of the elevation indicated.

2. Construct finished grade of slopes not steeper than 3H:1V to plus or minus 1/2 inch and on slopes steeper than 3H:1V to plus or minus 2 inches. Slopes shall not encroach upon roadbeds.
3. Maintain the moisture content of fill material as it is being placed within plus or minus 3 percent of the optimum, moisture content of the material as determined by the laboratory test herein specified.
4. Protect all existing and new construction including utilities, finishes and equipment from water, damage, weakening or other disturbance.

1.5 DEFINITIONS

A. Earthwork Terminology used in this Section and not defined herein shall be interpreted in accordance with the definitions given in ASTM D653.

1. Sub-grade: Sub-grade is the lowest elevation of excavation and the highest elevation if embankment required to accommodate the indicated construction.
2. Backfill: Soil or soil-rock material used to refill excavations and to refill excavated spaces around building walls.
3. Imported Material: Soil or granular material which is hauled in from off-site areas.
4. Unsuitable Material: Excavated material or material below the natural ground surface in embankment areas or below sub-grade elevation in excavated areas, which is unsuitable for its planned use.
5. Relative Compaction: The ratio, expressed as a percentage, of the in-place place dry density of fill material as compacted in the field to the maximum dry density of the same material as determined by laboratory test ASTM D1557, Method D.
6. Optimum Moisture Content: The water content at which a soil can be compacted to a maximum dry unit weight by a given compactive effort.
7. Relative Density: Refer to ASTM D4253 and ASTM D4254.
8. Excavation: Excavation is the removing of all materials encountered within the Contract Limits, regardless of the nature of the material encountered and the method by which it is removed, for grading, sub-grading for roadways or paved areas and other structures not specified elsewhere in these specifications. All excavation is unclassified and no additional compensation will be made for rock.

1.6 PROJECT CONDITIONS

A. Protection

1. Provide the necessary barricades, signs, lights, etc. to prevent accidents, to avoid all hazards and to protect the public, the work and property at all times, including Saturdays, Sundays, and holidays.
2. Be responsible for any and all damages which may arise or occur to any party whatsoever by reason of neglect in providing proper lights, guards, barriers or any other safeguards to prevent damage to property, life and limb.
3. Prior to any excavation the Contractor, with the cooperation of the Owner of the respective existing utility or its agents shall locate and paint the location of all water services, gas services, gas mains, water mains, sanitary sewers, telephone raceways or conduits and drains, within five (5) feet of the proposed excavations.
4. In case water, gas pipes, conduits, or other utilities are broken in the prosecution of the work, the Contractor shall stop work and give immediate notice to the proper authorities and shall be responsible for any damage to persons or property caused by such breaks. Failure to give prompt notice to the authorities shall deem the Contractor responsible for any damages legal or otherwise caused by the interruption or loss of utility service.

B. Parking and Storage

1. Parking of vehicles and storage of materials shall be confined to designated areas approved by the Owner.

C. Dust Control

1. During the progress or work, the Contractor shall conduct his operation and maintain the area of his activities so as to minimize the creation and dispersion of dust.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Unfavorable Weather Conditions

1. Excavating, filling, backfilling, and grading work shall not be performed during weather conditions which might damage the condition of existing ground, in-progress work, or completed work. When the work is interrupted by rain, excavating, filling, backfilling and grading work shall not resume until the site is suitable for the work.
2. Sub-grade shall be free from mud, snow, ice, and deleterious material when work is resumed.

PART 2 - PRODUCTS

2.1 FILL AND BACKFILL

A. Material suitable for use as fill and backfill shall be an inert, non-expansive soil, free from organic matter and of such quality that it will compact thoroughly without the presence of voids. Excavated on-site soil will be considered suitable for fill and backfill.

B. Suitable excavated material shall be conditioned for reuse and properly stockpiled for later filling and backfilling operations. Conditioning shall consist of spreading material in layers not to exceed 8 inches and raking free of debris and rubble. Rocks exceeding four inches in largest dimension and deleterious material shall be moved from the site and disposed of.

PART 3 - EXECUTION

3.1 EXISTING UTILITIES

A. Verify on site the location and depth (elevation) of all existing utilities and services before performing any excavation work. Excavation within 3 feet of a utility line shall be performed by hand.

3.2 EXCAVATION

A. General

1. Excavation consists of the removal and on-site placement or disposal of whatever material is encountered when establishing required sub-grade elevations.
2. Excavation shall be made to the grades as shown on the Contract Drawings.
3. Where excavation grades are not shown on the Contract drawings, excavation shall be made as required to accommodate the installation of all facilities.

B. Cold Weather Protection

1. Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degrees Fahrenheit.

C. Stability of Excavations

1. Sloped sides of excavation shall comply with state and local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.
2. Maintain sides and slopes of excavations in a safe condition until completion of backfilling.

D. Shoring and Bracing

1. Provide materials for shoring and bracing, such as sheet piling, uprights, stringers and cross-braces, in good serviceable condition.
2. Establish requirements for trench shoring and bracing to comply with local Codes and authorities having jurisdiction.
3. Maintain shoring and bracing excavations regardless of the time period excavations will be open. Carry down shoring and bracing as excavation progresses.

E. Material Storage

1. Stockpile suitable excavated materials where directed, as required for fill.
2. Locate and retain soil materials away from edge of excavation.

3.3 BACKFILL

A. Backfill excavation as promptly as work permits, but not until waterproofing membrane is applied and is ready to be backfilled, if applicable.

B. Placement and Compaction

1. Place backfill materials in layers not more than 4” in loose depth for materials by hand-operated tampers.
2. Place backfill and fill materials evenly adjacent to structures, to required elevations. Take care to prevent wedging action of backfill against structures by carrying the material uniformly around structure to approximately same elevation in each life.

3.4 GRADING

A. Grade areas adjacent to building lines to drain away from structures and to prevent ponding. Finish below the required sub-grade elevations.

3.5 CLEAN-UP

A. Upon completion of the work of this section, place in stockpile areas all excess excavated material, rubbish, trash and debris resulting from operations. Leave the site in a neat and orderly condition.

END OF SECTION 31 50 00

SECTION 321116

SUBBASE COURSE

PART 1 - GENERAL

1.1 SUMMARY

A. This item consists of the preparation of the subgrade and the construction of a layer of aggregate for driveways, footways/sidewalks, and roadway pavement of the depth indicated, to the lines and grades shown on the drawings, or as directed by the engineer.

B. Section Includes:
1. Aggregate subbase.
2. Aggregate base course.

C. Related Sections:
1. 310000 - Earthwork
2. 321600 - Concrete Sidewalk

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.

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials:
1. AASHTO M288 - Standard Specification for Geotextile Specification for Highway Applications.

B. ASTM International:
1. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
2. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
3. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
4. ASTM D2940 - Standard Specification for Graded Aggregate Material for Bases or Subbases for Highways or Airports.
5. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

1.4 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Product Data:
1. Submit data for geotextile fabric.

C. Samples: Submit, in air-tight containers, 10 lb. sample of each type of aggregate fill to testing laboratory.

D. Materials Source: Submit name of aggregate materials suppliers.

E. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

A. Furnish each aggregate material from single source throughout the Work.

B. Perform Work according to Pennsylvania Department of Transportation standards.

C. Maintain one copy of each document on site.

PART 2 - PRODUCTS

2.1 AGGREGATE MATERIALS

A. Subbase Aggregate:
   1. No. 2A Stone Aggregate in accordance with PennDOT Publication 408, Section 703.

B. Base Course Aggregate:
   1. No. 2A Stone Aggregate in accordance with PennDOT Publication 408, Section 703.

2.2 ACCESSORIES

A. Geotextile Fabric:
   1. Class 4, Type C Woven Geotextile Fabric in accordance with PennDOT Publication 408, Section 735.

PART 3 - EXECUTION

3.1 GENERAL

A. Subbase material shall not be placed on soft, muddy or frozen areas, nor until all irregularities in the prepared areas, including soft areas in the foundation, have been satisfactorily corrected. The subgrade shall be compacted to not less than one hundred percent (100%) of the determined dry weight density.

B. Unstable subbase conditions, including soft foundation areas which develop ahead of the base and paving operations shall be satisfactorily corrected by scarifying, reshaping, and compacting, or by replacement as required.

3.2 PLACEMENT

A. Install geotextile fabric over subgrade as indicated on the plans an in accordance with manufacturer’s instructions.
   1. Lap ends and edges minimum 6 inches.
   2. Anchor fabric to subgrade when required to prevent displacement until aggregate is installed.

B. Place aggregate in equal thickness layers over prepared substrate to total compacted thickness indicated on Drawings.
   1. Maximum Layer Compacted Thickness: 6 inches

2. Minimum Layer Compacted Thickness: 3 inches

C. Level and contour surfaces to elevations, profiles, and gradients indicated.

D. Add small quantities of fine aggregate to course aggregate when required to assist compaction.

E. Maintain optimum moisture content of fill materials to attain specified compaction density.

F. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

G. When constructed in part width, the extension of the subbase construction shall not proceed to its full width until the existing edge of the subbase is trimmed and all foreign and deleterious material is removed from the remaining prepared area.

3.3 COMPACTION

A. The uniformly spread material shall be compacted by means of approved equipment to not less than one hundred percent (100%) of the maximum dry weight density (PENNSYLVANIA TEST METHODS (PTM) No. 106, Method B) as determined by PTM No. 112, or PTM No. 402. When the material is too coarse to satisfactorily use these methods, compaction will be determined by the Engineer based on non-movement of the material under the specified compaction equipment. Compaction shall progress gradually from the sides to the center with each succeeding pass uniformly overlapping the previous pass, and shall continue until the entire area is satisfactorily shaped and compacted to the required lines and grades. One (1) density determination shall be made for each three thousand (3,000) square yards or less, on each layer of completed subbase.

3.4 DEPTH TEST

A. The depth of the finished subbase will be determined by cutting or digging holes to the full depth of the completed subbase. One depth measurement shall be made for each three thousand (3,000) square yards, or less, of the completed subbase. Any section in which the subbase is one half inch (1/2”) or more deficient in specified depth shall be scarified to a depth of at least three inches (3”), blended with the necessary additional material, and then recompacted to the specified density and depth or otherwise satisfactorily corrected.

B. All test holes shall be cut or dug, backfilled with similar material, and satisfactorily compacted by and at the expense of the Contractor. This operation shall be under the direct supervision of the inspector who will check the depth for record purposes.

3.5 MAINTENANCE OF TRAFFIC

A. No traffic shall be allowed on the completed subbase other than necessary local traffic and that developing from the operation of essential construction equipment, unless otherwise directed by the Engineer. Any defects which may develop in the construction of the subbase or any damage caused by the operation of local or job traffic is the responsibility of the Contractor and shall be immediately repaired or replaced at the expense of the Contractor.

B. The competed subbase shall be uniformly moistened immediately prior to the construction of the base course and/or pavement, except when a hot-mix bituminous base course is to be placed.

C. Completed subbase which has been subjected to hauling or exposed to the elements for periods in excess of one-hundred-twenty (120) calendar days will require re-testing of the

material and re-approval by the Engineer before construction of the base course or pavement may proceed. Subbase so used or exposed, not meeting the requirements herein specified shall be reconstructed or replaced as directed by the Engineer at the expense of the Contractor.

END OF SECTION 321116

SECTION 321216

ASPHALT PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes all labor, equipment, and materials necessary for the installation and testing of Warm Mix Asphalt Superpave Wearing Course, Warm Mix Asphalt Superpave Binder Course, and Warm Mix Asphalt Superpave Binder Course of specified depths.

B. Section Includes:
   1. Asphalt paving base course, binder course, and wearing course.

C. For bituminous asphalt paving in public right-of-way. Refer to the City of Philadelphia, Department of Streets, Standard Construction Items for materials, equipment, installation, and testing requirements.

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.

B. Related Sections:
   1. Section 310000 - Earthwork
   2. Section 321116 - Subbase Course

1.3 REFERENCES

A. The most current version of the publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.
   1. Pennsylvania Department of Transportation (PennDOT), Publication 408/2020
   2. PennDOT Bulletin No. 15: Qualified Products List for Construction
   3. Asphalt Institute (AI): “The Asphalt Handbook”
   4. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM):
      a. ASTM D 692 - Coarse Aggregate for Bituminous Paving Mixtures
      b. ASTM D 979 - Sampling Bituminous Paving Mixtures
      c. ASTM D 1073 - Fine Aggregate for Asphalt Paving Mixtures
      d. ASTM D 1188 - Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples
      e. ASTM D 2041 - Theoretical Maximum Specific Gravity and Density of Asphalt Mixtures
      f. ASTM D 2726 - Bulk Specific Gravity and Density of Non-Absorptive Compacted Asphalt Mixtures
      g. ASTM D 2950 - Density of Bituminous Concrete in Place by Nuclear Methods
      h. ASTM D 3549 - Thickness or Height of Compacted Asphalt Mixture Specimens
      i. ASTM D 3666 - Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials

B. The Contractor is required to have one copy of the latest edition of each of the following publications available for review in the job-site construction office at all times while performing the

work described in this Section. The Contractor is to comply with each of the following unless more stringent requirements are indicated on the Drawings or within these specifications.

