SECTION 01 57 13

EROSION AND SEDIMENT CONTROL GENERAL

1.01 RELATED DOCUMENTS.

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

1.02 SUMMARY

A. Work under this section shall include all labor, materials and equipment necessary to meet all applicable requirements and as specified in the contract.

B. Section Includes:
   1. Installation and maintenance of both temporary and permanent soil erosion and sediment control measures
   2. Slope protection and stabilization practices.
   3. Implementation of the Stormwater Pollution Prevention Plan (SWPPP) to protect surface water quality.

C. Related Sections:
   1. Division 31 Section "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
   2. Division 31 Section "Dewatering" for lowering and disposing of ground water during construction.
   3. Division 32 Section "Turf and Grasses" for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.

1.03 UNIT PRICES

A. Work in this Section is affected by unit prices for erosion and sediment control specified in Division 01 Section "Unit Prices."

1.04 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

B. Baffles: Porous barriers installed inside a temporary sediment trap, rock dam sediment trap, sediment basin, or skimmer sediment basin used to reduce velocity (turbulent flow) of the water flowing through the measure and facilitate the settling of sediment from the water before discharge.

C. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill

D. Check Dam: A small temporary stone dam constructed across a drainage way (such as a temporary diversion ditch) used to reduce erosion in the channel and trap sediment behind the dam.

E. Construction Sequence: Schedule of work sequenced to control the timing of land disturbing activities and installation of erosion and sediment control measures.

F. Excavation: Removal of material encountered above subgrade elevations and to the limits and dimensions indicated.

G. Fill: Soil materials used to raise existing grades.

H. Inlet Protection: A temporary measure used to prevent sediment from entering inlets and conduit systems during construction. Inlet protection allows protected early use of storm drainage system and provides sediment storage around inlets.

I. Land Grading: Re-shaping the ground surface to designed proposed grades to accommodate development.

J. Landscape Planting: Stabilizing disturbed areas by establishing vegetative cover with trees, shrubs, vines and/or ground cover.

K. Level Spreader: A non-erosive outlet for concentrated runoff constructed to disperse flow uniformly over a long slope.

L. Mulching: Application of a protective blanket of straw, wood chips, shredded bark, gravel or synthetic material to bare soil surface.

M. Outlet Stabilization Structure (Riprap Apron): A structure designed to dissipate energy, reduce velocity and control erosion at the outlet of a pipe or channel.

N. Permanent Seeding: Establishment of permanent perennial vegetative cover with seed to control runoff and minimize erosion.
O. Rolled Erosion Control Products (RECP): Rolled erosion control products are manufactured or fabricated into rolls designed to reduce soil erosion and assist with the growth and establishment of vegetation. Products include mulch control netting, open weave textiles, erosion control blankets, and three dimensional turf reinforcement mats.
P. Sediment (Silt) Fence: A temporary sediment control measure consisting of fabric buried at the bottom, stretched and supported by (sometimes wire and) posts. Measure retains sediment laden flow from small disturbed areas and allows sediment deposition.
Q. Sediment Control Structure: A temporary (or permanent only when used in conjunction with a permanent detention or retention basin) structure used to detain sediment laden water, diminish turbulent flow, and allow sediment to settle. Retains sediment on construction site to prevent sedimentation in receiving waters.
R. Skimmer (Skimmer Sediment Basin): An earthen embankment with a trapezoidal spillway lined with impermeable geotextile or laminated plastic membrane and equipped with a floating skimmer for dewatering. Skimmer basins are designed to provide an area for runoff to pool and settle
S. Sodding: Establishing permanent cover by laying a continuous layer of grass sod.
T. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.
U. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk
V. Surface Roughening: Roughening the soil surface on a slope with horizontal grooves cross-slope, stair stepping or tracking with construction equipment.
W. Temporary Diversions: A temporary ridge or excavated channel, or both, constructed across sloping land on a pre-determined grade. Temporary Diversions must extend to sediment control structures.
X. Temporary Gravel Construction Entrance/Exit: A graveled pad located at points where vehicles and equipment leave the construction site.
Y. Temporary Seeding: Planting rapid-growing annual grasses, small grains, or legumes to provide initial, temporary cover for erosion control on disturbed areas.
Z. Temporary Slope Drain: Flexible pipe extending from the top to the bottom of a cut or fill slope used to transport sediment laden water from a temporary diversion into a sediment control structure.
AA. Temporary Sediment Trap: A small, temporary ponding basin, without a pipe outlet structure, formed by an embankment or excavation to capture sediment. Structure detains sediment laden runoff, reduces turbulent flow and allows sediment to drop out to protect receiving waters.
BB. Temporary Sediment Basin: A larger temporary or part of a permanent system, including a controlled outlet structure, used to detain sediment laden water, diminish turbulent flow, and allow sediment to settle. Retains sediment on construction site to prevent sedimentation in receiving waters.
CC. Top-soiling: Preserving and using topsoil to enhance final site stabilization with vegetation.
DD. Tree Preservation: Practices used to preserve and protect trees from damage during construction.
EE. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings

1.05 SUBMITTALS

A. Qualification Data: For third party 'Qualified Inspector (Professional)' if not provided by the Owner.
B. Off-site Soil Qualification: For each borrow or waste site for soil material proposed for fill and/or waste that is not permitted under the Project site NPDES coverage:
    1. Copy of the site's NPDES Notice of Coverage (or similar coverage/approval document)
    2. Copy of the erosion and sediment control plan including best management practices and stabilization schedules to be used to include the site under the current NPDES Permit coverage.

1.06 QUALITY ASSURANCE

A. Intent: The main concern associated with erosion and sedimentation on the site is movement of sediment to off-site and off-site receiving waters and its affect on water quality. The Owner's intent is that the Contractor install, inspect, maintain and modify sufficient erosion and sediment control practices to retain sediment within the boundaries of the site in addition to complying with all regulatory codes, laws, rules, and ordinances. All erosion and sediment control measures shall conform to the drawings and to the latest requirements imposed by federal, state and local authorities. The Contractor is responsible for any repair and damages and shall be financially responsible for any penalties imposed.

B. Drawing Review: It is the Contractor's responsibility to review the erosion and sediment control drawings and the Storm Water Pollution Prevention Plan (SWPPP) prepared by the engineer prior to implementation. All measures shall be implemented in accordance with this specification, contract drawings and documents and all regulatory authorities having jurisdiction. Where conflicting requirements arise the more restrictive rules shall govern.

C. Contractor Responsibility: Contractor is to provide all temporary and permanent non-structural and structural measures shown on the drawings, and as directed by the Owner or NPDES authority for the duration of the work. SWPPP and Erosion and Sediment Control drawings are guidelines, additional measures not specified may be necessary and shall be implemented to address conditions that may develop during the construction process. Additional measures needed but not specified in the SWPPP or on the drawings shall be at no additional cost to the Owner.

D. Coordination: Temporary structural measures shall be coordinated with permanent measures to the extent practical to assure economical, effective and continuous erosion and sediment control throughout construction and a seamless transition between temporary and permanent post construction operation.

E. Contractor Inspections: Contractor shall inspect all erosion and sediment control measures at least at the beginning and at the end of each day to ascertain all devices are functioning properly during construction. Contractor shall fully and completely inspect the entire site once every seven (7) calendar days and within 24 hours of 0.5 inches (12 mm) of rain or more per 24 hour period, or more often if required by the governing Construction General Permit; these inspection findings must be reported on Form C-1. Any measures found to be unsatisfactory during that inspection shall be corrected within 48 hours of the inspection. The Owner may suspend the performance of any or all other construction work until the unsatisfactory condition has been corrected. Such suspension shall not be the basis of any claim by the Contractor for additional compensation nor for an extension of time to complete the work. Any Notices of Violations (NOV), fines or other corrective actions requested by authorities having jurisdiction or by the Owner shall be the sole responsibility of the Contractor.

F. Contractor Response to Notice of Violation: Should the Contractor receive an inspection report or Notice of Violation from the regulatory authority (NPDES authority, Natural Resources Conservation Service, or other county or city authority) the report or notice shall immediately be forwarded to the Owner's representative. The Contractor shall **not** respond to an inspection or Notice of Violation without first gaining approval for the response from the Owner.

G. Protect Adjacent Properties: Contractor is to protect adjacent properties, watercourses, threatened, endangered and protected species and critical habitats, any identified cultural, archeological or historic resources, and receiving water resources from erosion and sediment damage throughout the time of construction.

H. SWPPP Pre-construction Meeting: Prior to beginning work, a pre-construction SWPPP meeting shall be held by the Owner and the site engineer. The General Contractor and its site work subcontractor must be present at this meeting.

1.07 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing earth moving indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.
   1. Do not proceed with work on adjoining property until directed by Owner.
C. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth moving operations.
D. Do not commence earth moving operations until all Phase I temporary sediment control measures are in place.
E. Do not commence earth moving operations until plant-protection measures specified in Division 01 Section "Temporary Tree and Plant Protection" are in place.
F. The following practices are prohibited within protection zones:
   1. Storage of construction materials, debris, or excavated material.
   2. Parking vehicles or equipment.
   3. Foot traffic.
   4. Erection of sheds or structures.
   5. Impoundment of water.
   6. Excavation or other digging unless otherwise indicated.
   7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
G. Do not direct vehicle or equipment exhaust towards protection zones.
H. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
B. Riprap: ASTM D 4992-94 evaluation; ASTM D 6092-97e1 standard practice for size specification.
C. Sand: ASTM C 33; fine aggregate.

2.02 GEOTEXTILES

A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
   1. Survivability: Class 2; AASHTO M 288.
   2. Grab Tensile Strength: 157 lbf (700 N); ASTM D 4632.
   3. Sewn Seam Strength: 142 lbf (630 N); ASTM D 4632.
   4. Tear Strength: 56 lbf (250 N); ASTM D 4533.
   5. Puncture Strength: 56 lbf (250 N); ASTM D 4833.
   6. Apparent Opening Size: No. 70 (0.212-mm) sieve, maximum; ASTM D 4751.
   7. Permittivity: 0.1 per second, minimum; ASTM D 4491.
   8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.
B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
   1. Survivability: Class 2; AASHTO M 288.
   2. Grab Tensile Strength: 247 lbf (1100 N); ASTM D 4632.
   3. Sewn Seam Strength: 222 lbf (990 N); ASTM D 4632.
   4. Tear Strength: 90 lbf (400 N); ASTM D 4533.
   5. Puncture Strength: 90 lbf (400 N); ASTM D 4833.
   6. Apparent Opening Size: No. 60 (0.250-mm) sieve, maximum; ASTM D 4751.
   7. Permittivity: 0.02 per second, minimum; ASTM D 4491.
   8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.
C. Sediment Fence: Fabric with slit tape yarns in one direction (warp or fill) only. Fabric must have strong rot-proof synthetic fibers formed into either a woven or non-woven fabric.
   1. Fabric may be manufactured with pockets for posts, hems with cord, or with posts pre-attached using staples or button head nails.

2. Fabric to have manufacturer's mark, either with an approved color mark yarn in the fabric or the manufacturer's name and product trade name labeled on the fabric at a minimum of 100 ft (30 m) intervals.
3. Fabric has no treatment or coating that might significantly alter its physical properties after installation.
4. Contains stabilizers and/or inhibitors to make the filaments resistant to deterioration from sun or heat exposure.
5. Makes a pervious sheet of synthetic fibers oriented into a stable network so that the fibers retain relative position with respect to each other under normal handling, installation, and service conditions.
6. Has finished fabric edges to prevent the outer yarn from pulling away from the fabric.
7. Have no defects or flaws that would significantly affect physical and/or functional properties.
8. Has the following physical and dimensional requirements and properties:
    a. Minimum tensile strength in pounds (Newtons): Warp 260 (1155), Fill 180 (800) ASTM D 4632.
    b. Elongation: 40%, ASTM D4632
    c. Apparent opening size (max. sieve size): No. 30 (600 um), ASTM D 4751
    d. Flow rate in gallons per minute per square foot (L/min./m^2): 70 (2850)
    e. Ultraviolet stability (percent of required initial minimum tensile strength): 80% ASTM D4632 and ASTM D4355
    f. Permittivity: 0.1 per second, minimum; ASTM D 4491.
    g. Bursting strength, psi (kPa): 175 (1200), ASTM D 3786
    h. Minimum fabric width: 36" (900 mm)

D. RECP: Rolled Erosion Control Products, woven geo-textile fabric, manufactured for the establishment of vegetation for erosion control including:
1. Mulch Control Netting: Planar woven natural fiber or extruded geo-synthetic mesh used as a temporary degradable RECP to anchor loose fiber mulches. Maximum gradient for slope applications 5:1 ASTM D6459, maximum permissible shear stress channel applications is 0.25 lbs per square foot ASTM D6460, minimum tensile strength 5 lbs/ft ASTM D5035.
2. Open Weave Textile: Temporary degradable RECP composed of processed natural or polymer yarns woven into a matrix, used to provide erosion control and facilitate vegetation establishment. Maximum gradient for slope applications 3:1 ASTM D6459, maximum permissible shear stress channel applications is 1.50 lbs per square foot ASTM D6459, minimum tensile strength 50 lbs/ft ASTM D5035.
3. Erosion Control Blanket: Temporary degradable RECP composed of processed natural or polymer fibers mechanically, structurally or chemically bound together to form a continuous matrix to provide erosion control and facilitate vegetation establishment. Maximum gradient for slope applications 2:1 ASTM D6459, maximum permissible shear stress channel applications is 1.75 lbs per square foot ASTM D6460, minimum tensile strength 75 lbs/ft ASTM D5035.
4. Turf Reinforcement Mat: Long-term non-degradable RECP composed of UV stabilized, non-degradable, synthetic fibers, filaments, nettings, and/or wire mesh processed into three dimensional reinforcement matrices designed for permanent and critical hydraulic applications where design discharges exert velocities and shear stresses that exceed the limits of mature, natural vegetation. TRM provide sufficient thickness, strength and void space to permit soil filling and/or retention and the development of vegetation within the matrix. Maximum gradient for slope applications 1:1 ASTM D6459, maximum permissible shear stress channel applications is 8.0 lbs per square foot ASTM D6460, minimum tensile strength 150 lbs/ft ASTM D5035, minimum thickness 0.25 inches (6.35 mm) ASTM D6525.

2.03 SEDIMENT FABRIC FENCING

A. Woven wire fabric fencing to be used with sediment fabric:
1. Ensure wire fence fabric is at least 32 inches (810 mm) high with at least 6 horizontal wires.
2. Ensure the vertical wires have maximum spacing of 6 inches (78 mm)
3. Ensure the top and bottom wires are at least 10 gauge (2.49 mm) and all other wires are at least 14 gauge (3.48 mm).

B. Posts: Use post sizes and types as determined by the type of fence being installed. Hardwood posts are limited to ash, hickory, or oak, or other approved hardwood or softwood.
   1. Wood Posts: At least 2” (50 mm) in diameter or 2” x 2” (50 x 50 mm) 5 feet (1.5 m) long, and straight enough to provide a fence without a noticeable misalignment. Wood shall be commercial quality lumber of size and shape indicated. Each stake shall be free from decay, splits or cracks longer than the thickness of the stake or other defects that would weaken the stakes and cause the stakes to be structurally unsuitable.
   2. Steel posts to be “U”, “T”, or “C” shaped with a minimum weight of 1.15 pounds per foot (1.7 kg/m), 5 feet (1.5m) long, and have projections for fastening the fence to the posts.
   3. Fasteners for Wood Posts: Wire staples that are at least 17 gauge (1.37 mm), legs at least ½ inch (13 mm) long, and a crown of at least ¾ inch (19 mm) wide.
   4. Nails for Wood Posts: Use nails that are at least 14 gauge (2.03 mm), 1 inch (25 mm) long, with button heads of at least ¾ inch (19 mm).

2.04 SKIMMER

A. Skimmer: The Skimmer is a dewatering device used to slowly dewater sediment basins from the top of the water column. Manufactured by J.W. Faircloth & Son, Post Office Box 757, Hillsborough, NC, 27278. Telephone (919) 732-1244, or approved equal.

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS

A. The Contractor shall comply with and fully implement the Stormwater Pollution Prevention Plan (SWPPP) provided in the contract documents.
B. Prior to beginning work, review erosion and sediment control drawings as they apply to the current site conditions. Any deviation from the drawings shall be submitted to the Owner and site engineer at least 72 hours prior to commencing that work.
C. Hold a SWPPP pre-construction meeting prior to beginning work.
D. Where required by the governing Construction General Permit, the General Contractor is to notify NPDES authority, in writing (or as required by local regulations) prior to initial land disturbance.

3.02 PREPARATION

A. Sequence of Construction: The approved construction sequence, as permitted and approved shall be adhered to during the execution of the work. All grading, drainage, best management practices (BMPs) for erosion and sediment control and all stabilization measures shall be constructed in the order presented in the Sequence of Construction. Modifications to the Sequence of Construction may occur only as approved by the Owner (and authority having jurisdiction when required).
   1. PHASE ONE Erosion and Sediment Control: All Phase One erosion and sediment control measures including but not limited to the required NPDES postings at the construction entrance/exit, construction of the temporary gravel construction entrance/exit, installation of perimeter sediment fence, temporary sediment basins and traps, and temporary diversion channels to sediment control structures shall be completed prior to any major land disturbing activity, including grubbing. Land disturbing activity during Phase One will be limited to the areas necessary to install Phase One best management practices only.
   2. PHASE TWO Erosion and Sediment Control: Grading (and mass grading) activity shall commence in Phase Two and includes additional erosion and sediment control measures as indicated on the drawings Contractor is to provide inspection, maintenance and recordkeeping throughout Phase One until Final Stabilization.
   3. PHASE THREE Erosion and Sediment Control: When complexity of project requires additional phases, they shall commence and be adhered to in the order presented on the drawings and in the SWPPP unless modified and approved by the Owner (and authority having jurisdiction when required).
B. Temporary Construction Entrance/Exit and Lay Down Area:
   1. Temporary construction entrance/exit shall be installed and maintained as shown on the drawings. In addition to the entrance/exit shown on the drawings, a temporary gravel construction entrance/exit shall be installed and maintained at any point where construction

vehicles enter a public right-of-way, street or parking area, or exit the site. The pad shall be used to reduce mud tracked from construction vehicles onto public streets. The entrance/exit pad shall be constructed as shown on the drawings. Any sediment tracked onto the public street shall be cleaned immediately.

2. A 30,000 square foot, 6" thick stone base lay down area shall be established at grade and as located on the drawings or as directed by the Owner. A 24 foot gravel drive shall connect the temporary gravel construction entrance/exit and the lay down area, and the lay down area and the building pad. When the job nears completion, this stone may be incorporated into the pavement section provided it is in place and any overlying contaminated material has been removed.

3.03 DRAWING INTENT

A. Implementation of the erosion and sediment control measures shown on the drawings include but may not be limited to the approved measures. Contractor is responsible for providing all measures necessary that may be additional to accomplish the intent of the drawings. The quantity of best management practices shown on the drawings may be affected by actual conditions that occur during construction of the project. Additional sediment fence, diversion channels, sediment traps, inlet protection, and any other measure shown on the drawing may be necessary to provide adequate sediment control.

3.04 DEWATERING

A. Discharge from dewatering operations for the excavated areas shall not be directed to surface waters without first properly removing the suspended sediment from the water. The Contractor shall obtain any required permits associated with dewatering activities.

3.05 STABILIZATION

A. Limit Disturbed Area: Contractor to limit disturbed earthwork operations to the area commensurate with the Contractor's capability in keeping finished grading, seeding, mulching, stone base, and other control measures current and in accordance with the Schedule of Construction Activity. Should seasonal limitations make such coordination unrealistic, as determined by the Owner, temporary erosion control measures (stabilization) shall be provided immediately by the Contractor at no expense to the Owner.

B. Temporary Stabilization: The Contractor shall incorporate all permanent erosion control measures into the project at the earliest practical time to minimize the need for temporary stabilization. Temporary stabilization shall be used where stabilization is needed or required prior to installation of permanent measures due to seasonal concern or NPDES stabilization requirements.

C. Ground Cover Sufficient to Restrain Erosion: Any disturbed area where grading activities have temporarily or permanently ceased for more than 14 days (or a shorter time required by the local NPDES authority) shall be seeded, mulched and watered. Permanent stabilization consists of permanent seeding and landscaping per specification or stone base for paving or building construction. Temporary stabilization may include temporary seeding, mulch, stone base, mulch fiber matrix, or other methods.

D. Slopes: Slopes shall be permanently seeded and mulched as excavation or fill proceeds to the extent possible. Slopes shall be temporarily seeded and mulched as necessary. Any graded slopes steeper than 3:1 shall be protected with erosion control blanket (RECP) as indicated on the drawings.

3.06 OWNER INSPECTION

A. The Owner's representative shall inspect the site and recordkeeping materials at least once per month.

B. If Owner determines that the site is out of compliance with the governing NPDES Permit, the Contractor will have 24 hours to initiate and 48 hours to complete corrective action.

C. The Owner's NPDES Compliance Manager shall visit the site periodically.

D. If the Owner's Compliance Manager determines the site is out of compliance, the Contractor shall make corrective actions within 48 hours and produce any follow-up information requested by the Compliance Manager within the number of days specified in the Compliance Manager's report.

3.07 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
   1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.
   2. Provide temporary cover for soil stockpiles if not active for more than 14 days.
   3. Provide perimeter protection (sediment fence, wattle, or as shown on the drawings) around stockpile to prevent sediment from leaving the area.

3.08 STORM DRAINAGE

A. Inlets: All inlets are to be provided with inlet protection as indicated on the drawings immediately upon construction.

B. Outlets: All storm drainage outlets must be stabilized (velocity dissipation) as shown on the drawings before discharge becomes operational.

END OF SECTION 015713

SECTION 01 71 23

FIELD ENGINEERING

PART 1 - GENERAL

1.01 SUMMARY

A. The Contractor shall provide construction stakeout sufficient to construct the proposed improvement in accordance with the approved construction plans.

B. All stakeout services shall be completed under the direct supervision of a Professional Land Surveyor licensed in the State where the project is located.

C. The Owner shall provide the following prior to the commencement of any stake-out services:
   1. Construction site drawings and associated electronic files.
   2. Copies of the topographic survey that the approved site plans have been based on. The topographic survey shall include at least one benchmark, which shall be used for vertical control; and,
   3. Copies of the boundary survey that the approved site plans have been based on. The boundary survey shall be closed and monumented/ironed. These monuments/irons shall be used for horizontal control related to the site boundary and the dimensional control plan.

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 receive instructions prior to proceeding. No additional compensation will be considered resulting from grade variances once site clearing has commenced.

PART 2 - PRODUCTS

2.01 MATERIALS

A. The Contractor/Surveyor shall supply all stakeout materials.

2.02 EQUIPMENT

A. The Contractor/Surveyor shall supply all equipment necessary to accomplish the work.

PART 3 - EXECUTION

3.01 PERFORMANCE STANDARDS

A. Building Layout
   1. Set a minimum of 4 building corners (to be the outer most building limits or as requested by the Contractor) with 2 (10 foot minimum) offsets per corner. A benchmark or a finished floor benchmark will be set within close proximity to the proposed building.

B. Building Pad/Limits Certification
   1. Grade elevations for the building limits (finished floor elevation) shall be provided at a 50 foot grid for subgrade acceptance, stone base acceptance, and prior to slab placement.

C. Detention/Retention Ponds and Storm Drainage
   1. The Contractor shall provide an as-built survey of all constructed detention/retention ponds and associated drainage structures prior to final acceptance, including a written certification verifying the constructed pond volume and inverts of the proposed drainage structures.

D. Curb Layout
   1. Stakes shall be located at a minimum of 25 feet and a maximum of 50 feet intervals and also at points of curvature, points of tangency, radius points, and transitions, high and low points, and deflections. Offsets will be at 4 feet from face of curb, elevations to top of curb, elevations of top of curb to be provided at this 4 foot offset.

E. Storm and Sanitary Manholes

   15 feet and 25 feet offset stakes in the same direction will be set from the centerline opening of structure lath. One offset stake will have an elevation to top of rim and inverts. Intermediate grade stakes to pipe invert elevation will be provided if needed. (Note: These stakes are not to conflict with piping.)

F. Catch Basins

1. Set a centerline of structure lath with 10 foot offset HUB along the face of curb on either side of the lath at face of curb. One offset stake will have an elevation to top of grate and inverts. (Note: These stakes are not to conflict with piping.)

G. Utility Layout
   1. Water – Stakes shall be located at 50 foot intervals along centerline of pipe and at deflections with no offsets. One 10 foot offset stake to the center of hydrant with a grade ring elevation will be provided;
   2. Lighting – Centerline of lighting structure with a 5 foot offset will be staked. Offset stake elevation will be to finished grade; and,
   3. Centerline of pipes will be staked with no offset.

H. Roadway Layout
   1. Grade stakes shall be located at centerline of roadway at 50 foot intervals, including point of curvature, point on curve, point of tangency, and points of vertical curves. Grades shall be at finished grade.

I. Wall Layout
   1. Stakes with 10 feet offset shall be provided at 50 feet intervals, deflections, beginning and end of wall. Additional stakes may be required, depending on wall height and conditions.

J. Limits of Disturbance
   1. Clearing limits shall be staked at 100 feet ± intervals and at all critical areas.

K. Grade Stakes
   1. Stakes will be provided at a 50 foot grid. Grade elevations shall be to finished grade.

3.02 CONTRACTOR VERIFICATION

A. Contractor will field verify the utility location, size and invert elevations at points of connection in area of conflict, prior to construction and protect them from damage.
   1. Finished subgrades shall be verified by the Contractor to ensure proper elevation and conditions for construction above subgrade;
   2. Protect subgrade from excessive construction traffic and wheel loading including concrete and dump trucks; and,

B. Notify Owner if it is necessary to destroy or remove control points and/or benchmarks due to construction. Contractor shall be responsible for the protection of benchmarks, including the cost for relocation as required.

C. Advise Owner of any discrepancies between plans and field layout.

3.03 QUALITY ASSURANCE

A. The survey crew shall discuss all layout procedures with the Contractor's supervisor prior to commencing work.

B. A survey crew daily report detailing that day's work, shall be completed and signed by the Contractor's supervisor at the end of that day's layout.

C. Copies of sketches, cut sheets, etc. shall be provided to the Contractor by the beginning of the next workday.

D. All costs related to re-staking due to construction or Contractors' work resulting in destruction or movement of stakes, shall be paid for by the Contractor and at no additional expense to the Owner.

E. Building dimensions shall be obtained only from the approved architectural/structural drawings. Dimensions are to be obtained only from the appropriate approved (engineering, architectural and structural) drawings. The surveyor shall report any conflicts to the Contractor and Owner.

END OF SECTION 017123

SECTION 024116

DEMOLITION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections *31 and 32*, apply to this Section.

1.02 SUMMARY

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

B. Related Sections include the following:
   1. Division 2 Section "Summary" for use of the premises and phasing requirements.
   2. Division 2 Section "Construction Progress Documentation" for preconstruction photographs taken before building demolition.
   3. Division 2 Section "Temporary Facilities and Controls" for temporary construction, protection facilities, and environmental-protection measures for building demolition operations.
   4. Division 2 Section "Construction Waste Management and Disposal" for recycling and disposal of nonhazardous demolition wastes and for removal and storage of refrigerant.
   5. Division 2 Sections for demolishing or relocating site plumbing items.
   6. Division 2 Sections for demolishing or relocating site electrical items.
   7. Division 2 Section "Site Clearing" for site clearing and removal of above- and below-grade site improvements not part of building demolition
   8. Division 2 Section “Erosion and Sediment Control” for stabilization and control of discharges from the site.

1.03 DEFINITIONS

A. Demolish: Completely remove and legally dispose of off-site.

B. Recycle: Recovery of demolition waste for subsequent processing in preparation for reuse.

C. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner. Include fasteners or brackets needed for reattachment elsewhere.

D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or recycled.

1.04 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.

1.05 SUBMITTALS

A. Qualification Data (when required by Owner or Authorities Having Jurisdiction):
   1. Demolition Firm
   2. Test Control Firm
   3. For Refrigerant Recovery Technician.
   4. Licensed Professional Providing Demolition Oversight.

B. Proposed Protection Measures: Submit informational report, including drawings, that indicates the measures proposed for protecting individuals and property. The drawing shall outline proposed methods for dust control, noise control and maintaining the surrounding streets and

buildings in a clean condition for both demolition operations and during debris removal. Indicate proposed locations and construction of barriers.

1. Adjacent Buildings: Detail special measures proposed to protect adjacent buildings to remain.

C. Schedule of Demolition Activities: Contractor to submit for review and approval a detailed schedule for all proposed work to the Owner with the bid package. Submission shall include:
   1. Detailed sequence of demolition work, with starting and ending dates for each activity.
   2. Step-by-step description of all aspects pertaining to the demolition and protection of existing structures, the surrounding community, labor forces, rubble material management and disposal
   3. Temporary interruption of utility services.
   4. Shutoff and capping or re-routing of utility services.

D. Traffic Control Plan: Contractor shall submit Traffic Control Plan with bid package complying with Division 32 Section 321321 “Traffic Control”

E. Utility Schedule:
   1. Contractor to submit to Owner and all affected utility/service companies a proposed schedule of coordination for all necessary utility/service shut-offs, capping and continuation of utility services as required in the contract bid package.
   2. Contractor to provide Owner with written confirmation for all utility or service companies serving the site that service has been terminated prior to capping, abandoning or removal of any utility and prior to commencement of building demolition.
   3. Contractor shall accurately locate and mark on the contract drawings the location of all underground utility and services that have been capped and those that are to remain within the contract area.