1. City of Philadelphia, Department of Streets: Standard Construction Items, except that measurement and payment sections do not apply.
2. Publication 408: Specifications, except that measurement and payment sections do not apply.

1.4 SUBMITTALS

A. Product Data: For each product specified. Include technical data and tested physical and performance properties.

B. Job-Mix Design: Certification, by PennDOT and other authorities having jurisdiction, of approval of each job mix proposed for the Work.

C. Qualification Data: For firms and persons specified in the “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.

D. Material Test Reports: Test Reports shall be from the approved testing agency. Indicate and interpret test results for compliance of materials with requirements indicated.

E. Material Certificates: Certificates signed by manufacturers certifying that each material complies with the requirements.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who has completed warm-mix asphalt paving similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Manufacturer Qualifications: Engage a firm experienced in manufacturing warm-mix asphalt similar to that indicated for this project and with a record of successful in-service performance.

1. Firm shall be a registered and approved paving mix manufacturer listed in PennDOT Bulletin No. 15.

C. Testing Agency Qualifications: Demonstrate to the Owner's satisfaction, based on Owner’s evaluation of criteria conforming to ASTM D 3666, that the independent testing agency has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work.

D. Obtain materials from the same source throughout the project.

E. Pre-construction conference: Conduct conference at the project site to comply with the requirements of Division 1 sections and to review the methods and procedures related to asphalt paving including but not limited to the following:

1. Review proposed sources of paving materials, including capabilities and location of plant that will manufacturer warm-mix asphalt.
2. Review condition of substrate and preparatory work performed by other trades.
3. Review requirements for protecting paving work, including restriction of traffic during installation period for remainder of construction period.
4. Review and finalize construction schedule for paving and related work. Verify availability of materials, paving installer’s personnel, and equipment required to execute the work without delays.

5. Review inspection and testing requirements, governing regulations, and proposed installation procedures.
6. Review forecasted weather conditions and procedures for coping with unfavorable conditions.

1.6 REGULATORY REQUIREMENTS

A. Contractor shall obtain all necessary City of Philadelphia Streets Department road opening permits and approvals, and City of Philadelphia Department of Licenses and Inspections permits and approvals, upon the Contractor receiving Notice to Proceed and prior to proceeding with the Work.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if substrate is wet or excessively damp or if the following conditions are not met:
1. Asphalt Base Course: Minimum air or surface temperature of 35 deg F at time of placement in accordance with PennDOT Publication 408, Section 313.3(b).
2. Asphalt Wearing Course: Minimum air or surface temperature of 40 deg F at time of placement in accordance with PennDOT Publication 408, Section 413.3(b).

PART 2 - PRODUCTS

2.1 AGGREGATES

A. Aggregates shall be in accordance with the latest version of PennDOT Publication 408, Section 413.2(b). Provide aggregate from sources listed in PennDOT Bulletin 14.

2.2 ASPHALT MATERIALS

A. Asphalt Cement: PG-64-22 emulsion in accordance with PennDOT Publication 408, Section 413.2(a)1.
1. Water: Potable
2. Mix designs shall contain a maximum of 15% reclaimed asphalt pavement.

B. AUXILIARY MATERIALS
1. Herbicide: Commercial chemical for weed control, registered by Environmental Protection Agency (EPA) and PADEP. Provide granular, liquid, or wettable powder form.
2. Sand: Type B in accordance with PennDOT Publication 408, Section 703.
3. Joint Sealant: ASTM D 3405 or AASHTO M 301, hot applied, single component, polymer-modified bituminous sealant.
4. Geotextile: Class 4, Type A Non-Woven Needle Punched Geotextile Fabric in accordance with PennDOT Publication 408, Section 735.

C. MIXES
1. Warm-mix Asphalt: Provide dense, hot-laid, warm mix asphalt plant mixes approved by PennDOT and complying with the following requirements:
a. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
b. Superpave Base Course: Superpave Asphalt Mixture Design, WMA Base Course, PG 64-22, 3 to <10 Million ESALs, 25 mm Mix, in accordance with PennDOT Publication 408, Section 313.

c. Superpave Binder Course: Superpave Asphalt Mixture Design, WMA Binder Course, PG 64-22, 3 to < 10 Million ESALs, 19 mm Mix, in accordance with PennDOT Publication 408, Section 413.
d. Superpave Wearing Course: Superpave Asphalt Mixture Design, WMA Wearing Course, PG 64-22, 3 to < 10 Million ESALs, 9.5 mm Mix, in accordance with PennDOT Publication 408, Section 413.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to support paving and imposed loads.

B. Refer to Section 321116 for subbase preparation requirements. Refer to Section 321136 for Concrete Base Course Preparation.

C. Verify gradients and elevations of subbase or base are correct.

D. Asphalt paving courses shall be installed in accordance with PennDOT Publication 408, Section 413.

E. Protect adjacent work and structures from splashing of paving materials.

### 3.2 CONDITIONING OF EXISTING SURFACE

A. The vertical surface of curbs, structures, gutters, and existing paving in contact with bituminous mixtures, shall be painted with a uniform coating of bituminous material of the class and type designated for the surface course.

### 3.3 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subbase or base is ready to receive paving.
1. Sweep loose granular particles from surface of unbound-aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course.

B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted aggregate base before applying paving materials.
1. Apply herbicide only if absolutely necessary. Owner approval in writing is required prior to any herbicide application. Herbicide application must comply with all federal, state and local regulations.

C. Adjust elevation of existing utility structure tops to remain, including but not limited to manholes, inlet grates, valve boxes, etc. to final grades. Depending on the type of utility structure, adjustment shall be accomplished by the installation of factory-fabricated adjustment rings, installation of additional masonry courses under existing manhole castings or inlet tops, or resetting structures. Coordinate with utility owners prior to disturbing existing underground utilities to remain.

D. At existing curbs to remain, mill existing pavement as required to maintain existing curb reveal unless otherwise noted on the Drawings.

3.4 DEMOLITION

A. Saw cut and notch existing paving as indicated on Drawings.

B. Clean existing paving to remove foreign material, excess joint sealant and crack filler from paving surface.

C. Repair surface defects in existing paving to provide uniform surface to receive new paving.

3.5 WARM-MIX ASPHALT PLACING

A. Machine place warm-mix asphalt mix on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and compacted thickness as indicated on the Drawings.
   1. Place warm-mix asphalt base course in a single lift and thickness indicated on the Drawings or within these specifications.
   2. Place warm-mix asphalt binder course in a single lift and thickness indicated on the Drawings or within these specifications.
   3. Place warm-mix asphalt wearing surface course in single lift and thickness indicated on the Drawings or within these specifications.
   4. Spread mix at minimum temperature as indicated in PennDOT Publication 408, Section 413.
   5. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes, unless otherwise indicated on the Drawings or within these specifications.

B. Place paving in consecutive strips not less than 10 feet wide, except where infill edge strips of a lesser width are required. After the first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete asphalt binder course for a section before placing asphalt wearing 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 warm-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.6 JOINTS

A. Construct joints to ensure continuous bond between adjoining paving sections. Construct joints free of depressions with same texture and smoothness as other sections of warm-mix asphalt course.
   1. Clean contact surfaces and apply tack coat.
   2. Offset longitudinal joints in successive courses a minimum of 6 inches, however, the joint at the top layer shall be at the centerline of the roadway for 2-lane roads, and at the lane lines for roads with more than two lanes.
   3. Offset transverse joints in successive courses a minimum of 24 inches.
   4. Construct transverse joints by bulkhead method or sawed vertical face method as described in AI's "The Asphalt Handbook".
   5. Compact joints as soon as warm-mix asphalt will bear roller weight without excessive displacement.
   6. Compact asphalt at joints to a density within 2 percent of specified course density.

B. Apply bituminous material of the class and type designated for the surface course where new pavement meets existing bituminous pavement, and where bituminous pavement meets curbs and utility structures. Apply sealant in layer thickness that provides for curing and will not cause

tracking or lifting of sealant to other surfaces. Apply a fine sand covering temporarily over sealant during curing period.

## 3.7 PAVEMENT COMPACTION

A. When the subgrade is exposed proof roll according to the requirements shown. Densify to a stable subgrade. If the Owner determines that the subgrade cannot be densified to a stable condition, then the Owner may direct the Contractor to remove additional subgrade material to the depth required for a stable condition. The Contractor shall then replace unstable subgrade material with 2A stone compacted in 6-inch loose lifts.

B. Begin new pavement compaction as soon as placed warm-mix paving will bear roller weight without excessive displacement. Compact warm-mix paving with hot, hand tampers, or vibratory-plate compactors in areas inaccessible to rollers.
   1. Complete compaction before mix temperature cools to 185 F.

C. Breakdown Rolling: Accomplish breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Repair surfaces by loosening displaced material, filling with warm-mix asphalt, and rerolling to required elevations.

D. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling, while warm-mix asphalt is still hot enough to achieve specified density. Continue rolling until warm-mix asphalt course has been uniformly compacted to the following density:
   1. Density: not less than 95 percent of the density requirements established by the Marshall method at the time of approval of the mix design.

E. Finish Rolling: Finish roll paved surfaces to remove roller marks while warm-mix asphalt is still warm.

F. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while still hot, with back of rake or smooth iron. Compact thoroughly using tamper or other satisfactory method.

G. Repairs: Remove newly paved areas that are defective or contaminated with foreign materials. Remove paving course over areas affected and replace with fresh, warm-mix asphalt. Compact by rolling to specified density and surface smoothness.

H. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

I. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

## 3.8 INSTALLATION TOLERANCES

A. Thickness: Compact each course to produce the thickness indicated on the Drawings within the following tolerances:
   1. Base Course: Plus or minus ¼ inch
   2. Binder Course: Plus or minus ¼ inch
   3. Wearing Surface Course: Plus ¼ inch, no minus.

B. Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10 foot straightedge applied transversely or longitudinally to paved areas:
   1. Base Course: ¼ inch.
   2. Binder Course: ¼ inch
   3. Wearing Surface Course: 1/8 inch.
   4. Crowned Surfaces: Test with crowned template centered at right angle to crown. Maximum allowable variance from template is 0.25 inch.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: As part of this contract, the Contractor shall engage a qualified independent testing agency meeting the requirements of paragraph 1.06 to perform field inspections and test and to prepare test reports.
   1. Testing agency shall conduct and interpret tests and state in each report whether tested Work complies with or deviates from specified requirements.

B. Additional testing, at Contractor's sole expense, will be performed to determine compliance of corrected Work with specified requirements.

C. Thickness: In-place compacted thickness of warm-mix asphalt courses will be determined according to ASTM D3549.

D. Surface Smoothness: Finished surface of warm-mix asphalt will be tested for compliance with smoothness tolerances.

E. In-Place Density: Samples of uncompacted paving mixtures and compacted pavement will be secured by the testing agency according to ASTM D 979.
   1. Reference laboratory density shall be determined by averaging results from 4 samples of warm-mix asphalt-paving mixture delivered daily to site and compacted according to job-mix specifications.
   2. Reference maximum theoretical density shall be determined by averaging results from 4 samples of warm-mix asphalt paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
   3. In-place density of compacted pavement shall be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.
   4. One core sample shall be taken for every 1000 sq. yd. or less of installed pavement, but no case will fewer than 3 cores be taken.
      a. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.
      b. The Contractor shall fill all holes from which cores were taken. Restore and seal the surface to conditions similar to the adjacent areas.

F. Remove and replace or install additional warm-mix asphalt, at the Contractor’s sole expense, where test results or measurements indicate that it does not comply with specified requirements.

3.10 CLEANUP

A. Remove bituminous material from utility structure frames and covers. Open and reset utility manhole covers and inlet grates to ensure castings are not sealed shut.

B. Clean up debris and unused material, and remove from the site. Dispose of all material in accordance with local, state, and federal regulations. Do not dump material in manholes or inlets.

END OF SECTION 321216

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SECTION 321600

CONCRETE SIDEWALKS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section includes all labor, equipment, and materials necessary for the installation of the following as specified on the Drawings:
   1. Sidewalk pavement on an aggregate subbase.

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.