F. Permits:
   1. Prior to submission of a bid package, the Contractor shall investigate all permit requirements and include any cost for these requirements in the bid. Prior to the commencement of work, the Contractor shall obtain all necessary permits and certificates associated with utility disconnections, storage tank removals and building demolition work from any and all Federal, State or regulatory authorities having jurisdiction. The Contractor shall incur all fees and other requirements associated with all permits and certificates. Copies of all permits and certificates obtained including drawing and permit preparation, procurements, revisions and filing fees shall be borne by the Contractor.
   2. All permits and certificates shall be obtained by the Contractor prior to applying for and obtaining general demolition permits. The following permits and certificates shall be obtained by the Contractor if applicable:
      a. Plumbing permit for water shut-off
      b. Water shut-off certificate (original)
      c. Plumbing permit for sewer seal
      d. Building and/or Fire Department permit for underground storage tank removal
      e. Letters from Electric and Gas Utility companies and gas meter shut-offs
      f. Letters from Cable TV companies for cable disconnections and removals
      g. Certificate from Tax Office (taxes paid);
      h. Letter to adjacent Owners of proposed demolition with proof of receipt
      i. Exterminator Certificate
      j. Board of Health approval
      k. Soil Erosion and Sediment Control Permit
      l. Asbestos Abatement Permit
      m. Asbestos Abatement Completion
      n. Demolition Contractor’s License
      o. Any other permit or certificate required to perform the demolition work

G. Building Demolition Plans: Drawings indicating the following:
   1. Locations of temporary protection

H. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.

I. Pre-demolition Video: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by building demolition

operations. Documentation to include condition of on-site and adjacent structures and features including but not limited to curbs, sidewalks, landscapes, pavements, utility structures at grade, light poles, telephone poles, fences, bollards, etc… Comply with Division 1 Section 013200 “Construction Progress Documentation” . Submit before the Work begins.

J. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes. Contractor to provide written permission from property owner on whose property the demolition material is to be disposed. Copies of any agreements shall be furnished to the Owner prior to sending any materials from the demolition site.

K. Hazardous Materials: Contractor to deliver manifest or disposal tickets to Owner and Owner’s Engineer for each truck that exits and enters the project site. Manifests shall include:
   1. Date and time of departure from demolition site.
   2. Type of material removed from site and type of material brought to the site.
   3. Amount of material in tons.
   4. Truck ID number
   5. Final destination of excess material.
   6. Date and time of entry to the demolition material
   7. Date and time of entry to the demolition site.
   8. Amount of material
   9. Source of material brought on-site.

L. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.06 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.

B. Statement of Refrigerant Recovery: Statement shall be signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant present was recovered and recovery was performed according to EPA regulations. Include name, address and signature on statement along with the date refrigerant was recovered.

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

D. Standards: Comply with ANSI A10.6 and NFPA 241.

E. Pre-demolition Conference: Conduct conference at Project site to comply with requirements in *Division 01 Section 013200 "Project Management and Coordination."*. Review methods and procedures related to building demolition including, but not limited to, the following:
   1. Inspect and discuss condition of construction to be demolished.
   2. Review structural load limitations of existing structures.
   3. Review and finalize building demolition schedule and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays.
   4. Review and finalize protection requirements.
   5. Review procedures for noise control and dust control.
   6. Review procedures for protection of adjacent buildings.
   7. Review items to be salvaged and returned to Owner.

F. Progress Meetings: Once demolition work has begun Contractor shall schedule, administer and attend regularly scheduled meetings. Contractor shall include selected subcontractors as necessary to attend Progress Meetings. Contractor to schedule time and frequency of meetings at Owner’s request to maintain optimum degree of communication between all parties involved.

1.07 PROJECT CONDITIONS

A. Buildings to be demolished will be vacated and their use discontinued before start of the Work.

B. Buildings immediately adjacent to demolition area will be occupied. Conduct building demolition so operations of occupied buildings will not be disrupted.
   1. Provide not less than 72 hours' notice of activities that will affect operations of adjacent occupied buildings.
   2. Maintain access to existing walkways, exits, and other facilities used by occupants of adjacent buildings.

a. Do not close or obstruct walkways, exits, or other facilities used by occupants of adjacent buildings without written permission from authorities having jurisdiction.

C. Owner assumes no responsibility for buildings and structures to be demolished.
   1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

D. Removal and Relocation of Existing Utilities/Structures: The Contractor shall be responsible for removal and/or relocation of existing utilities/structures, whether shown or not shown on the drawings, at locations where conflicts occur with proposed improvements at no additional cost to the owner.

E. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work unless otherwise indicated in the contract documents.
   1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Owner. Hazardous materials will be removed by Owner under a separate contract.

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

1.08 COORDINATION

A. Arrange demolition schedule so as not to interfere with Owner's on-site operations or operations of adjacent occupied buildings.

PART 2 - PRODUCTS

2.01 The Contractor shall supply all materials as required for this work.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Review Project Record Documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

B. Inventory and record the condition of items to be removed and salvaged. Provide video of conditions that might be misconstrued as damage caused by salvage operations. Comply with *Division 01 Section 013200 "Construction Progress Documentation".*

C. Survey condition of existing building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during building demolition operations. Correlate existing conditions with requirements indicated on drawings to help determine extent of work.

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

E. Verify that all asbestos containing materials have been removed before proceeding with building demolition operations.

F. Verify all sediment control measures are in place per the Phase I Erosion and Sediment Control Plan and Division 31 Section 311100 "Erosion and Sediment Control" *(forthcoming Division 31 Section 311100)* and the Stormwater Pollution Prevention Plan.

3.02 PREPARATION

A. Refrigerant: Remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction before starting demolition.

B. Existing Utilities: Locate, identify, disconnect, and seal or cap off indicated utilities serving buildings and structures to be demolished.
   1. Arrange to shut off indicated utilities with utility companies.
   2. If removal, relocation, or abandonment of utility services will affect adjacent occupied buildings, then provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures as acceptable to Owner and authorities having jurisdiction.
   3. Cut off pipe or conduit a minimum of 24 inches (610 mm) below grade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing according to requirements of authorities having jurisdiction.

C. Existing Utilities: Refer to Divisions 22 and 26 Sections for shutting off, disconnecting, removing, and sealing or capping utilities. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.

D. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished.
   1. Strengthen or add new supports when required during progress of demolition.

E. Salvaged Items: Comply with the following:
   1. Clean salvaged items of dirt and demolition debris.
   2. Pack or crate items after cleaning. Identify contents of containers.
   3. When permitted by Owner items removed may be stored in protected storage location during demolition and returned in original locations after demolition operations are complete. Store items in a secure area until delivery to Owner.
   4. Transport items to storage area designated by Owner or as indicated on Drawings.
   5. Protect items from damage during transport and storage.

3.03 PROTECTION

A. Existing Facilities: Protect adjacent walkways, loading docks, building entries, and other building facilities during demolition operations. Maintain exits from existing buildings.

B. Existing Utilities: Maintain utility services to remain and protect from damage during demolition operations.
   1. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction.
   2. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and authorities having jurisdiction.
      a. Provide at least 72 hours' notice to occupants of affected buildings if shutdown of service is required during changeover.

C. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction and as indicated. Comply with requirements in Division 01 Section 015000 "Temporary Facilities and Controls"
   1. Protect adjacent buildings and facilities from damage due to demolition activities.
   2. Protect existing site improvements, appurtenances, and landscaping to remain.
   3. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
   4. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
   5. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.
   6. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations.
   7. Erect and maintain dustproof partitions and temporary enclosures to limit dust, noise, and dirt migration to occupied portions of adjacent buildings.

D. Remove temporary barriers and protections where hazards no longer exist. Where open excavations or other hazardous conditions remain, leave temporary barriers and protections in place.

3.04 DEMOLITION, GENERAL

A. General: Demolish indicated existing buildings and site improvements completely as specifically identified on the construction drawings. Use methods required to complete the Work within limitations of governing regulations and as follows:
   1. Do not use cutting torches until work area is cleared of flammable materials. Maintain portable fire-suppression devices during flame-cutting operations.
   2. Maintain fire watch during and hours after flame cutting operations as required by authorities having jurisdiction.
   3. Maintain adequate ventilation when using cutting torches.

4. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

B. Engineering Surveys: During demolition, perform surveys to detect hazards that may result from building demolition activities.

C. Site Access and Temporary Controls: Conduct building demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
   1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
   2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

3.05 DEMOLITION BY MECHANICAL MEANS

A. Proceed with demolition of structural framing members systematically, from higher to lower level. Complete building demolition operations above each floor or tier before disturbing supporting members on the next lower level.

B. Remove debris from elevated portions of the building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
   1. Remove structural framing members and lower to ground by method suitable to minimize ground impact and dust generation.

C. Salvage: Items to be salvaged are indicated on Drawings**.**

D. Below-Grade Construction: Abandon foundation walls and other below-grade construction. Cut below-grade construction flush with grade.

E. Below-Grade Construction: Demolish foundation walls and other below-grade construction that are within footprint of new construction and extending 10 feet (3 m) outside footprint indicated for new construction. Abandon below-grade construction outside this area.
   1. Remove below-grade construction, including basements, foundation walls, and footings, to at least 24 inches (600 mm) below grade or as indicated on drawings or as required to eliminate conflict with new construction.

F. Existing Utilities: Abandon existing utilities and below-grade utility structures. Cut utilities flush with grade.

G. Existing Utilities: Demolish existing utilities and below-grade utility structures that are within 10 feet (3 m) outside footprint indicated for new construction. Abandon utilities outside this area.

1. Fill abandoned utility structures with satisfactory soil materials or recycled pulverized concrete and as indicated on the drawings or directed by Owner and according to backfill requirements in Division 31 Section312000 "Earth Moving"

3.06 DEMOLITION BY EXPLOSIVES

A. Explosives: Perform explosive demolition only as approved by Owner and according to governing regulations.

3.07 SITE RESTORATION

A. Below-Grade Areas: Rough grade below-grade areas ready for further excavation or new construction.

B. Below-Grade Areas: Completely fill below-grade areas and voids resulting from building demolition operations with satisfactory soil materials according to backfill requirements in Division 31 Section 312000"Earth Moving"

C. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

3.08 REPAIRS

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

B. Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.
C. Restore exposed finishes of patched areas and extend restoration into adjacent construction in a manner that eliminates evidence of patching and refinishing.

3.09 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and safely dispose of all items in accordance with applicable EPA, State and local authorities having jurisdiction and all codes and ordinances. *(See Division 01 Section "Construction Waste Management and Disposal" for recycling and disposal of demolition waste.)*
B. All recycling must be conducted in accordance with all currently applicable EPA, State and Local authorities having jurisdiction waste flow regulations. All recycling of demolition debris must be approved by Owner.
   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.
C. Do not burn demolished materials.

3.10 CLEANING

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

END OF SECTION 024116

SECTION 31 10 00

SITE CLEARING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Protecting existing vegetation to remain.
   2. Removing existing vegetation.
   3. Clearing and grubbing.
   4. Stripping and stockpiling topsoil.
   5. Removing above- and below-grade site improvements.
   6. Disconnecting, capping or sealing, and removing site utilities abandoning site utilities in place.

B. Related Sections:
   1. Division 01 Section "Field Engineering" for temporary utility services, construction and support facilities, security and protection facilities
   2. Division 02 Section “Demolition" for demolition of buildings, structures, and site improvements.
   3. Division 01 Section “Erosion and Sediment Control”.
   4. Division 31 Section “Earth Moving”.

1.03 DEFINITIONS

A. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

B. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches (50 mm) in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.

D. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.

E. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.04 MATERIAL OWNERSHIP

A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.05 SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.
   1. Use sufficiently detailed photographs or include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.06 QUALITY ASSURANCE

A. Pre-construction meeting: Discuss site clearing and vegetation protection at SWPPP Pre-construction meeting at project site or agreed-upon location prior to site clearing and grading.

1.07 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
   2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.
   1. Do not proceed with work on adjoining property until directed by Owner.
   2. 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.
   3. 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.

C. 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 receive instructions prior to proceeding. No additional compensation will be considered resulting from grade variances once site clearing has commenced.

D. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

E. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

F. Do not commence site clearing operations until temporary sediment control, runoff control and other best management practices including plant protection measures are in place as shown on the Drawings and indicated in the Sequence of Construction.

G. The following practices are prohibited within protection zones:
   1. Storage of construction materials, debris, or excavated material.
   2. Parking vehicles or equipment.
   3. Foot traffic.
   4. Erection of sheds or structures.
   5. Impoundment of water.
   6. Excavation or other earthwork unless otherwise indicated.
   7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

H. Do not direct vehicle or equipment exhaust towards protection zones.

I. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

J. Soil Stripping, Handling, and Stockpiling: Perform only when the topsoil is dry or slightly moist.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Division 31 Section "Earth Moving."
   1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site. Borrow material must be obtained from a permitted site.

PART 3 - EXECUTION

3.01 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly identify trees, shrubs, and other vegetation to remain or to be relocated. Flag each tree trunk at 54 inches (1372 mm) above the ground.
C. Protect existing site improvements to remain from damage during construction.
   1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.02 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide erosion and sediment control measures to prevent soil erosion and discharge of sediment and other pollutants to surface waters or airborne dust to adjacent properties and walkways, according to erosion and sediment control Drawings and requirements of authorities having jurisdiction.
B. Provide erosion and sediment control measures in accordance with Division 01 Section “Erosion and Sediment Control” , prior to any construction activity (including demolition).
C. At Final Stabilization, remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.03 TREE AND PLANT PROTECTION

A. General: Protect existing trees and plants to remain or be relocated on-site according to work shown on the Construction Drawings. All trees and plants to remain shall be barricaded and protected during the construction process
   1. Tree Protection
      a. Erect and maintain a temporary fence directly below the drip line of individual trees or directly below the perimeter drip line of groups of trees to remain. Remove fence when construction is complete.
      b. Do not excavate, for any reason, within the area directly below the drip lines of trees, unless otherwise indicated.
      c. Where excavation for new construction is required within the drip line of trees, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.
      d. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by the Owner.
B. Limit of clearing is to be staked in accordance with Division 01 Section “Field Engineering”, and verified by Owner prior to removal of any trees.
C. All trees and plants not designated to remain within the area to be graded, shall be cut and the removal of stumps shall comply with Article 3.5 of this Section. Burning on site is not permitted, unless otherwise approved by the Owner and authorities having jurisdiction.
D. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Owner.

3.04 EXISTING UTILITIES

A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.
   1. Arrange with utility companies to shut off indicated utilities.
B. Locate, identify, and disconnect utilities indicated to be abandoned in place.
C. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Notify Owner not less than seven calendar days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Owner's written permission.
D. Excavate for and remove underground utilities indicated to be removed.

3.05 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
   1. Do not remove trees, shrubs, grass, and other vegetation indicated to remain or to be relocated.
   2. Removal includes digging or grinding down stumps and remove roots, obstructions, and debris to a depth of 18 inches (450 mm) below exposed subgrade.

3. In areas outside the building limits where the depth of fill exceeds 8 feet in height, unless otherwise directed by the Owner, sound trees shall be cut at a height of not more than 6 inches above natural ground.
4. Use only hand methods for grubbing within protection zones.
5. Chip removed tree branches and stockpile in areas shown on the Drawings and as approved by Owner. Re-use material as indicated on the Drawings otherwise dispose of off-site.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches (200 mm), and compact each layer to a density equal to adjacent original ground, and in accordance with Division 31 Section “Earth Moving”.

3.06 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to the full depth encountered in areas indicated to be graded and in a manner to prevent intermingling with underlying subsoil or other waste materials.
1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects more than 2 inches (50 mm) in diameter; trash, debris, weeds, roots, and other waste materials.

C. Stockpile sufficient topsoil material to facilitate seeding and landscaping. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain away from stockpile. Refer to Division 01 Section “Erosion and Sediment Control” or cover to prevent windblown dust and erosion by water.
1. Limit height of topsoil stockpiles to 72 inches (1800 mm).
2. Do not stockpile topsoil within tree protection zones.
3. Dispose of surplus soil material, unsuitable or excess topsoil, obstructions, demolished materials, and waste materials, including trash and debris, and in compliance with all regulations. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.
4. Stockpile surplus topsoil to allow for re-spreading deeper topsoil.

3.07 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

3.08 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

B. If indicated on the Drawings and/or in the Stormwater Pollution Prevention Plan separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 311000

SECTION 31 20 00

EARTH MOVING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Cutting, proofrolling, filling, grading and preparing subgrades, required lines, dimensions, contours and elevations for proposed improvements including slabs-on-grade, walks, pavements, turf and grasses, and plants as shown and implied on the drawings or required by these specifications.
   2. Scarifying, compaction, moisture content conditioning and control, and removal of unsuitable materials to ensure proper preparation of areas for the proposed improvements.
   3. Excavating and backfilling for buildings and structures.
   4. Special construction procedures for the site recommended in the geotechnical report for preparation of building and pavement areas.
   5. Drainage course for concrete slabs-on-grade.
   6. Subbase course for concrete walks and pavements.
   7. Subbase course and base course for asphalt paving.
   8. Subsurface drainage backfill for walls and trenches.
   9. Excavating and backfilling trenches for utilities and pits for buried utility structures.

B. Related Sections:
   1. Division 01 Section "Field Engineering" for temporary controls, utilities, and support facilities; also for temporary site fencing if not in another Section.
   2. Division 31 Section "Earth Moving" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
   3. Division 32 Section “Planting” for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.
   4. Division 32 Section “Planting” for finish grading in planting areas and tree and shrub pit excavation and planting.

1.03 UNIT PRICES

A. Work of this Section is affected by unit prices for earth moving specified in Division 01 Section "Unit Prices."

B.

C. Rock Measurement: Volume of rock actually removed, measured in original position, but not to exceed the following. Unit prices for rock excavation include replacement with approved materials.
   1. 24 inches (600 mm) outside of concrete forms other than at footings.
   2. 12 inches (300 mm) outside of concrete forms at footings. Additional depth may be required due to local codes or based on the geotechnical engineering study.
   3. Neat outside of minimum required dimensions of concrete cast against grade.
   4. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
   5. 6 inches (150 mm) beneath bottom of concrete slabs-on-grade.
   6. 12 inches (300 mm) beneath pipe invert elevation in trenches, and 12 inches (300 mm) wider than outside surface of either side of pipe or conduit. Removal of rock for trench excavation will be paid as part of the corresponding utility items unless stated elsewhere in the contract documents.

1.04 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
   1. Initial Backfill: Backfill or bedding material backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
   2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
   1. Classified Excavation: Classified excavation shall be defined as the excavation necessary to subgrade lines and grades as shown on the contract drawings, which shall be a lump sum bid. Any and all unsuitable material, undercut excavation, mass rock excavation, trench rock excavation, mechanical rock excavation and soil stabilization shall be paid in addition to the classified excavation lump sum bid, by unit prices measured in-place. In the event the Owner elects to change the lines and grades as shown on the contract drawings, unit process shall be used to increase or decrease the contract amount in accordance with the change.
   2. Unclassified Excavation: Unclassified excavation shall be defined as all material excavated to and below the lines and grades as shown on the contract drawings to provide a firm and unyielding subgrade, regardless of its nature or composition, which includes any and all on-site cut or fill, off-site import or export, topsoil removal, subgrade preparation, unsuitable material, undercut excavation, mass rock excavation, trench rock excavation, mechanical rock excavation, utility and storm drainage trench excavation, and soil stabilization. Unclassified excavation shall be a lump sum bid with a unit price per cubic yard for unclassified excavation. In the event the Owner elects to change the lines and grades as shown on the contract drawings, the unclassified excavation unit price shall be used to increase or decrease the contract amount in accordance with the change.
   3. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Owner. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.
   4. Bulk Excavation: Excavation more than 10 feet (3 m) in width and more than 30 feet (9 m) in length.
   5. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Owner. Unauthorized excavation, as well as remedial work directed by Owner, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.
   1. If necessary, off-site fill (borrow) shall be obtained and provided by the Contractor. The Contractor is responsible for all permits and regulatory requirements associated with offsite borrow sources.

H. Geogrid: A biaxial polymeric grid formed by a regular network of integrally connected tensile elements with apertures of sufficient size to allow interlocking with surrounding soil, rock, or earth to function primarily as a reinforcement.

I. Minimum Average Roll Value (MARV): A value based on testing and determined in accordance with ASTM D4759-92.

J. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. (0.76 cu. m) for bulk excavation or 3/4 cu. yd. (0.57 cu. m) for footing, trench, and pit excavation that cannot be removed by rock excavating equipment

equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:

1. Excavation of Footings, Trenches, and Pits: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch- (1065-mm-) wide, maximum, short-tip-radius rock bucket; rated at not less than 138-hp (103-kW) flywheel power with bucket-curling force of not less than 28,700 lbf (128 kN) and stick-crowd force of not less than 18,400 lbf (82 kN) with extra-long reach boom; measured according to SAE J-1179.
2. Bulk Excavation: Late-model, track-mounted loader; rated at not less than 230-hp (172-kW) flywheel power and developing a minimum of 47,992-lbf (213.3-kN) breakout force with a general-purpose bare bucket; measured according to SAE J-732.

K. Rock: Rock material in beds, ledges, un-stratified masses, conglomerate deposits, and boulders of rock material defined as:

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.
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.
3. Mechanical Excavation: Any material that must be excavated by a minimum 10,000 lb. mechanical hammer and occupying an original volume of at least 2 cubic yards.

L. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

M. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

N. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

O. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.05 SUBMITTALS

A. Product Data: For each type of the following manufactured products required:

1. Geotextiles.
2. Controlled low-strength material, including design mixture.
3. Geofoam.
4. Warning tapes.

B. Samples for Verification: For the following products, in sizes indicated below:

1. Geotextile and Geogrid: Submit product data sheet and certification from Manufacturer the product supplied meets the requirement of this section. Submit Manufacturer’s installation instructions and general recommendations.

C. Qualification Data: For qualified testing agency.

D. Construction Sequence

1. Within 10 days after award of the contract, the Contractor shall submit to the Owner, with his bid package, a schedule detailing the sequence and time of completion of all phases of work under this section.

E. Material Test Reports:

1. At least two (2) weeks in advance of importing material and for each borrow soil material proposed for fill and backfill, the Contractor shall notify the geotechnical engineer of the location of the borrow area. The geotechnical engineer shall furnish reports to the Owner and Contractor information as follows:
    a. Moisture and Density Relationship: ASTM D1557 or D698 as required by the project geotechnical engineering study.
    b. Mechanical Analysis: AASHTO T-88.
    c. Plasticity Index: ASTM D4318.

d. Classification according to ASTM D 2487.
e. 5 pound sample of each type of borrow material in an air tight container for the approval of the geotechnical engineer and Owner.
f. The name of each material supplier and specific type and source of each material. Any change in source or soil type throughout the project will require approval of the geotechnical engineer and Owner.

2. For Trench Excavation and Backfill: Contractor shall contact all utility companies and identify any requirements necessary for the construction of the Project. In addition provide:
   a. Contractor to provide written confirmation on the status of all utility construction approvals and requirements to the Owner at the time of the pre-construction conference or no later than 30 days following the project possession date.
   b. Submit a sample of each type of offsite fill and/or bedding material that is to be used in backfilling trenches.
3. For Aggregate Base Course: at least two weeks in advance of imported aggregate use, the Contractor shall submit the following laboratory test date, in conformance with the specified DOT aggregate materials:
   a. Particle Size Analysis: AASHTO T-88; and,
   b. Density: Modified Proctor Test (ASTM D1557)
   c. Name of aggregate base course material supplier and specific type and source of each material, including relevant DOT compaction or specifications. Any change in source or aggregate base course type throughout the job requires approval of the Owner and the geotechnical engineer.
   d. The geotechnical engineer shall prepare field reports that indicate compaction test location, elevation data, testing results and acceptability. The Owner and Contractor shall be provided with copies of reports within 24 hours of time test was performed.

F. Blasting plan approved by authorities having jurisdiction is to be provided to the Owner at least 14 calendar days prior to commencement of blasting. Blasting plan to include all Federal, State and local permits applicable to the blasting operation. Blasting will be performed in accordance with all applicable laws, regulations, ordinances and industry standards. Plan shall coordinate with grading contractor to insure appropriate safety procedures are followed including signage and signaling devices.

G. Blasting Contractor: All blasting to be performed by an insured, certified and licensed blasting Contractor. Proof of applicable insurance, license and certifications must be provided to the Owner at least 30 days prior to commencement of any blasting work. **Blasting Contractor shall carry the following insurance: Workers Compensation, Comprehensive General Liability, Broad Form Property Damage, Contractual Liability and Explosion, Collapse and Underground Hazard (naming the Owner as additionally insured).** Contractor must indemnify and hold harmless the Owner for all claims for damages arising from the blasting operation.

H. The Blasting Contractor shall furnish a seismic survey report from seismic survey agency. The report will show the number of holes drilled, depth of holes, the burden and spacing, the amount of powder per hole, pound of powder per delay, the delay pattern, seismograph locations, and chronograph locations. The Seismic survey shall provide seismograph recordation of each blast at all adjacent structures. All reports shall be forwarded to the Owner.

I. Contractor shall have the responsibility of furnishing a pre-blast survey of the surrounding area. Survey will include a one-quarter mile radius of the surrounding area.

J. The Contractor shall provide and maintain a post-blast report including the amount of material displaced by each blast, the amount of explosive utilized in each blast, and the number of shots detonated. This report will be forwarded to the Owner.

K. Pre-blast Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces, which might be misconstrued as damage caused by blasting operations. Submit before blasting begins.

1.06 QUALITY ASSURANCE

A. Blasting: Comply with applicable requirements in NFPA 495, "Explosive Materials Code," and prepare a blasting plan reporting the following:

1. Types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
2. Seismographic monitoring during blasting operations.

B. Blasting Requirements;
1. Perform blasting only after receiving written approval from Owner and authorities having jurisdiction.
2. Provide heavy mats as necessary to minimize concussion. Handle, store and use explosives in accordance with the Manual of Accident Prevention in Construction by the Associated General Contractor's of America, Inc., 1978 edition.

C. Seismic Survey Agency: An independent testing agency, acceptable to authorities having jurisdiction, experienced in seismic surveys and blasting procedures to perform the following services:
1. Report types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
2. Seismographic monitoring during blasting operations.

D. Contractor Qualifications: The Contractor shall provide at least one supervisory person who shall be present at all times during execution of the work and who is thoroughly familiar with the type of work being performed and its best methods for completion. This person shall have the authority to act on behalf of the Contractor.

E. Geotechnical Engineering Study (Soils Report)
1. The Owner employed a geotechnical engineer to investigate sub-surface soil conditions and make recommendations regarding site work construction procedures. Perform all work in accordance with the recommendations and requirements therein. If conflicts exist between the geotechnical engineering study and the construction drawings and specifications, the more stringent requirements shall apply.

F. Geotechnical Testing Agency Qualifications: A geotechnical engineer shall be familiar with the requirements of the geotechnical engineering study, selected and paid by the Owner, will be retained to perform construction inspection on site based on density testing, visual observation and judgment. These inspections shall not relieve the Contractor from his responsibility to complete the work in accordance with the drawings and specifications.
1. Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.
2. Provide one compaction test per Table 3.16C for each lift within the pavement area.
3. Provide construction inspection and testing on trench backfilling operations.
4. Provide visual field confirmation and density testing of subgrade preparation and fill placement procedures as part of the construction testing requirements. The Contractor shall be informed as soon as possible of test results.
5. Geotechnical engineer shall prepare field reports that indicate compaction test location, elevation data, testing results and acceptability. The Owner and Contractor shall be provided with written copies of the results within 24 hours of time test was performed.
6. All costs associated with required re-inspection due to failures shall be paid for by the Contractor at no additional expense to the Owner. The Owner reserves the right to direct any inspection that they deem necessary. Contractor shall provide free access to the site for inspection activities.

G. Pre-excavation Conference: Conduct conference at Project site.

H. Geogrid Pre-construction Conference: Contractor to arrange site meeting with material supplier, installer, Owner and Engineer prior to installation of geogrid. Owner and Engineer shall be notified at least seven (7) days prior to the meeting.

I. Project Record Documents: Contractor to accurately record actual locations of all subsurface utilities, structures and obstructions encountered. Accurately record any as-built variation from the construction drawings and specifications. The Contractor shall provide as-built drawings within 30 days of project completion.

1.07 PROJECT CONDITIONS

A. General: The Contractor shall be responsible for removal and/or relocation of existing utilities at locations where conflicts occur with proposed utility improvements whether shown or not shown on the drawings. Removal and/or relocation shall be at no additional cost to the Owner.

B. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
   2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

C. Improvements on Adjoining Property: Authority for performing earth moving indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.
   1. Do not proceed with work on adjoining property until directed by Owner.

D. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth moving operations.

E. Do not commence earth moving operations until temporary erosion- and sedimentation-control measures, specified in Division 2 Section "Temporary Facilities and Controls," Division 2 Section “Erosion and Sediment Control” and Division 2 Section "Site Clearing," are in place.

F. Do not commence earth moving operations until plant-protection measures specified in Division 2 Section "Temporary Tree and Plant Protection" are in place.

G. The following practices are prohibited within plant-protection zones (if indicated on the Drawings:
   1. Storage of construction materials, debris, or excavated material.
   2. Parking vehicles or equipment.
   3. Erection of sheds or structures.
   4. Impoundment of water.
   5. Excavation or other digging unless otherwise indicated.
   6. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

H. Do not direct vehicle or equipment exhaust towards protection zones.

I. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

A. General: Obtain and provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups consistent with geotechnical report and according to ASTM D 2487; free of rock or gravel larger than 2 inches (50 mm) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
   1. Soil materials used for 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 sieve shall be non-plastic. Fill with fewer fines (less than #200) must be approved by the geotechnical engineer. Fill with more than 20% fines may be acceptable only if so indicated in the geotechnical engineering study.
   2. Prior to placement material used for fill shall not contain:
      a. Debris (other than crushed concrete and brick meeting the requirements in 2.1.B.3);
      b. Timber or railroad ties;
      c. Deleterious materials such as steel rails;
      d. Trash or hazardous materials.
      e. Hazardous materials, unsuitable and deleterious materials and debris shall be disposed of off-site in accordance with all applicable regulations.
   3. On-site Soils:
      a. On-site materials for use as fill shall consist of excavated soil from other portions of the site.

b. Contractor to use on-site soil judiciously to facilitate construction schedule including the use of the most readily compactable soil for fill in building areas and fill within 2 feet of pavement sub-grade.
c. Topsoil shall not be utilized as engineered fill.
d. Excavated material containing rock, stone or masonry debris smaller than 2 feet in its largest dimension may be mixed with suitable material and utilized inside the building limits up to 6 feet below proposed subgrade and up to 3 feet below proposed subgrade outside building limits.
e. Excavated material containing rock, stone or masonry debris smaller than 6 inches in the largest dimension may be mixed with suitable material and utilized inside the building limits up to 3 feet below proposed subgrade and up to 18 inches below proposed subgrade outside the building limits.
f. No material greater than 2 inches in its largest dimension may be utilized inside the building limits within 3 feet of the proposed subgrade or within 18 inches of proposed subgrade for all other areas.
g. No material greater than 1-1/2 inches in its largest dimension may be utilized as backfill for storm drainage or utility trenches.

4. Imported Borrow:
   a. Imported fill (borrow) shall meet the requirements of on-site soils and shall be free from all hazardous substances. Certification of compliance, and if requested, test results certifying compliance shall be furnished by the geotechnical engineer.
   b. The Owner reserves the right to test off-site borrow material for conformance with these specifications.

C. Unsatisfactory Soils: Soil identified by the geotechnical engineer according to ASTM D 2487.
   1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.

E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve. All aggregate shall meet the state department of transportation specifications for the state in which the project is located for gradation and other specified material requirements.

F. Recycled Concrete Aggregate Base Course: Recycled concrete aggregate may be approved by the Owner for use in lieu of aggregate base course specified under the following conditions:
   1. The gradation, plasticity, soundness, and abrasion requirements of the material shall meet the governing department of transportation specifications for recycled concrete aggregate or aggregate base course.
   2. The Contractor shall be required to submit a sieve analysis to the Owner for review and approval
   3. The recycled concrete aggregate shall not contain foreign materials, which includes reinforcing steel, wood, and other friable material.
   4. The Contractor shall obtain all required permits and report recycled materials usage as required by the regulatory authorities having jurisdiction.
   5. The Owner reserves the right to not approve use of the recycled concrete aggregate, for both pavement base structure and building pad construction. Approval of the use of recycled concrete aggregate shall only be authorized in writing by the Owner.

G. Recycled Bituminous Concrete Base Course: Bituminous concrete on the site shall be milled or removed prior to placing any fill. Bituminous concrete may be reused under and immediately below the pavement stone base course if so indicated and approved by the geotechnical engineer and Owner.

H. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.

I. Bedding Materials: As shown on the drawings and specified on the trenching and bedding details and approved by the Owner and/or the geotechnical engineer.
   1. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch (25-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.
   2. Bedding Material: As specified on the trenching and bedding details and/or conforming to local codes. Where conflict exists, the more stringent code or specification shall apply.

J. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch (37.5-mm) sieve and 0 to 5 percent passing a No. 8 (2.36-mm) sieve.

K. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch (25-mm) sieve and 0 to 5 percent passing a No. 4 (4.75-mm) sieve.

L. Sand: ASTM C 33; fine aggregate.

M. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.02 EQUIPMENT

A. Compactor for mass earthwork shall be minimum 5 ton static drum weight vibratory roller or 5 ton static drum weight sheep's footed 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 of limited use, a double drum walk behind roller or "jumping jack" tamper may be used.

2.03 GEOTEXTILES

A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
   1. Grab Tensile Strength: 157 lbf (700 N); ASTM D 4632.
   2. Sewn Seam Strength: 142 lbf (630 N); ASTM D 4632.
   3. Tear Strength: 56 lbf (250 N); ASTM D 4533.
   4. Puncture Strength: 56 lbf (250 N); ASTM D 4833.
   5. Apparent Opening Size: No. 60 (0.250-mm) sieve, maximum; ASTM D 4751.
   6. Permittivity: 0.2 per second, minimum; ASTM D 4491.
   7. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the geotechnical report.

C. Structural Soil Reinforcement Geogrid: Shall be integrally formed and deployed as a single layer having the following characteristics (all are MARV values unless otherwise noted)

Property	Type 1	Type 2	Type 3	Type 4
Aperture Stability Modulus at 20 cm-kg	0.32 m-N/deg	.065 m-N/deg	.058 m-N/deg	0.75 m-N/deg
Rib Shape	Rectangular or Square	Rectangular or Square	Rectangular or Square	Rectangular or Square
Rib Thickness	.030 in (0.76 mm)	.045 in (1.14 mm)	.050 in (1.27 mm)	.070 in (1.78 mm)

Nominal Aperture Size	1 inch	1 inch	2 inches	1.25 inches
Junction efficiency	93%	93%	93%	93%
Flexural Rigidity	250k mg-cm	750k mg-cm	450k mg-cm	2000k mg-cm
Minimum True Initial Modulus in Use MD	17,140 lb/ft	27,240 lb/ft	24,000 lb/ft	34,270 lb/ft
CMD	27,240 lb/ft	44,550 lb/ft	34,270 lb/ft	42,840 lb/ft

2.04 CONTROLLED LOW-STRENGTH MATERIAL

A. Controlled Low-Strength Material: Self-compacting, flowable concrete material produced from the following:
   1. Portland Cement: ASTM C 150, Type per geotechnical report.
   2. Fly Ash: ASTM C 618, Class C or F.
   3. Normal-Weight Aggregate: ASTM C 33, 3/4-inch (19-mm) nominal maximum aggregate size.
   4. Foaming Agent: ASTM C 869.
   5. Water: ASTM C 94/C 94M.
   6. Air-Entraining Admixture: ASTM C 260.

B. Produce conventional-weight, controlled low-strength material with **80-psi (550-kPa)** compressive strength when tested according to ASTM C 495.

2.05 ACCESSORIES

A. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored as follows:
   1. Red: Electric.
   2. Yellow: Gas, oil, steam, and dangerous materials.
   3. Orange: Telephone and other communications.
   4. Blue: Water systems.
   5. Green: Sewer systems.

PART 3 - EXECUTION

3.01 PREPARATION

A. Prior to bidding work within this Section, the Contractor shall become thoroughly familiar with the geotechnical engineering study, existing site conditions, and all portions of the work within this Section.

B. Do not perform any work required by this section prior to completion of all required inspections, tests and approvals.

C. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.

D. Protect and maintain benchmarks, property corners, monuments and other reference points from damage or displacement. If a marker must be removed or relocated it shall be performed by a licensed professional land surveyor at no additional cost to the Owner.

E. Notify utility companies to allow removal and/or relocation of any utilities that are in conflict with the proposed improvements. Locate, identify, protect and maintain in operating condition, existing utilities encountered during utility installation. Repair any damage to surface or subsurface improvements encountered or shown on the Drawings.

F. Set all lines, elevations, and grades for utility and drainage system work and maintain for the duration of the work.

G. Verify location, size, elevation, and other pertinent data required to make connections between existing utilities, drainage systems, and proposed construction indicated on the Drawings. Coordinate all building utility connection locations and elevations with architectural drawings.

H. When performing grading operations during periods of prolonged wet or dry conditions, provide adequate measures for surface drainage or ground water and moisture control of the soils (i.e. wetting or drying, scarify and disking) so as to place and compact the soil within the moisture content range of a few percentage points of its optimum water content. Any disturbed areas should be proof rolled at the end of each day.

I. 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.

J. Protect and maintain all erosion control, sediment control, and runoff control and materials management measures during earth moving operations. Refer to erosion and sediment control drawings for staging earthwork operations and for measures that must be implemented prior to the commencement of earthwork.

K. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

L. Remove from the site any material encountered during grading operation that in the opinion of the Owner or geotechnical engineer is unsuitable or undesirable for backfilling in pavement or building areas. Do not allow debris and unsuitable material to accumulate on-site. Dispose of excess materials from the site.

M. Any material exported or imported from or to the Project site shall be hauled from or to a site that has coverage under NPDES or a State Construction General Permit (or Individual Permit). Coverage may either be under a separate Notice, or included in coverage under the Project Notice. If the borrow or waste site has NPDES or State Construction General Permit coverage a copy of the Notice of Intent and Notice of Coverage (or equal) shall be placed in the SWPPP Ledger.

3.02 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Install dewatering systems that will be required to construct the Project. Water pumped out of excavations shall be disposed of onsite, and will not be discharged to the municipal storm drainage system or to surface waters unless approval to do so has been documented in writing by the Contractor.

C. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.03 EXPLOSIVES

A. Explosives: Obtain written permission from authorities having jurisdiction before bringing explosives to Project site. Perform blasting by using explosives on Project site only after receiving written approval from the Owner. .

1. Perform blasting without damaging adjacent structures, property, or site improvements.
2. Perform blasting without weakening the bearing capacity of rock subgrade and with the least-practicable disturbance to rock to remain.
3. Handle, store and use explosives in accordance with the Manual of Accident Prevention in Construction by the Associated General Contractors of America, Inc., 1978 edition.
4. Obtain all required Federal, State and Local permits applicable to the blasting operations.

5. Coordinate with grading Contractor to insure appropriate safety procedures are followed including signage and signaling devices.
6. Drill and blast such that rock will be suitable for use on the site as fill per this specification.

3.04 EXCAVATION, GENERAL

A. General
1. The building limits shall be as identified on the construction drawings. The building subgrade shall be constructed to include a minimum of 10 feet beyond the building limits, or as directed by the Owner;
2. Structures include buildings, footings, foundations, retaining walls, embankment berms for storm water detention basins, slabs, tanks, curbs, mechanical and electrical appurtenances or other man-made stationary features constructed above or below the ground surface;
3. The building pad subgrade shall be prepared in strict accordance with the geotechnical engineering study and these specifications, whichever is more stringent; and,
4. 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. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:
   a. 24 inches (600 mm) outside of concrete forms other than at footings.
   b. 12 inches (300 mm) outside of concrete forms at footings.
   c. 6 inches (150 mm) outside of minimum required dimensions of concrete cast against grade.
   d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
   e. 6 inches (150 mm) beneath bottom of concrete slabs-on-grade.
   f. 12 inches (300 mm) beneath pipe invert elevation in trenches, and 12 inches (300 mm) wider than outside surface of any pipe or conduit.

C. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be classified as earth and rock. Do not excavate rock until it has been classified and cross sectioned by Owner. The Contract Sum will be adjusted for rock excavation according to unit prices included in the Contract Documents. Changes in the Contract Time may be authorized for rock excavation.
1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation.
   a. Intermittent drilling; blasting, if permitted; ram hammering; or ripping of material not classified as rock excavation is earth excavation.
2. Rock excavation includes removal and disposal of rock. Remove rock to lines and subgrade elevations indicated to permit installation of permanent construction without exceeding the following dimensions:
   a. 24 inches (600 mm) outside of concrete forms other than at footings.
   b. 12 inches (300 mm) outside of concrete forms at footings.
   c. 6 inches (150 mm) outside of minimum required dimensions of concrete cast against grade.
   d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
   e. 6 inches (150 mm) beneath bottom of concrete slabs-on-grade.
   f. 12 inches (300 mm) beneath pipe invert elevation in trenches, and 12 inches (300 mm) wider than outside surface of any conduit or pipe.

3.05 EXCAVATION FOR STRUCTURES

A. Where existing grades are above proposed subgrade elevation, excavate materials in the building areas to line and grade as shown in the drawings being careful not to over excavate beyond the elevations needed for building subgrades.
   1. Excavate organic soils from the building area. If approved by Owner, organic soil excavation material may be used in landscaped area.
   2. Excavated on-site soils which meet the requirements of the geotechnical engineer may be used as building area fill.
   3. Unsuitable material, such as wood or any other deleterious materials determined to be unsuitable by the geotechnical engineer for use as on-site fill shall be disposed of off-site in accordance with this specification.

B. Excavate to indicated elevations and dimensions within a tolerance of plus 0 to minus 1/2 inch (12 mm). If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
   1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
   2. Pile Foundations: Per geotechnical engineer.
   3. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch (25 mm). Do not disturb bottom of excavations intended as bearing surfaces.

C. Excavations at Edges of Tree- and Plant-Protection Zones:
   1. Excavate by hand to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
   2. Cut and protect roots according to requirements in Division 01 Section "Temporary Tree and Plant Protection."

3.06 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.07 EXCAVATION FOR UTILITY TRENCHES

A. Contact authorities having jurisdictions and utility companies before excavation begins.

B. Utility alignments are designed to avoid obstructions whenever possible. The Contractor shall immediately notify Owner if unanticipated significant obstructions are encountered during utility installation work.

C. Cut trench banks for safety and remove stones as necessary to avoid point-bearing. All trench excavation side walls shall be sloped, shored, sheeted, braced or otherwise supported by means of sufficient strength to protect the workers within in accordance with the applicable rules and regulations established by the Department of Labor, Occupational Safety and Health Administration (OSHA), and by local codes and regulations. Moveable trench boxes shall not be allowed for HDPE, CMP or spiral ribbed pipes larger than 18” when installed in a trench condition in accordance with current OSHA requirements.

D. Excavate trenches at proper width and depth for laying pipe, conduit or cable and in accordance with utility company and/or manufacturer requirements.
   1. Beyond building perimeter, excavate trenches to allow installation of top of pipe at line, grade and elevation as shown on the Drawings, or at minimum 12 inches below frost line.

E. All trench width requirements for pipe, conduit, or cable shall be the minimum practical width that will allow for proper compaction of backfill, comply with trench and bedding details, and satisfy all safety, municipal and utility company regulations. Excavate trenches to uniform widths to provide the necessary clearance on each side of pipe or conduit.

F. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide uniform bearing and support for each section of pipe at every point along the entire length except where necessary to excavate for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Dig bell holes and depressions

for joints after trench bottom has been graded. Dig no deeper, longer, or wider than needed to make the joint connection properly. Remove projecting stones and sharp objects along trench subgrade.

1. Where foundation material is found to be of poor supporting value or of rock, the Owner's engineer may make minor adjustments in the location of the pipe to provide a more suitable foundation. Where this is not practical, the existing unsuitable material will be removed by undercutting to a depth directed by the geotechnical engineer and backfilling with suitable conditioning material consisting of crushed stone, gravel, or a combination of sand and crushed gravel as approved by the geotechnical engineer. Final selection of suitable conditioning material will be made by the geotechnical engineer.
2. Where foundation material is unacceptable and trench is over-excavated a suitable conditioning material or pipe bedding material will be used as specified by the geotechnical engineer. Bedding material is to be compacted at a minimum of 92% dry density as determined by ASTM D1557, Modified Proctor Test. Place bedding material as specified by geotechnical engineer and as shown on the trenching and bedding details on the Drawings.

G. Blasting: Contractor shall drill and blast so that the rock will be suitable for use on the site as fill. Rock size should not exceed 24 inches and have enough smaller size pieces to create fold free matrix when placed and compacted. Particle velocity from blasting shall not exceed 2 inches per second as measured by a chronograph.

H. Excavated Material: Stockpile excavated material suitable for backfilling in an orderly manner far enough from the trench to avoid overloading the excavation side wall. Remove unsuitable excavated materials from the site. Any abandoned structures, utilities, or debris discovered during construction shall be removed and disposed of, or capped.

I. Utility Installation Depths: Utility installation shall meet the following minimum pipe installation depths, or applicable codes and ordinances, measured from finished grade to the top of the pipe barrel:

1. Water Mains: 42 inches or 12 inches below the frost line whichever is deeper, or as specified on the plans.
2. Sanitary Sewer: As indicated on the drawings, or (36 inches to top of pipe barrel minimum).
3. Storm Drainage (Sewer): Elevations and grades as shown on the drawings, (24 inches minimum)
4. Electrical Conduits: 24 inches, or as required by NEC 300-5, NEC 710-36 codes, or the regulatory authority standard, or utility company standards whichever is deeper.
5. Telephone Conduits: 24 inches, or the regulatory authority standard, or utility company standards whichever is deeper.
6. Landscape Irrigation Piping: See Section 328400 .

J. Laterals: All utilities intended to connect to services within the building shall be extended from the building a distance of five feet in the direction of the utility service and at elevations to connect at those locations shown on the Drawings. All utility ends will be plugged and marked by a 2 inch by 4 inch piece of wood extending from the utility invert to 4 feet above final grade.

K. Trenches in Tree- and Plant-Protection Zones:

1. Hand-excavate to indicated lines cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.

3.08 UNDERCUT EXCAVATION

A. When approved by the Owner and recommended by the geotechnical engineer, the Contractor will be required to remove natural soil materials in areas where fills are to be placed where soil materials are determined to be undesirable. The Contractor shall be required to remove the undesirable material and backfill with approved material. The backfill material shall be compacted per Table 3.16.C.

B. At locations where undesirable material is shown on the drawings or identified in the geotechnical engineering study removal and replacement shall be per the drawings or as directed by the geotechnical engineer or Owner.

C. At locations where soil is wet the Contractor shall provide a “good faith” effort in drying and disking these areas prior to requesting approval for undercut excavation.
D. Where undercut excavation is required adjacent or beneath the location of a proposed drainage structure, undercut excavation and backfill shall extend a sufficient distance adjacent to the installation to prevent future operations from disturbing the completed drainage structure.
E. 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 disposed of by the Contractor as directed by the geotechnical engineer in accordance with 3.10.M of this specification.
F. The Contractor shall conduct undercut operations in such a way that the necessary measurements can be taken before any backfill is placed.
G. Backfill in undercut areas shall be placed as a continuous operation along with undercutting operation, or as recommended by the geotechnical engineer. No backfill material shall be placed in water or in wet conditions unless otherwise recommended by the geotechnical engineer and approved by the Owner.

3.09 SUBGRADE INSPECTION

A. Notify Owner when excavations have reached required subgrade.
B. If Owner determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
C. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons **(13.6 tonnes)** to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
    1. Completely proof-roll subgrade in one direction**,** repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph (5 km/h).
    2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Owner, and replace with compacted backfill or fill as directed.
D. Authorized additional excavation and replacement material will be paid for according to Contract provisions.
E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Owner, without additional compensation.

3.10 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi (17.2 MPa), may be used when recommended by the geotechnical engineer and approved by Owner.
    1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by geotechnical engineer and approved by Owner.

3.11 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
    1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.
    2. Stockpiles shall be surrounded by perimeter sediment control measures and shall be covered with temporary measures to prevent erosion as soon as practical but no longer than 14 days after completion of the pile.

3.12 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:
    1. Construction below finish grade including, where applicable, sub drainage, damp proofing, waterproofing, and perimeter insulation.
    2. Surveying locations of underground utilities for Record Documents.
    3. Testing and inspecting underground utilities.

4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring and bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.13 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Trenches under Footings: Backfill trenches excavated under footings and within **1**8 inches (450 mm) of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Division 03 Section "Cast-in-Place Concrete"

D. Trenches under Roadways: If shown on the Drawings or specified by the geotechnical engineer provide support for piping or conduit less than 30 inches (750 mm) below surface of roadways.

E. Backfill voids with satisfactory soil while removing shoring and bracing.

F. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.

G. Fill around pipes and conduit shall be placed and compacted in accordance with the trenching and bedding details shown on the Drawings. Place and compact initial backfill approved by the geotechnical engineer, to a height not to exceed 8 inches (200 mm) over the pipe or conduit.
   1. Select material shall be used as specified by trenching and bedding details and where required by the geotechnical engineer. Backfill is to be kept free of stones, frozen lumps, chunks of highly plastic clay or other objectionable material.
   2. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
   3. Grade and maintain backfill areas to minimize erosion or saturation will not damage pipe bed or backfill.
   4. Heavy equipment shall not be operated over any pipe until it has been properly backfilled with a minimum of 24 inches of cover. Where any part of the required cover is above the proposed finished grade, the Contractor shall place, maintain and finally remove such material at no cost to the Owner. Pipe which becomes misaligned, shows excessive settlement, or has been otherwise damaged by the Contractor's operations shall be removed and replaced by the Contractor at no cost to the Owner.

H. Place and compact final backfill of satisfactory soil to final subgrade elevation.

I. Install warning tape directly above utilities, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.14 SOIL FILL

A. Fill areas to contours and elevations shown on the Construction Drawings with materials deemed satisfactory, less the topsoil depth as specified in Section 329300.

B. Existing grades below building areas shall be leveled prior to fill placement. Contractor shall remove any existing lawn and topsoil in these areas prior to placement of any fill.

C. All existing grades below building areas shall be proofrolled and compacted per this specification.

D. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

E. Fill shall not be placed:
   1. In areas of standing water, frozen or thawing ground or in areas that have not been approved by the geotechnical engineer.
   2. During unfavorable weather conditions. When work is interrupted by heavy rains fill operations shall not be resumed until all saturated surface soils are returned to satisfactory moisture content as determined by the geotechnical engineer.

F. Place and compact fill material in layers (lifts):
   1. Layers shall be made smooth and free from ruts or indentations at the end of any work day when precipitation is forecasted too prevent saturation of surface fill material. Fill surfaces

shall be graded smooth to drain and sealed with a drum roller at the completion of each work day.

2. Layers (or lifts) shall not exceed 12 inches (300 mm) in depth and shall be compacted systematically to achieve at least 6 passes of the compactor. Larger layer thickness may be approved if broken rock is used and placed at least 6 feet (1.8 m) below grade.
3. Each layer shall be compacted to minimum densities listed in Table 3.16.C and as specified by the geotechnical engineer.

G. Layers (lifts) to required elevations as follows:
1. Under grass and planted areas, use satisfactory soil material.
2. Under walks and pavements, use satisfactory soil material.
3. Under steps and ramps, use engineered fill or fill material approved by geotechnical engineer.
4. Under building slabs, use engineered fill or fill material approved by geotechnical engineer.
5. Under footings and foundations, use engineered fill or fill material approved by geotechnical engineer.

H. Place soilfill on subgrades free of mud, frost, snow, or ice. Wet or saturated material shall be air dried as necessary to achieve field densities specified in this Section. Removal and replacement shall not occur without prior approval of Owner. Removal and replacement shall be used if necessary to facilitate the construction schedule.

I. Contractor shall adjust water content by aeration or adding water to achieve the required density. Assist drying by disking, harrowing or pulverizing until moisture content is reduced to achieve proper compaction and facilitate the construction schedule.

J. Contractor to 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. Surface subgrade after compaction shall be hard, uniform, smooth, and stable and true to grade and cross-section.

3.15 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.16 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 12 inches (300 mm) in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to **ASTM D 698** and **ASTM D 1557**. In areas to receive fill and at the final cut subgrade, proofroll and compact the exposed ground surface following clearing and grubbing and any required excavation with a minimum of 4 passes of an approved compactor and obtain at least the density required in the geotechnical engineering study and as indicated below:

TABLE 3.16.C

Location or Area	Standard Proctor Density ASTM D698 (AASHTO T 99)	Modified Proctor Density ASTM D1557 (AASHTO T 180)	Testing Frequency 1 per lift per
Structures and Walkways	95%	92%	20,000 sf
Retaining Walls	95%	92%	1,000 sf
Trenches	95%	92%	150 lf
Landscape or Unimproved Areas	92%	90%	20,000 sf
Building and Pavement Subgrades (Top 18 inches)	100%	95%	10,000 sf
Building and Pavement Subgrades (Below Top 18 inches)	95%	92%	15,000 sf
Out-Parcels (Below Top 18 inches)	95%	92%	20,000 sf

1. In addition to the above referenced table, proofrolling shall be completed in accordance with Section 3.17 Proofrolling.
2. 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 in Table 3.16.C above.
3. Prior to preparing subgrade in low lying areas perform the following:
   a. Drain standing water by gravity or with a pump. Water should not be discharged directly into a storm drain. Sediment laden water may only be discharged to an approved sediment control measure.
   b. After drainage is complete, remove organic debris, mud, debris and other unsuitable material using equipment and methods that will minimize disturbance to the underlying soils.
   c. Thoroughly compact subgrade as specified in Table 3.16.C.
   d. If proposed for fill, all muck, mud and other materials removed from the low area shall be dried on-site by spreading in thin layers for observation by Owner and geotechnical engineer. If after observation by Owner or geotechnical engineer the material is found to be unsuitable, it shall be removed from the site.

3.17 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 shall be proofrolled. Any areas which deflect, rut or pump under the loaded construction equipment shall be

undercut and replaced with compacted fill material or stone base course as directed by the geotechnical engineer and approved by the Owner, at no additional cost to the Owner.

C. Proofrolling shall be completed with pneumatic tired and loaded 10 wheel tandem-axle dump truck weighing not less than 25 tons (22.6 tonnes) to identify soft pockets and areas of yielding. Other equipment may be used if approved by the geotechnical engineer. Do not proofroll wet or saturated subgrades.

D. Construction methods shall be as follows:
   1. After the subgrade or stone base course has been completed the subgrade or stone base course shall then be proofrolled. The coverage areas and methods will be identified by the geotechnical engineer.
   2. Completely proofroll subgrade in one direction unless otherwise directed by the Owner or geotechnical engineer.
   3. The equipment speed shall be limited to 3 mph (5km/h) such that the geotechnical engineer can comfortably and slowly walk along side the equipment.
   4. If necessary to take corrective action, such as but not limited to under drain installation, undercut and backfill of unsuitable material, and/or aeration of excessively wet materials in areas that have been proofrolled, see Section 3.8. 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, the corrective work and additional proofrolling shall be performed by the contractor at on cost to the Owner.
   5. The contractor shall protect all structural facilities on the project including but not limited to box culverts, pipe culverts, and utilities from damage by the proofrolling equipment.

3.18 GRADING

A. General: Shape to conform to the grades shown on the drawings. Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
   1. Provide a smooth transition between adjacent existing grades and new grades.
   2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
   1. Turf or Unpaved Areas: Plus or minus 1 inch (25 mm).
   2. Walks: 0 to -1/2 inches (13 mm) of the proposed subgrade.
   3. Pavements: 0 to -1/2 inches (13 mm) of the proposed subgrade

C. Grading inside Building Lines: 0 to -1/2 inches (13 mm) of the proposed subgrade when tested with a 50-foot (15-m) grid across the Lowe's building pad/limits.

3.19 BUILDING PAD LIMITS AND PAVED AREA CERTIFICATIONS FOR GEOTECHNICAL ENGINEER AND LAND SURVEYOR

A. The building pad/limits and pave area subgrades shall be satisfactorily proofrolled.

B. The Developer and/or Contractor shall provide the Building Pad/Limits and Paved Area(s) Certification forms for subgrade and stone base. Forms shall be completed in full. Building pad limits and paved area subgrades shall be constructed in accordance with the Drawings and these Specifications. Construction staking methods shall be in accordance with these specifications.

C. Prior to completion of the building pad acceptance report, the Contractor and/or developer shall be required to address all subsurface recommendations identified in the geotechnical engineering study or by the geotechnical engineer retained by the owner.

D. The Owner will not take ownership of the building pad until the pad certification form is received and approved by the Owner. The Building Pad/Limits and Paved Area(s) Certification Forms are attached to this Section.

3.20 SUBSURFACE DRAINAGE

A. Subdrainage Pipe: Specified in Division 33 Section "Subdrainage."

B. Subsurface Drain: Place subsurface drainage geotextile around perimeter of sub drainage trench. Place a 6-inch (150-mm) course of filter material on subsurface drainage geotextile to

support sub drainage pipe. Encase sub drainage pipe in a minimum of 12 inches (300 mm) of filter material, placed in compacted layers 6 inches (150 mm) thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches (150 mm).

1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698.

C. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches (300 mm) of final subgrade, in compacted layers 6 inches (150 mm) thick. Overlay drainage backfill with one layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches (150 mm).

1. Compact each filter material layer if used to 85 percent of maximum dry unit weight according to ASTM D 698.

3.21 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:

1. If shown on the Drawings install geogrid reinforcement of base/subbase and/or subgrade improvements according to manufacturer's written instructions, overlapping sides and ends. Geogrid is to be laid at proper elevation and alignment as shown on the drawings. Granular fill placement over geogrid to be in lifts and compacted as directed to minimize development of wrinkles or movement. At minimum a lift of 6 inches must be placed over geogrid prior to operation of tracked vehicles. Rubber-tired equipment may pass over geogrid reinforcement at slow speeds (less than 10 mph) when integrally-formed geogrids are used. When woven, multilayered or welded-strip geogrids are used, rubber-tired equipment shall not be allowed to pass directly on the geogrid until minimum 6 inch base lift has been installed.
2. If shown on the Drawings install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
3. If subbase course is shown on the Drawings, place base course material over subbase course under hot-mix asphalt pavement.
4. Place in uniform loose depth and without segregation. All stone base delivered to the site shall be spread and rolled by the end of each day.
5. Shape subbase course and base course to required crown elevations and cross-slope grades.
6. Place subbase course and base course 8 inches (200 mm) or less in compacted thickness in a single layer.
7. Place subbase course and base course that exceeds 8 inches (200 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 4 inches (100 mm) thick.
8. Each layer of material shall have been sampled, tested, compacted, and approved prior to placing succeeding layers of subbase course, base course material or pavement.
9. Contractor shall utilize methods of handling, hauling, and placing which will minimize segregation and contamination. Aggregate which is contaminated with foreign materials shall be rejected and removed and replaced by the Contractor at no additional cost to the Owner.