B. Related Sections:
   1. Section 310000 - Earthwork
   2. Section 321116 - Subbase Course

1.3 REFERENCES

A. The most current version of the publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.
   1. Pennsylvania Department of Transportation (PennDOT), Publication 408/2020
   2. PennDOT Bulletin No. 14: Aggregate Producers
   3. PennDOT Bulletin No. 15: Qualified Products List for Construction

1.4 PREINSTALLATION MEETINGS

A. Convene minimum one week prior to commencing Work of this Section.

1.5 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Product Data:
   1. Submit required information regarding concrete materials, joint filler, admixtures, and curing compounds.
   2. Mix Design:
      a. Submit concrete mix design for each concrete strength prior to commencement of Work.
      b. Submit separate designs if admixtures are required for hot- and cold-weather concrete Work.
      c. Identify mix ingredients and proportions, including admixtures.
   3. Identify chloride content of admixtures and whether or not chloride was added during manufacture.

C. Manufacturer’s Certificate: Certify that products meet or exceed specified requirements.

D. Source Quality-Control Submittals: Indicate results of factory tests and inspections.

E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

F. Qualifications Statement:
   1. Submit qualifications for manufacturer and installer.

1.6 QUALITY ASSURANCE

A. Perform Work according to PennDOT Publication 408, Section 704.

B. Obtain cementitious materials from same source throughout.

C. Maintain copies of each standard affecting Work of this Section on Site.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.

B. Installer: Company specializing in performing Work of this Section with minimum three years' experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store materials according with manufacturer's instructions.

C. 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

2.1 AGGREGATE SUBBASE

A. As specified in Section 321116 - Subbase Course

2.2 SIDEWALK

A. Concrete: Class A, in accordance with PennDOT Publication 408, Section 704.

B. Cure: PennDOT Publication 408, Section 711.2(a).

C. Joint Material: PennDOT Publication 408, Section 705.1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that compacted subgrade is dry and ready to support paving and imposed loads.

B. Verify that gradients and elevations of subgrade are as indicated on Drawings.

3.2 SIDEWALK

A. In accordance with PennDOT Publication 408, Section 676.3. The thickness of the sidewalk paving and aggregate shall be as defined in the construction plans.

END OF SECTION 321600

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SECTION 329000

PLANTINGS AND SEEDING

## PART 1 - GENERAL

### 1.1 SCOPE OF WORK

A. The work of this Section includes furnishing all labor, materials, equipment and incidentals required to complete all planting related landscaping work indicated on the Drawings and as specified herein, including but not necessarily limited to the following;

1. Excavation for plantings.
2. Furnishing and installing plant materials as shown on the Drawings, including shrubs, trees, and perennials.
3. Mulch, fertilize, stake, and prune all plants and trees.
4. Watering all specified plants.
5. Final cleanup and all other work required to complete the job in accordance with the Drawings and Specifications.
6. Preparation of as-planted sketch plans.
7. Maintenance of all specified plants and trees for an 8-week maintenance period.
8. Monthly planting status reporting of completed planted and maintenance activities.
9. Provision of “As Planted” record drawings.
10. Plant and tree warranties.

### 1.2 REFERENCE STANDARDS

A. American Association of Nurserymen (AAN)

B. ANSI Z60.1 - American Standard for Nursery Stock, most current edition

C. ANSI A 300 - Standard Practices for Tree, Shrub, and other Woody Plant Maintenance, most current edition and parts.

D. Soil Science Society of America (SSSA) Methods of Soil Analysis, Parts 1, 2, 3 & 4

E. American Society of Agronomy (ASA)

F. Other Agencies

1. American Society of Testing and Materials (ASTM)
   a. ASTM A 641/A 641M - Galvanized-steel wire
   b. ASTM B 221, Alloy 6063-T6, Aluminum Edging
   c. ASTM D5539-94 – Standard Specification for Seed Started Mix
2. Association of Official Agricultural Chemists (AOAC)
3. Woods End Research Laboratory, Solvita compost maturity index test.
4. International Society of Arboriculture (ISA)
5. PWD GSI Landscape Design Guidebook recommended plant list (Fall Update)
6. Philadelphia Parks and Recreation (PP&R - previously Fairmount Park Commission) Recommended Street Tree List
7. PP&R Contractor Guidelines.
8. USDA Rules and Regulations under the Federal Seed Act
9. Philadelphia Streets Department, Standard Construction Items.
10. Pennsylvania Department of Transportation, Form 408 Specifications.

G. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.3 SUBMITTALS

A. Submit complete product data for all materials furnished under this Section. One set of complete submittals is required per planting season. Any changes to materials require resubmittal. Unless otherwise noted below, all submittals must be received at least three (3) months prior to the start of the upcoming planting season.

B. Submit qualifications of crew, equipment, and suppliers using the Landscaping Qualifications Form in Appendix F. Qualifications must conform to the requirements detailed in Section 1.06, Contractor Qualifications, below.

C. Samples, testing and certifications of all materials shall be submitted for inspection and acceptance upon Owner's request. None of the landscaping materials shall be delivered to the site until samples and test results are approved by Owner/Authorized Representative, however such approval does not constitute final acceptance.

1. Mulch: Submit [1-quart] 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.

D. Submit a schedule for planting at least three (3) months prior to the start of the upcoming planting season. Schedule shall conform to planting seasons as defined in these Specifications and take into account allotted days for completion of the Work in the Contract; any extensions of the time allotment to be made for accommodation of planting seasons may be made at the sole discretion of a Project Manager.

E. Submit a proposed list of plant species with botanical and common names, variety, size, quantity, and source of plant materials in the varieties, sizes, and quantities indicated on the Drawings at least three (3) months prior to the start of the upcoming planting season. Sources of planting materials must be confirmed by the Contractor and written documentation of plant availability in accordance with the submitted planting schedule shall be provided by the supplier(s).

F. Plant Substitutions for plants not available locally should be ordered from nurseries located out of the state. Substitutions may be permitted only after substantiated written confirmation and documentation is submitted that a specified plant is either not obtainable or is not recommended for the location as shown on the landscaping plan. Substitutions should be drawn from the recommended plant list included in the PWD GSI Landscape Design Guidebook.

G. The Contractor must provide to a Project Manager each of their plant supplier's shipping lists for review and approval after ordering, but prior to supplier's shipping any plant material. Only specified plant species will be accepted. No cultivated varieties (cultivars) are acceptable.

H. The Contractor shall be required to submit status reports to Owner/Authorized Representative on a monthly basis during planting and maintenance activities. Photographic documentation as detailed in Section 01110 (Photographic Documentation) shall be provided as part of each status report. A template for the Project Status Report is appended to these Specifications.

I. Submit Monthly Project Status Reports using the template in Appendix D. Project Status Reports shall list detail all planting, maintenance activities, and upcoming site work. Photographic

documentation shall be included with the Monthly Project Status Report in accordance with Section 01110 (Photographic Documentation) of these Specifications. Project Status Reports shall be submitted within one (1) week of the end of each month.

J. Sketch plans, photographs, and written documentation of all plant installations, including initial planting and any plant replacements during the eight (8)-week maintenance period shall be submitted for approval within one (1) week of provisional acceptance subsequent to the maintenance period.

1. Sketch plans must include a revised schedule with species (botanical name) and cultivars and final quantities along with a revised planting plan.
2. Landscape sketch plans may be a markup of the original landscaping plan. Changes to the original landscaping plan shall be clearly noted and shown in red.
3. All sketches shall be labeled “As Planted”, dated, and shall contain the name or initials of the Designer.

## 1.4 CONTRACTOR QUALIFICATIONS

A. Crew Requirements: Crews shall consist of a minimum of two workers. One (1) landscape foreperson shall be present at all times during execution of the work. The foreperson shall direct all work performed under the following sections. Notify the Department of the name and phone number of crew member with credentials outlined below, along with a contact phone number, at least five (5) business days in advance of the first day of the specified activity.

1. The foreperson shall have experience with at least five (5) landscape installations of similar scope and complexity and shall have a minimum of three (3) years of experience in successful completion of similar landscape installation work. The Vendor must submit a resume of the foreperson(s) who will supervise the work crew(s).
2. All crew certification documentation should be readily available onsite so Owner/Authorized Representative can confirm certifications during site inspections.
3. Multiple certifications can be held by an individual crew member to satisfy the requirements set for in these Specifications.

B. Pesticide applications: No pesticides shall be applied unless approved in writing by the Owner. For pesticide applications, one (1) crew member must have certification as a Pest and Disease Applicator, Pennsylvania State licensed, certified commercial applicator, category: Ornamental and Shade Trees, Lawn and Turf. This crew member shall be required to be present during application of pest and disease control practices. The Vendor must submit the Pesticide and Disease Applicator’s License IDs for employees performing pest and disease control.

1. The Vendor must submit a resume of the employee(s) who will supervise the work crew(s).
2. All crew certification documentation should be readily available onsite so Owner/Authorized Representative can confirm certifications during site inspections.
3. Multiple certifications can be held by an individual crew member to satisfy the requirements set for in these Specifications.

## 1.5 QUALITY ASSURANCE

A. All plant materials shall be tagged and approved by the Owner prior to site delivery. The Contractor shall notify Owner/Authorized Representative of planting and tagging days a minimum of seven (7) days prior.

B. Each plant or same-species group of plants shipped to the job site must be clearly labeled with its scientific name and common name. The Contractor is responsible to check to see that the plants are correctly labeled. Owner/Authorized Representative will not accept improperly labeled

plants. The Contractor is prohibited to add, alter or remove labels. The Contractor will not be paid for material that is improperly labeled or for material on which the Contractor has altered or removed the labels.

1.6 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 ("root ball"), with a ball size not less than the 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 the 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 or stormwater soil.

H. Multi-stem trees: Trees that have shall have three or more main stems that arise from the ground from a single root crown or at a point just above the root crown.

I. 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.

J. 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.

K. Planting Area: Areas to be planted.

L. 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.

M. 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.

N. Plugs: A cylinder of medium in which a plant is grown. The term is generally used to describe seedlings and rooted cuttings which have been removed from the container but with the medium held intact by the roots.

O. 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.

P. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.

Q. Stormwater Soil: A planting soil mixture intended to provide water quality management by filtering stormwater runoff and provide sufficient infiltration for management of specified quantities of surface water flows.

R. Subgrade: Surface or elevation of subsoil remaining after completing excavation or backfill immediately beneath planting soil or lightweight fill material , that is integrated with Specified Soil or Growing Media by tilling in a layer of Transition Mix.

1.7 INSPECTION OF PLANT MATERIALS

A. Owner/Authorized Representative may observe plants and trees at supplier before delivery to site for compliance with requirements for genus, species, variety, size, and quality. Owner/Authorized Representative reserves the right to be present for inspection of plants at nursery and may attach their seal to each plant. The Contractor is responsible for paying any up charge for Owner/Authorized Representative to attach their seal to specific plants.

B. Owner/Authorized Representative shall be present at time of delivery to inspect plants and trees delivered to the site. A Project Manager retains the right to inspect or reject substandard plants or trees for size and condition of balls and root systems, insects, injuries, latent defects, and speciation, and to reject unsatisfactory or defective material at any time during progress of work. Rejected plants and trees must be removed immediately from the project site.

C. The Contractor shall stake the plant layout for approval by Owner/Authorized Representative. No plants or trees may be planted without on-site approval by Owner/Authorized Representative.

D. All trees shall be labeled by tree name (genus, species, and cultivar), and all labels securely attached to individual trees upon delivery to the jobsite.

1.8 DELIVERY, STORAGE AND HANDLING

A. The Contractor shall confine the storage of material and equipment to locations approved by Owner/Authorized Representative.

B. 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.

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. Accompany each delivery of bulk materials with appropriate certificates.

D. Materials shall not be dropped or dumped from vehicles. Materials shall be reviewed for compliance with specified requirements. Unacceptable materials shall be removed and disposed from the job site. Materials shall be stored in designated areas.

E. Deliver plants freshly dug. Do not prune trees and shrubs, except as directed by Owner/Authorized Representative. Protect bark, branches, and root system from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during delivery. Carefully handle all trees and shrubs during delivery to avoid mechanical damage. Handle all planting stock by the root ball. After delivery, set plants in a location protected from sun and wind. Provide adequate water to the root ball package during shipping and storage.

F. Roots of plants shall be adequately protected at all times from sun and from drying winds.

G. Plants which cannot be planted immediately upon delivery shall be set on the ground, out of direct sun if possible, and be well-protected with soil, mulch, or other acceptable material. Plant materials shall not be stored on site for more than two (2) days prior to planting. It is the Contractor's responsibility to keep plants watered and maintained upon delivery to site; give plants enough water so that the entire soil mass is wet and water is draining out the pot bottom. Secure plants from theft and vandalism.