C. Pavement Shoulders: Place shoulders along edges of subbase course and base course to prevent lateral movement. Construct shoulders, at least 12 inches (300 mm) wide, of satisfactory soil materials and compact simultaneously with each subbase and base layer to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

D. Compaction:

1. Compact each layer of subbase course and/or base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 98 percent of maximum dry unit weight according to Modified Proctor density ASTM D 1557.
2. Subbase course and base course shall be compacted at the optimum moisture content as determined by the geotechnical engineer and approved by the Owner. The Contractor shall dry or add moisture to materials when required to provide a uniformly compacted and acceptable subbase or base.

3. Final layer of material shall be shaped to conform to the lines, grades and typical sections as shown on the drawings or as established by the engineer. When compacted, the base course shall be smooth, hard, dense, unyielding, and well bonded.

E. Quality Control:
   1. Thickness of the base course shall be within a tolerance of plus or minus ½ inch of the required thickness as specified on the drawings for building pad and pavement areas.
   2. The elevation of the base course within the building limits shall be within a tolerance of 0 to ½ inch. All other areas shall be within a tolerance of plus or minus 0.10 feet.
   3. The Contractor shall be required to repair any areas which do not conform to this tolerance or specification. Any repairs required shall be at no cost to the Owner, and shall meet these specifications.
   4. The developer and/or Contractor shall provide Lowe's Building Pad/Limits and Paved Area(s) Certifications for stone base which are located at the end of this section.

3.22 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

A. Place drainage course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
   1. Install sub drainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
   2. Place drainage course 6 inches (150 mm) or less in compacted thickness in a single layer.
   3. Place drainage course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.

3.23 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified geotechnical engineer to perform the following special inspections:
   1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
   2. Determine that fill material and maximum lift thickness comply with requirements.
   3. Determine, at the required frequency, that in-place density of compacted fill complies with requirements.

B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

D. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Owner.

E. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the locations and frequencies shown in Table 3.16.C:

F. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.24 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Owner; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
   1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.
   2. Correction of subgrade after compaction shall be hard, uniform, smooth, and stable and true to grade and cross-section.

3.25 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

B. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Owner.
   1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 312000

BUILDING PAD/LIMITS CERTIFICATION FORM

Project	
Date	
Geotech. Engineer	
Surveyor	
Grading Contractor	
Const. Mgr.	

□ **SUBGRADE**

□ **STONE BASE**

GEOTECHNICAL ENGINEERING CERTIFICATION

I certify that the building pad/limits for the above referenced project, has been constructed in accordance with the Geotechnical Investigation prepared by _____ dated, _____, and Project Specifications, dated _____.

All earth cut and fills have been installed competently, properly and have been compacted under the supervision of the below certifying Geotechnical Engineer. The building pad/limits has been acceptably prepared to support the proposed construction. A final report containing a description of the grading work, on-site recommendations and the results of testing and inspections has been prepared and is dated _____.

Geotechnical Engineer (signature) _____ Date _____

Registration No._____ Expiration Date _____

Affix Seal Here (not valid unless sealed)

ELEVATION CERTIFICATION

I certify to the satisfactory completion of the grading for the building pad/limits in accordance with the approved drawings and specifications engineered by_____. All as-built subgrade elevations have been taken on a 50' grid across the Project building pad/limits and are within the tolerance of 0 to –1/2 inches of the proposed subgrade elevation as required by the Project Specifications.

Finished Floor Elevation _____ Date _____

Surveyor (signature) _____ Expiration Date _____

Registration No. _____ Affix Seal Here (not valid unless sealed)

GRADING CONTRACTOR VERIFICATION

I verify to the satisfactory completion of grading for the building pad/limits in accordance with the approved Grading Drawings and Project Specifications.

Contractor (signature) _____ Date _____

PAVED AREA(S) CERTIFICATION FORM

Project	
Date	
Geotech. Engineer	
Surveyor	
Grading Contractor	
Const. Mgr.	

☐ **SUBGRADE**

☐ **STONE BASE**

GEOTECHNICAL ENGINEERING CERTIFICATION

I certify that the paved area, located at _____, for the above referenced project, has been constructed in accordance with the Geotechnical Investigation prepared by _____ dated, _____, and Project Specifications, dated _____.

All earth cut and fills have been installed competently, properly and have been compacted under the supervision of the below certifying Geotechnical Engineer. The paved area has been acceptably prepared to support the proposed construction. A final report containing a description of the grading work, on-site recommendations and the results of testing and inspections has been prepared and is dated _____.

Geotechnical Engineer (signature) _____ Date _____

Registration No._____ Expiration Date _____

Affix Seal Here (not valid unless sealed)

ELEVATION CERTIFICATION

I certify to the satisfactory completion of the grading for the paved area in accordance with the approved drawings and specifications engineered by_____. All as-built subgrade elevations have been taken on a 50' grid across the paved areas and are within the tolerance of 0 to –1/2 inches of the proposed subgrade elevation as required by the Project Specifications.

Date _____

Surveyor (signature) _____ Expiration Date _____

Registration No. _____ Affix Seal Here (not valid unless sealed)

GRADING CONTRACTOR VERIFICATION

I verify to the satisfactory completion of grading for the paved areas in accordance with the approved Grading Drawings and Project Specifications.

Contractor (signature) _____ Date _____

SECTION 31 31 16

TERMITE CONTROL

PART 1- **GENERAL**

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following for termite control:
   1. Soil treatment.

1.03 DEFINITIONS

A. EPA: Environmental Protection Agency.
B. PCO: Pest control operator.

1.04 SUBMITTALS

A. The General Contractor and the Sub-contractor must execute the provided Conformance Submittal for each product specified.
B. Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's record information, including the following as applicable:
   1. Date and time of application.
   2. Moisture content of soil before application.
   3. Brand name and manufacturer of termiticide.
   4. Quantity of undiluted termiticide used.
   5. Dilutions, methods, volumes, and rates of application used.
   6. Areas of application.
   7. Water source for application.
C. Warranties: Warranties specified in this Section.

1.05 QUALITY ASSURANCE

A. Applicator Qualifications: A PCO who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment in jurisdiction where Project is located and who is experienced and has completed termite control treatment similar to that indicated for this Project and whose work has a record of successful in-service performance.
B. Applicator Qualifications: A PCO who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment in jurisdiction where Project is located and who is an experienced installer who employs workers trained and approved by bait station system manufacturer to install manufacturer's products.
C. Regulatory Requirements: Formulate and apply termiticides, and label with a Federal registration number, to comply with EPA regulations and authorities having jurisdiction.

1.06 PROJECT CONDITIONS

A. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with EPA-Registered Label requirements and requirements of authorities having jurisdiction.

1.07 COORDINATION

A. Coordinate soil treatment application with excavating, filling, and grading and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs, before construction.

1.08 WARRANTY

A. General Warranty: The warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty: Written warranty for five years from date of Substantial Completion, signed by applicator and Contractor certifying that termite control work, consisting of applied soil termiticide treatment, will prevent infestation of subterranean termites. If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.

1.09 MAINTENANCE SERVICE

A. Continuing Service: Provide a proposal for continuing service, including monitoring, inspection, and retreatment for occurrences of termite activity, from applicator to Owner, in the form of a standard yearly (or other period) continuing service agreement, starting on the date of Substantial Completion. State services, obligations, conditions, and terms for agreement period and for future renewal options.

PART 2- **PRODUCTS**

2.01 SOIL TREATMENT

A. Termiticide: Provide an EPA-registered termiticide complying with requirements of authorities having jurisdiction, in a soluble or emulsible, concentrated formulation that dilutes with water or foaming agent, and formulated to prevent termite infestation. Use only soil treatment solutions that are not harmful to plants. Provide quantity required for application at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to the product's EPA-Registered Label.

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

C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. BASF Corporation.
   2. Bayer Corporation.
   3. Dow AgroSciences.
   4. FMC Corporation.
   5. Syngenta.

PART 3- **EXECUTION**

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of the soil, interfaces with earthwork, slab and foundation work, landscaping, and other conditions affecting performance of termite control. Proceed with application only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's written instructions for preparing substrate. Remove all extraneous sources of wood cellulose and other edible materials such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil and around foundations.

B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated, except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended by termiticide manufacturer.

C. Fit filling hose connected to water source at the site with a backflow preventer, complying with

requirements of authorities having jurisdiction.

3.03 APPLICATION, GENERAL

A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's EPA-Registered Label for products.

3.04 APPLYING SOIL TREATMENT

A. Application: Mix soil treatment termiticide solution to a uniform consistency. Provide quantity required for application at the label volume and rate for the maximum specified concentration of termiticide, according to manufacturer's EPA-Registered Label, to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction. Distribute the treatment evenly.
   1. Slabs-on-Grade and Basement Slabs: Under ground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
   2. Foundations: Adjacent soil including soil along entire inside perimeter of foundation walls, along both sides of interior partition walls, around plumbing pipes and electric conduit penetrating slab, and around interior column footers, piers, and along entire outside perimeter, from grade to bottom of footing. Avoid soil washout around footings.
   3. Penetrations: At expansion joints, control joints, and areas where slabs will be penetrated.

B. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.

C. Protect termiticide solution, dispersed in treated soils and fills, from being diluted until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.

D. Post warning signs in areas of application.

E. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

END OF SECTION 313116

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CONFORMANCE SUBMITTAL
Section 313116 – Termite Control

Project Location _____
(*City, State*)

General Contractor: _____
(*Company Name, Phone Number*)

_____
(*Address*)

Sub-Contractor: _____
(*Company Name, Phone Number*)

_____
(*Address*)

The following product has been selected (check one box) for use in this project from the list of acceptable products specified:

☐ BASF Corporation.

☐ Bayer Corporation.

☐ Dow AgroSciences.

☐ FMC Corporation.

☐ Syngenta.

I represent to the owner that the product selected will be installed in compliance with the applicable codes for the authorities having jurisdiction and in accordance with the project specification. If noncompliance is discovered the General Contractor shall make or cause to be made all necessary corrections to meet the applicable codes and specifications. Immediately or as directed by the owner, the work shall be completed without additional cost to the Owner and / or the contract.
General Contractor:

_____
(*Signature of the Authorized Agent of the General Contractor*)

_____
(*Print Name of the Authorized Agent of the General Contractor*)

I represent to the owner that the product selected will be installed in compliance with the applicable codes for the authorities having jurisdiction and in accordance with the project specification. If noncompliance is discovered the General Contractor shall make or cause to be made all necessary corrections to meet the applicable codes and specifications. Immediately or as directed by the owner, the work shall be completed without additional cost to the Owner and / or the contract.
Sub-Contractor:

_____
(*Signature of the Authorized Agent of the Sub-Contractor*)

_____
(*Print Name of the Authorized Agent of the Sub-Contractor*)

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SECTION 32 12 16

ASPHALT PAVING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Cold milling of existing hot-mix asphalt pavement.
   2. Hot-mix asphalt patching.
   3. Hot-mix asphalt paving.
   4. Hot-mix asphalt paving overlay.
   5. Asphalt surface treatments.
   6. Pavement-marking paint.
   7. Imprinted asphalt.

B. Related Sections:
   1. Division 02 Section “Structure Demolition" for demolition, removal, and recycling of existing asphalt pavements, and for geotextiles that are not embedded within courses of asphalt paving.
   2. Division 31 Section "Earth Moving" for aggregate subbase and base courses and for aggregate pavement shoulders.
   3. Division 32 Sections for other paving installed as part of crosswalks in asphalt pavement areas.
   4. Division 32 Section "Concrete Paving Joint Sealants" for joint sealants and fillers at paving terminations.

1.03 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials (AASHTO)
   1. M140 - Standard Specification for Emulsified Asphalt Nineteenth Edition; Revised Per Interim Specifications - Specifications - 1999 R(1998)
   2. M226 -Standard Specification for Viscosity Graded Asphalt Cement Nineteenth Edition R(1996)
   3. T245 - Standard Method of Test for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus Nineteenth Edition; ASTM D1559-76
   4. PP46-01 – Recommended Practice for Geosynthetic Reinforcement of the Aggregate Base Course of Flexible Pavement Structures, April 2001 Interim Edition of the AASHTO Provisional Standards.

B. American Society for Testing and Materials (ASTM)
   1. D1559 – Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus.
   2. D2041 - Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
   3. D2171 – Standard Test Method for Viscosity of Asphalts by Vacuum Capillary Viscometer (RAP Asphalt Mixes)
   4. D1388-96 – Standard Test Method for Stiffness of Fabrics, Option A
   5. D3786 – Standard Test method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics
   6. D4355 – Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water
   7. D4439 – Terminology for Geotextiles
   8. D4873 – Guide for Identification, Storage, and Handling of Geotextiles
   9. D6637-01 – Standard Test Method for Determining Tensile Properties of Geogrids by the Single or Multi-rib Tensile Method

10. D4354-96 – Practice for Sampling of Geosynthetics for Testing
11. D4759-92 – Practice for Determining the Specification Conformance of Geosynthetics
12. D5818-95 – Practice for Obtaining Samples of Geosynthetics from a Test Section for Assessment of Installation Damage
13. ASTM D-140 Standard Practice for Sampling of Bituminous Materials
14. ASTM D-449 Asphalt Used in Damp-proofing and Waterproofing, Type II and III
15. ASTM D-2939 Standard Test Methods Emulsion Bitumen's Use as Protective Coatings
16. ASTM D-3405 Joint Sealant Hot-Applied for Concrete and Asphalt Pavement
17. ASTM D-3320 Emulsified Coal Tar Pitch (Mineral Colloid Type)
18. ASTM D-3910 Design, Testing and Construction of Slurry Seal

C. Asphalt Institute (AI)
1. MS-2 – Mix Design Method for Asphalt Concrete and Other Hot Mix Types
2. MS-22 – Principles of Construction of Hot-Mix Asphalt Pavement, Addendum

1.04 DEFINITIONS

A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

B. Geosynthetics:
1. Geogrid: A biaxial polymeric grid formed by a regular network of integrally connected tensile elements with apertures of sufficient size to allow interlocking with the surrounding soil, rock, or earth to function primarily as reinforcement.
2. Non-woven Geotextile: An interlayer (paving fabric) used above fatigued asphalt or binder layer and beneath asphalt pavement overlay to provide a permanent moisture barrier and to retard reflective cracking.
3. Woven Geogrid: A geogrid product formed by weaving discrete strips of polymer into a network. These geogrids usually require a protective coating to protect the polymer from premature degradation.
4. Welded Strip Geogrid: A geogrid product formed by heat bonding (welding) discrete strips of polymer into a network.
5. Average Roll Value: Minimum Average Roll Value (MARV) is property value calculated as typical minus two standard deviations.

1.05 SUBMITTALS

A. Product Data: Contractor to submit mix design using either of the two methods below for each pavement course and each type of product indicated. Mix design data submittal shall be submitted to the Owner for review and approval 45 days prior to schedule production and paving of the mix design.
1. "Marshal Stability": Marshal Stability design mix submittals shall include type and name of mix, gradation analysis, grade of asphalt cement, Marshall Stability in pounds flow, effective asphalt content in percent (%), and corresponding copies of covering State Department of Transportation material specifications or regulatory authorities having jurisdiction for each proposed material.
2. "Superpave": Superpave design mix submittals may be submitted in lieu of a "Marshall Stability" design mix, meeting the specifications of the governing State Department of Transportation or regulatory authorities having jurisdiction.

B. Material Certificates: Contractor shall submit product data statement (at end of this Section) stating that asphalt mix to be supplied complies with the specifications of the governing State Department of Transportation or regulatory authority having jurisdiction, as well as copies of the regulatory specifications corresponding to the asphalt mix formula and material. The Conformance Submittal shall be signed by the asphalt mix producer and the Contractor.

C. Samples for Verification: For the following products (if used on the project), in manufacturer's standard sizes unless otherwise indicated:
1. Each paving fabric, 12 by 12 inches (300 by 300 mm) minimum.
2. Each pattern and color of imprinted asphalt.

D. Cutting and Patching Proposal: Where asphalt cutting and patching is necessary to complete the work, the Contractor shall submit a proposal describing procedures to be followed at least 10 days prior to the time cutting and patching will be performed. The Contractor shall not proceed

with cutting and patching work until authorized by the Owner to proceed. The Cutting and Patching Proposal will include:

1. Extent of cutting and patching including how it will be performed and why it can not be avoided.
2. Changes to existing construction describing anticipated results including a description of any changes to structural elements, operating components, changes in building appearance and other significant visual elements.
3. List of products to be used and firms or entities that will perform the work.
4. Dates when cutting and patching will be performed.
5. List of utilities that will or could be affected, list of utilities that will be relocated, and a list of utilities that will be temporarily out of service. If existing utilities will be out of service provide length of time service will be disrupted.
6. Indicate if cutting and patching will involve adding reinforcement to structural elements and provide details necessary to integrate reinforcement with the original structure.
7. Owner's approval must be received prior to proceeding with the work. Owner approval does not waive its right to later require removal and replacement of unsatisfactory work.

E. Asphalt Seal Coat: Submit materials certificate to the Owner's engineer which is signed by the Contractor, certifying that materials comply with, or exceed the requirements herein.

F. Geotextiles:

1. Submit product data sheet and certification from the Manufacturer that the geotextile or geogrid product supplied meets the requirements of this Section. Manufacturer's certificate to include statement that furnished geotextile meets MARV requirements of the specification.
2. Manufacturing Quality Control test results shall be provided upon request.
3. Submit Manufacturer's installation instructions and general recommendations

G. Qualification Data: For qualified manufacturer and Installer.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by authorities having jurisdiction or the DOT of state in which Project is located.

B. Installer Qualifications: Imprinted-asphalt manufacturer's authorized installer who is trained and approved for installation of imprinted asphalt if required for this Project.

C. Comply with Asphalt Institute Manual MS-22, "Construction of Hot Mix Asphalt Pavements", unless more stringent requirements are indicated.

D. Geosynthetics:

1. Pre-Construction Conference: Prior to installation of any pavement overlay geotextile system, the Contractor shall arrange a meeting at the site with the geotextile material supplier and, where applicable the geotextile installer. The Owner and the Engineer shall be notified at least three days in advance of the time of the meeting. A representative of the supplier shall be available on an "as-needed" basis during construction.
2. Sampling and Testing: Sampling and testing to verify conformance with specification in accordance with ASTM D 4354.
3. Acceptance: Shall be in accordance with ASTM D 4759 based on testing of either conformance submittal using Procedure A of ASTM D 4354 or based on manufacturer's certifications and testing of quality control samples obtained using Procedure B of ASTM D 4354.
4. Sewn Seams (if required): Field sewn or factory sewn samples shall be submitted to Engineer for approval prior to installation. Submit 6 foot (2 meter) length of sewn seam for approval.

E. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.

F. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of the regulatory authority having jurisdiction and State Department of Transportation for asphalt paving work.

G. Cutting and Patching: The Contractor shall perform all cutting, fitting or patching that may be required to complete the work or to make its several parts fit together properly. The Contractor shall not damage or endanger any portion of the work or the work of the Owner or any separate contractors by cutting, patching or otherwise altering any work, or by excavation. The contractor shall not cut or otherwise alter the work of the Owner or any separate contractor except with the

written consent of the Owner and the separate contractor. The Contractor shall not unreasonably withhold from the Owner or any separate contractor his consent to cutting or other altering the work.

H. Cutting and Patching: Cutting and patching activities shall not:
   1. Change load caring capacity or load-deflection ratio of structural elements
   2. Reduce the capacity of operational elements to perform as intended or increase required maintenance or decrease operational life or safety.
   3. Reduces the buildings aesthetic qualities (as determined by the Owner). Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
   4. If possible retain original installer or fabricator to cut and patch work described. If original installer or fabricator is not available, engage another recognized, experienced and specialized firm to do the work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.

B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

C. Geotextiles:
   1. Labeling, shipment and storage shall follow ASTM D 4873.
   2. Product labels shall clearly show the manufacturer or supplier name, style name and roll number.
   3. Each shipping document shall include a notation certifying that the material is in accordance with the manufacturer’s certificate.
   4. Each geotextile roll shall be wrapped with a material that will protect the geotextile from damage to shipment, water, sunlight, and contaminates. Protective wrapping shall be maintained during shipment and storage. If wrapping is damaged prior to installation, outer wrap of geotextile shall be removed and discarded prior to installation.
   5. During storage rolls to be elevated above ground and adequately protected from construction damage, extended exposure to ultraviolet radiation, precipitation, chemicals, flames, sparks, temperatures below -20 deg C (-29 deg C) or in excess of 71 deg C (160 deg F) and any other environmental condition that might damage the product.

1.08 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if sub-grade is wet or excessively damp, during rainy weather, if rain is imminent or expected before time required for adequate cure, if the sub-grade or base course is frozen or if the air temperature, measured in the shade away from artificial heat at the location of the paving operations does not meet:
   1. Prime Coat: Minimum ambient temperature in the shade has been 40 degrees F for at least 12 hours immediately prior to application.
   2. Tack Coat: Minimum ambient temperature in the shade has been 40 degrees F for at least 12 hours immediately prior to application or minimum.
   3. Asphalt Base Course: Minimum surface temperature of 35 deg F and rising at time of placement.
   4. Asphalt Binder (Intermediate) Course: Minimum surface temperature of 40 deg F and rising at the time of placement.
   5. Asphalt Surface Course: Minimum surface temperature of 50 deg F (15.6 deg C) at time of placement.

B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F (4.4 deg C) for oil-based materials, and 55 deg F (12.8 deg C) for water-based materials, and not exceeding 95 deg F (35 deg C).

C. Imprinted Asphalt Paving (If Used on Project): Proceed with coating imprinted pavement only when air temperature is at least 50 deg F (10 deg C) and rising and will not drop below 50 deg F (10 deg C) within 8 hours of coating application. Proceed only if no precipitation is expected within two hours after applying the final layer of coating.

PART 2 - PRODUCTS

2.01 AGGREGATES

A. General: Use materials and gradations that have performed satisfactorily in previous installations.

B. Coarse Aggregate: ASTM D 692, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.

C. Fine Aggregate: AASHTO M 29, sharp-edged natural sand or sand prepared from stone, gravel, or combinations thereof.

2.02 ASPHALT MATERIALS

A. Asphalt Binder: AASHTO M 320 or AASHTO MP 1a, performance grade as specified by local authorities having jurisdiction or state department of transportation.

B. Asphalt Cement: Type and grade of asphalt cement for the paving mixture shall comply with the applicable requirements of AASHTO M 226, Table 2, and meeting governing DOT specifications.

C. Prime Coat: Emulsified asphalt applications shall meet the requirements of AASHTO M 140 and the governing DOT specifications.

D. Tack Coat: Emulsified asphalt applications shall meet the requirements of AASHTO M 140 and the governing DOT specifications.

E. Hot Mix Asphalt: Unless otherwise noted on the drawings, the design mix shall have the minimum stability base in accordance with AASHTO T245 or ASTM D 1559 and as specified by the State Department of Transportation in which the Project is located.

F. Reclaimed Asphalt Pavement (RAP): May be utilized as approved by the Owner. No more than 25% (total mixture) of RAP material shall be utilized in proposed mixes and shall meet the governing State Department of Transportation specifications. The origin of the RAP material shall be clearly identified to the owner prior to approval, including the RAP percentage identified in the pavement mix de4sign submittal. RAP material shall be free of contamination, including dirt, debris, concrete, clean stone, and other pollutants.

G. Water: Potable.

H. Undersealing Asphalt: ASTM D 3141, pumping consistency.

I. Asphalt Seal Coat Equipment:

1. Self-propelled squeegee equipment shall have at least two squeegee or brush devices (one behind the other) to assure adequate distribution and penetration of sealer into the bituminous pavement. Equipment shall have continuous agitation or mixing capabilities to maintain homogenous consistency of pavement sealer mixture throughout the application process.
2. Pressurized spray application equipment shall be capable of spraying pavement sealer with sand added. Equipment shall have continuous agitation or mixing capabilities to maintain homogenous consistency of pavement sealer mixture throughout the application process.
3. Hand squeegee and brushes shall be acceptable only in areas where practicality prohibits the use of mechanized equipment.

J. Asphalt Seal Coat: Shall be as per the requirement of the regulatory authority having jurisdiction or as approved by the Owner.

1. SealMaster Polymer Modified Coal Tar Sealer (PMCTS) with the following specifications:
   a. Material shall be homogeneous and show no separation or coagulation that cannot be overcome by moderate stirring.
   b. Non Volates: 40%
   c. Ash Non Volates: 35 - 40%
   d. Solubility of non Volitates in CS2%: 20 min.
   e. Specific Gravity: 25C – 1.18 Min.
   f. Drying Time: 8 hours max. (Typically less than 60 min.)
   g. Adhesion and Resistance to Water: No penetration or loss of adhesion
   h. Resistance to Heat: No blistering or sagging
   i. Flexibility: No cracking or flaking
   j. Resistance to Impact: No chipping, flaking or cracking
   k. Resistance to Volatilization: 10% loss in weight maximum
   l. Wet Film Continuity: Smooth non-granular free from course particles

2. Sealmaster Polymer Modified MasteSeal (PMM) to be used in AK, CA, AZ and NM only, with the following specifications:
    a. Material shall be homogeneous and show no separation or coagulation that cannot be overcome by moderate stirring.
    b. Non Volates: 43% - 47%
    c. Ash Non Volates: 42% - 52%
    d. Solubility of non Volitates in CS2%: 20 min.
    e. Specific Gravity: 25C – 1.15 – 1.25
    f. Drying Time: 8 hours max.
    g. Adhesion and Resistance to Water: No penetration or loss of adhesion
    h. Resistance to Heat: No blistering or sagging
    i. Flexibility: No cracking or flaking
    j. Resistance to Impact: No chipping, flaking or cracking
    k. Resistance to Volatilization: 10% loss in weight maximum
    l. Wet Film Continuity: Smooth non-granular free from course particles

3. Oil Spot Treatment: SealMaster PetroSeal or prep seal oil sot primer as specified by the manufacturer for pavement sealer.
4. Aggregate or sand as required and specified by the manufacturer.
5. Silica Sand: 400 meeting 40 to 60 fineness rating (AFS) .Black Beauty Slag Sand (with comparable sieve rating) may be substituted when silica sand is not available.
6. Polymer Additive (optional).
7. Fortifier
    a. Water based epoxy-latex additive, 3%, designed as a fortifier for refined coal tar emulsions to increase resistance to power steering marks, fuel and chemical effects and to assist in fast drying of the coating is acceptable.
    b. Thickeners are not permitted.

2.03 AUXILIARY MATERIALS

A. Herbicide: Commercial chemical for weed control, registered by the EPA. Provide in granular, liquid, or wettable powder form.

B. Sand: ASTM D 1073 or AASHTO M 29, Grade Nos. 2 or 3.

C. Paving Geotextile: AASHTO M 288, nonwoven polypropylene; resistant to chemical attack, rot, and mildew; and specifically designed for paving applications.
    1. Minimum Average Roll Values:
        a. Grab Tensile Strength: ASTM D 4632, Type I 90 lbs (400 N), Type II 120 lbs (530 N)
        b. Grab Elongation: ASTM D 4632, Type I & II 50%
        c. Mullen Burst: ASTM D 3786, Type I 180 psi (1240 kPa), Type II 230 psi (1580 kPa)
        d. Mass Per Unit Area: ASTM D 5261, Type I 3.6 oz/syd (122 g/sm), Type II 4.6 oz/syd (156 g/sm)
        e. Asphalt Retention: ASTM D 6140, Type I 0.20 gal/syd (.9 L/sqm), Type II 0.24 gal/syd (1.1 L/sqm)
        f. Melting Point: ASTM D 276 Type I & II 320 deg F (160 deg C)
        g. UV Resistance: ASTM D 4355, Type I & II 70% at 150 hours.
    2. Tack Coat: Sealant material used to impregnate and seal the geotextile as well as bond it to both the base pavement and overlay shall be a paving grade asphalt recommended by the geotextile manufacturer and approved by the Engineer. Emulsions that contain solvents shall not be used. The grade of asphalt cement specified for hot-mix design in each geographic location is generally the most acceptable material.

D. Joint Sealant: ASTM D 6690 or AASHTO M 324, Type I, hot-applied, single-component, polymer-modified bituminous sealant.

E. Pavement-Marking Paint: Alkyd-resin type, lead and chromate free, ready mixed, complying with AASHTO M 248.
    1. Color: White (on asphalt paving).
    2. Materials:

a. **Sherwin Williams Setfast Non- leaded Chlorinated Rubber -** White on asphalt (TM5126), yellow on concrete (TM5127), or as indicated on the drawing(s) is preferred.
b. **Sherwin Williams "Setfast Acrylic Waterborne Traffic Marking Paint"** – White on asphalt (TM226, yellow on concrete (TM225), or as indicated on the drawing(s)
c. **Valspar Enterprise Latex Traffic Marking Paint** - White on asphalt (#2540), yellow on concrete (#2541), or as indicated on the drawing(s).
d. **PPG (Pittsburg Paints)"SEEDHIDE® Traffic and Zone Marking Flat Latex" –** White on asphalt (11-23), yellow on concrete, or as indicated on the drawing(s).

3. Execution
   a. Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 50 degrees F not exceeding 90 degrees F and relative humidity at a maximum of 85%.
   b. Surface shall be clean and free of dirt, grease, oil, or other contaminants which could interfere with adhesion.
   c. Apply paint material at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils and dry film thickness of 10 mils per coat.
   d. Paint to be applied in 2 coats using a template or striping machine. Stripes shall be a minimum width of 4 inches unless otherwise noted on the Drawings.
4. Temporary Pavement Markings
   a. Temporary paint shall be applied in accordance with permanent pavement marking specifications however only one (1) coat of paint shall be required. The contractor may use a temporary removable pavement marking tape only as approved in writing by the Owner. Tape that has become damaged and is no longer serviceable shall be replaced without additional compensation.
   b. All temporary markings shall be removed when no longer required. Any pavement area that has been determined to be damaged as a result of the removal operation shall be repaired at no additional cost to the Owner.
5. Pavement Marking Removal
   a. A motorized abrasive device shall be utilized to remove existing markings. Existing pavement marking lines and symbols that are to be removed shall be accomplished such that material or structural damage to the surface or texture of the pavement is avoided. The Contractor shall repair any damage to the pavement at no expense to the Owner. After removal, the pavement shall be in a condition that will not mislead or misdirect customers or motorists. Pavement marking removal within public rights of way shall be completed in accordance with the regulatory authority having jurisdiction and the Drawings and Specifications.

F. Wheel Stops: Precast, air-entrained concrete, 2500-psi (17.2-MPa) minimum compressive strength, 6 inches (150 mm) high by 6 inches (150 mm) wide by 72 inches (1800 mm) long. Provide chamfered corners, drainage slots on underside, and holes for anchoring to substrate.
   1. Dowels: Galvanized steel, 3/4-inch (19-mm) diameter, 12-inch (300-mm) minimum length. Or #4 bars 12-inch (300 mm) minimum.

2.04 IMPRINTED ASPHALT MATERIALS (When Used on the Project)

A. Templates: Imprinted-asphalt manufacturer's standard flexible templates for imprinting pattern into hot asphalt paving.
   1. Pattern: As indicated on the Drawings.

B. Coating System: Imprinted-asphalt manufacturer's standard system formulated for exterior application on asphalt paving surfaces.

2.05 MIXES

A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes as indicated on the Drawings and approved by authorities having jurisdiction and the State Department of Transportation where the project is located**;** designed according to procedures in AI MS-2, "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types";. and complying with the following requirements:
   1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to begin paving.

B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
   1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph (5 km/h).
   2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes).
   3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

C. Proceed with paving only after unsatisfactory conditions have been corrected.

D. Verify that utilities, traffic loop detectors, and other items requiring a cut and installation beneath the asphalt surface have been completed and that asphalt surface has been repaired flush with adjacent asphalt prior to beginning installation of imprinted asphalt.

E. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed. Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.02 COLD MILLING

A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.
   1. Milling of existing asphalt pavement shall be at the depth and location as indicated on the Construction Drawings or as directed by the Owner.
   2. Mill to a uniform finished surface free of excessive gouges, grooves, and ridges. The milled pavement surface shall be thoroughly cleaned of all loose aggregate particles, dust, and other objectionable material by the use of power brooms, power blowers and power vacuums and other means.
   3. Control rate of milling to prevent tearing of existing asphalt course.
   4. Repair or replace curbs, manholes, and other construction damaged during cold milling. Contractor shall coordinate any adjustment of manholes, meter boxes, drainage inlets, valve boxes, and other utilities affected by the milling operations.
   5. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
   6. All milled material shall become the property of the Contractor and shall be disposed of off-site or used in conformance with Section 312000) or for utilization as Reclaimed Asphalt Pavement in conformance with this specification and only as approved by the Owner.

3.03 CUTTING AND PATCHING

A. Preparation: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that might be exposed during cutting and patching operations.

B. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at earliest feasible time, and complete without delay.

C. Cutting: Cut existing construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to the original condition.
   1. Cut existing construction by sawing, drilling, breaking, chipping, grinding and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original installer and comply with original installer's written recommendations.
      a. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size

required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.

b. Existing Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.

c. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.

d. Excavating and Backfilling: Comply with requirements in applicable Specification Sections where required by cutting and patching operations.

e. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.

f. Proceed with patching after construction operations requiring cutting are complete.

D. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of the other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified below:

E. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches (300 mm) into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Re-compact existing unbound-aggregate base course to form new sub-grade.

F. Surface Preparation: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepare substrate surface is ready to receive paving. Sweep loose granular particles from surface of un-bound aggregate base course.

G. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

H. Patching: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces. Restore exposed finished of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

3.04 REPAIRS

A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch (25 mm) in existing pavements.

1. Install leveling wedges in compacted lifts not exceeding 3 inches (75 mm) thick.

B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4 inch (6 mm).

1. Clean cracks and joints in existing hot-mix asphalt pavement.
2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch (6 mm) wide. Fill flush with surface of existing pavement and remove excess.
3. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch (6 mm) wide. Fill flush with surface of existing pavement and remove excess.

3.05 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces by use of power blower or mechanical sweeping equipment.. Ensure that prepared sub-grade is ready to receive paving.

1. Surface hairline cracks up to ½ inch must be filled with crack filler; cracks larger than ½ inch must be cleaned and filled with elastomeric emulsion crack filler.
2. When using a high performance crack sealant, please note on proposal.
3. Potholes, alligator cracks, and similar surface defects must be cut out and repaired.

B. Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.20 gal./sq. yd. Apply enough material to penetrate and seal but not flood surface. Allow prime coat to cure.

1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
2. Protect primed substrate from damage until ready to receive paving.

C. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).
1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
3. Adequate traffic control shall be provided to prohibit traffic from traversing applied area.

3.06 PAVING GEOTEXTILE INSTALLATION

A. Preparation:
1. Washed concrete sand may be spread over an asphalt-saturated geotextile to facilitate movement of equipment during construction or to prevent tearing or delaminating of the geotextile. Hot-mix broadcast in front of construction vehicle tires may also serve this purpose. If sand is applied, excess quantities shall be removed from the geotextile prior to placing the surface course.
2. Sand is not usually required. However, ambient temperatures are occasionally sufficiently height to cause bleed-through of the asphalt sealant resulting in undesirable geotextile adhesion to construction vehicle tires.
3. Neither the asphalt sealant nor the geotextile shall be placed when weather conditions, in the opinion of the Owner or Engineer are not suitable. Air and pavement temperatures shall be sufficient to allow the asphalt sealant to hold the geotextile in place. For asphalt cements air temperature shall be at least 10 deg C (50 deg F) and rising. For asphalt emulsions air temperature shall be 15 deg C (60 deg F) and rising.
4. The surface shall be free of dirt, water, vegetation or other debris.

B. Installation of Tack Coat:
1. Apply tack coat, asphalt binder, asphalt cement, as specified on the Drawings uniformly to existing pavement surfaces.
2. Rate of asphalt sealant application must be sufficient to satisfy the asphalt retention properties of the geotextile and bond the geotextile and overlay the pavement.
3. Application shall be by manufacturers recommendations. Minimum temperature shall be 150 deg C (300 deg F) and shall not exceed 160 deg C (320 deg F).
4. Target width of asphalt sealant application shall be the geotextile width plus 6 inches (150 mm). The asphalt sealant shall not be applied any farther in advance of geotextile placement than the distance the contractor can maintain free of traffic.

C. Installation of Geosynthetic (Paving Fabric):
1. Geotextile to be placed onto the asphalt sealant (calendared or smooth side up) with minimum wrinkling prior to the time the asphalt has cooled and lost tackiness. Upon approval of Engineer wrinkles or folds in excess of 1 inch (25 mm) shall be slit and laid flat.
2. Place paving geotextile promptly according to manufacturer's written instructions. Broom or roll geotextile smooth and free of wrinkles and folds.
3. Overlap longitudinal joints 4 inches (100 mm) and transverse joints 6 inches (150 mm). Transverse joints shall be lapped in direction of paving to prevent edge pickup by the paver. A second application of asphalt sealant to the geotextile overlap will be required if needed to ensure proper bonding of the double geotextile layer as directed by the Engineer.
4. Protect paving geotextile from traffic and other damage and place hot-mix asphalt paving overlay the same day.
5. Removal and replacement of geotextile that is damaged will be

D. Protection:
1. Traffic on the geotextile will be permitted for emergency and construction vehicles only.
2. Placement of the hot-mix overlay should closely follow geotextile installation.
3. Prior to placing a seal coat (or thin overlay such as an open-graded friction course), lightly sand the geotextile and a spread rate of 0.15 to 0.20 lb per square foot and pneumatically roll the geotextile tightly into the sealant.

3.07 HOT-MIX ASPHALT PLACING

A. Machine place hot-mix asphalt 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 thickness when compacted.
   1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
   2. Place hot-mix asphalt surface course in single lift.
   3. Spread mix at minimum temperature of 250 deg F (121 deg C) and at maximum temperature of 325 deg F.
   4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
   5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet (3 m) wide unless infill edge strips of a lesser width are required.
   1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.08 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course. Construct joints parallel to traffic flow.
   1. Clean contact surfaces and apply tack coat to joints.
   2. Offset longitudinal joints, in successive courses, a minimum of 6 inches (150 mm).
   3. Offset transverse joints, in successive courses, a minimum of 24 inches (600 mm).
   4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations." Or as shown on Drawings.
   5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
   6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.09 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.
   1. Complete compaction before mix temperature cools to 185 deg F (85 deg C).

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
   1. Density: Compare density of in-place material against laboratory specimen of same mixture. Average density shall meet specifications and requirements of the State Department of Transportation in which the Project is located.
      a. Average Density: 95 percent of reference maximum theoretical density according to ASTM D 2041, for binder (intermediate) and surface courses.
      b. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, for base courses.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.
G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.10 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:
   1. Base Course: Plus or minus 1/4 inch (6 mm).
   2. Binder (Intermediate) Course: Plus or minus ¼ inch (6 mm)
   3. Surface Course: Plus or minus 1/8 inch (3 mm).
B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot (3-m) straightedge applied transversely or longitudinally to paved areas:
   1. Base Course: 1/2 inch (12 mm).
   2. Binder (Intermediate) Course: ¼ inch (6 mm)
   3. Surface Course: 1/8 inch (3 mm**)**.
C. Testing: Contractors duties relating to testing include:
   1. Notify Owner 72 hours prior to asphalt paving
   2. Notify laboratory of conditions requiring testing
   3. Coordinate with laboratory for field testing.

3.11 SURFACE TREATMENTS

A. Application: Apply pavement sealer with ambient temperature is at least 50 degrees F and rising for a period of at least 24 hours after application. And subject to the following limitations:
   1. Do not apply when temperatures are expected to drop below 50 degrees F in a 24-hour period or if rain is expected or imminent within 8 hours
   2. Do not apply pavement sealer when ambient temperature is 90 degrees and above without first cooling the surface with a fine mist of water (fogging). The fogging should only dampen the surface without causing water pockets to form.
   3. Do not apply between September 15 and May 1 unless the specifications and requirements of the State Department of Transportation WEATHER LIMITATIONS in which the project is located permit application between these dates.
B. Surface Preparation:
   1. Surface must be free from dirt, dust and includes grass along the edges. Remove and dispose of any loose and unsuitable materials, dirt, and debris from pavement surface by power blower or mechanical sweeping equipment.
   2. Surface hairline cracks up to ½ inch must be filled with crack filler; cracks larger than ½ inch must be cleaned and filled with elastomeric emulsion crack filler.
   3. When using a high performance crack sealant, please note on your proposal.
   4. Potholes, alligator areas, and similar surface defects must be cut out and repairs made.
   5. Treat all grease, oil and gasoline spots with compatible primer of the manufactured coating. In hot weather, the surface should be fogged with water prior to sealing.
   6. Prior to spreading pavement sealer, paint all existing white paint stripes with black paint.
   7. Contractor to dispose of all cans bags and leftover materials off-site.
C. Application:
   1. Mix pavement sealer in accordance with the manufacturer's procedure to a uniform consistency before using. For each coat, the sealant shall be diluted with clean potable water while agitating. The percent of water to be added will be as per the manufacturer specification based on the asphalt surface quality, and the type of traffic it will experience. When the rubberized mixture has thickened, add sand or aggregate slowly to the mixing tank. Mix thoroughly before and slowly during the application.

a. First coat on all parking areas at a rate of .13 gallons per square yard/coat. At no time are total coats to exceed .051 gallons per square yard. The first coat may be applied by hand squeegee, self propelled squeegee equipment or pressurized spray equipment. Hand squeegee or self propelled squeegee equipment is preferred.
b. Second coat on all parking areas at a rate of .13 gallons per square yard/coat. At no time total coats are to exceed .051 gallons per square yard. The second coat must be applied with pressurized spray equipment.

2. Lines, stencils, and markings shall be repainted in original size & location, unless otherwise directed by the Owner, in accordance with this specification.
3. It is the Contractor's responsibility to check local zoning codes & regulations.
4. All seal coat and re-striping projects must be performed during available time periods (usually at night) that DO NOT interfere with normal store operations. Applications must be staged to provide customers free access to Lowe's the following business day.

3.12 WHEEL STOPS

A. Install wheel stops in bed of adhesive as recommended by manufacturer.
B. Securely attach wheel stops to pavement with not less than two galvanized-steel dowels embedded at one-quarter to one-third points. Securely install dowels into pavement and bond to wheel stop. Recess head of dowel beneath top of wheel stop.

3.13 IMPRINTING ASPHALT (when used on project)

A. General: Imprint asphalt according to manufacturer's written instructions, using manufacturer's recommended equipment.
B. Freshly Laid Asphalt: Immediately after asphalt has been laid and compacted but still plastic, begin the surface imprinting process.
   1. Monitor asphalt surface temperature in compliance with manufacturer's written recommendations to ensure required temperature to perform surface imprinting.
   2. Reheat asphalt if surface temperature drops below that required.
C. Reheating Asphalt: Soften asphalt pavement surface by heating to a depth of at least 1/2 inch (13 mm) without burning asphalt.
   1. Heat to a temperature of 300 to 325 deg F (149 to 163 deg C) immediately before applying templates.
   2. Regularly monitor the pavement temperature to prevent overheating.
   3. Direct flame heaters are not permitted.
   4. If pavement is overheated and begins to emit black smoke, remove damaged pavement by milling down 1 inch (25 mm) and replace removed pavement with new, compacted surface course prior to resuming imprinting work.
D. Surface Imprinting: Apply and imprint templates to a minimum depth as indicated on the Drawings and as required to embed precut marking material flush or barely beneath pavement surface.
E. Coating Application: After imprinted surface has cooled, apply according to Drawings and manufacturer's recommendations. Do not allow traffic until coating has completely dried and cured.
F. Precut Marking Material Application: Position precut marking material aligned with imprinted pattern and slowly heat to a temperature no higher than 325 deg F (163 deg C) until marking material begins to liquefy and flow. Do not allow traffic until installed marking material has cooled to ambient temperature.

3.14 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform tests, inspections and to prepare reports. Testing agency will be paid by Owner..
B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.
C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
D. In-Place Density: Testing agency will take samples of un-compacted paving mixtures and compacted pavement according to ASTM D 979 or AASHTO T 168.

1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.
    a. Two 4 inch core sample will be taken for every 5000 sq. yd. (836 sq. m) or less of intermediate course, at locations chosen by the Owner.
    b. The Owner shall provide random location field density testing of in-place compacted pavement determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.

E. Contractor to replace and compact hot-mix asphalt where core tests were taken.

F. The Owner reserves the right to take additional testing. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements. All areas that do not comply with specified requirements shall be remedied by the Contractor as prescribed by the Owner.

3.15 DISPOSAL

A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.
1. Do not allow milled materials to accumulate on-site. Perimeter protection shall be provided for milled material stockpiles temporarily stored on site where there is a potential for these materials to mix with stormwater and be discharged from the site.
2. Cleaning asphalt paving equipment and tools is not permitted on site.

END OF SECTION 321216

MARSHALL STABILITY
MIX DESIGN SUBMITTAL FORM

Project Location: _____
Type/Name of Mix: _____
AC Grade: _____
Reclaimed Asphalt Pavement (RAP) Mix: ڤ Yes _____% RAP or ڤ No

Gradation Limits	
Sieve Size	% Passing by Weight
Marshall Design Properties ڤ 50 Blow Method or ڤ 75 Blow Method	
Number of Blows, each end (___ inch specimen)	
Stability (lbs.)	
Flow (0.01 in.)	
Voids in Total Mix, VTM (%)	
Voids in Mineral Aggregate, VMA (%)	
Voids Filled with Asphalt, VFA (%)	
AC Content (%)	
Fines to Asphalt Ratio	

SUBMITTAL WILL BE REJECTED WITHOUT EACH OF THE FOLLOWING ATTACHED:

1. State Department of Transportation (DOT) or Authority Having Jurisdiction (AHJ) asphalt mix design specifications for each type of mix.
2. Material certificates stating the asphalt mix to be supplied complies with the specifications of the DOT or AHJ signed by the Asphalt Mix Producer and the Contractor.
3. Origin or RAP material if applicable.

SUPERPAVE
MIX DESIGN SUBMITTAL FORM

Project Location: _____
Type/Name of Mix: _____
Reclaimed Asphalt Pavement (RAP) Mix: ف Yes _____% Binder in RAP or ف No
Reclaimed Asphalt Shingle (RAS) Mix: ف Yes _____% Binder in RAS or ف No

Gradation Limits Mix Type (Nominal Maximum Aggregate Size)	
ف 9.5 mm ف 12.5 mm ف 19.0 mm ف 25.0 mm ف 37.5 mm	
Sieve Size	% Passing

Binder PG Grade	
No. Gyration N_{ini} /N_{des} /N_{max}	
Voids in Mineral Aggregate VMA (%)	
Voids in Total Mix VTM (%)	
Voids Filled with Asphalt VFA (%)	
%Gmm @ N_{ini}	
%Gmm @ N_{max}	
Dust to Binder Ratio ($P_{0.075}/P_{be}$)	

NOTE: Mix design must be performed in accordance with the Superpave mix design system as described in AASHTO PP 28.

SUBMITTAL WILL BE REJECTED WITHOUT EACH OF THE FOLLOWING ATTACHED:

1. State Department of Transportation (DOT) or Authority Having Jurisdiction (AHJ) asphalt mix design specifications for each type of mix.
2. Material certificates stating the asphalt mix to be supplied complies with the specifications of the DOT or AHJ signed by the Asphalt Mix Producer and the Contractor.
3. Origin or RAP/RAS material if applicable.

SECTION 32 12 36.13

ASPHALT SEAL AND FOG COAT

PART 1 - GENERAL

1.01 SUMMARY

A. Work under this section shall include cleaning and preparing the pavement surface, mixing the pavement sealer, and applying the asphalt pavement sealer over existing bituminous pavement surfaces.

B. Restriping parking lot markings for an existing parking lot for maintenance and repair application. Areas to receive parking lot markings are all areas within the property boundary.

1.02 REFERENCED SECTIONS

A. Section 321216 - Asphalt Paving

B. Section 321313- Concrete Pavement Curb and Sidewalk

1.03 REFERENCE STANDARDS

A. American Society of Testing and Materials
   1. ASTM D-140 Standard Practice for Sampling of Bituminous Materials
   2. ASTM D-449 Asphalt Used in Damp-proofing and Waterproofing, Type II and III
   3. ASTM D-2939 Standard Test Methods Emulsion Bitumen's Use as Protective Coatings
   4. ASTM D-3405 Joint Sealant Hot-Applied for Concrete and Asphalt Pavement
   5. ASTM D-3320 Emulsified Coal Tar Pitch (Mineral Colloid Type)
   6. ASTM D-3910 Design, Testing and Construction of Slurry Seal

1.04 SUBMITTALS

A. Material Certificates: Submit materials certificate to the Owner's engineer which is signed by the Contractor, certifying that materials comply with, or exceed, the requirements herein.

B. Seal Coat design shall be as per the requirement of the regulatory authority having jurisdiction or as approved by the Owner.

PART 2 - PRODUCTS

2.01 MATERIALS

A. SealMaster Polymer Modified Coal Tar Sealer (PMCTS) at the following specifications:
   1. SealMaster Specification
      a. Material – Material shall be homogenous and show no separation or coagulation that cannot be overcome by moderate stirring.
      b. Non Volatiles – 40%
      c. Ash Non Volatiles – 35 – 40%
      d. Solubility of Non Volatiles in CS2% - 20 min.
      e. Specific Gravity 25C – 1.18 MIN.
      f. Drying Time – 8 hr. MAX. (Typically less than 60 min.)
      g. Adhesion & Resistance to Water – No Penetration or Loss of Adhesion
      h. Resistance to Heat – No Blistering or Sagging
      i. Flexibility – No Cracking or Flaking
      j. Resistance to Impact – No Chipping, Flaking or Cracking
      k. Resistance to Volatilization – 10% Loss in Weight Max.
      l. Wet Film Continuity – Smooth, Nongranular Free from course particles

B. SealMaster Polymer Modified MasterSeal (PMM) to be used in AK, CA, AZ and NM ONLY at the following specifications:
   1. SealMaster Specification
      a. Material – Material shall be homogenous and show no separation or coagulation that cannot be overcome by moderate stirring.
      b. Non-Volatile, 43 – 47%

c. Ash of Non-Volatile, 42 – 52%
d. Specific Gravity 25oc 1.15 – 1.25
e. Drying Time – 8hrs. MAX.
f. Adhesion & Resistance to Water – No Penetration or Loss of Adhesion
g. Resistance to Heat – No Blistering or Sagging
h. Flexibility – No Cracking or Flaking
i. Resistance to Impact – No Chipping, Flaking or Cracking

Note: Only materials meeting the above specifications will be accepted. Certificate of Compliance from the refined coal tar manufacturer is required prior to application.

C. Oil Spot Treatment: SealMaster PetroSeal or prep seal oil spot primer as specified by the manufacturer for pavement sealer.
D. Water
E. Aggregate or sand as required and specified by the manufacturer
F. Polymer Additive (optional)
G. Fortifier
1. Water based epoxy-latex additive, designed as a fortifier for refined coal tar emulsions to increase resistance to power steering marks, fuel and chemical effects to assist in fast drying of the coating is acceptable.
2. Thickeners only are not permitted.

2.02 EQUIPMENT

A. Self-propelled squeegee equipment shall have a least 2 squeegee or brush devices (one behind the other) to assure adequate distribution and penetration of sealer into the bituminous pavement. Equipment shall have continuous agitation or mixing capabilities to maintain homogenous consistency of pavement sealer mixture throughout the application process.
B. Pressurized spray application equipment shall be capable of spraying pavement sealer with sand added. Equipment shall have continuous agitation or mixing capabilities to maintain homogenous consistency of pavement sealer mixture throughout the application process.
C. Hand squeegee and brushes shall be acceptable only in areas where practicality prohibits the use of mechanized equipment.

2.03 MIX DESIGNS

A. Sealer concentrate – 100 Gallon
B. Silica Sand 400 Meeting 40 to 60 fineness rating (AFS).
1. Black Beauty Slag Sand (w/ comparable sieve rating) may be substituted when silica sand is not available.
C. Water – Specified material does not require onsite dilution
D. Fortifier 3%
E. Curing agents on high traffic areas (when applicable)

PART 3 - EXECUTION

3.01 Apply pavement sealer when ambient temperature is 50° F and rising for a period of 24 hours after application. Do not apply when temperature is expected to drop below 50° F in a 24-hour period. Do not apply if rain is imminent within 8 hours.

3.02 Do not apply pavement sealer when ambient temperature is 90° F and above without first cooling the surface with a fine mist of water (fogging). The fogging should only dampen the surface without causing puddling.

3.03 Between September 15 and May 1, check the specifications and requirements of the State Department of Transportation WEATHER LIMITATIONS on the permitted dates of applying the seal coats.

3.04 SURFACE PREPARATION

A. Surface must be free from dirt, dust and includes grass along the edges. Remove and dispose of any loose and unsuitable materials, dirt, and debris from pavement surface by power blower or mechanical sweeping equipment.
B. Surface hairline cracks up to ½ inch must be filled with crack filler; cracks larger than ½ inch must be cleaned and filled with elastomeric emulsion crack filler.
C. When using a high performance crack sealant, please note on your proposal.
D. Potholes, alligator areas, and similar surface defects must be cut out and repairs made.
E. Treat all grease, oil and gasoline spots with compatible primer of the manufactured coating. In hot weather, the surface should be fogged with water prior to sealing.
F. Prior to spreading pavement sealer, paint all existing white paint stripes with black paint.
G. Contractor to dispose of all cans, bags and leftover materials off-site.

3.05 APPLICATION

A. Mix pavement sealer in accordance with the manufacturer's procedure to a uniform consistency before using. For each coat, the sealant shall be diluted with clean potable water while agitating. The percent of water to be added will be as per the manufacturer specification based on the asphalt surface quality, and the type of traffic it will experience. When the rubberized mixture has thickened, add sand or aggregate slowly to the mixing tank. Mix thoroughly before and slowly during the application.
    1. First coat on all parking areas at a rate of .13 gallons per square yard/coat. At no time are total coats to exceed 0.51 gallons per square yard. The first coat may be applied by hand squeegee, self propelled squeegee equipment or pressurized spray equipment. Hand Squeegee or self propelled squeegee equipment is preferred.
    2. Second coat on all parking areas at a rate of .13 gallons per square yard/coat. At no time are total coats to exceed 0.51 gallons per square yard. The second coat must be applied with pressurized spray equipment.
B. Allow a minimum of 24 hours of curing time before allowing traffic over treated surface or application of traffic marking paint. Use of solvent borne paint shall not be permitted.
C. Lines, stencils, and markings shall be repainted in original size & location, unless otherwise directed by the Owner, in accordance with Section 02745 Pavement Markings and Removal.
D. It is the Contractor's responsibility to check local zoning codes & regulations.
E. All seal coat and re-striping projects must be performed during available time periods (usually at night) that DO NOT interfere with normal store operations. Applications must be staged to provide customers free access to the building the following business day.

END OF SECTION 321236.13

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SECTION 32 13 13

CONCRETE PAVEMENT CURB AND SIDEWALK

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes exterior cement concrete pavement for the following:
   1. Driveways and roadways.
   2. Parking lots.
   3. Curbs and gutters.
   4. Walkways.
   5. Unit paver base (if used).

B. Related Sections include the following:
   1. Division 03 Section "Cast-in-Place Concrete" for general building applications of concrete.
   2. Division 31 Section “Earth Moving” for subgrade preparation, grading, and subbase course.
   3. Division 32 Section "Concrete Paving Joint Sealants" for joint sealants of joints in concrete pavement and at isolation joints of concrete pavement with adjacent construction (if used).

1.03 REFERENCE STANDARDS

A. American Society of Testing Materials (ASTM)
   1. A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
   2. A185 - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
   3. A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
   4. C33 - Standard Specification for Concrete Aggregates
   5. C94 - Standard Specification for Ready-Mixed Concrete
   6. C150 - Standard Specification for Portland Cement
   7. C171 - Standard Specification for Sheet Materials for Curing Concrete
   8. C260 - Standard Specification for Air-Entraining Admixtures for Concrete
   9. C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
   10. C494/C494M - Standard Specification for Chemical Admixtures for Concrete
   11. C979 - Standard Specification for Pigments for Integrally Colored Concrete
   12. C1116 - Standard Specification for Fiber-Reinforced Concrete and Shotcrete
   13. D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
   14. D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
   15. D3405 - Standard Specification for Joint Sealants, Hot-Applied, for Concrete and Asphalt Pavements
   16. D5249 - Standard Specification for Backer Material for Use with Cold- and Hot-Applied Joint Sealants in Portland-Cement Concrete and Asphalt Joints
   17. D5893 - Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements

B. American Concrete Institute (ACI)
   1. 301R-99 – Specifications for Structural Concrete
   2. 304R – Placing and Handling Concrete, etc.
   3. 309R-96 – Guide for Consolidating of Concrete
   4. 330.1 – Standard Specifications for Plain Concrete Parking Lots
   5. 330R-92 – Guide for Design & Construction of Concrete Parking Lots

6. 211.1R-91 – Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete

C. American Association of State Highway and Transportation Officials (AASHTO)
1. M182 – Standard Specifications for Burlap Cloth made from Jute for Kenaf
2. M153 – Standard Specifications for Preformed Sponge Rubber and Cork Expansion Joint Filler.

1.04 SUBMITTALS

A. Product Data: For each type of manufactured material and product mix indicated.
B. Design Mixtures: For each concrete pavement mixture (see attached form at the end of this section). Include alternate mixture designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.
C. General Contractor and Subcontractor shall execute the Conformance Submittal(s) at the end of this section.
D. Minutes of pre-installation conference.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products who complies with ASTM C 94/C 94M requirements for production facilities and equipment.
B. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by requirements in the Contract Documents.
C. Concrete Testing Service: The Owner will engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
1. A slump test and an air entrainment test shall be performed for each load delivered.
2. Four (4) standard test cylinders shall be taken for each 55 cubic yards of concrete or each days pour, whichever is more frequent. Two cylinders shall be broken at 7 days and two cylinders shall be broken at 28 days.
D. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
1. Before submitting design mixtures, review concrete pavement mixture design and examine procedures for ensuring quality of concrete materials and concrete pavement construction practices. Require representatives, including the following, of each entity directly concerned with concrete pavement, to attend conference:
a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete producer.
d. Concrete pavement subcontractor.