H. No tree shall be planted if the root ball is cracked, broken, or dropped either before or during the planting process. No container plants will be accepted if the container is cracked or broken except upon special approval of Owner/Authorized Representative.

I. Deliver plants on day of installation after preparations for installation have been completed. A Project Manager shall be onsite to approve condition and speciation of delivered trees and plant layout.

1.9 PROJECT CONDITIONS

A. Restrictions: Planting shall only be performed during the periods within the seasons which are normal for such work as determined by weather and by locally acceptable practice and which are approved by Owner/Authorized Representative. No planting shall be performed between acceptable planting periods unless otherwise approved by Owner/Authorized Representative. The Contractor shall schedule his work to conform to these requirements. Planting close to the end of the season should be avoided if possible to maximize favorable planting conditions.

1. Spring Planting: March 15 – June 15.
2. Fall Planting: September 15 – December 15.

B. Weather Limitations: Proceed with planting activities 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 and according to manufacturer's written instructions. Owner/Authorized Representative reserves the right to postpone planting activities due to unfavorable weather conditions.

1. During periods of drought, irrigation shall be provided as approved by Owner/Authorized Representative. Water rates shall be equivalent to one inch (1") of rainfall per week.

C. Access over finished grade soils shall be restricted. If access is required across placed soils, Contractor shall be required to rework compacted soil areas prior to fine grading to the full depth of the placed soils as directed by Owner/Authorized Representative.

1.10 SITE ACCESS

A. For each of the different areas where the Contractor needs to gain access to perform his work, the Contractor shall make arrangements with the Owner in advance to access the site. These arrangements may require the construction of temporary roadways or bridges and the removal and replacement of existing structures.

1.11 EXISTING STRUCTURES AND PAVING

A. It is expected the Contractor will prepare their own preconstruction documentation in addition to the City's own photographs, to verify the original site conditions and the immediate vicinity of the project areas. The Contractor shall provide a set of preconstruction photographs to the Owner/Authorized Representative.

B. Any disturbed paving or curb, footway or driveway shall be restored according to any instructions provided by the Philadelphia Streets Department. All disturbed surfaces outside of the Streets Department restoration area shall be restored in kind.

1.12 MAINTENANCE SERVICE

A. Project Maintenance: Provide maintenance of planted areas by skilled employees of the landscape installer as defined under quality assurance above. Maintain as required in Part 3 herein. Begin maintenance immediately after plantings are installed and continue for an eight (8) week period.

1.13 INSPECTION FOR PLANTING CERTIFICATION

A. Planting certification for provisional approval shall be determined by Owner/Authorized Representative on a site by site basis. Certification shall verify that the plants are in healthy condition at the time of inspection, that the planting methodology appears correct, and that the plants should be expected to survive as installed by the Contractor. Certification shall be made by a designee of the Owner that has experience locally installing native plants of similar types used in the project. Individual plantings or entire areas or species may be rejected at this time for certification. Owner/Authorized Representative reserves the right to determine remediation required in the event of non-certified plantings, up to and including full replacement.

B. A Project Manager will perform inspection on a site by site basis at the end of the eight (8)-week maintenance period and upon the written request of the Contractor received at least ten (10) calendar days before the anticipated date of inspection.

C. At the end of the maintenance period, the Contractor shall be responsible for replacement planting for any plants that are missing, dead, not true to name or size as specified, or not in satisfactory growth, as determined by Owner/Authorized Representative. Any determination made by a Project Manager regarding plant replacement shall be final, and the Contractor shall be responsible for replacing the plantings in kind (unless otherwise directed) as soon as weather conditions permit during the next appropriate planting season at no additional cost to the City. The Contractor shall not be responsible for damage or plant mortality due to vandalism.

D. The Contractor shall prepare a list of items to be completed or corrected for review by Owner/Authorized Representative. Upon completion of the inspection, Owner/Authorized Representative shall amend the list of items to be completed or corrected. Corrective work shall be completed within two (2) weeks of receipt of the list of items needing correction or completion.

E. The eight (8)-week maintenance period must reoccur if any replacement of plants is required the time of inspection.

F. After all necessary corrective work has been completed and approved by Owner/Authorized Representative subsequent to required maintenance period(s), Owner/Authorized Representative shall certify in writing the planting certification and the one-year warranty period will commence.

G. Should approval of work be delayed after the end of the maintenance period(s) has elapsed, the Contractor shall continue maintenance activities until such approval is granted.

1.14 WARRANTY PERIOD AND REPLACEMENTS

A. The Contractor shall warranty that plant material is properly handled and installed. The Contractor shall be responsible for replacement planting required for a period of twelve (12) months after a planting is certified. At the end of the warranty period, plants that are missing, dead, not true to name or size as specified, or not in satisfactory growth, as determined by Owner/Authorized Representative, shall be replaced within the quantity limits set forth in section 1.16.D below. Any determination made by a Project Manager regarding plant replacement shall be final, and the Contractor shall be responsible for replacing the plantings in kind (unless otherwise directed) as soon as weather conditions permit during the next appropriate planting season at no additional cost to the City. The Contractor shall not be responsible for damage or plant mortality due to vandalism.

B. All replacement of plants and trees shall be conducted in accordance with the material and construction (including schedule) in these Specifications.

C. Replace any trees or shrubs that are more than twenty-five percent (25%) dead or in unhealthy condition at end of warranty period, as determined by Project Manager. Reseed herbaceous cover that is less than eighty-five percent (85%) alive at end of warranty period.

D. Plant replacements for all plants installed during a planting season, across all sites under the contract, shall be limited to the following quantities at the end of the warranty period:

1. 20% of trees
2. 20% of shrubs
3. 20% of herbaceous cover
4. Additional replacements may be required from installation to the end of the provisional maintenance period should plants not survive.

1.15 FINAL INSPECTION AND FINAL ACCEPTANCE

A. At the end of the warranty period, final inspection will be made by a Project Manager. Owner/Authorized Representative will request the Contractor to attend the site inspection at least ten (10) calendar days before the anticipated date of inspection.

B. Upon completion of the inspection, Owner/Authorized Representative shall provide a list of items to be completed or corrected. Corrective work shall be completed within two (2) weeks of receipt of items needing correction or completion.

C. After all necessary corrective work has been completed, a Project Manager will certify in writing the final acceptance of planting.

## PART 2 - PRODUCTS

### 2.1 PLANT CONDITIONERS

A. Herbicide application is not permitted for school planting. All weeding shall be performed manually.

B. Water used in this work shall be furnished by the Contractor and shall be suitable for irrigation and free from ingredients harmful to plant life. Hose and other watering equipment required for the work shall be furnished by the Contractor.

C. The use of hydrogels (in soil mixes or directly applied to plant roots) is prohibited in any green stormwater infrastructure system.

### 2.2 PLANT MATERIALS

A. Furnish and install plants, and pre-tagged and approved trees, as shown on the Drawings and specified herein. Plants shall be nursery grown under climatic conditions similar to those in the locality of the project and shall conform to the variety and sizes indicated. Plant material not obtained from an approved source is prohibited.

B. Plants shall conform to the indicated botanical names and standards of size, culture and quality for the highest grades and standards as adopted by the ANSI Z60.1 - American Standard for Nursery Stock. All plants shall meet specified sizes and be provided as plugs, container grown, field potted, or field balled and burlapped materials as specified.

1. All single-stem trees must have a straight trunk, well–balanced crown, and intact leader. Branching height (height of the lowest living branch) must be one-third to one-half (⅓ - ½) of tree height. Shrubs must be multi-stemmed with a well-balanced crown.
2. Tree measurements should be taken with branches and trunks or canes in their normal position. Do not prune to obtain required sizes. Take height measurements from or near the top of the root flare for field-grown stock and container grown stock. Measure main body of tree for height and spread; do not measure branches or roots tip to tip. Take caliper measurements six inches (6”) above root flare for trees up to four-inch (4”) caliper size and 12 inches (12”) above the root flare for larger sizes.
3. All trees are to be a minimum of two inches (2”) caliper and balled and burlapped, or as specified in the landscaping drawings. Shrubs must be in a three (3) gallon container minimum and at least three to four feet (3-4’) feet tall, or as specified in the landscaping drawings.
4. All container grown materials shall be grown to specified size in a container and shall be healthy, vigorous, well rooted and established in the container in which they are growing. A container grown plant shall have a well-established root system reaching the sides of the containers to maintain a firm root ball, but shall not have excessive root growth encircling the inside of the container.
5. Plugs shall be cut into square or round plugs, strongly rooted, and capable of vigorous growth and development when planted; Plug Size: three (3) inches
6. Measure plant materials with stems, petioles, and foliage in their normal position. Plants shall be of sufficient dimensions to include most of the fibrous roots and conforming to the standards of the AAN and ANSI Z60.1.

C. Plants shall be freshly dug for delivery. No heeled in plants or plants from cold storage shall be accepted. All plants shall be sound, healthy, well branched, and free of disease or pests. Plants shall be free of physical damage such as bark abrasions, disfiguring knots, sunscald, or unhealed

cuts over three-quarters of an inch (¾"). Trees with multiple leaders shall not be accepted. Plants or trees with girdling root systems shall not be accepted.

D. Plants larger than those shown in the planting schedule on the Drawings may be used, if approved by a Project Manager, but use of such plants shall be at no additional cost to the Owner. If the use of larger plants is approved, the spread of roots or ball of earth shall be increased in proportion to the size of the plant as approved and in accordance with ANSI Z60.1.

E. All plants shall be grown on their own roots. Grafted materials are only acceptable if grafted at least twelve (12) months before use, unless otherwise specified.

F. Plant material not obtained from an approved source is prohibited

2.3 TREES

A. In accordance with the design plans.

2.4 SEEDING

A. Seeding on the site shall be one of the following design mixes:

1. Drought Defy "Diamond Quality Mix" as manufactured by Reed and Perrine, 396 Main Street, Tennent, NJ, 732-446-6363:
   a. 35% Titanium LS Tall Fescue
   b. 35% Raptor II Tall Fescue
   c. 20% GrandSlam II Perennial Rye
   d. 10% Zinger Kentucky Bluegrass
2. "Sports Turf Mix" as manufactured by The Turf Trade, 517 Franklinville Road Mullica Hill, NJ 08032, 856-478-6704:
   a. 40% Turbo Tall Fescue
   b. 40% Hemi or Bullseye Tall Fescue
   c. 10% Octane or Secretariate 2 Perennial Ryegrass
   d. 10% Fusion Perennial Ryegrass
3. "Advantage Mix" Tall Fescue/Rye Mix (80/20) as manufactured by Fisher and Son, 110 Summit Drive, Exton PA 19341, 1-800-262-2127:
   a. 50% Inferno Tall Fescue
   b. 30% Quest Tall Fescue
   c. 10% Revenge GLX Perennial Ryegrass
   d. 10% Replay Perennial Ryegrass

2.5 MULCH

A. Organic mulch shall be double-shredded well-composted, hardwood bark, aged six (6) months to one year. Size shall be a maximum width or length of two inches (2") and a minimum of a half inch (½") in width or length. Mulch shall be free of wood chips, stones or other undesirable matter. Mulch shall be natural hardwood color. Dyes shall not be permitted.

1. Source: The Contractor is reminded that mulch generally meeting these requirements is available for purchase from the Fairmount Park Organic Recycling Center, 3850 Ford Road, Philadelphia, (215) 685-0108.
2. Other supplier conforming to organic mulch requirements above.

2.6 WEED-FREE STRAW AND SALT HAY

A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

2.7 TREE WRAP

A. Contractor shall not use tree wrap on trees unless specifically directed by Owner/Authorized Representative. Where directed by Owner/Authorized Representative, tree wrap shall be a woven polypropylene fabric. When used, tree wrap shall be installed on each tree immediately after planting.

2.8 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 by length indicated, pointed at one end.
2. Wood Deadmen: Timbers measuring 8 inches in diameter and 48 inches long, treated with specified wood pressure-preservative treatment.
3. Flexible Ties: Wide rubber or elastic bands or straps of length required to reach stakes.
4. Guys and Tie Wires: ASTM A 641/A 641M, Class 1, galvanized-steel wire, two-strand, twisted, 0.106 inch (2.7 mm) in diameter.
5. Tree-Tie Webbing: UV-resistant polypropylene or nylon webbing with brass grommets.

2.9 EROSION CONTROL MATERIALS

A. Erosion-Control Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a 100% biodegradable mesh. Include manufacturer's recommended steel wire staples, six (6) inches long.

B. Erosion-Control Fiber Mesh: Biodegradable burlap or spun-coir mesh, a minimum of 0.92 lb./sq. yd., with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, six (6) inches long.