1.06 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
2. Products: Subject to compliance with requirements, provide one of the products specified.
3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.
   1. Use flexible or curved forms for curves with a radius 100 feet (30.5 m) or less.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.03 STEEL REINFORCEMENT

A. Plain-Steel Welded Wire Reinforcement: ASTM A 185, 6 inches x 6 inches #10 mesh fabricated from as-drawn steel wire into flat sheets.

B. Reinforcing Bars: ASTM A 615/A 615M, Grade 40 deformed.

C. Plain Steel Wire: ASTM A 82, as drawn.

D. Deformed-Steel Wire: ASTM A 496.

E. Diamond Dowel Bars: ¼" x 4-1/2" Diamond Dowels by PNA.

F. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete.

2.04 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source throughout the Project:
   1. Portland Cement: ASTM C 150, Type I, Type II or III.
   2. If indicated on the plan and only as approved by the Owner supplement with the following:
      a. Fly Ash: ASTM C 618, Class F.

B. Normal-Weight Aggregates: ASTM C 33, Combined aggregate gradation for concrete pavement and other designated concrete shall be 8% - 18% for large top size aggregates (1-1/2") or 8% - 22% for smaller top size aggregates (1" or ¾") retained on each sieve below the top size above the no. 100 sieve. Select coarse-aggregate size from options in first subparagraph below; add gradation requirements if preferred. PCA recommends maximum aggregate size of 3/4 inch (19 mm) in base slab if seeded exposed aggregate is pavement finish.
   1. Maximum Coarse-Aggregate Size: 1-1/2 inches nominal.

C. Water: ASTM C 94/C 94M.

D. Air-Entraining Admixture: ASTM C 260.

E. Calcium Chloride: The use of calcium chloride or admixtures containing more than 0.05% chloride ions is prohibited.

F. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
   1. Air-Entraining Admixture: ASTM C 260.
   2. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
   3. Retarding Admixture: ASTM C 494/C 494M, Type B.
   4. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
   5. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
   6. Water-Reducing and Accelerating Admixture: ASTM C 494/C 494M, Type E.

2.05 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) dry.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.

E. Clear Solvent Borne Liquid Membrane Forming Curing Compound: ASTM C 309, Type 1, Class B.

F. Clear Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

G. White Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B.

2.06 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 175, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

B. Coloring Agent: When required, add coloring agent to mix according to manufacturer's written instructions.
   1. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black**,** non-fading, and resistant to lime and other alkalis.
   2. Color: As indicated on Drawings and per manufacturer's designation.

C. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery with emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.

D. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

E. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to requirements, and as follows:

F. Chemical Surface Retarder: Water-soluble, liquid-set retarder with color dye, for horizontal concrete surface application, capable of temporarily delaying final hardening of concrete to a depth of 1/8 to 1/4 inch (3 to 6 mm).

G. Pigmented Mineral Dry-Shake Hardener: Factory-packaged dry combination of portland cement, graded quartz aggregate, color pigments, and plasticizing admixture. Use color pigments that are finely ground, nonfading mineral oxides interground with cement.

2.07 PAVEMENT MARKINGS

A. Pavement-Marking Paint: Lead and chromate free, ready mixed, complying with AASHTO M 248.
   1. Color: Yellow (on concrete).

B. Materials:
   1. **Sherwin Williams Setfast Non- leaded Chlorinated Rubber -** White on asphalt (TM5126), yellow on concrete (TM5127), or as indicated on the drawing(s) is preferred.
   2. **Sherwin Williams "Setfast Acrylic Waterborne Traffic Marking Paint"** – White on asphalt (TM226, yellow on concrete (TM225), or as indicated on the drawing(s)
   3. **Valspar Enterprise Latex Traffic Marking Paint** - White on asphalt (#2540), yellow on concrete (#2541), or as indicated on the drawing(s).
   4. **PPG (Pittsburg Paints)"SEEDHIDE® Traffic and Zone Marking Flat Latex" –** White on asphalt (11-23), yellow on concrete, or as indicated on the drawing(s).

C. Execution
   1. New concrete pavement shall age a minimum of 30 days before painting, unless otherwise approved by the Owner.
   2. Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 50 degrees F not exceeding 90 degrees F and relative humidity at a maximum of 85%.
   3. Surface shall be clean and free of dirt, grease, oil, or other contaminants which could interfere with adhesion.
   4. Apply paint material at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils and dry film thickness of 10 mils per coat.
   5. Paint to be applied in 2 coats using a template or striping machine. Stripes shall be a minimum width of 4 inches unless otherwise noted on the Drawings.

D. Temporary Pavement Markings
   1. Temporary paint shall be applied in accordance with permanent pavement marking specifications however only one (1) coat of paint shall be required. The contractor may use a temporary removable pavement marking tape only as approved in writing by the Owner. Tape that has become damaged and is no longer serviceable shall be replaced without additional compensation.

2. All temporary markings shall be removed when no longer required. Any pavement area that has been determined to be damaged as a result of the removal operation shall be repaired at no additional cost to the Owner.

E. Pavement Marking Removal
   1. A motorized abrasive device shall be utilized to remove existing markings. Existing pavement marking lines and symbols that are to be removed shall be accomplished such that material or structural damage to the surface or texture of the pavement is avoided. The Contractor shall repair any damage to the pavement at no expense to the Owner. After removal, the pavement shall be in a condition that will not mislead or misdirect customers or motorists. Pavement marking removal within public rights of way shall be completed in accordance with the regulatory authority having jurisdiction and the Drawings and Specifications.

2.08 WHEEL STOPS

A. Wheel Stops: Precast, air-entrained concrete, 2500-psi (17.2-MPa) minimum compressive strength, 6 inches (150 mm) high by 6 inches (150 mm) wide by 72 inches (1820 mm) long. Provide chamfered corners and drainage slots on underside and holes for anchoring to substrate.
   1. Dowels: Galvanized steel, 3/4-inch (19-mm) diameter, 12-inch (300-mm) minimum length. Or #4 bars 12-inch (300 mm) minimum.

2.09 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 211.IR-91 and ACI 304 and ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.
   1. Use a qualified independent testing agency for preparing and reporting proposed concrete mixture designs for the trial batch method.

B. Proportion mixtures to provide normal-weight concrete with the following properties:
   1. Compressive Strength (28 Days): 4000 psi (27.6 MPa).
   2. Slump Limit: Maximum 5 inches (125 mm) at time of placement for pavement, 2 inch (50 mm) for curb and sidewalk.

C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
   1. Air Content: 5-% to 8% for pavement, curb and sidewalk.

D. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
   1. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

F. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements, only as authorized by the Owner in writing as follows:
   1. Fly Ash or Pozzolan: 25 percent.

G. Color Pigment: When indicated on the Drawings add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.10 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M and ASTM C 1116. Furnish batch certificates for each batch discharged and used in the Work.
   1. When air temperature is between 85 deg F (30 deg C) and 90 deg F (32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: On-site mixing must be approved by the Owner. Comply with requirements and measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For concrete mixes of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For concrete mixes larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared sub-base surface below concrete pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding.
   1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph (5 km/h).
   2. Proof-roll with a loaded 10-wheel tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes).
   3. Subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inc**h (13 mm)** require correction according to requirements in Division 31 Section "Earth Moving."

C. Proceed with concrete pavement operations only after nonconforming conditions have been corrected and sub-grade is ready to receive pavement.

3.02 PREPARATION

A. Remove loose material from compacted sub-base surface immediately before placing concrete.

3.03 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Maintain sufficient quantity of forms to allow continuing work so that forms are in place a minimum of 24 hours after concrete placement.

C. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

D. Flexible or curved forms shall be used on curves. Forms shall be of full depth of the concrete and of strength when staked sufficient to resist the pressure of concrete and the loads resulting from the finishing operations without springing, settling or losing shape.

3.04 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Accurately position and support reinforcement and secure against displacement. Set wire ties with ends directly into concrete.

E. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction. Support reinforcing steel on wire chairs to ensure wire stays mid-depth of sidewalk section during concrete pour.

3.05 JOINTS

A. General: Form pre-molded expansion and contraction joints, construction joints, control joints, thickened edge expansion joints, isolation joints, and tool edgings true to line with faces

perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.

1. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour unless pavement terminates at isolation joints.

1. Diamond Dowels: Install ¼" x 4-1/2" Diamond Dowels by PNA at 24" on center or as shown on the drawings. Install per manufacturer's recommendations.

C. Isolation Joints: Locate isolation joints as shown on the Drawings. Form isolation joints of preformed joint-filler strips abutting Provide catch basins, manholes, inlets, structures, walks, light pole bases and other fixed objects , and where indicated.

1. Expansion: Provide joint filler for the entire depth of the slab section and not less than one (1) inch below finished surface so as to allow for joint sealer. Provide thickened edge expansion joint as indicated on the Drawings.
    a. Provide ½" expansion joints for curb and gutter and sidewalk at 100 feet on center.
    b. Provide ½" contraction joints for curb and gutter at 10 feet on center.
    c. Extend joint fillers full width and depth of joint.
    d. Terminate joint filler not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished surface if joint sealant is indicated.
    e. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
    f. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
    g. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Contraction ("control") Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, or 1 inch, whichever is deeper. For sidewalks, control joint spacing shall be equal to the sidewalk width. For concrete pavement, control joint spacing shall be placed as shown on the drawings but no greater than 30 times the slab thickness on center both ways.

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 3/8-inch (10-mm) radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate groove marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3-mm-) wide joints into concrete within 24 hours of concrete placement and as soon as the cutting action will not tear, abrade, or otherwise damage surface. If required re-saw joint immediately prior to installing sealant to achieve a ¼ inch joint width - second saw joint to be ¼-inch (6 mm) if required. Power saws are to be equipped with a bag to collect concrete dust. Concrete dust shall be disposed of in accordance with the Stormwater Pollution Prevention Plan.

E. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 3/8-inch (10-mm) radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

3.06 CONCRETE PLACEMENT

A. General: All concrete walks and aprons shall be a minimum of 4 inches thick as shown on the Drawings, with a turned down edge as detailed. Comply with tolerances in ACI 330.1 Specification for Plain Concrete Parking Lots.

B. Inspection: Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast in. Notify other trades to permit installation of their work.

C. Remove snow, ice, or frost from sub-base surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.

D. Moisten sub-base to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

E. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
F. Do not add water to fresh concrete after testing.
G. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
H. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
   1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.
I. Screed pavement surfaces with a straightedge and strike off.
J. Commence initial floating using bull floats or darbies to impart an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
K. Curbs and Gutters: When automatic machine placement is used for curb and gutter placement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete. If results are not approved, remove and replace with formed concrete.
L. Slip-Form Pavers: When automatic machine placement is used for pavement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce pavement to required thickness, lines, grades, finish, and jointing as required for formed pavement.
   1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of paver machine during operations.
M. When adjoining pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained 85 percent of its 28-day compressive strength.
N. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
   1. When air temperature has fallen to or is expected to fall below 40 deg F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
   2. Do not use frozen materials or materials containing ice or snow.
   3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mix designs.
O. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
   1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
   2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
   3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.07 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.
B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
   1. Medium Textured Broom Finish: Draw a medium bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, medium (1/16 (1.6mm)) texture.

3.08 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
B. Comply with ACI 306.1 for cold-weather protection.
C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:
    1. Moist Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
        a. Water.
        b. Continuous water-fog spray.
        c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.
    2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
    3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
    4. All exterior concrete surfaces shall receive one coat of exterior sealer.

3.09 PAVEMENT TOLERANCES

A. Comply with tolerances of ACI 117 (based on ACI 330.1) and as follows:
    1. Elevation: 1/4 inch (6 mm).
    2. Thickness: Plus 3/8 inch (10 mm), minus 1/4 inch (6 mm).
    3. Surface: Gap below 10-foot- (3-m-) long, unleveled straightedge not to exceed 1/4 inch (6 mm).
    4. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch (25 mm).
    5. Vertical Alignment of Tie Bars and Dowels: 1/4 inch (6 mm).
    6. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2 inch (13 mm).
    7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4 inch per 12 inches (6 mm per 300 mm).
    8. Joint Spacing: 3 inches (75 mm).
    9. Contraction Joint Depth: Plus 1/4 inch (6 mm), no minus.
    10. Joint Width: Plus 1/8 inch (3 mm), no minus.

3.10 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Owner.
B. Allow concrete pavement to cure for 28 days and be dry before starting pavement marking.
C. Sweep and clean surface to eliminate loose material and dust.
D. Apply paint with mechanical equipment to produce pavement markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils (0.4 mm).

3.11 WHEEL STOPS

A. Securely attach wheel stops into pavement with not less than two galvanized steel dowels embedded in holes drilled or cast into wheel stops at one-quarter to one-third points. Firmly bond

each dowel to wheel stop and to pavement. Securely install dowels into pavement and bond to wheel stop. Recess head of dowel beneath top of wheel stop.

3.12 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage and pay for a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Slump and Air Content Testing Frequency: Obtain at least 1 composite sample for each load delivered.
    a. Slump: ASTM C 143/C 143M; Perform additional tests when concrete consistency appears to change.
    b. Air Content: ASTM C 231, pressure method.
    c. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above.
2. Test Cylinder Frequency: Obtain four standard test cylinders for each 55 cubic yards of concrete or each day's pour, whichever is more frequent.
    a. Compressive-Strength Tests: ASTM C 39/C 39M; test 2 specimen cylinders at 7 days and 2 specimen cylinders at 28 days.

C. Strength of each concrete mix will be satisfactory if average of any 3 consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).

D. Test results shall be reported in writing to Owner, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.

F. Remove and replace concrete pavement where test results indicate that it does not comply with specified requirements.

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

3.13 REPAIRS AND PROTECTION

A. Remove and replace concrete pavement that is broken, damaged, or defective or that does not comply with requirements in this Section.

B. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.

C. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

DESIGN INFORMATION

	Please check one
Based on Standard Deviation Analysis	
Trial Mix Test Data	

DESIGN CHARACTERISTICS

Density		pcf
Strength		psi (28 day)
Air		% specified

If trial mixes are used the Mix Design is proportioned to achieve f'cr = f'c + 1200 psi
(1400 psi for strength higher than 5000 psi at 28 days)

MATERIALS	***Type/ Source***	***Specific Gravity***	***Weight/lb.***	***Absolute Vol. cu.ft.***
Cement				
Microsilica				
Coarse Aggregate				
Fine Aggregate				
Water				
Other				
		TOTAL		27.0 cu. ft.

* Water/Cement Ratio (lbs. water/lbs. cement) = _____%

ADMIXTURES	**Manufacturer**	**Dosage oz/cwt**
Water Reducer		
Air Entraining Agent		
High Range Water Reducer		
Non-Corrosive Accelerator		
Other		

Slump before HRWR		*inches*
Slump after HRWR		*inches*

Standard Deviation Analysis (from experience records):

# of Test Cylinders Evaluated:	
Standard Deviation:	

f'cr-f'c + 1.34s or f'cr = f'c + 2.33s - 500

Slump before HRWR		*inches*		
Slump after HRWR		*inches*		

Standard Deviation Analysis (from experience records):

# of Test Cylinders Evaluated:	
Standard Deviation:	

f'cr-f'c + 1.34s or f'cr = f'c + 2.33s - 500

(Refer to ACI 301 for increased deviation factor when less than 30 tests are available)

LABORATORY TEST DATA

Compressive Strength	Age (days)	Mix # 1	Mix #2	Mix #3
	7	psi	psi	psi
	7	psi	psi	psi
	28	psi	psi	psi
	28	psi	psi	psi
	28 average	psi	psi	psi

REQUIRED ATTACHMENTS

	Please Check
Coarse Aggregate Gradation Report	
Fine Aggregate Gradation Report	
Concrete Compressive Strength Data or Trial Mixture Test Data	
Admixture Compatability certification letter	

Submitted by:

Name:	
Address:	
Phone #:	
Main Plant Location:	
Miles from Project:	
Secondary Plant Location:	
Miles from Project:	
Date:	

CONFORMANCE SUBMITTAL
SECTION 321313 – CONCRETE PAVEMENT CURB AND SIDEWALK

Project Location _____
(*City, State*)

General Contractor: _____
(*Company Name, Phone Number*)

_____
(*Address*)

Sub-Contractor: _____
(*Company Name, Phone Number*)

_____
(*Address*)

The following products have been selected (check one box) for use in this project from the list of acceptable products specified:

Exterior Concrete Sealant:
☐ Sonneborn "Kure-N-Seal 30" exterior acrylic sealer
☐ Euclid "Super Rez-Seal

Cold-Applied Joint Sealant ASTM D5893, self leveling silicone sealant:
☐ Crafco Inc. "Roadwaver Silicone-SL"
☐ Dow Corning 888
☐ Dow Corning 890-SL
☐ Sonneborn "Sonomeric 1 Sealant"
☐ Tremco "Vulkem 45"

Hot-Applied Joint Sealant: ASTM D3405, Polymeric sealant.
☐ Crafco Inc. "ROADSAVER 22"
☐ W.R. Meadows, Inc. "SEALTIGHT HI-SPEC"

I represent to City/Owner/Engineer that the product selected will be installed in compliance with the applicable codes for the authorities having jurisdiction and in accordance with the contract documents. If noncompliance is discovered the General Contractor shall make or cause to be made all necessary corrections to meet the applicable codes and specifications. Immediately or as directed by Owner the work shall be completed without additional cost to the Owner and / or the contract.

Sub-Contractor: _____
(*Signature of the Authorized Agent of the Sub-Contractor*) Date

_____
(*Print Name of the Authorized Agent of the Sub-Contractor*)

General Contractor: _____
(*Signature of the Authorized Agent of the General Contractor*) Date

_____
(Print Name of the Authorized Agent of the General Contractor

SECTION 32 13 73

CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Cold-applied joint sealants.
   2. Cold-applied, jet-fuel-resistant joint sealants.
   3. Hot-applied joint sealants.
   4. Hot-applied, jet-fuel-resistant joint sealants.

B. Related Sections:
   1. Division 32 Section " Asphalt Paving" for constructing joints between concrete and asphalt pavement.
   2. Division3 2 Section "Concrete Pavement Curb and Sidewalk" for constructing joints in concrete pavement.
   3. Testing will not be required if joint-sealant manufacturers submit joint-preparation data that are based on previous testing, not older than 24 months, of sealant products for compatibility with and adhesion to joint substrates and other materials matching those submitted.

1.03 SUBMITTALS

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

B. Product Certificates: For each type of joint sealant and accessory, from manufacturer.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for joint sealants.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain each type of joint sealant from single source from single manufacturer.

1.05 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.
   2. When joint substrates are wet.
   3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
   4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.

B. Colors of Exposed Joint Sealants: As indicated on the Drawings.

2.02 COLD-APPLIED JOINT SEALANTS

A. Single-Component, Self-Leveling, Silicone Joint Sealant for Concrete: ASTM D 5893, Type SL.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Crafco Inc., an ERGON company; RoadSaver Silicone Sealant.
      b. Dow Corning Corporation; 888.
      c. Sonneborn “Sonometic 1 Sealant”
      d. Tremco “Vulkem 45”.

2.03 HOT-APPLIED JOINT SEALANTS

A. Hot-Applied, Single-Component Joint Sealant for Concrete and Asphalt: ASTM D 6690, Types I, II, and III.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Craftco Inc. “Roadsaver 222”
      b. Meadows, W. R., Inc.; Sealtight Hi-Spec.

2.04 CONCRETE SEALANTS

A. Exterior Concrete Sealant: Sonneborn “kure-n-Seal 30” exterior acrylic sealer, or Euclid “Super Rez-Seal.

2.05 JOINT FILLERS

A. Joint Fillers: Resilient pre-molded bituminous impregnated fiberboard units complying with ASTM D 1751, asphalt-saturated cellulosic fiber, ASSHTO M 152, Type I: or ASTM D 1752, cork or self-expanding cork.

2.06 JOINT-SEALANT BACKER MATERIALS

A. General: Provide joint-sealant backer materials that are non-staining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.
B. Round Backer Rods for Hot-Applied Joint Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.
C. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D 5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.
D. Backer Strips for Cold- and Hot-Applied Joint Sealants: ASTM D 5249; Type 2; of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

2.07 PRIMERS

A. Primers: Product 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.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.
B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.03 INSTALLATION OF JOINT SEALANTS

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

B. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install joint-sealant backings of kind indicated to support joint sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
   1. Do not leave gaps between ends of joint-sealant backings.
   2. Do not stretch, twist, puncture, or tear joint-sealant backings.
   3. Remove absorbent joint-sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install joint sealants using proven techniques that comply with the following and at the same time backings are installed:
   1. Place joint 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 Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants according to the following requirements to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint:
   1. Remove excess joint sealant from surfaces adjacent to joints.
   2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.

F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

3.04 CLEANING

A. Clean off excess joint sealant or sealant smears adjacent to joints as the Work progresses, by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.05 PROTECTION

A. Protect joint sealants, during and after curing period, from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations in repaired areas are indistinguishable from the original work.

3.06 PAVEMENT-JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Joints within cement concrete pavement.
   1. Joint Location:
      a. Expansion and isolation joints in cast-in-place concrete pavement.
      b. Contraction joints in cast-in-place concrete pavement.
      c. Construction joints in cast-in-place concrete pavement.
      d. Saw joints in joints in cast-in-place concrete pavement
      e. Other joints as indicated.
   2. Silicone Joint Sealant for Concrete:
      a. Crafco Inc., an ERGON company; RoadSaver Silicone.
      b. Dow Corning Corporation; 888.
      c. Sonneborn “Sonometic 1 Sealant”
      d. Tremco “Vulkem 45”.
   3. Hot-Applied Joint Sealant for Concrete:
      a. Craftco Inc. “Roadsaver 22”

b. Meadows, W. R., Inc.; Sealtight Hi-Spec.

4. Joint-Sealant Color: Unless otherwise indicated on Drawings: Gray.

END OF SECTION 321373

SECTION 32 92 00

TURF AND GRASSES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Seeding.
   2. Hydroseeding.
   3. Sodding.
   4. Plugging.
   5. Sprigging.
   6. Meadow grasses and wildflowers.
   7. Turf renovation.
   8. Erosion-control material(s).
   9. Grass paving.

B. Related Sections:
   1. Division 31 Section "Site Clearing" for topsoil stripping and stockpiling.
   2. Division 31 Section "Earth Moving" for excavation, filling and backfilling, and rough grading.
   3. Division 32 Section "Planting Irrigation" for turf irrigation.
   4. Division 33 Section "Storm Utility Drainage Piping" for subsurface drainage.

1.03 DEFINITIONS

A. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.

B. Finish Grade: Elevation of finished surface of planting soil.

C. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

D. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

E. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

F. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

G. Subgrade: Surface or elevation of subsoil remaining after excavation is complete or top surface of a fill or backfill before planting soil is placed.

H. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

I. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil, but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated.
   1. Pesticides and Herbicides: Include product label and manufacturer's application instructions specific to this Project.

B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name, percentage by weight of each species and variety, and

percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

1. Certification of each seed mixture for turfgrass sod. Include identification of source and name and telephone number of supplier.

C. Conformance Submittal: Submit Installer's Qualifications as indicated prior to beginning work for qualified landscape installer.

D. Product Certificates: For soil amendments and fertilizers, from manufacturer.

E. Material Test Reports: For standardized ASTM D 5268 topsoil and imported or manufactured topsoil.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful turf establishment.

1. Professional Membership: Installer shall be a member in good standing of either the American Landscape Contractors Association or the American Nursery and Landscape Association.
2. Registration. Installer shall be a Registered Landscape Contractor (where applicable).
3. Experience: Five years' experience in turf installation in addition to requirements in Division 2 Section "Quality Requirements."
4. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
5. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.
6. Pesticide Applicator: State licensed, commercial.

B. Soil-Testing Laboratory Qualifications: An independent laboratory or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

C. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; deleterious material; pH; and mineral and plant-nutrient content of the soil.

1. Testing methods and written recommendations shall comply with USDA's Handbook No. 60.
2. The soil-testing laboratory shall oversee soil sampling, with depth, location, and number of samples to be taken per instructions from Architect. A minimum of three representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.
3. Report suitability of tested soil for turf growth.
    a. Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq. ft. (92.9 sq. m) or volume per cu. yd. (0.76 cu. m) for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
    b. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws, as applicable.

B. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod in time for planting within 24 hours of harvesting. Protect sod from breakage and drying.

C. Fertilizer: Deliver to site in original unopened standard size bags showing weight, analysis and name of manufacturer. Store in weatherproof place and keep dry to maintain effectiveness. Store partially used bags in sealed containers.

D. Bulk Materials:
   1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
   2. Provide perimeter-control measures to prevent displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
   3. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

1.07 PROJECT CONDITIONS

A. Planting Restrictions: See drawings for planting periods and specific species for specific planting dates.

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

1.08 MAINTENANCE SERVICE

A. Initial Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until acceptable turf is established but for not less than the following periods:
   1. Seeded Turf: 60 days from date of planting completion.
      a. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.
   2. Sodded Turf: 30 days from date of installation.
   3. Plugged and Sprigged Turf: 60 days from date of planting completion.

B. Continuing Maintenance Proposal: From Installer to Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options. Include with Maintenance Service Proposal as defined in Division 21 Section 329300 Part 1.10.

PART 2 - PRODUCTS

2.01 SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances.

B. Seed Species: State-certified seed of grass species as indicated on the drawings, with not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed:

C. Grass Seed Mix: Proprietary seed mix as indicated on the drawings.

2.02 TURFGRASS SOD

A. Turfgrass Sod: Certified, complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture, strongly rooted, and capable of vigorous growth and development when planted.

B. Turfgrass Species: Shall be as indicated on the drawings or as approved by the Owner.

C. Turfgrass Species: Sod of grass species (from seed at sod farm) as follows, with not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed:

2.03 PLUGS

A. Plugs: Turfgrass sod, certified, complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture, cut into square or round plugs, strongly rooted, and capable of vigorous growth and development when planted; of the following turfgrass species and plug size:

1. Turfgrass Species: Shall be as indicated on the drawings.
2. Plug Size: Shall be as indicated on the drawings.

2.04 SPRIGS

A. Sod Sprigs: Healthy living stems, rhizomes, or stolons with a minimum of two nodes and attached roots free of soil, of the following turfgrass species:
   1. Turfgrass Species: Shall be as indicated on the drawings.
   2. Turfgrass Species: Shall be as indicated on the drawings.

2.05 MEADOW GRASSES AND WILDFLOWERS

A. Wildflower Seed: Fresh, clean, and dry new seed, of mixed species as follows:
   1. Species as identified on drawings.
B. Native Grass Seed: Fresh, clean, and dry new seed, of mixed species as follows:
   1. Species as identified on drawings.
C. Wildflower and Native Grass Seed: Fresh, clean, and dry new seed, of mixed species as follows:
   1. Species as identified on drawings.
D. Seed Carrier: Inert material, sharp clean sand or perlite, mixed with seed at a ratio of not less than two parts seed carrier to one part seed.

2.06 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
   1. Class: T, with a minimum of 99 percent passing through No. 8 (2.36-mm) sieve and a minimum of 75 percent passing through No. 60 (0.25-mm) sieve.
   2. Class: O, (only in high wind areas) with a minimum of 95 percent passing through No. 8 (2.36-mm) sieve and a minimum of 55 percent passing through No. 60 (0.25-mm) sieve.
   3. Provide lime in form of ground dolomitic limestone.
B. Sulfur: Granular, biodegradable, containing a minimum of 90 percent sulfur, and with a minimum of 99 percent passing through No. 6 (3.35-mm) sieve and a maximum of 10 percent passing through No. 40 (0.425-mm) sieve.
C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
D. Aluminum Sulfate: Commercial grade, unadulterated.
E. Perlite: Horticultural perlite, soil amendment grade.
F. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 (0.30-mm) sieve.
G. Sand: Clean, washed, natural or manufactured, and free of toxic materials.

2.07 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch (25-mm) sieve; soluble salt content of 2 to 5 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
   1. Organic Matter Content: 50 percent of dry weight.
B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or of granular texture, with a pH range of 3.4 to 4.8.
C. Wood Derivatives: Decomposed, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.
D. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.

2.08 FERTILIZERS

A. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 1 percent nitrogen and 10 percent phosphoric acid.
B. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
   1. Composition: 1 lb/1000 sq. ft. (0.45 kg/92.9 sq. m) of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight unless recommended in soil reports from a qualified soil-testing laboratory or as specified on the drawings.

D. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
   1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight, unless recommended in soil reports from a qualified soil-testing laboratory or as specified on the drawings.

2.09 PLANTING SOILS

A. Planting Soil: ASTM D 5268 topsoil, with pH range of 5.5 to 7, a minimum of 6 percent organic material content; free of stones 1 inch (25 mm) or larger in any dimension and other extraneous materials harmful to plant growth. Mix ASTM D 5268 topsoil with the following soil amendments in the following quantities to produce planting soil:
   1. Ratio of Loose Compost to Topsoil by Volume: 1:4.

B. Planting Soil: Existing, native surface topsoil formed under natural conditions with the duff layer retained during excavation process and stockpiled on-site. Verify suitability of native surface topsoil to produce viable planting soil. Clean soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.
   1. Supplement with native surface (topsoil) planting soil when quantities are insufficient.
   2. Mix existing, native surface topsoil with the following soil amendments in the following quantities to produce planting soil:
      a. Ratio of Loose Compost to Topsoil by Volume: 1:4.
      b. Ratio of Loose Sphagnum 1:4.

C. Planting Soil: Existing, in-place surface soil. Verify suitability of existing surface soil to produce viable planting soil. Remove stones, roots, plants, sod, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth. Mix surface soil with the following soil amendments in the following quantities to produce planting soil:
   1. Ratio of Loose Compost to Surface Soil by Volume: 1:3.