2.10 WATER

A. Water used in this work shall be furnished by the Contractor and shall be suitable for irrigation and free from ingredients harmful to plant life. Hose and other watering equipment required for the work shall be furnished by the Contractor.

B. The use of hydrogels (in soil mixes or directly applied to plant roots) is prohibited in any green stormwater infrastructure system.

PART 3 - EXECUTION

3.1 GENERAL

A. Planting, mulching and conditioning shall only be performed during those periods within the seasons which are normal for such work as determined by the weather and locally accepted practice, as approved by Owner/Authorized Representative and set forth in Section 1.10 herein.

B. Protect adjacent and adjoining structures, utilities, walks, pavements, fences and other facilities, trees, shrubs, mulched beds, plantings, and mulched areas from damage caused by planting operations. Any damages to infrastructure shall be repaired by the Contractor at no cost to Owner.

C. Schedules for planting shall be submitted to Owner/Authorized Representative for approval at least three (3) months prior to the start of the upcoming planting season. The Contractor shall notify Owner/Authorized Representative of plant tagging and planting days with a minimum of seven (7) days' notice. In the event of inclement weather, planting should occur when conditions permit. In the event of rain, specifically, planting should occur the following day.

D. The Contractor shall stake out locations of trees and secure approval of layout prior to planting.

3.2 EXAMINATION

A. Examine areas to receive plants for compliance with requirements and conditions affecting installation and performance of the Work.

1. The Contractor shall review details of existing subsurface infrastructure to ensure digging or staking does not damage existing infrastructure. Contractor is responsible for costs to repair any damage to subsurface infrastructure caused by planting or staking operations.
2. 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.
3. Verify that plants and vehicles loaded with plants can travel to planting locations with adequate overhead clearance.
4. Review details of subsurface infrastructure to ensure digging or staking does not interfere with other assets.
5. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
6. 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 Project Manager and replace with new stormwater soil.

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

3.3 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, other facilities, trees, shrubs, mulched beds, plantings, 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. All plants shall be installed at locations as shown on the Drawings. The Contractor shall stake out locations, outline areas, and obtain a Project Manager's approval of layout before excavating or planting. Make minor adjustments as required.

3.4 MINOR GRADING AND FILL

A. See Section 334003 for requirements of placement and grading of planting and stormwater soils.

B. The addition of soil may be required given the condition of the site as directed by Owner/Authorized Representative. Minor grading shall take place following the addition of soil, or as deemed necessary by Owner/Authorized Representative.

C. Protect newly graded soils from traffic, freezing and erosion. Keep soils free of trash, debris or construction materials from other work.

D. Repair and re-establish grades to specified tolerances where completed surfaces become eroded, rutted, settled, or over compacted due to subsequent construction operations or weather conditions.

E. Scarify or remove and replace material to a depth as directed by Owner/Authorized Representative.

F. Where settling occurs, before final acceptance, remove mulch and backfill with additional approved soil, compact to specified density.

G. Finished grades to be landscaped or seeded shall include a minimum stormwater layer of six inches (6”). Finished grades to be otherwise surfaced shall allow sufficient elevation for the completed surface to produce the finished grades and elevations as shown on the Drawings.

## 3.5 PLANTING OPERATIONS

A. Planting shall be done by experienced workmen familiar with planting procedures under the supervision of a qualified foreman.

B. The Contractor shall make all efforts to not destroy soil structure by excessive traffic, working, or compacting the soil throughout the planting operation. Utilize the smallest practicable piece of low ground pressure mechanical equipment in the adjacent areas.

C. To prevent potential for plant settlement, do not over-excavate prior to planting.

D. Stormwater soil shall be backfilled in lightly compacted layers of not more than nine inches (9”) and each layer watered sufficiently to settle before the next layer is put in place.

E. If more than two (2) days elapse following preparation of stormwater soil, then the Contractor shall be responsible for regrading and loosening areas before planting.

F. Plants which cannot be planted immediately upon delivery shall be set on the ground, out of direct sun when possible, and be well-protected with soil, mulch, or other acceptable material. Plant materials shall not be stored on site for more than two (2) days prior to planting. It is the Contractor’s responsibility to keep plants watered and maintained upon delivery to site; give plants enough water so that the entire soil mass is wet and water is draining out the pot bottom. Secure plants from theft and vandalism.

G. Owner/Authorized Representative reserves the right to reject a plant or group of plants at any time during the project.

## 3.6 EXCAVATION FOR TREES AND SHRUBS

A. Planting Pits and Trenches

1. Excavate circular planting pits with sides sloping inward at a 45-degree angle where possible, or as indicated in planting detail drawings. 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 planting stock where possible, or as indicated in tree planting detail drawings.
3. For bare root stock, excavate at least 12 inches wider than root spread or as indicated on the drawings, whichever is the greater dimension and deep enough to accommodate vertical roots.
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; the root flare must be visible for planted trees.
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: Topsoil, planting soil, or stormwater soil removed from excavations may be used as backfill soil unless otherwise indicated.

C. Obstructions: Notify Owner/Authorized Representative if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations

1. Hardpan Layer: Drill 6-inch-diameter holes, 24 inches apart, into free-draining strata or to a depth of 10 feet, whichever is less, and backfill with free-draining material.

D. Drainage:

1. Notify Project Manager/Contracting Officer if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.
2. Verify by testing that pits are free draining. If pits are not free draining notify Owner/Authorized Representative and submit alternative method of drainage for approval

## 3.7 INSTALLATION OF TREES AND CONTAINER SHRUBS

A. Remove all debris from the pit and tamp loose soil in the bottom of the pit by hand.

B. Do not handle the plant by the trunk, branches, leaves or stem.

C. Place the plant straight in the center of the planting pit, carrying the plant by the root mass.

D. Carefully cut and remove all of the wire baskets that are packaging the root system using the least amount of disturbance as possible.

E. Cut and remove all ropes around the burlapped ball. Remove all nails. Remove all burlap, wires, and/or other materials from the planting hole.

F. When planting container plants, scarify the sides and bottom of the root mass such that no roots continue to circle around the root mass. When possible, pull encircling roots away from root mass and position them in the soil around the planting hole such that they are being pulled away from the plant.

G. Backfill planting pit with soil and tamp firmly to fill all voids and air pockets. Do not over compact soil (backfilled soil should have a maximum bulk density of 1.5g/cm3). Make sure plant remains straight during backfilling/tamping procedure.

H. The top of the root mass of the trees/shrubs should be flush with, or slightly elevated (no more than 1/8th its height) above the final grade. Do not cover stem with soil or mulch.

I. When planting on a slope, plant “out-of-the-hill” by raising the grade around the planted hole so it is flat at the surface. Do not plant “into-the-hill” by lowering the grade and do not leave the grade at an angle.

J. Water plants thoroughly at their bases immediately after planting to saturate backfill. Watering shall occur of a sufficient quantity to saturate the backfill and shall be applied slowly enough to sink into the soil avoiding runoff.

K. Install slow-release watering bags on all trees such as Treegator or equivalent with at least 15 gallon capacity. Fill watering bags during maintenance.

L. A layer of mulch should be placed around each tree and shrub installed as set forth in herein and as indicated in planting detail drawings.

M. The Contractor shall leave no open planting pits at the close of each day.

N. A woven polypropylene tree wrap shall be used to protect trees from deer damage if so directed by Owner/Authorized Representative. Tree wrap shall be installed on each tree immediately after planting.

O. Maintain protection of trees during installation and maintenance periods. Treat, repair or replace any damaged planting.

P. During planting, all areas shall be kept neat, clean and free of all trash and debris, and all reasonable precautions shall be taken to avoid damage to existing plants, turf, structures, and private property.

Q. Remove all tags, labels, strings and wire from the plant materials, unless otherwise directed by Owner/Authorized Representative.

R. Promptly remove soil debris created by work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks or other paved areas.

S. Final cleanup shall be the responsibility of the Contractor and consist of removing all trash and materials incidental to the project and disposing of them off-site.

T. When planting on side slopes, grade shall be raised to provide a level surface for planting.

3.8 PROTECTION OF TREES

A. Refer to section 015639 for Tree Protection requirements.

3.9 TREE REMOVAL

A. Refer to section 015639 for Tree Removal requirements.

3.10 TRIMMING AND PRUNING

A. Each plant shall be trimmed in accordance with AAN and ANSI Z60.1 standards to preserve the natural character of the plant and as directed by Owner/Authorized Representative.

B. Trimming and pruning shall be done with clean, sharp tools.

3.11 TREE STABILIZATION

A. Trunk Stabilization by Upright Staking and Tying: Install trunk stabilization as follows unless otherwise indicated:

1. Place stakes as low as possible, no higher than 2/3 the height of the tree.
2. Stake trees with two stakes for trees up to 12 feet high and 2-1/2 inches or less in caliper; three stakes for trees less than 14 feet high and up to 4 inches in caliper. Space stakes equally around trees.
3. Materials used to tie the tree to the stake should be flexible and allow for movement all the way down to the ground so that trunk taper develops correctly.
4. Support trees with bands of flexible ties at contact points with tree trunk. 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: Stake and guy trees more than 14 feet in height and more than 3 inches in caliper unless otherwise indicated. Install trunk stabilization as follows:

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 long, driven to grade. Adjust spacing to avoid penetrating root balls or root masses. Provide turnbuckle for each guy wire and tighten securely.
    b. For trees more than 6 inches in caliper, anchor guys to wood deadmen buried at least 36 inches below grade. Provide turnbuckle for each guy wire and tighten securely.
    c. Support trees with bands of flexible ties at contact points with tree trunk and reaching to turnbuckle. Allow enough slack to avoid rigid restraint of tree.
    d. Attach flags to each guy wire, 30 inches above finish grade.
    e. Paint turnbuckles with luminescent white pain

C. No staking shall be performed without full understanding of subsurface infrastructure locations.

3.12 INSTALLATION OF CONTAINER PLANTS

A. Install plants after stapled erosion control blanket is installed and approved by a Project Manager (where applicable). When stapled erosion control blanket is approved, dig a hole for each plug or plant that is about the same depth as the soil of the plug or potted plant. For plugs, a ‘dibble bar’ with the same diameter as the plug can be used to create the hole, when punched through the blanket. For container plants, the stapled erosion control blanket shall be cut in a circular hole shape to match the diameter of the container.

B. Remove the plants and soil from the pots and carefully break apart bound root balls. Position each plant in its hole so that the soil level of each plant is flush to the surrounding finished grade soil surface. After planting, fill soil in around the plant completely, firming the soil and ensuring there are no air pockets as plants are installed. When planted, cover the top of the potted soil mix with about ½-in of stormwater soil to match surrounding finished grades and help reduce wicking of moisture out of the potted soil mix. Water installed plants immediately after planting. Where specified on the Drawings, install mulch as directed.

C. When planting on a slope, plant “out-of-the-hill” by raising the grade around the planted hole so it is flat at the surface. Do not plant “into-the-hill” by lowering the grade and do not leave the grade at an angle.

3.13 GROUND COVER AND HERBACEOUS 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 stormwater soil for backfill.

C. Dig holes large enough to allow spreading of roots.

D. For plugs supplied in flats, plant each in a manner that minimally disturbs the root system.

1. Plant plugs in holes or furrows, spaced twelve (12) inches apart in triangular pattern unless otherwise indicated on drawings. On slopes, contour furrows to near level.

E. Work soil around roots to eliminate air pockets and maintain plant at finished grade.

F. Water thoroughly after planting, taking care not to wet plant foliage when sunny.

G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.14 PLANTING AREA MULCHING

A. Immediately after planting operations are completed, planting beds placed outside the infiltration areas and channels (areas covered in erosion control blankets) shall be covered with the specified mulch as indicated.

1. For Trees and Shrubs in Turf Areas: Apply organic mulch ring of 3-inch average thickness, with a 3-foot radius around trunks or stems. Do not place mulch within three inches (3”) of trunks or stems.
2. For Continuous Planting Areas: Apply 3-inch average thickness of organic mulch extending 12 inches beyond edge of individual planting and over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within three inches (3”) of trunks or stems and off of leaves or stems for container plants and plugs.

B. No mulch shall be placed in areas that will experience surface flows (channels, swales, etc.) or surface ponding of water (areas of basins, bumpouts, or other surface features that are designed for surface water detention). These areas that will be flooded shall only be covered with erosion control blankets and plantings or landscaping stone as specified.

## 3.15 WATERING

A. Trees shall be watered twice within the first twenty-four (24) hours of the time of planting and not less than twice per week until provisional acceptance. Trees shall be watered at the roots, to minimize wetting of the leaves. Water shall be released slowly to prevent runoff and in sufficient quantity to saturate the soils (approximately fifteen to twenty (15-20) gallons per watering). In the event of steady rainfall, frost, or yellowing of the leaves, watering may be temporarily reduced with the approval of Owner/Authorized Representative.