D. Imported Planting Soil: Imported topsoil or manufactured topsoil from off-site sources. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches (100 mm) deep; do not obtain from agricultural land**,** bogs or marshes.
   1. Additional Properties of Imported Topsoil or Manufactured Topsoil: Screened and free of stones 1 inch (25 mm) or larger in any dimension; free of roots, plants, sod, clods, clay lumps, pockets of coarse sand, paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials harmful to plant growth; free of obnoxious weeds and invasive plants including quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, and bromegrass; not infested with nematodes, grubs, other pests, pest eggs, or other undesirable organisms and disease-causing plant pathogens; friable and with sufficient structure to give good tilth and aeration. Continuous, air-filled, pore-space content on a volume/volume basis shall be at least 15 percent when moisture is present at field capacity. Soil shall have a field capacity of at least 15 percent on a dry weight basis.
   2. Mix imported topsoil or manufactured topsoil with the following soil amendments in the following quantities to produce planting soil:
      a. Ratio of Loose Compost to Topsoil by Volume: 1:4.

2.10 MULCHES

A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

B. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch (25-mm) sieve; soluble salt content of 2 to 5 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
   1. Organic Matter Content: 50 to 60 percent of dry weight.
C. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic and free of plant-growth or germination inhibitors; with a maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.
D. Non-asphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.
E. Asphalt Emulsion: NOT PERMITTED.

2.11 PESTICIDES

A. General: Pesticide, registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
B. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
C. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

2.12 EROSION-CONTROL MATERIALS

A. Rolled Erosion-Control Blankets (RECP): Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6 inches (150 mm) long.
B. Erosion-Control Fiber Mesh: Biodegradable burlap or spun-coir mesh, a minimum of 0.92 lb/sq. yd. (0.5 kg/sq. m), with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, 6 inches (150 mm) long.
C. Turf Reinforcement Mats (TRM): Cellular, non-biodegradable slope-stabilization mats designed to isolate and contain small areas of soil over steeply sloped surface, thickness as detailed on the drawings. Include manufacturer's recommended anchorage system for slope conditions.
   1. Products: See drawings and details,

2.13 GRASS-PAVING MATERIALS

A. Grass Paving: Cellular, non-biodegradable plastic mats, designed to contain small areas of soil and enhance the ability of turf to support vehicular and pedestrian traffic, see plan and details for mat thickness. Include manufacturer's recommended anchorage system for slope conditions.
   1. Products: See drawings and details.
B. Base Course: Sound crushed stone or gravel complying with [ASTM D 448 for Size No. 8] Division 2 Section "Earthwork" for base-course material.
C. Sand: Sound, sharp, washed natural sand or crushed stone complying with gradation requirements in ASTM C 33 for fine aggregate.
D. Proprietary Growing Mix: As shown on the drawings or submitted and acceptable to Owner.
E. Sandy Loam Soil Mix: Sound, sharp, washed, natural sand or crushed stone complying with gradation requirements in ASTM C 33 for fine aggregate blended with planting soil as specified. Use blend consisting of 1/2 sand and 1/2 planting soil.
F. Soil for Paving Fill: Planting soil as specified on the drawings.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas to be planted for compliance with requirements and other conditions affecting performance.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.

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

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Owner and replace with new planting soil.

3.02 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.
2. Protect grade stakes set by others until directed to remove them.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.03 TURF AREA PREPARATION

A. Limit turf subgrade preparation to areas to be planted.

B. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 6 inches (150 mm). Remove stones larger than 1 inch (25 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
1. Apply superphosphate fertilizer directly to subgrade before loosening.
2. Spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil.
   a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
   b. Mix lime with dry soil before mixing fertilizer.
3. Spread planting soil to a depth of 6 inches (150 mm) but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
   a. Spread approximately 1/2 the thickness of planting soil over loosened subgrade. Mix thoroughly into top 2 inches (50 mm) of subgrade. Spread remainder of planting soil.
   b. Reduce elevation of planting soil to allow for soil thickness of sod where used.

C. Unchanged Subgrades: If turf is to be planted in areas unaltered or undisturbed by excavating, grading, or surface-soil stripping operations, prepare surface soil as follows:
1. Remove existing grass, vegetation, and turf. Do not mix into surface soil.
2. Loosen surface soil to a depth of at least 8 inches (200 mm). Apply soil amendments and fertilizers according to planting soil mix proportions and mix thoroughly into top 4 inches (100 mm) of soil. Till soil to a homogeneous mixture of fine texture.
   a. Apply superphosphate fertilizer directly to surface soil before loosening.
3. Remove stones larger than 1 inch (25 mm) in any dimension and sticks, roots, trash, and other extraneous matter.
4. Legally dispose of waste material, including grass, vegetation, and turf, off Owner's property.

D. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch (13 mm) of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future. All turf areas shall slope to drain

E. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

F. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.04 PREPARATION FOR EROSION-CONTROL MATERIALS

A. Prepare area as specified in "Turf Area Preparation" Article.

B. For turf reinforcement mats (TRM), install planting soil in two lifts, with second lift equal to thickness of erosion-control mats. Install erosion-control mat and fasten as recommended by material manufacturer.
C. Fill cells of turf reinforcement mat with planting soil and compact before planting.
D. For rolled erosion-control blanket (RECP) or mesh, seed area, install RECP from top of slope, working downward, and as recommended by material manufacturer for site conditions and as shown on the details. Fasten as recommended by material manufacturer.
E. Moisten prepared area before planting if surface is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

3.05 PREPARATION FOR GRASS-PAVING MATERIALS

A. Reduce subgrade elevation soil to allow for thickness of grass-paving system. Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade so that installed paving is within plus or minus 1/2 inch (13 mm) of finish elevation. Roll and rake, remove ridges, and fill depressions.
B. Install base course (sand, soil mix, proprietary growing mix, or soil for paving fill) as shown on drawings) and as recommended by paving-material manufacturer for site conditions; comply with details shown on Drawings. Compact according to paving-material manufacturer's written instructions.
C. Install paving mat and fasten according to paving-material manufacturer's written instructions.
D. Before planting, fill cells of paving mat with planting soil mix as shown on the drawings and compact according to manufacturer's written instructions.
E. Moisten prepared area before planting if surface is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

3.06 SEEDING

A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph (8 km/h). Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
   1. Do not use wet seed or seed that is moldy or otherwise damaged.
   2. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.
B. Sow seed at a total rate as indicated on the drawings.
C. Rake seed lightly into top 1/8 inch (3 mm) of soil, roll lightly, and water with fine spray.
D. Protect seeded areas with slopes exceeding 3:1 with RECP installed and stapled according to manufacturer's written instructions.
E. Protect seeded areas with turf reinforcement mats where shown on Drawings; install and anchor according to manufacturer's written instructions.
F. Protect seeded areas with slopes not exceeding 3:1 and not indicated to receive RECP or TRM by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre (42 kg/92.9 sq. m) to form a continuous blanket in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.
   1. Anchor straw mulch by crimping into soil with suitable mechanical equipment, or bond by spraying with approved tackifier at rate specified by manufacturer.
G. Protect seeded areas from hot, dry weather or drying winds by applying specified mulch within 24 hours after completing seeding operations. Water and soak areas, scatter mulch uniformly and roll surface smooth.

3.07 HYDROSEEDING

A. Hydroseeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.
   1. Mix slurry with non-asphaltic fiber-mulch, or manufacturer's recommended tackifier.
   2. Apply slurry uniformly to all areas to be seeded in a two-step process. Apply first slurry coat at a rate so that mulch component is deposited at not less than 500-lb/acre (5.2-kg/92.9 sq. m) dry weight, and seed component is deposited at not less than the specified seed-sowing rate. Apply slurry cover coat of fiber mulch (hydromulching) as indicated on the drawings or at a rate of 1000 lb/acre (10.4 kg/92.9 sq. m).

3.08 SODDING

A. Area: Shall be as indicated on the drawings or at minimum a three (3) foot wide strip along walks, roadways and parking areas to reduce erosion.
B. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.
C. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.
    1. Lay sod across angle of slopes exceeding 4:1.
    2. Anchor sod on slopes exceeding 6:1 with steel staples spaced as recommended by sod manufacturer but not less than 2 anchors per sod strip to prevent slippage.
D. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches (38 mm) below sod.

3.09 PLUGGING

A. Plant plugs in holes or furrows, spaced as indicated on the drawings. On slopes, contour furrows to near level.

3.10 SPRIGGING

A. Plant freshly shredded sod sprigs in furrows as indicated on drawings. Place individual sprigs with roots and portions of stem in moistened soil, as indicated, and fill furrows without covering growing tips. Lightly roll and firm soil around sprigs after planting.
B. Broadcast Method: If broadcast method is indicated on drawings, spread sprigs uniformly over prepared surface at rate indicated and mechanically force sprigs into lightly moistened soil.
    1. Spread a 1/4-inch- (6-mm-) thick layer of planting soil on sprigs.
    2. Lightly roll and firm soil around sprigs after planting.
    3. Water sprigs immediately after planting and keep moist by frequent watering until well rooted.

3.11 TURF RENOVATION

A. Renovate existing turf.
B. Renovate existing turf damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.
    1. Reestablish turf where settlement or washouts occur or where minor regrading is required.
    2. Install new planting soil as required.
C. Remove sod and vegetation from diseased or unsatisfactory turf areas; do not bury in soil.
D. Remove topsoil containing foreign materials such as oil drippings, fuel spills, stones, gravel, and other construction materials resulting from Contractor's operations, and replace with new planting soil.
E. Mow, dethatch, core aerate, and rake existing turf.
F. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.
G. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner's property.
H. Till stripped, bare, and compacted areas thoroughly to a soil depth of 6 inches (150 mm).
I. Apply soil amendments and initial fertilizers required for establishing new turf and mix thoroughly into top 4 inches (100 mm) of existing soil. Install new planting soil to fill low spots and meet finish grades.
J. Apply seed and protect with straw mulch, or sod as required for new turf.
K. Water newly planted areas and keep moist until new turf is established.

3.12 TURF MAINTENANCE

A. Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.

1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

B. Watering: Water to keep turf uniformly moist to a depth of 6 inches (150 mm).
1. Watering shall be done in such a manner and as frequently as deemed necessary by the Owner to assure continued growth of healthy grass.
2. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
3. Water turf with fine spray at a minimum rate of 1 inch (25 mm) per week unless rainfall precipitation is adequate.
4. Owner will provide water, if available on-site, if not available on-site the Contractor shall provide all necessary water. The Contractor shall furnish all labor, fuel and equipment necessary and required to transport and apply water to the turf areas as required.

C. Protection: Protect seeded or sod area from trespass during grass establishment. Furnish and install fences, signs, and barriers or any other necessary temporary protective devices. Damage resulting from trespass, erosion, settlement, or other causes shall be repaired at the Contractor's expense. All temporary measures must be removed prior to final acceptance.

D. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowing. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowing to maintain the following grass height:
1. Bentgrass to a height of 1 inch (26 mm) or less.
2. Bermuda grass to a height of 1 to 1-1/2 inch (26 to 40 mm).
3. Centipedegrass, perennial ryegrass and zoysiagrass to a height of 1 to 2 inches (25 to 50 mm).
4. Kentucky bluegrass, buffalograss and red fescue to a height of 1-1/2 to 2 inches (38 to 50 mm).
5. Bahiagrass, turf-type tall fescue, and St Augistine grass to a height of 2 to 3 inches (50 to 75 mm).

E. Turf Post fertilization: Apply fertilizer after initial mowing and when grass is dry.
1. Use fertilizer that will provide actual nitrogen of at least 1 lb/1000 sq. ft. (0.45 kg/92.9 sq. m) to turf area.

3.13 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by Owner:
1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with uniform coverage exceeding 85 percent perennial vegetative cover.
2. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.
3. Satisfactory Plugged Turf: At end of maintenance period, the required number of plugs has been established as well-rooted, viable patches of grass, and areas between plugs are free of weeds and other undesirable vegetation.
4. Satisfactory Sprigged Turf: At end of maintenance period, the required number of sprigs has been established as well-rooted, viable plants, and areas between sprigs are free of weeds and other undesirable vegetation.

B. After grass growth has started all areas or parts of areas, which fail to show a uniform stand of grass for any reason whatsoever shall be re-seeded repeatedly until all areas are covered with a satisfactory growth of grass at no additional cost to the Owner.

C. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

3.14 MEADOW GRASSES AND WILDFLOWERS

A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph (8 km/h). Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
   1. Do not use wet seed or seed that is moldy or otherwise damaged.
B. Sow seed at a total rate as shown on the drawings.
C. Brush seed into top 1/16 inch (1.6 mm) of soil, roll lightly, and water with fine spray.
D. Protect seeded areas from hot, dry weather or drying winds by applying compost or straw mulch within 24 hours after completing seeding operations. Soak areas, scatter mulch uniformly to a thickness of 3/16 inch (4.8 mm), and roll surface smooth.
E. Water newly planted areas and keep moist until meadow is established.

3.15 MEADOW GRASSES AND WILDFLOWER MAINTENANCE

A. Maintain and establish meadow by watering, weeding, mowing, trimming, replanting, and performing other operations as required to establish a healthy, viable meadow. Roll, regrade, and replant bare or eroded areas and remulch. Provide materials and installation the same as those used in the original installation.
   1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and meadow damaged or lost in areas of subsidence.
   2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
   3. Apply treatments as required to keep meadow and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.
B. Watering: If indicated on the drawings, install and maintain temporary piping, hoses, and meadow-watering equipment to convey water from sources and to keep meadow uniformly moist.
   1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
   2. Water meadow with fine sprays at a minimum rate of 1/2 inch (13 mm) per week until final acceptance unless rainfall precipitation is adequate.

3.16 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents in accordance with requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
B. Post-Emergent Herbicides (Selective and Non-Selective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.

3.17 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
B. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.
C. Remove nondegradable erosion-control measures after grass establishment period.

END OF SECTION 329200

SECTION 33 10 00

FACILITY WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 31 Section 312000 “Earth Moving”, apply to this Section.

1.02 SUMMARY

A. This Section includes water-distribution piping and related components outside the building from tapping the main to:
   1. Within 5 feet of outside the building limits for domestic and irrigation water service
   2. 1 foot above finished floor elevation for the fire service mains
   3. Supply and discharge piping including connections to fire protection water tank if shown on the plans..

B. All work shall conform to the requirements of the local water authority, fire marshal, and other regulatory authorities having jurisdiction, or this specification, whichever is more stringent.

C. Utility-furnished products include water meters that will be furnished to the site, ready for installation.

1.03 DEFINITIONS

A. EPDM: Ethylene propylene diene terpolymer rubber.
B. LLDPE: Linear, low-density polyethylene plastic.
C. PA: Polyamide (nylon) plastic.
D. PE: Polyethylene plastic.
E. PP: Polypropylene plastic.
F. PVC: Polyvinyl chloride plastic.
G. RTRF: Reinforced thermosetting resin (fiberglass) fittings.
H. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

1.04 REFERENCE STANDARDS

A. Factory Mutual (FM)
   1. Approval Guide

B. Underwriters Laboratories (UL)
   1. Fire Protection Equipment Directory
   2. UL 1285 - Pipe and Couplings, Polyvinyl Chloride (PVC), for Underground Fire Service
   3. UL 262 - Gate Valves for Fire-Protection Service
   4. UL 246 - Hydrants for Fire-Protection Service

C. National Sanitation Foundation (NSF)
   1. NSF 14 - Plastics Piping System Components and Related Materials
   2. NSF 61 - Drinking Water System Components - Health Effects

D. National Fire Protection Association (NFPA)
   1. NFPA 70 - National Electrical Code
   2. NFPA 24 - Standard for the Installation of Private Fire Service Mains and their Appurtenances
   3. NFPA 1963 - Screw Threads and Gaskets for Fire Hose Connections (revision of ANSI/NFPA 1963-1993)
   4. NFPA 13 – Installation of Sprinkler Systems (latest edition)

E. American Water Works Association (AWWA)
   1. C151 Ductile-Iron Pipe, Centrifugally Cast, for Water (revision of ANSI/AWWA C151/A21.51-91)
   2. C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water

3. C150 - Thickness Design of Ductile-Iron Pipe
4. C110 - Ductile-Iron and Gray-Iron Fittings, 3 in through 48 in (75 mm through 1200 mm), for Water and Other Liquids
5. C153 - Ductile-Iron Compact Fittings, 3 in. through 24 in. (76 mm Through 610 mm) and 54 in. through 64 in. (1,400 mm Through 1,600 mm), for Water Service
6. C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 Inch through 12 Inch for Water Distribution
7. C500 - Gate Valves for Water and Sewage Systems
8. C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
9. C550 - Protective Epoxy Interior Coatings for Valves and Hydrants
10. C509 - Resilient-Seated Gate Valves for Water Supply Service
11. M44 – Distribution Valves: Selection, Installation, Field Testing, and Maintenance
12. C800 - Underground Service Line Valves and Fittings
13. C702 - Cold Water Meters - Compound Type
14. C502 - Hydrants, Dry Barrel Fire
15. M41 – Ductile Iron Pipe and Fittings
16. C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances
17. C605 - Water Treatment - Underground Installation of Polyvinyl Chloride PVC Pressure Pipe and Fittings for Water
18. M23 - PVC Pipe: Design and Installation
19. M17 - Fire Hydrants: Installation, Field Testing, and Maintenance
20. C651 - Disinfecting Water Mains

F. American Society for Testing and Materials (ASTM)

1. B88 - Standard Specification for Seamless Copper Water Tube
2. B813 - Standard Specification for Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube
3. B32 - Standard Specification for Solder Metal
4. D2241 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
5. D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
6. F645 - Standard Guide for Selection, Design, and Installation of Thermoplastic Water Pressure Piping Systems

G. American Society of Mechanical Engineers (ASME)

1. B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings R(1994)
2. B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

H. Manufacturer's Standardization Society (MSS)

1. SP-60 - Connecting Flange Joint Between Tapping Sleeves and Tapping Valves

I. Copper Development Association (CDA)

1. Copper Tube Handbook

1.05 SUBMITTALS

A. The General Contractor and Subcontractor(s) shall execute the Conformance Submittal(s) at the end of this section.

1.06 QUALITY ASSURANCE

A. Regulatory Requirements:
1. Comply with requirements of regulatory authorities having jurisdiction or the utility company supplying water including tapping of water mains, backflow prevention installation, testing, and disinfection.
2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

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

C. Electrical Components, Devices, and Accessories: UL listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
D. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.
E. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.
F. NFPA Compliance: Comply with NFPA 13 and NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.
G. NSF Compliance:
   1. Comply with NSF 14 for plastic potable-water-service piping.
   2. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:
   1. Ensure that valves are dry and internally protected against rust and corrosion.
   2. Protect valves against damage to threaded ends and flange faces.
   3. Set valves in best position for handling. Set valves closed to prevent rattling.
B. During Storage: Use precautions for valves, including fire hydrants, according to the following:
   1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
   2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use hand wheels or stems as lifting or rigging points.
D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
F. Protect flanges, fittings, and specialties from moisture and dirt.
G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.08 PROJECT CONDITIONS

A. Removal and Relocation of Existing Utilities: The contractor shall be responsible for removal and/or relocation of existing utilities, where conflicts occur but may or may not be shown on the Drawings, at no additional cost to the Owner.
B. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:
   1. Notify Owner two (2) days in advance of proposed interruption of service.
   2. Do not proceed with interruption of water-distribution service without Owner's written permission.

1.09 COORDINATION AND FEES

A. The Contractor shall be responsible for obtaining and payment of all tap and construction permit fees associated with this section.
B. The Contractor shall provide and install domestic and irrigation water lines, meters, and appurtenances as shown on the drawings to within 5 feet of building limits, including, but not limited to, any taps, meters, vault, and backflow prevention. If Contractor’s Work terminates at a connection point where work by others is complete, Contractor shall make the connection. If future connections will be required by others, Contractor shall install plugging and marking apparatus as necessary to protect the Work.
C. The Contractor shall provide and install fire service water lines, meters, and appurtenances as shown on drawings to 1 foot above finished floor elevation, including, but not limited to any taps, meters, backflow prevention, hydrants, and free standing fire department connections. If Contractor’s Work terminates at a connection point where work by others is complete, Contractor

shall make the connection. If future connections will be required by others, Contractor shall install plugging and marking apparatus as necessary to protect the Work.

PART 2 - PRODUCTS

2.01 COPPER TUBE AND FITTINGS

A. Soft Copper Tube: NPS 3 inches or smaller; **ASTM B 88, Type K**, annealed temper.
   1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type or ASME B 16.22 for wrought-copper and copper allow, solder joint pressure fitting type. Furnish only wrought-copper fittings if indicated.
   2. Soldering flux shall be in accordance with ASTM B813, water-flushable type.
   3. Solder filler metal shall be in accordance with ASTM B 32, with 0.20 percent maximum lead content.
   4. Copper, Pressure-Seal Fittings:
      a. NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
      b. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.

2.02 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe, NPS 3 inches or larger: AWWA C151 Class 350, and shall have a cement-mortar lining of standard thickness in accordance with AWWA C104; pipe thickness shall be in accordance with AWWA C150; pipe shall have push-on joints in accordance with AWWA C110, additional pipe:
   1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
   2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
      a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

2.03 PVC PIPE AND FITTINGS

A. Polyvinyl Chloride (PVC) Pipe, NPS 4 inches to NPS 12 inches:

   1. PVC pipe shall conform to the requirements of AWWA C900, Class 150, DR 18. Pipe joints shall be elastomeric joints only. Sleeve couplings are not permitted except as necessary for repairs during testing, or connections to existing mains. Comply with UL 1285 for fire-service mains. Fittings shall be mechanical-joint ductile-iron compact fittings in accordance with AWWA C153 or standard size in accordance with AWWA C110.

B. Polyvinyl Chloride (PVC) Pipe NPS 2 inch to NPS 3 inch:

   1. Pipe shall conform to the requirements of ASTM D2241, SDR 21, with elastomeric joints conforming to ASTM D3139. Pipe jointing shall be by elastomeric joints only. Sleeve couplings are not permitted except as necessary for repairs during testing, or connections to existing mains. Fittings shall be PVC fabricated fittings with elastomeric gaskets, or ductile iron compact fittings conforming to AWWA C153 with elastomeric gaskets.

2.04 GATE VALVES

A. AWWA, Cast-Iron Gate Valves:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings
   2. Nonrising-Stem, Metal-Seated Gate Valves:
      a. Description: Gray- or ductile-iron body and bonnet; with cast-iron or bronze double-disc gate, bronze gate rings, bronze stem, and stem nut.
         1) Standard: AWWA C500, UL 262, FM-Approved.

2) Minimum Pressure Rating: 200 psig (1380 kPa).
3) End Connections: Mechanical joint per AWWA C111.
4) Interior Coating: Complying with AWWA C550.
5) Nut: 2 inches square, complying with AWWA C500.

3. Nonrising-Stem, Resilient-Seated Gate Valves:
   a. Description: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
      1) Standard: AWWA C509 UL 262 FM-Approved.
      2) Minimum Pressure Rating: 200 psig (1380 kPa).
      3) End Connections: Mechanical joint per ANSI A21.11 (AWWA C111).
      4) Interior Coating: Complying with AWWA C550.
      5) Nut: 2 inches square, complying with AWWA C500.

2.05 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Tapping-Sleeve Assemblies:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings.
   2. Description: Sleeve and valve compatible with drilling machine.
      a. Standard: MSS SP-60.
      b. Tapping Sleeve: Cast- or ductile-iron or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve.
      c. Valve: AWWA, cast-iron, nonrising-stem, metal or resilient-seated gate valve with one raised face flange mating tapping-sleeve flange.

B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches (125 mm) in diameter.
   1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.
   2. Provide 24” x 24” x 6” thick concrete apron around all valve boxes in asphalt pavement areas.

2.06 CORPORATION VALVES AND CURB VALVES (STOPS)

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

B. Curb Valves: Comply with AWWA C800. Include bronze body, ground-key plug or ball, and wide tee head, with inlet and outlet matching service piping material.

C. Service Boxes for Curb Valves: Similar to AWWA M44 requirements for cast-iron valve boxes. Include cast-iron telescoping top section of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over curb valve and with a barrel approximately 3 inches (75 mm) in diameter.
   1. Shutoff Rods: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve.

2.07 WATER METERS

A. Manufacturers:
   1. Basis-of-Design Product: Subject to compliance with requirements, if utility company does not furnish water meter provide the product indicated on Drawings.

B. 1-1/2 Inch Compound-Type Water Meters:
   1. Description:
      a. Standard: AWWA C702.
      b. Registration: Flow in gallons (liters).

C. Fire Service Meters:
   1. Description: Use Fire Service Meter only when required by authorities having jurisdiction. Include meter modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly.
      a. Standard: AWWA C703.
      b. Registration: Flow in **gallons (liters)**.

2.08 BACKFLOW PREVENTERS

A. Comply with regulatory authorities having jurisdiction requirements.
   1. Maximum Pressure Loss (RPZ valve): 12 psig (83 kPa) at 2250 gpm maximum, through middle 1/3 of flow range.
   2. Maximum Pressure Loss (double detector check valve): 5 psig (83 35) at 2250 gpm maximum, through middle 1/3 of flow range.

2.09 WATER METER BOXES

A. Description: Cast-iron body and cover (H-20 rated) for disc-type water meter, with lettering "WATER METER" in cover; and with slotted, open-bottom base section of length to fit over service piping. Use only when required by the utility authority. Provide a 24” x 24” x 6” thick concrete apron in pavement areas.

2.10 FIRE HYDRANTS

A. Dry-Barrel Fire Hydrants:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings.
   2. Description: Freestanding, with one NPS 4-1/2 (DN 115) and two NPS 2-1/2 (DN 65) outlets, 5-1/4-inch (133-mm) main valve, drain valve, and NPS 6 (DN 150) mechanical-joint inlet. Include interior coating according to AWWA C550. Hydrant shall have cast-iron body, compression-type valve opening against pressure and closing with pressure.
      a. Standard: AWWA C502 UL 246, FM-Approved.
      b. Pressure Rating: **150 psig (1035 kPa**).
      c. Outlet Threads: NFPA 1963, with external hose thread used by local fire department. Include cast-iron caps with steel chains.
      d. Operating and Cap Nuts: Pentagon, 1-1/2 inches (38 mm) point to flat.
      e. Direction of Opening: Open hydrant valve by turning operating nut to left or counterclockwise. A clearly visible arrow and the word “OPEN” shall be cast in relief on the top of the hydrant to designate direction of opening.
      f. Exterior Finish: Red alkyd-gloss enamel paint (two coats), unless otherwise indicated.

2.11 RESTRAINED JOINT SYSTEMS FOR FIRE LINE LEAD IN

A. The following section shall only apply to the portion of fire protection main extending from the 90 degree elbow below the sprinkler riser room floor to the flanged end of the pipe extending 1’-0” above the sprinkler riser room finished floor and the horizontal portion of pipe extending from the 90 degree elbow towards the building foundation.

B. The fire protection main entering the sprinkler riser room through the floor shall be restrained from movement by the following:

   1. Pipe Clamps
      a. Clamp dimensions shall be 5/8” x 2½” for 10” pipe, 5/8” x 3” for 12” and larger pipe;
      b. Clamp bolt dimensions shall be ¾” for 10” pipe, 7/8” for 12” and larger pipe;
      c. The diameter of the bolt hole shall be 1/16” larger than that of the corresponding bolt.
   2. Tie Rods: Threaded sections of rods shall not be formed or bent. Rods shall not be less than 5/8” in diameter and the minimum number of rods for each clamp shall be:
      a. 10” Pipe: (4)-5/8” or (3)-3/4” or (2)-7/8” rods;
      b. 12” Pipe: (6)-5/8” or (4)-3/4” or (3)-7/8” rods; and
      c. 14” Pipe: (8)-5/8” or (5)-3/4” or (4)-7/8” rods
      d. 16” Pipe: (10)-5/8” or (7)-3/4” or (5)-7/8” rods

3. Washers
   a. Cast-iron washer dimensions shall be 5/8” x 3” for 10” pipe, ½” x 3½” for 12” pipe and larger;
   b. Steel washer dimensions shall be ½” x 3” for 10” pipe, ½” x 3½” for 12” pipe and larger; and
   c. The diameter of the hole in the washer shall be 1/8” larger than the rod.
4. Polyethylene Encasement: To prevent corrosion, a polyethylene tube/sheet shall be applied to the exterior piping, fittings, clamp and rods. The polyethylene casing shall be applied per the manufacturer’s listing and shall extend 6” above finished floor elevation in the sprinkler room.

PART 3 - EXECUTION

3.01 EARTHWORK
A. Refer to Division 31 Section 312000 “Earth Moving” for excavating, trenching, and backfilling.

3.02 PIPING APPLICATIONS
A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.
B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.
C. Do not use flanges or unions for underground piping.
D. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.
E. Underground water-service piping shall be as shown on the plans

3.03 VALVE APPLICATIONS
A. General Application: Use mechanical-joint-end valves for NPS 2 (DN 50) and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FMG, nonrising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 (DN 50) and smaller installation.
B. Drawings indicate valve types to be used.
C. Provide 24” x 24” x 6” thick concrete apron around all valve boxes in asphalt pavement areas.

3.04 PIPING SYSTEMS - COMMON REQUIREMENTS
A. See Division 22 Section "Common Work Results for Plumbing" for piping-system common requirements.