B. Plantings must be thoroughly watered twice within the first twenty four (24) hours of the time of planting and not less than twice per week until provisional acceptance. Plants shall be watered at the roots to minimize the wetting of the leaves. Overhead watering is permitted only during overcast weather. Water shall be released slowly to prevent runoff and in sufficient quantity to saturate the soils.

C. Suitable water for planting and maintenance will be the responsibility of the Contractor. The Contractor shall furnish his own hose and hose connections or other watering equipment.

D. See Table of Maintenance Tasks and Schedule for further watering requirements.

## 3.16 SITE RESTORATION

A. General

1. Restore all disturbed areas to the satisfaction of Owner/Authorized Representative.
2. Backfill all disturbed areas outside the Limits of Disturbance to original elevation and slope. Ensure stability of reconstructed slopes. On steep slopes, provide and arrange logs, large rocks or other devices to check erosion. Slope areas shall be seeded with the specified seed mix. The entire disturbed area of the slope shall be covered with erosion control blanket to prevent erosion. The fabric shall be pinned to the slope at 3-three foot (3') intervals.
3. Restore all disturbed trenches, rubble gutters, bridle paths, asphalt paths, cinder roads, stone walls, structures, utilities, sidewalks and other fixtures in kind, to original condition, and to the satisfaction of Owner/Authorized Representative.

## 3.17 MAINTENANCE

A. Maintenance for provisional acceptance shall begin immediately after planting is installed on a site by site basis. Contractor will begin a formalized cyclical maintenance program that will last until the end of the maintenance period of eight (8) weeks.

B. Proposed maintenance activities and schedule shall be coordinated with the Owner/Authorized Representative and shall be in accordance with the program submitted by the Contractor based on Table of Provisional Maintenance Tasks and Schedules below.

C. Plants shall be watered, mulched, weeded, pruned, and sprayed as described herein and otherwise maintained and protected during this period. Dead or damaged plants shall be replaced before the end of the provisional maintenance period. Maintenance activities are outlined in the table below.

D. Submit Monthly Project Status Reports using the template in Appendix B detailing the completed maintenance activities.

E. Site inspection for provisional approval shall take place at the end of the eight (8) week period. The Contractor shall coordinate the site inspection with the Owner/Authorized Representative ten (10) calendar days prior to the anticipated date of inspection. Should approval by the Owner/Authorized Representative be delayed until after the 8-week period has elapsed, the Contractor is responsible for continuing maintenance activities until such approval is granted.

F. Table of Provisional Maintenance Tasks and Schedules:

| **Task** | **Description** | **Frequency** |
|---|---|---|
| Remove trash, sediment and organic debris | Remove trash, sediment, and organic debris from all SMP surfaces and inlet gutters | Weekly |
| | Clean pretreatment devices; empty filter bags for inlets, domed rises or other structures. Sweep or vacuum at least five (5) ft. one either side of inlets or curb cuts. | Monthly |
| Remove non-target/invasive vegetation | Remove all non-target or invasive vegetation not part of the original planting manually. Weeds shall be disposed of offsite in an approved manner. | Monthly, from March to November |
| Water vegetation | Place and fill 15-20 gallon water bags such as Treegator® or equivalent on trees. Follow directions of manufacturer. Replace bags if they become damaged or missing. | Weekly |
| | Water shrubs and herbaceous plants at the base of the plant with a hose or ground-level irrigation system. Natural rainfall is not considered a watering as it will not provide the required depth of water. Each watering should slowly soak the entire depth of root system. | 3 times per week on dry days; no later than 3-4 hours from dusk. Watering with an overhead system is only permitted when weather is overcast. |
| | Water groundcover and plugs - do not allow soil to dry out. Provide a half-inch (0.5”) of water at each watering. | Daily, when there is no rainfall for first 6 weeks; twice weekly thereafter |
| Apply insecticides or other chemicals | Apply insecticides or other chemicals | As approved by Owner / Authorized Representative |

| | | |
|---|---|---|
| Prune trees and shrubs | Remove dead, damaged, or diseased wood | As needed during Provisional Maintenance period; should be completed prior to Final Owner/Authorized Representative Inspection and Walk-through |
| Replace tree stakes | Replace or amend tree stakes or tree protection | As needed during Provisional Maintenance period; should be completed prior to Final Owner/Authorized |

| | | |
|---|---|---|
| | | Representative Inspection and Walk-through |
| Apply mulch | Apply mulch to landscaped beds as needed to maintain three-inch (3”) depth; extending from the edge of the bed or pit to a radius of three inches (3”) from the stem of each plant. Mulch shall not touch the woody stem of a shrub or tree. When there is more than a one-inch (1”) drop from the edge of the pavement to the mulch, add mulch to reduce the gap to a minimum of a half-inch (0.5”) from the edge of the pavement. | As needed during Provisional Maintenance period; should be completed prior to Final Owner/Authorized Representative Inspection and Walk-through |
| Reset elevation of plants | Reset settled plants to proper grade and position | As needed during Provisional Maintenance period; should be completed prior to Final Owner/Authorized Representative Inspection and Walk-through |
| Replace dead or damaged plants | Replace plants that are more than 25% dead | As needed during Provisional Maintenance period; should be completed prior to Final Owner/Authorized Representative Inspection and Walk-through |

END OF SECTION 329000

SECTION 330561

CONCRETE MANHOLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Modular precast concrete manholes and structures with tongue-and-groove joints and masonry transition to cover frame, covers, anchorage, and accessories.
2. Bedding and cover materials.

B. Related Requirements:
1. Section 310000 - Earthwork.
2. Section 334201 - Stormwater Gravity Piping and Inlets

1.2 DEFINITIONS

A. Bedding: Specialized material placed under manhole prior to installation and subsequent backfill operations.

1.3 REFERENCE STANDARDS

A. American Association of State Highway Transportation Officials:
1. AASHTO M306 - Standard Specification for Drainage, Sewer, Utility, and Related Castings.

B. American Concrete Institute:
1. ACI 530/530.1 - Building Code Requirements and Specification for Masonry Structures.

C. ASTM International:
1. ASTM A48/A48M - Standard Specification for Gray Iron Castings.
2. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
3. ASTM C55 - Standard Specification for Concrete Building Brick.
4. ASTM C478 - Standard Specification for Circular Precast Reinforced Concrete Manhole Sections.
5. ASTM C497 - Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile.
6. ASTM C877 - Standard Specification for External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections.
7. ASTM C913 - Standard Specification for Precast Concrete Water and Wastewater Structures.
8. ASTM C923 - Standard Specification for Resilient Connectors between Reinforced Concrete Manhole Structures, Pipes, and Laterals.
9. ASTM C990 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
10. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
11. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

1.4 COORDINATION

A. Coordinate Work of this Section with connection to stormwater conveyance, site sanitary sewerage gravity piping, and trenching.

1.5 PREINSTALLATION MEETINGS

A. Convene minimum one week prior to commencing Work of this Section.

1.6 SUBMITTALS

A. Product Data: Submit manufacturer information for manhole covers, component construction, features, configuration, and dimensions.

B. Shop Drawings:
   1. Indicate structure locations and elevations.
   2. Indicate sizes and elevations of piping, conduit, penetrations, and rim elevation.

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. Source Quality-Control Submittals: Indicate results of factory tests and inspections.

F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.7 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of manholes and connections, and record invert elevations.

1.8 QUALITY ASSURANCE

A. Perform Work according to City of Philadelphia standards.

B. Maintain one copy of each standard affecting Work of this Section on Site.

1.9 QUALIFICATIONS

A. Manufacturer:
   1. Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.
   2. Listed on PennDOT Bulletin 15.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Handling: Comply with precast concrete manufacturer instructions for unloading and moving precast manholes and drainage structures.

C. Storage:
   1. Store materials according to manufacturer instructions.
   2. Store precast concrete manholes and drainage structures to prevent damage to Owner's property or other public or private property.
   3. Repair property damaged from materials storage.

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.

1.11 AMBIENT CONDITIONS

A. Cold Weather Requirements: Comply with ACI 530/530.1.

1.12 EXISTING CONDITIONS

A. Field Measurements:
   1. Verify field measurements prior to fabrication.
   2. Indicate field measurements on Shop Drawings.

1.13 WARRANTY

A. Furnish five-year manufacturer's warranty for concrete manholes.

PART 2 - PRODUCTS

2.1 CONCRETE AND MASONRY MANHOLES

A. Manufacturers:
   1. Furnish materials from a source listed in PennDOT Bulletin 15.

B. Manhole Sections:
   1. Materials:
      a. Reinforced Precast Concrete: Comply with ASTM C478.
      b. Gaskets: Comply with ASTM C923.
   2. Joints:
      a. Comply with ASTM C913.
      b. Maximum Leakage: 0.025 gal. per hour per foot of joint at 3 feet of head.

C. Mortar and Grout:
   1. Mortar:
      a. As specified in PennDOT Publication 408, Section 705.7(b).
   2. Grout: As specified in PennDOT Publication 408, Section 1001.2(d).

D. Reinforcement:
   1. As specified in PennDOT Publication 408, Section 709.

E. Clear Inside Dimensions:
   1. Diameter: 48 inches.

F. Design Depth:
   1. As indicated on Drawings.

G. Clear Cover Opening:
   1. Diameter: 26 inches.

H. Pipe Entry: Furnish openings as required.

I. Structure Joint Gaskets:
   1. Provide rubber gaskets per ASTM C443 or Neoprene gaskets per ASTM C361 as specified in PennDOT Publication 408, Section 705.5(b)3.

2.2 FRAMES AND COVERS

A. Manufacturers:
   1. Furnish materials from a source listed in PennDOT Bulletin 15.

B. Description:
   1. Material:
      a. Cast iron.
      b. Comply with AASHTO M105, Class 35B and AASHTO M306.
   2. Lid:
      a. Bearing Surface: Machined flat.
      b. Configuration: Removable.
      c. Security: None.
   3. Cover Design: Closed.
   4. Live-Load Rating: HS-25.
   5. Furnish sealing gasket.
   6. Cover: Molded with identifying name.
   7. Nominal Lid Size: 26 inches diameter.

2.3 GRADE ADJUSTMENT RINGS

A. Manufacturers:
   1. Furnish materials from a source listed in PennDOT Bulletin 15.

B. Riser Rings:
   1. Thickness of 2 to 12 Inches:
      a. Precast concrete.
      b. Comply with PennDOT Publication 408, Section 605.2(d).
      c. A maximum of two grade adjustment rings are permitted for grade adjustment. Total depth of rings is limited to 12” maximum.

2.4 MATERIALS

A. Cover and Bedding:
   1. Bedding: Construct manholes on a subbase constructed of compacted No. 2A coarse aggregate. Place in 4” layers to provide a 12” minimum depth.
   2. Cover: Backfill excavated spaces around the structure with acceptable embankment material.

2.5 ACCESSORIES

A. Steps: As specified in PennDOT Publication 408, Section 605(c) and from a manufacturer listed in PennDOT Bulletin 15.

B. Joint Sealant: Comply with ASTM C990.

C. Grout: Non-Shrink as specified PennDOT Publication 408, Section 1080.2(c).

2.6 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed assembly.

B. Certificate of Compliance:
   1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
   2. Specified shop tests are not required for Work performed by approved manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Verify that items provided by other Sections of Work are properly sized and located.

B. Verify that built-in items are in proper location and are ready for roughing into Work.

C. Verify that excavation base is ready to receive Work and excavations and that dimensions and elevations are as indicated on Drawings.

### 3.2 PREPARATION

A. Mark each precast structure by indentation or waterproof paint showing date of manufacture, manufacturer, and identifying symbols and numbers as indicated on Drawings to indicate its intended use.

B. Coordinate placement of inlet and outlet pipe or duct sleeves as required by other Sections.

C. Do not install manholes and structures where Site conditions induce loads exceeding structural capacity of manholes or structures.

D. Inspect precast concrete manholes and structures immediately prior to placement in excavation to verify that they are internally clean and free from damage; remove and replace damaged units.

### 3.3 INSTALLATION

A. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface structures or utilities in immediate or adjacent areas.

B. Correct over-excavation with coarse aggregate.

C. Remove large stones or other hard matter impeding consistent backfilling or compaction.

D. Protect manhole from damage or displacement while backfilling operation is in progress.

E. Excavating:
   1. As specified in Section 310000 – Earthwork and in indicated locations and depths.
   2. Provide clearance around sidewalls of manhole or structure for construction operations.
   3. If ground water is encountered, prevent accumulation of water in excavations; place manhole or structure in dry trench.
   4. Where possibility exists of watertight manhole or structure becoming buoyant in flooded excavation, anchor manhole or structure to avoid flotation as approved by Architect/Engineer.

F. Base and Alignment:
   1. Install manholes supported at proper grade and alignment on compacted crushed-stone bedding.

2. Grout base of shaft sections to achieve slope to exit piping, trowel smooth, and contour to form continuous drainage channel.
3. Form and place manhole or structure cylinders plumb and level, to correct dimensions and elevations.

G. Attachments:
1. As Work progresses, build fabricated metal items and steps.
2. Cut and fit for pipe.
3. Set cover frames and covers level to correct elevations without tipping.

H. Backfilling: As specified in Section 310000 - Earthwork.

I. Precast Concrete Manholes:
1. Lift precast components at lifting points designated by manufacturer.
2. When lowering manholes into excavations and joining pipe to units, take precautions to ensure that interior of pipeline and structure remains clean.
3. Assembly:
   a. Assemble multisection manholes and structures by lowering each section into excavation.
   b. Install rubber gasket joints between precast sections according to manufacturer recommendations.
   c. Lower, set level, and firmly position base section before placing additional sections.
4. Remove foreign materials from joint surfaces and verify that sealing materials are placed properly.
5. Maintain alignment between sections by using guide devices affixed to lower section.
6. Joint sealing materials may be installed on Site or at manufacturer's plant.
7. Verify that installed manholes meet required alignment and grade.
8. Remove knockouts or cut structure to receive piping without creating openings larger than required to receive pipe; fill annular spaces with mortar.
9. Cut pipe flush with interior of structure.
10. Shape inverts through manhole as indicated on Drawings.

J. Sanitary Manhole Drop Connections:
1. Concrete Encasement: Minimum 2 feet outside of manhole.
2. Form channel from pipe drop to sweep into main channel at maximum angle of 30 degrees.

K. Castings:
1. Set frame and cover 2 inches above finished grade for manholes and other structures with covers located within unpaved areas to allow area to be graded away from cover beginning 1 inch below top surface of frame.

## 3.4 ADJUSTING

A. Vertical Adjustment of Existing Manholes and Structures:
1. If required, adjust top elevation of existing manholes and structures to finished grades as indicated on Drawings.
2. Frames, Grates, and Covers:
   a. Remove frames, grates, and covers cleaned of mortar fragments.
   b. Reset to required elevation according to requirements specified for installation of castings.

END OF DOCUMENT 330561

SECTION 334009

CONNECTIONS TO EXISTING STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY OF WORK

A. The Work described in this Section shall include all materials, labor, equipment and incidentals required to make connections to structures from stormwater conduit piping as shown on the drawings. All orifice, underdrain, distribution, or other piping that connects to a structure shall have the connection constructed per these Specifications.

1.2 REFERENCES

A. ASTM C 109, Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-inch or 50 mm Cube Specimens).

B. ASTM D 638, Test Method for Tensile Properties of Plastics.

C. ASTM D 695, Test Method for Compressive Properties of Rigid Plastics.

1.3 SUBMITTALS

A. Before starting this work, submit for approval of Owner/Authorized Representative, manufacturer's literature describing Epoxy Mortar Gel and Epoxy Bonding Agent. Literature must address each requirement (e.g. Compressive Strength per ASTM C109) as specified.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. The following products are acceptable as Epoxy Mortar Gel, provided they continue to meet all requirements:

1. Meta Bond HM Gel, as manufactured by American Meta Seal Company, 509 Washington Avenue, Carlstadt, NJ 07072.
2. Sikadur 31 Hi-Mod Gel, as manufactured by Sika Corporation, Box 297, Lyndhurst, NJ 07071.
3. Thermal-Chem Mortar Resin Gel (Product No. 304), as manufactured by Thermal-Chem, Inc., 1400 Louis Avenue, Elkgrove, IL 60007.
4. Approved equivalent product.

B. The following products are acceptable as Epoxy Bonding Agent, provided they continue to meet all requirements.

1. Meta Bond HM, or Meta Bond HM Gel, as manufactured by American Meta Seal Company.
2. Sikastix 370, Sikadur Hi-Mod, or Sikadur 31 Hi-Mod Gel, as manufactured by Sika Corporation.
3. Thermal-Chem Mortar Resin (Product No. 3), or Thermal-Chem Mortar Resin Gel (Product No. 34), as manufactured by Thermal-Chem, Inc.
4. Approved equivalent product.

2.2 MATERIALS

A. Epoxy Mortar Gel shall:

1. Be a 100% solids formulation.
2. Have a Tensile Strength per ASTM D 638 not less than 3000 psi after 7 days at 73□F.
3. Have a Tensile Elongation per ASTM D 638 not over 7%.
4. Have a Compressive Strength per ASTM D 695 not less than 3000 psi after 24 hours at 73 degrees F, and not less than 6000 psi after 7 days at 73 degrees F.

B. Sand shall:

1. Be oven-dry silica sand.
2. Have at least 70% by weight pass #20 sieve.
3. Have not over 35% by weight pass #40 sieve.

C. Epoxy Bonding Agent shall meet the requirements for Epoxy Mortar Gel.

2.3 MIXES

A. Epoxy Mortar shall consist of Epoxy Mortar Gel and Sand mixed at a 1:1 ratio by loose volume.

PART 3 - EXECUTION

3.1 MAKING CONNECTION

A. Make hole(s) in existing structure as necessary to permit connection. Core through existing concrete structures and cut reinforcing as necessary. Remove all dirt, laitance, and other loose or undesirable material from mating surfaces. Check hole(s) for fit.

B. Comply fully with manufacturer's instructions. Coat mating surfaces with Epoxy Bonding Agent and set pipe. Seal all openings with Epoxy Mortar. Support pipe securely to prevent movement and protect for at least 24 hours.

END OF SECTION 334009

SECTION 334200

STORMWATER CONVEYANCE

PART 1 - GENERAL

1.1 SUMMARY OF WORK

A. Section Includes:
1. Stormwater drainage piping.
2. Manholes.
3. Inlets and catch basins.
4. Cleanouts
5. Bedding and cover materials.

B. Related Requirements:
1. Section 310000 – Earthwork.
2. Section 312316.13 – Trenching.
3. Section 330561 – Concrete Manholes
4. Section 334009 – Connections To Existing Structures
5. Inlets and catch basins.
6. Cleanouts
7. Bedding and cover materials.

1.2 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials (AASHTO)
1. AASHTO M252 - Standard Specification for Corrugated Polyethylene Pipe (4-in to 10-in)
2. AASHTO M294 - Standard Specification for Corrugated Polyethylene Pipe (12-in to 36-in)

B. American Society for Testing and Materials (ASTM)
1. ASTM A746 - Standard Specification for Ductile Iron Gravity Sewer Pipe.
2. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
3. A STM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3).
4. A STM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3).
5. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity Flow Application.
6. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
7. ASTM F405 - Standard Specification for Corrugated Polyethylene (PE) Pipe and Fittings.
8. ASTM F477 – Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

9. ASTM F667/F667M - Standard Specification for 3 through 24 in. Corrugated Polyethylene Pipe and Fittings.

C. American Water Works Association (AWWA)
   1. AWWA C150-08 – Thickness Design of Ductile-Iron pipe.
   2. AWWA C151-09 – Ductile-Iron Pipe, centrifugally cast.
   3. AWWA C111/A21.11-17 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

D. Philadelphia Water Department Quality Certification Standards (QC)
   1. QC-2 Standards for Gray/Ductile Iron Castings
   2. QC-13 Standards for Thermoplastic Pipe and Fittings

E. Commonwealth of Pennsylvania, Department of Transportation Specifications, Publication 408 (most recent edition).
   1. Bulletin 15, General Index of Approved Product Suppliers.
   2. Section 735 – Geotextiles

F. Where reference is made to one of the above standards the revision in effect at the time of bid opening shall apply.

## 1.3 COORDINATION

A. Coordinate Work of this Section with termination of storm sewer connection outside building, trenching, connection to foundation drainage system, and municipal sewer utility service.

## 1.4 SUBMITTALS

A. Product Data: Submit manufacturer information describing pipe, pipe accessories, manholes, inlets, catch basins, headwalls, end sections and cleanouts.

B. Submit shop drawings showing details of pipe, fittings, joints and construction methods.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Manufacturer Instructions: Submit special procedures required to install specified products.

E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

F. Qualifications Statement:
   1. Submit qualifications for manufacturer

## 1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of pipe runs, connections, catch basins, inlets, headwalls, end sections, cleanouts, and invert elevations.

B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

## 1.6 QUALITY ASSURANCE

A. HDPE pipe shall be furnished by a manufacturer / facility that is certified by the National Transportation Product Evaluation Program (NTPEP). The pipe shall be designed, constructed, and installed in accordance with the best practices and methods and shall comply with this Section.

B. PP pipe shall be furnished by a manufacturer who is fully experienced, reputable, and qualified in the manufacture of the HDPE/PP pipe. The pipe shall be designed, constructed, and installed in accordance with the best practices and methods and shall comply with this Section.

C. All pipe, fittings, cleanout covers, domed riser covers, and other products shall be installed to ensure a minimum loading capacity in accordance with H-20 loading, as required by Philadelphia Department of Streets. Any deviation from manufacturer's specifications for product installation (without approval by manufacturer or signed and sealed statement of adequacy by Professional Engineer) is prohibited.

D. Maintain one (1) copy of each standard affecting Work of this Section on Site.

## 1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

## 1.8 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store materials according to manufacturer instructions.

C. 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.

## 1.9 EXISTING CONDITIONS

A. Field Measurements:
   1. Verify field measurements prior to fabrication.
   2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 CORRUGATED PE PIPING

A. Pipe:
   1. Comply with ASTM F405.
      a. Type: Smooth interior.
      b. Inside Nominal Diameter: As Shown on the Drawings.

B. Fittings: PE.

C. Joints: Comply with ASTM F405.

2.2 DUCTILE IRON PIPE

A. Pipe:
   1. Comply with ASTM A746, Class 50.
   2. Type: Service.
   3. Inside Nominal Diameter: As Shown on the Drawings.
   4. Ends: Bell and spigot.

B. Fittings: Ductile Iron

C. Joints:
   1. Comply with ASTM A746.
   2. Joint Devices: Rubber gasket.

2.3 REINFORCED CONCRETE PIPING:

A. Pipe: In accordance with PennDOT Publication 408, Section 601.

B. Fittings: Reinforced concrete.

C. Joints:
   1. Comply with ASTM C443.
   2. Gaskets: Rubber, compression.

2.4 MANHOLES

A. As specified in Section 330561 – Concrete Manholes.

2.5 CATCH BASINS AND INLETS

A. Inlet Box and Top Section:
   1. In accordance with PennDOT Publication 408, Section 605.2(d).

B. Grates and Frames:
   1. In accordance with PennDOT Publication 408, Section 605.2(a).

## 2.6 END SECTIONS

A. Flared end section shall be in accordance with PennDOT Publication 408, Section 616.2.

## 2.7 CLEANOUTS

A. Shaft and Top Section:
   1. Material: Same material as horizontal pipe section.
   2. Joints: Lipped male/female.
   3. Nominal Shaft Diameter: Same as horizontal pipe section, 6 inches maximum.
   4. Top Section: Concentric cone.

B. Cleanout Lids and Frames:
   1. Materials: Cast iron.
   2. Lid:
      a. Hinged
      b. Lockable
      c. Design: Stamped “CLEANOUT”
   3. Nominal Lid and Frame Size: 6 inch diameter.

C. Base Pad:
   1. Material: Cast-in-Place concrete as specified in Section 033053 – Site Cast-in-Place Concrete.

## 2.8 DETECTABLE UNDERGROUND TAPE

A. Detectable Warning Tape shall be six inches wide (6”), 5-mil thickness, with aluminum foil core. Tape shall be printed with an appropriate legend (“Caution: Buried Storm Sewer Below” or as approved) and shall conform to the color standards of the APWA for buried utilities (green for sewer).

# PART 3 - EXECUTION

## 3.1 CONSTRUCTION CERTIFICATION FORM

A. The contractor will be required to fill out and complete the Philadelphia Water Department SMP Construction Certification Form, as part of the Construction Certification Package (CCP). The contractor will be required to make, record, and document all measurements, required photos, and provide required documents, reports, and certifications outlined in the CCP.

B. The CCP shall be completed and signed by one of the following:
   1. Professional Engineer

2. Registered Architect
3. Landscape Architect
4. Professional Land Surveyor
5. Professional Geologist
6. Licensed Contractor

C. The contractor shall contact the project's assigned PWD Inspector at least three (3) days prior to the start of construction of any SMP, including excavation and soil testing, if applicable. The SMP installation must be observed by the PWD inspector.

D. Provide the PWD Inspector an estimated schedule for placement of any of the following:
1. Geotextile
2. Stone
3. Storage media
4. Piping
5. Soil
6. Other SMP-related devices or appurtenances.

## 3.2 EXAMINATION

A. Verify that trench cut is ready to receive Work of this Section.

B. Verify that excavations, dimensions, and elevations are as indicated on the Drawings.

## 3.3 PREPARATION

A. Correct over-excavation with coarse aggregate.

B. Remove large stones and other hard matter that could damage piping or impede consistent backfilling or compaction.

## 3.4 INSTALLATION OF PIPE

A. Excavate trench to 12 inches below pipe invert, and as specified in Section 312316.13 – Trenching.

B. Hand trim excavation for accurate placement of piping to indicated elevations.

C. No single piece of pipe shall be laid unless it is straight. The centerline of the pipe shall not deviate from a straight line drawn between the centers of the openings at the ends of the pipe by more than one-sixteenth of an inch (1/16") per foot of length. If a piece of pipe fails to meet this requirement check for straightness, it shall be rejected and removed from the site.

D. All pipe shall be examined before laying and no piece shall be installed which is found to be defective.

E. If any defective pipe is discovered after it has been installed, it shall be removed and replaced with a sound pipe in a satisfactory manner at no additional cost to Owner. All pipe and fittings shall be thoroughly cleaned before installation, shall be kept clean until they are used in the work and when laid, shall conform to the lines and grades required. HDPE pipe and fittings shall be installed in accordance with ASTM D2321 and the requirements of the manufacturer (see "Corrugated HDPE Pipe Installation Guide" from ADS), or as otherwise provided herein or on the Drawings.

F. After the excavation is complete to normal grade of the bottom of the trench and bottom preparation according to the Drawings and Specifications is completed, crushed stone bedding shall be placed, compacted and graded to provide firm, uniform and continuous support for the pipe. The pipe shall be laid accurately to the lines and grades indicated on the Drawings. Blocking under the pipe will not be permitted. Bedding shall be placed evenly on each side of the pipe to mid diameter and hand tools shall be used to force the bedding where needed to give firm continuous support for the pipe. AASHTO #57 aggregate shall then be placed to twelve inches (12") above the top of the pipe. Detectable underground utility marking tape shall be installed over all pipe not otherwise marked. The initial three feet (3') of backfill above the bedding shall be placed in one-foot (1') layers and carefully compacted. Generally the compaction shall be done evenly on each side of the pipe and compaction equipment shall not be operated directly over the pipe until sufficient backfill has been placed to ensure that such compaction equipment will not have a damaging effect on the pipe. Equipment used in compacting the initial three feet (3') of backfill shall be approved by the pipe manufacturer's representative prior to use.

G. All piping shall be sound and clean before installation. When installation is not in progress for any length of time, the open ends of the pipe shall be closed by watertight plug or other approved means. Good alignment shall be preserved during installation. The deflection at joints shall not exceed that recommended by manufacturer.

H. Before any joint is made, the pipe shall be checked to assure that a close joint with the next adjoining pipe has been maintained and that the inverts are matched and conform to the required grade. The pipe shall not be driven down to grade by striking it.

I. Precautions shall be taken to prevent flotation of the pipe in the trench.

J. When moveable trench bracing such as trench boxes, moveable sheeting, shoring or plates are used to support the sides of the trench, care shall be taken in placing and moving the boxes or supporting bracing to prevent movement of the pipe, or disturbance of the pipe bedding and the backfill. Trench boxes, moveable sheeting, shoring or plates shall not be allowed to extend below the top of the pipe. As trench boxes, moveable sheeting, shoring or plates are moved, crushed stone shall be placed to fill any voids created and the backfill shall be recompacted to provide uniform side support for the pipe.

K. The use of ninety-degree (90°) bend pipe fittings is not permitted in the installation of piping. The Contractor shall use minimum-angle fittings to construct the pipe layout diagrammatically shown in the Drawings. The maximum fitting angle approved for use is forty-five-degrees (45º), and fittings of lesser angles (22½° or 11¼°) are preferred for use where practical.

## 3.5 BACKFILLING AND COMPACTING PIPES

A. Do not place backfill around any structure requiring time to gain strength (e.g., masonry or concrete), until so directed by Owner/Authorized Representative.

B. Place Ordinary Backfill up to three feet (3') below subgrade elevation in all sewer trenches and sewer manholes to be abandoned. Place Select Backfill Material-2RC for three feet (3') below subgrade elevation in all sewer trenches and sewer manholes to be abandoned.

C. Compact backfill around and to a depth of six inches (6") over pipes and fittings by hand tamping. Compact all other backfill in eight-inch (8") layers by mechanical tamping. Puddling is prohibited.

D. When backfill has been placed to three feet (3') below street surface or finish grade, cut off and remove sheathing and shoring (including soldier beams) two feet (2') below street surface or finish grade. All sheathing and shoring shall be removed in its entirety from excavations for infiltration facilities (tree trenches, basins, etc.).

## 3.6 INSTALLATION OF INLETS AND CATCH BASINS

A. Install inlet in accordance with PennDOT Publication 408, Section 605.3.

## 3.7 TOLERANCES

A. Maximum Variation from Indicated Pipe Slope: 1/8 inch 10 feet.

## 3.8 FIELD QUALITY CONTROL

A. Request inspection by Engineer prior to and immediately after placing aggregate cover over pipe.

B. If inspection indicates that Work does not meet specified requirements, remove Work and replace at no additional cost to the Owner.

## 3.9 CLEANING PIPELINES

A. As pipe laying progresses and at the conclusion of the work thoroughly clean all new pipelines by flushing with water or other means to remove all dirt, stones, pieces of wood or other material which may have entered during the construction period. If, after this cleaning, obstructions remain, they shall be removed prior to approval and acceptance of the pipe by Owner/Authorized Representative.

END OF DOCUMENT 334200

SECTION 33 42 01

STORMWATER GRAVITY PIPING

PART 1 - GENERAL

1.1 SUMMARY OF WORK

A. This section includes all materials and appurtenant work necessary to furnish and install cast iron drainage pipe and pipe connections to sewers.

1.2 REFERENCE STANDARDS

A. All sewer work in the public right-of-way under this contract shall be governed by, and done in accordance with the most recent revision or amendment to the Standard Specifications and Standard Details of the Philadelphia Water Department, including the following:

1. Standard Details and Standard Specifications for Sewers.
2. Standard Specifications for Excavation, Refilling, Grading, Landscaping and Repaving.
3. Standard Specifications for Masonry: Concrete.
4. Standard Specifications for Masonry: Stone and Brick.

B. The Standard Detail for Saddle Connection to RC Pipe Sewers is hereby modified so that the openings for the lateral connections shall be core drilled and rubber saddles shall be substituted in place of clay saddles. The 2000 psi concrete encasement around the saddle shall be extended to the cradle of sewer as shown in the Detail for Resilient Saddle Connection to RC Pipe Sewers affixed to the end of these specifications.

C. PennDOT Publication 72M, Roadway Construction Standards and PennDOT Publication 408, Section 605.

D. All materials and workmanship shall conform to the most recent revision or amendment to the following standards, except as modified by the Contract Documents:

1. ASTM A 74, Standard Specification for Cast Iron Soil Pipe and Fittings
2. ASTM C 94, Standard Specification for Ready-Mixed Concrete.
3. ASTM C 564, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
4. ASTM C 890, Standard Practice for Installation of Monolithic or Sectional Precast Concrete Water and Wastewater Structures.

1.3 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.

B. Certificates of Compliance: Before installation of any Precast Concrete Products, submit an acceptable Certificate of Compliance to Owner/Authorized Representative

C. Submit a list of materials to be provided for work under this Section including the name and address of the materials producer and the location from which the materials are to be obtained.

D. Submit certificates, signed by the materials producer, stating that materials meet or exceed the specified ASTM and ACI requirements

E. Submit detailed diagrams of all outflow structure depicting dimensions and materials used to construct the entire structure. Indicate knockout elevations and size for all pipe entering manhole structures or other concrete structures.

1.4 REGULATORY REQUIREMENTS

A. Traffic Control: Maintain access of and protection for vehicular and pedestrian traffic as required for construction activities in accordance with local regulations.

B. Contractor shall obtain all necessary City of Philadelphia Streets Department road opening permits and approvals, and City of Philadelphia Department of Licenses and Inspections permits and approvals, upon the Contractor receiving Notice to Proceed and prior to proceeding with the Work.

1.5 QUALITY ASSURANCE

A. All materials, methods of construction, and workmanship shall conform to applicable requirements of ASTM, PTM, PennDOT Standard Specifications and AASHTO Standards, unless otherwise specified.

PART 2 - PRODUCTS

2.1 BACKFILL

A. Ordinary Backfill Material may include all material excavated from the trench and free of objectionable matter, unless rejected by the Owner/Authorized Representative. The Contractor shall furnish any deficiency of Ordinary Backfill Material.

B. Furnish Select Backfill Material in accordance with PennDOT Publication 408 Specifications, Section 703.3, Select Granular Material-2RC (as amended). The use of slag as Select Backfill Material is hereby prohibited.

2.2 RUBBER SADDLES

A. Rubber Saddles for Lateral Connections to RC Pipe Sewers shall be manufactured from a blend of rubber that is laboratory tested and appropriate for sewer applications.

B. Pipe clamps and expansion rings shall be Type 304 Stainless Steel.

C. Rubber Saddles shall provide a watertight connection and be compatible with ASTM C-923.

2.3 GRAY (CAST) IRON DRAINAGE PIPE AND FITTINGS

A. All gray iron pipe shall be manufactured and tested in accordance with ASTM A 74 Standard specification for Cast Iron soil pipe and fittings.

B. Pipes shall have a nominal laying length of 5 feet and 10 feet for all size diameters.

C. Pipe shall conform to the Standard Specifications for Gray and Ductile Iron Pipe of PWD.

2.4 CONCRETE MIX

A. Concrete for sewer lateral connection to be in accordance with PennDOT Publication 408, Section 704 Class C Concrete.

PART 3 - EXECUTION

3.1 MAINTENANCE AND PROTECTION OF TRAFFIC DURING CONSTRUCTION

A. Maintain and protect traffic during construction as required elsewhere in these Contract Documents.

3.2 EXCAVATING

A. Excavate in accordance with the Standard Specifications for Excavation, Refilling, Grading, Landscaping, and Repaving. Excavation will not be classified, whether by type of material encountered, or by type of equipment required.

B. Use sheathing and shoring sufficient to avoid damage to or settlement of adjacent buildings, paving, and underground structures.

C. Protect from damage and provide adequate temporary support for all existing underground facilities, except those known to be abandoned. Repair any damage to existing underground facilities due to Contractor's operations without charge to the Owner.

D. Use of a Hydro-Hammer or similar equipment for breaking existing paving is hereby prohibited.

3.3 DEBRIS GRILLS

A. Take great care when breaking the sewer crown to prevent debris from being washed down the sewer.

B. At the end of each work day, cover the open end of the sewer with a metal debris grill to prevent debris from being washed down or thrown into the sewer during non-work hours. At the beginning of each work day, remove all accumulated debris before removing the debris grill.

C. Employ a rigid, portable metal debris grill which is sufficiently strong to withstand the impact of any debris which may be washed down stream or thrown against it. Openings shall be 3" x 3".

D. During working hours, prevent any debris, construction material, or equipment from being washed down the sewer. Remove any such material from the sewer without charge. Use debris grill during working hours when feasible.

3.4 BACKFILLING AND COMPACTING

A. Place and compact backfill in accordance with the Standard Specifications for Excavation, Refilling, Grading, Landscaping and Repaving, except as herein modified.

A. Do not place backfill around any structure requiring time to gain strength (e.g., masonry or concrete), until so directed by the Owner/Authorized Representative.

B. Place Ordinary Backfill up to three feet (3’) below subgrade elevation in all sewer trenches and sewer manholes to be abandoned. Place Select Backfill Material-2RC for three feet (3’) below subgrade elevation in all sewer trenches and sewer manholes to be abandoned.

C. Compact backfill around and to a depth of six inches (6”) over pipes and fittings by hand tamping. Compact all other backfill in eight-inch (8”) layers by mechanical tamping. Puddling is prohibited.

D. When backfill has been placed to three feet (3') below street surface or finish grade, cut off and remove sheathing and shoring (including soldier beams) two feet (2') below street surface or finish grade.

3.5 REPAVING

A. Restore all disturbed paving, curb, and grass areas as required elsewhere in the Contract Documents.

END OF SECTION 33 42 01