3.05 PIPING INSTALLATION
A. Water-Main Connection: Verify with regulatory authority having jurisdiction that size of tap and location shown on the drawings are acceptable. Tap water main according to requirements of water utility company and of size and in location indicated.
B. Make connections NPS 2 (DN 50) and smaller with drilling machine according to the following:
   1. Install service-saddle assemblies and corporation valves in size, quantity, and arrangement required by utility company standards.
   2. Install service-saddle assemblies on water-service pipe to be tapped. Position outlets for corporation valves.
   3. Use drilling machine compatible with service-saddle assemblies and corporation valves. Drill hole in main. Remove drilling machine and connect water-service piping.
   4. Install corporation valves into service-saddle assemblies.
   5. Install manifold for multiple taps in water main.
   6. Install curb valve in water-service piping with head pointing up and with service box.
C. Comply with NFPA 24 for fire-service-main piping materials and installation.
D. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.
E. Install PVC, AWWA pipe according to ASTM F 645 and AWWA M23.

F. Bury piping with depth of cover over top at least [42 inches (1061 mm), with top at least 12 inches (300 mm) below level of maximum frost penetration, or as required by regulatory authority having jurisdiction, whichever is deeper. If pipe is installed in an excavated “cut” section prior to completion of grading operations, pipe shall be installed so that minimum required cover will exist upon completion of grading operations.

G. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.

H. Extend water-service piping and connect to water-supply source and building-water-piping systems five (5) feet outside face of building wall in locations and pipe sizes indicated.
   1. Terminate water-service piping five (5) feet outside building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.

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

J. Pipe Bedding: Pipe bedding material shall be as specified on trenching and bedding details as shown on drawings. No pipe shall be laid resting on a rock, blocking or unyielding objects.

K. Location with Sewers: Separate trenches shall be provided for water lines and sewer lines, with lines separated by a minimum of 10 feet horizontally. Water mains that cross sewers shall have a minimum vertical separation of 18 inches.

L. All piping shall be installed and verified to be level. This shall apply to piping in the horizontal and vertical positions.

M. See Division 21 Section "Water-Based Fire-Suppression Systems" for fire-suppression-water piping inside the building.

N. See Division 22 Section "Domestic Water Piping" for potable-water piping inside the building.

3.06 JOINT CONSTRUCTION

A. See Engineering Drawings for basic piping joint construction.

B. Make pipe joints according to the following:
   1. Copper-Tubing, Pressure-Sealed Joints: Use proprietary crimping tool and procedure recommended by copper, pressure-seal-fitting manufacturer.
   2. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
   3. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
   4. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139 and pipe manufacturer's written instructions.
   5. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure. Refer to Division 22 Section "Common Work Results for Plumbing" for joining piping of dissimilar metals.

3.07 ANCHORAGE INSTALLATION

A. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
   1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
   2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
   3. Fire-Service-Main Piping: According to NFPA 24.

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

3.08 VALVE INSTALLATION

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

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

C. UL/FMG, Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.
D. UL/FMG, Valves Other Than Gate Valves: Comply with NFPA 24.
E. MSS Valves: Install as component of connected piping system.
F. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

3.09 WATER METER INSTALLATION

A. Install water meters, piping, and specialties according to utility company's written instructions.

3.10 ROUGHING-IN FOR WATER METERS

A. Rough-in piping and specialties for water meter installation according to utility company's written instructions.

3.11 BACKFLOW PREVENTER INSTALLATION

A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.
B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.
C. Do not install bypass piping around backflow preventers.

3.12 WATER METER BOX INSTALLATION

A. Install water meter boxes in paved areas flush with surface. Provide 24” x 24” x 6” thick concrete apron around all valve boxes in asphalt pavement areas.
B. Install water meter boxes in grass or earth areas with top 2 inches (50 mm) above surface.

3.13 FIRE HYDRANT INSTALLATION

A. General: Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position.
B. AWWA Fire Hydrants: Comply with AWWA M17.
C. UL/FMG Fire Hydrants: Comply with NFPA 24.

3.14 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
B. See Engineering Plans for piping connections to valves and equipment.

3.15 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.
    1. The Contractor shall test all pipe lines and appurtenances with water at test pressure of 200 psi or 50 psi in excess of the system working pressure, whichever is greater. Test pressure must be maintained for at least 2 hours. All leakage apparent after testing must be repaired immediately. The work will not be finally accepted until leakage shall be as follows:
        a. The amount of leakage at the joints shall not exceed 2 quarts per hour per 100 gaskets or joints, irrespective of pipe diameter.
        b. The amount of leakage specified above shall be permitted to be increased by 1 fluid ounce per inch valve diameter per hour for each metal seated valve isolating the test section.
        c. If dry barrel hydrants are tested with the main valve open so the hydrants are under pressure, an additional 5 fluid ounces per minute shall be permitted for each hydrant.
        d. The amount of leakage in buried piping shall be measured at the specified test pressure by pumping from a calibrated container.

2. Fire Water System tests shall be in full conformity with the requirements of all applicable codes, NFPA standards, and other authorities having jurisdiction.
    a. All new underground mains and lead-ins shall be flushed thoroughly before connection is made to internal system piping. The site utility subcontractor shall be responsible for disposal of the test water drained from the test outlets.
    b. The trench shall be backfilled between joints before testing to prevent movement of pipe.
    c. Test shall be made by the site utility subcontractor in the presence of the regulatory authority having jurisdiction and/or the Owner's representative.
    d. After the fire service underground main and lead-in have been installed by the site utility subcontractor and are ready for use, the site utility subcontractor shall furnish 2 completed copies of the "Contractor's Material and Test Certificate for Private Fire Service Mains" form to the General Contractor. Prior to attachment of any pipe or equipment to the lead-in located in the sprinkler room, the sprinkler subcontractor shall obtain a copy of the completed form from the General Contractor.
    e. The site utility subcontractor shall prepare reports of testing activities and submit 2 copies to the General Contractor.

C. Prepare reports of testing activities.

3.16 IDENTIFICATION

3.17 Install continuous underground detectable warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Division 31 Section 312000 "Earth Moving" .

3.18 CLEANING

A. Clean and disinfect water-distribution piping as follows:
1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
    a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow tostand for 24 hours.
    b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
    c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
    d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.

B. The site utility subcontractor shall prepare reports of purging and disinfecting activities and submit two (2) copies to the General Contractor.

C. All fire protection underground mains shall be flushed per the flow rates listed below:

Fire Pump and/or Water Storage Tank Installed		No Fire Pump or Water Storage Tank	
8" pipe	2,350 gpm	8" pipe	1,560 gpm
10" pipe	3,670 gpm	10" pipe	2,440 gpm
12" pipe	5,290 gpm	12" pipe	3,520 gpm
14" pipe	7,188 gpm		
16" pipe	9,388 gpm		

Underground and lead-in fire protection mains shall be flushed through fire hydrants at dead ends of the underground piping system or through aboveground flushing outlets which are accessible will allow water to drain to a safe location and will provide the required flow listed above. Flush

underground mains until water is clear. Continue to flush for five minutes after water is clear. Utilize approved water flow measuring devices to verify that the required water flow is achieved.

END OF SECTION 331000

CONFORMANCE SUBMITTAL

SECTION 331000 – Facility Water Distribution Piping

Project Location _____

(*City, State*)

General Contractor: _____

(*Company Name, Phone Number*)

_____

(*Address*)

Sub-Contractor: _____

(*Company Name, Phone Number*)

_____

(*Address*)

The following products have been selected (check one box) for use in this project from the list of acceptable products specified:

Domestic and Fire Mains:

☐ Ductile-Iron Pipe, AWWA C151 Class 350, MJ DI Compact Fittings

☐ Polyvinyl Chloride (PVC) Pipe, AWWA C900, Class _____, MJ DI Compact Fittings

☐ Other per AHJ: _____

Domestic and Irrigation Supply Lines:

☐ Copper Tubing, ASTM B88, Type K, Annealed Temper, Copper Fittings

☐ Polyvinyl Chloride (PVC) Pipe, ASTM D2241, SDR 21

☐ Other per AHJ: _____

Fire Hydrants, BFP's, Valves, Meters, Fittings, Vaults, and all other Appurtenances:

☐ Conform to Project Specifications and All Authorities Having Jurisdiction

---

I represent to the City/Owner/Engineer that the product selected will be installed in compliance with the applicable codes for the authorities having jurisdiction and in accordance with the contract documents. If noncompliance is discovered the General Contractor shall make or cause to be made all necessary corrections to meet the applicable codes and specifications. Immediately or as directed by Owner the work shall be completed without additional cost to the Owner and / or the contract.

Sub-Contractor: _____

(*Signature of the Authorized Agent of the Sub-Contractor*) Date

_____

(*Print Name of the Authorized Agent of the Sub-Contractor*)

General Contractor: _____

(*Signature of the Authorized Agent of the General Contractor*) Date

_____

(Print Name of the Authorized Agent of the General Contractor)

WATER DISTRIBUTION SYSTEM CERTIFICATION FORM

Project	
Date	
Engineer	
General Contractor	
Utility Contractor	
Const. Mgr.	

ENGINEER CERTIFICATION (If required)

I certify that the water distribution system for the above referenced project has been installed and tested in accordance with local code and Project Plans and Specifications dated _____**.**

Engineer _____

Registration No._____ Affix Seal Here (not valid unless sealed)

Date _____

GENERAL CONTRACTOR CERTIFICATION (Required)

I certify that the water distribution system for the above referenced project has been installed and tested in accordance with local code and Project Plans and Specifications dated _____**.**

General Contractor _____

License No._____

Date _____

UTILITY CONTRACTOR CERTIFICATION (Required)

I certify that the water distribution system for the above referenced project has been installed and tested in accordance with local code and Project Plans and Specifications dated _____**.**

Utility Contractor _____

License No._____

Date _____

* Submit this certification form with test results, local certificates, etc.

Contractor's Material and Test Certificate for Underground Piping

PROCEDURE

Upon completion of work, inspection and tests shall be made by the contractor's representative and witnessed by an owner's representative. All defects shall be corrected and system left in service before contractor's personnel finally leave the job.

A certificate shall be filled out and signed by both representatives. Copies shall be prepared for approving authorities, owners, and contractor. It is understood the owner's representative's signature in no way prejudices any claim against contractor for faulty material, poor workmanship, or failure to comply with approving authority's requirements or local ordinances.

Property name		Date
Property address		
Plans	Accepted by approving authorities (names)	
	Address	
	Installation conforms to accepted plans	☐ Yes ☐ No
	Equipment used is approved If no, state deviations	☐ Yes ☐ No
Instructions	Has person in charge of fire equipment been instructed as to location of control valves and care and maintenance of this new equipment? If no, explain	☐ Yes ☐ No
	Have copies of appropriate instructions and care and maintenance charts been left on premises? If no, explain	☐ Yes ☐ No
Location	Supplies buildings	
Underground pipes and joints	Pipe types and class	Type joint
	Pipe conforms to _____ standard Fittings conforms to _____ standard If no, explain	☐ Yes ☐ No ☐ Yes ☐ No
	Joints needed anchorage clamped, strapped, or blocked in accordance with _____ standard If no, explain	☐ Yes ☐ No
Test description	Flushing: Flow the required rate until water is clear as indicated by no collection of foreign material in burlap bags at outlets such as hydrants and blow-offs. Flush at flows not less than 390 gpm (1476 L/min) for 4-in. pipe, 880 gpm (3331 L/min) for 6-in. pipe, 1560 gpm (5905 L/min) for 8-in. pipe, 2440 gpm (9235 L/min) for 10-in. pipe, and 3520 gpm (13,323 L/min) for 12-in. pipe. When supply cannot produce stipulated flow rates, obtain maximum available. Hydrostatic: Hydrostatic tests shall be made at not less than 200 psi (13.8 bar) for 2 hours or 50 psi (3.4 bar) above static pressure in excess of 150 psi (10.3 bar) for 2 hours. Leakage: New pipe laid with rubber gasketed joints shall, if the workmanship is satisfactory, have little or no leakage at the joints. The amount of leakage at the joints shall not exceed 2 quarts per hour (1.89 L/hr) per 100 joints irrespective of pipe diameter. The leakage shall be distributed over all joints. If such leakage occurs at a few joints, the installation shall be considered unsatisfactory and necessary repairs made. The amount of allowable leakage specified above can be increased by 1 fluid ounce per inch valve diameter per hr. (30 mL/25 mm/hr) for each metal seated valve isolating the test section. If dry barrel hydrants are tested with the main valve open so the hydrants are under pressure, an additional 5 ounces per minute (150 mL/min) leakage is permitted for each hydrant.	
Flushing tests	New underground piping flushed according to _____ standard by (company) If no, explain	☐ Yes ☐ No
	How flushing flow was obtained ☐ Public water ☐ Tank or reservoir ☐ Fire pump	Through what type opening ☐ Hydrant butt ☐ Open pipe
	Lead-ins flushed according to _____ standard by (company) If no, explain	☐ Yes ☐ No
	How flushing flow was obtained ☐ Public water ☐ Tank or reservoir ☐ Fire pump	Through what type opening ☐ Y connection to flange and spigot ☐ Open pipe

Hydrostatic test	All new underground piping hydrostatically tested at _____ psi for _____ hours	Joints covered ☐ Yes ☐ No
Leakage test	Total amount of leakage measured _____ gallons _____ hours	
	Allowable leakage _____ gallons _____ hours	
Hydrants	Number installed / Type and make	All operate satisfactorily ☐ Yes ☐ No
Control valves	Water control valves left wide open If no, state reason	☐ Yes ☐ No
	Hose threads of fire department connections and hydrants interchangeable with those of fire department answering alarm	☐ Yes ☐ No
Remarks	Date left in service	
Signatures	Name of installing contractor	
	Tests witnessed by	
	For property owner (signed) / Title / Date	
	For installing contractor (signed) / Title / Date	
Additional explanation and notes		

SECTION 333000

SANITARY SEWER

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. This section includes sanitary sewer piping and related appurtenances from connection to main to within 5 feet of outside building limits.
2. Pipe and fittings.
3. Non-pressure and pressure couplings.
4. Expansion joints and deflection fittings.
5. Backwater valves.
6. Cleanouts.
7. Encasement for piping.
8. Manholes.

1.03 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)
   1. A746 - Standard Specification for Ductile Iron Gravity Sewer Pipe
   2. D3034 – Standard Specification for Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings
   3. F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
   4. F696 - Standard Specification for Poly Vinyl Chloride (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
   5. C476 - Standard Specification for Grout for Masonry
   6. C443 - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
   7. C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
   8. D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
   9. D478 - Standard Specifications for Precast Reinforced Concrete Manhole Sections
   10. C969 - Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Sewer Lines
B. American Society of Sanitary Engineers (ASSE)
C. American National Standards Institute (ANSI)
D. American Concrete Institute (ACI)
   1. 318 - Code Requirements for Structural Plain Concrete
E. National Sanitation Foundation (NSF)
F. American Water Works Association (AWWA)
   1. C110 - Ductile-Iron and Gray-Iron Fittings, 3 in through 48 in (75 mm through 1200 mm), for Water and Other Liquids (revision of ANSI/AWWA C110/A21.10-93)
   2. C1111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings C153 - Ductile-Iron Compact Fittings, 3 in. through 24 in. (76 mm Through 610 mm) and 54 in. through 64 in. (1,400 mm Through 1,600 mm), for Water Service (revision of ANSI/AWWA C153/A21.53-94).
   3. C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances (revision of ANSI/AWWA C600-93)
   4. C150 - ANSI Standard for Thickness Design of Ductile Iron Pipe
   5. C151 – ANSI Standard for Ductile Iron Pipe

6. C153 – ANSI Standard for Ductile Iron Pipe Compact Fittings

G. Federal Specifications
   1. SS-S-00210 - Sealing Compound Preformed Plastic for Pipe Joints

H. Uni-Bell PVC Pipe Association
   1. UNI-B-6 - Low-Pressure Air Testing of Installed Sewer Pipe

1.04 SUBMITTALS

A. Conformance Submittal: The General Contractor and the Subcontractor shall execute the Conformance Submittal(s) at the end of this Section.

B. Field inspection, testing and quality-control reports.

C. Sanitary Sewer Certification Form (signed by the Engineer, General Contractor and Utility Contractor) at the end of this Section.

1.05 DELIVERY, STORAGE, AND HANDLING

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

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

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

1.06 PROJECT CONDITIONS

A. Coordination and Fees:
   1. Contractor shall comply with requirements of the regulatory authorities having jurisdiction including tapping of sewer mains, installation and testing.
   2. Contractor shall be responsible for obtaining and payment of all tap and construction permit fees associated with this Section.
   3. Contractor to install all sanitary sewer lines and appurtenances as shown on the drawings to within 5 feet of building limits. If the Contractor’s work terminates at a connection point where work by others is complete, the Contractor shall make the connection. If future connections are required by others, the Contractor shall install plugging and marking as necessary to identify and locate the work.

B. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
   1. Notify Owner no fewer than two days in advance of proposed interruption of service.
   2. Do not proceed with interruption of service without Owner’s written permission.

PART 2 - PRODUCTS

2.01 DUCTILE-IRON, GRAVITY SEWER PIPE AND FITTINGS

A. Pipe: ASTM A 746, for push-on joints.

B. Standard Fittings: AWWA C110, ductile or gray iron, for push-on joints.

C. Compact Fittings: AWWA C153, ductile iron, for push-on joints.

D. Gaskets: AWWA C111, rubber.

2.02 PVC PIPE AND FITTINGS

A. Performance Requirements:

   1. Gravity Flow Non-Pressure Piping Pressure Ratings: at least equal to system test pressure.
   2. Force-Main Pressure Ratings: at least equal to system operating pressure but not less than 150 psig.

B. PVC Gravity Sewer Piping:
   1. 12 Inch and Smaller PVC Pipe and Fittings: ASTM D 3034, SDR, PVC gravity sewer pipe with bell-and-spigot ends and with integral ASTM F 477, elastomeric seals for gasketed joints.
   2. 15 Inch and Larger PVC Pipe and Fittings: ASTM F 679, SDR 35, Type T-1 wall thickness, PVC gravity sewer pipe with bell-and-spigot ends and with integral ASTM F 477, elastomeric seals for gasketed joints.

2.03 NONPRESSURE-TYPE TRANSITION COUPLINGS

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

B. Sleeve Materials:
   1. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
   2. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

C. Unshielded, Flexible Couplings:

2.04 CLEANOUTS

A. Cleanouts shall be provided on sanitary sewer service laterals at no more than 100' on center. Exterior cleanout plug shall be level with adjacent grade and provided with a 2' x 2' x 6" thick concrete apron as shown on the Drawings.

B. Cast-Iron Cleanouts:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide US Foundry cover USF 7621 or equal product as indicated on Drawings.
   2. Description: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.
   3. Top-Loading Classification(s): Heavy Duty.
   4. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

C. PVC Cleanouts:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings.
   2. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

2.05 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105.

B. Material: high-density, cross-laminated polyethylene film of 0.004-inch (0.10-mm) minimum thickness.

C. Form: Sheet.

D. Color: Black.

2.06 MANHOLES

A. Standard Precast Concrete Manholes:
   1. Description: ASTM C 478 (ASTM C 478M), precast, reinforced concrete, of depth indicated, with provision for rubber gasketed joints and rubber pipe boots.
   2. Inside Diameter: 48 inches (1200 mm) minimum unless otherwise indicated.
   3. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
   4. Base Section: 8-inch (175-mm) minimum thickness for floor slab and 5-inch (125-mm) minimum thickness for walls and base riser section; with separate base slab or base section with integral floor.
   5. Riser Sections: 5-inch (125-mm) minimum thickness, of length to provide depth indicated.
   6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated; with top of cone of size that matches grade rings.
   7. Gasket: ASTM C 443, rubber (when required by local authority having jurisdiction).
   8. Resilient Pipe Connectors: ASTM C 923 (ASTM C 923M), cast or fitted into manhole walls, for each pipe connection.
   9. Steps: Individual FRP steps wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 16-inch (400-mm) intervals. Omit steps if total depth from floor of manhole to finished grade is less than 42 inches (1050 mm).

10. Grade Rings (if required): Reinforced-concrete rings, 6- to 9-inch (150- to 225-mm) total thickness, with diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope.
11. Pipe Connectors: ASTM C 923, resilient, of size required for each pipe connecting to base section.
12. Joints of the manhole sections shall be tongue and groove filled with approved preformed butyl rubber base sealing compound conforming to Federal Specifications SS-S210A, Type 1, and Rope Form.

B. Designed Precast Concrete Manholes:
1. Description: ASTM C 913; designed according to ASTM C 890 for A-16 (ASSHTO HS20-44), heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for sealant joints.
2. Ballast: Increase thickness of one or more precast concrete sections or add concrete to manhole as required preventing flotation.
3. Joint Sealant: ASTM C 990 (ASTM 990M), bitumen or butyl rubber.
4. Resilient Pipe Connectors: ASTM C 923 (ASTM C 923M), cast or fitted into manhole walls, for each pipe connection.
5. Steps: Individual FRP steps or wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 16-inch (400-mm) intervals. Omit steps if total depth from floor of manhole to finished grade is less than **42 inches (1050 mm)**.
6. Grade Rings: Reinforced-concrete rings, 6- to 9-inch (150- to 225-mm) total thickness, with diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope.

C. Manhole Frames and Covers:
1. Description: Ferrous; 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser, with 4-inch- (100-mm-) minimum-width flange and 26-inch- (660-mm-) diameter cover. Include indented top design with 2 inch high lettering cast into cover, with the words "SANITARY SEWER." Cover must be bolted (to prevent theft).
2. Standard manhole frame and cover shall conform to the standard detail of the regulatory authorities having jurisdiction for the project. Otherwise manhole frames and covers shall be as detailed on the Drawings.

2.07 CONCRETE

A. General: Cast-in-place concrete complying with ACI 318, ACI 350/350R (ACI 350M/350RM), and the following:
1. Cement: ASTM C 150, Type II.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

B. PortlandCement Design Mix: 4000 psi (27.6 MPa) minimum, with 0.45 maximum water/cementitious materials ratio.
1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi (27.6 MPa) minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.
1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
    a. Invert Slope: 2 percent through manhole.
2. Benches: Concrete, sloped to drain into channel.
    a. Slope: 4 percent.

D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi (20.7 MPa) minimum, with 0.58 maximum water/cementitious materials ratio.
1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

PART 3 - EXECUTION

3.01 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving"

3.02 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewer piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

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

C. Clear interior of piping and structures of dirt and deleterious materials as work progresses. Place plug in end of incomplete piping at end of day and work stops for greater than 24 hours. Flush piping between manholes and other structures to remove collected debris when needed.

D. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

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

F. Install gravity-flow piping to within 5 feet of the building limits of sizes and in locations shown on the Drawings. Terminate piping as specified.

G. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of micro tunneling.

H. Install gravity-flow, nonpressure, drainage piping according to the following:

1. Install piping pitched down in direction of flow, at slope shown on the Drawings, and at a minimum slope of 1 percent for 6 inch diameter pipe and 0.5 percent for 8 diameter inch pipes unless otherwise indicated.
2. Install piping with 36-inch (915-mm) minimum cover.
3. Install ductile-iron, gravity sewer piping according to ASTM A 746.
4. Install PVC gravity sewer piping according to ASTM D 2321 and ASTM F 1668.

I. Install force-main, pressure piping according to the following:

1. Install piping with restrained joints at tee fittings and at horizontal and vertical changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place-concrete supports or anchors.
2. Install piping with 36-inch (915-mm) minimum cover.
3. Install ductile-iron special fittings according to AWWA C600.
4. Install PVC pressure piping according to AWWA M23 or to ASTM D 2774 and ASTM F 1668.

J. If indicated on Drawings install corrosion-protection piping encasement over the following underground metal piping according to ASTM A 674 or AWWA C105:

1. Ductile-iron pipe and fittings.
2. Expansion joints and deflection fittings.

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

3.03 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure, drainage piping according to the following:

1. Join ductile-iron, gravity sewer piping according to AWWA C600 for push-on joints.
2. Join PVC gravity sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints.
3. Join dissimilar pipe materials with nonpressure-type, flexible or rigid couplings.

B. Join force-main, pressure piping according to the following:

1. Join PVC pressure piping according to AWWA M23 for gasketed joints.

C. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
1. Use non-pressure flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
   a. Shielded flexible couplings for pipes of same or slightly different OD.
   b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
   c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.
2. Use pressure pipe couplings for force-main joints.

3.04 MANHOLE INSTALLATION

A. General: Install manholes complete with appurtenances and accessories indicated.
B. Install precast concrete manhole sections with sealants according to ASTM C 891.
C. Install FRP manholes according to manufacturer's written instructions.
D. Form continuous concrete channels and benches between inlets and outlet.
E. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches (76 mm) above finished surface elsewhere unless otherwise indicated.

3.05 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318.

3.06 BACKWATER VALVE INSTALLATION (If used)

A. Install horizontal-type backwater valves in piping manholes or pits.
B. Install combination horizontal and manual gate valves in piping and in manholes.
C. Install terminal-type backwater valves on end of piping and in manholes. Secure units to sidewalls.

3.07 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts, and use cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic and truck service areas.

B. Set cleanout frames and covers in cast-in-place-concrete, 24 by 24 by 6 inches (600 by 600 by 150 mm) deep. Set with tops flush with surrounding grade.
C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.08 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drains specified in the engineering drawings.
B. Connect force-main piping to building's sanitary force mains specified in Division 22 Section "Sanitary Waste and Vent Piping." Terminate piping where indicated.
C. Make connections to existing piping and underground manholes.
1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye fitting plus 6-inch (150-mm) overlap with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).
2. Make branch connections from side into existing piping, NPS 4 to NPS 20 (DN 100 to DN 500). Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).

3. Make branch connections from side into existing piping, NPS 21 (DN 525) or larger, or to underground manholes by cutting opening into existing unit large enough to allow 3 inches (76 mm) of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe or manhole wall, encase entering connection in 6 inches (150 mm) of concrete for minimum length of 12 inches (300 mm) to provide additional support of collar from connection to undisturbed ground.
    a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi (20.7 MPa) unless otherwise indicated.
    b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.
4. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

D. Connect to grease oil and sand interceptors specified in Division 2 Section "Sanitary Sewer."

3.09 CLOSING ABANDONED SANITARY SEWER SYSTEMS

A. The Contractor shall be responsible for removal and/or relocation of existing utilities as necessary, whether shown or not shown on the Drawings. At locations where conflicts occur with proposed sanitary sewer improvements, removal and relocation shall be at no additional cost to the Owner.

B. Abandoned Piping: Close and grout fill open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:
1. Close open ends of piping with at least 8-inch- (203-mm-) thick, brick masonry bulkheads.
2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

C. Abandoned Manholes: Excavate around manhole as required and use either procedure below:
1. Remove manhole and close open ends of remaining piping.
2. Remove top of manhole down to at least 36 inches (915 mm) below final grade. Fill to within 12 inches (300 mm) of top with gravel, or compacted dirt. Fill to top with concrete.

D. Backfill to grade according to Division 31 Section “Earth Moving”

3.10 IDENTIFICATION

A. Materials and their installation are specified in Division 31 Section "Earth Moving." Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.
1. Use warning tape or detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground manholes.

3.11 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches (600 mm) of backfill is in place, and again at completion of Project.
1. Submit separate report for each system inspection.
2. Defects requiring correction include the following:
    a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 95 percent of piping diameter.
    c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
    d. Infiltration: Water leakage into piping.
    e. Exfiltration: Water leakage from or around piping.
3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Re-inspect and repeat procedure until results are satisfactory.

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

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test to General Contractor within 2 days of test.
5. If authorities having jurisdiction do not have published procedures, perform tests as follows:
   a. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:
      1) Fill sewer piping with water. Test with pressure of at least 10-foot (3-m) head of water, and maintain such pressure without leakage for at least 15 minutes.
      2) Close openings in system and fill with water.
      3) Purge air and refill with water.
      4) Disconnect water supply.
      5) Test and inspect joints for leaks.
      6) Allowable leakage is a maximum of 50 gal. Per inch of nominal pipe size per mile of pipe per day.
      7) Option: Test ductile iron piping according to AWWA C600, Section “Hydrostatic Testing”. Use test pressure of at least 10 psig.
6. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
   a. Option: Test plastic gravity sewer piping according to ASTM F 1417.
7. Force Main: Perform hydrostatic test after thrust blocks, supports, and anchors have hardened. Test at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than 150 psig (1035 kPa).
   a. PVC Piping: Test according to AWWA M23, "Testing and Maintenance" Chapter.
8. Manholes: Perform hydraulic test according to ASTM C 969 (ASTM C 969M).

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

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

3.12 CLEANING

A. Clean dirt and superfluous material from interior of piping flush with potable water**.**

END OF SECTION 333000

CONFORMANCE SUBMITTAL

SECTION 333000 – SANITARY SEWER

Project Location _____
(*City, State*)

General Contractor: _____
(*Company Name, Phone Number*)

_____
(*Address*)

Sub-Contractor: _____
(*Company Name, Phone Number*)

_____
(*Address*)

The following products have been selected (check one box) for use in this project from the list of acceptable products specified:

Piping Materials:

☐ Ductile-Iron Pipe, ASTM A746
☐ Polyvinyl Chloride (PVC) Pipe, ASTM D3034, SDR 35, Elastomeric Gasket Joints ASTM F477
☐ Other per AHJ: _____

Manholes:

☐ Precast with Cored or Cast Holes with Properly Sized Boots
☐ Other per AHJ: _____

I represent to City/Owner/Engineer that the products selected will be installed in compliance with the applicable codes for the authorities having jurisdiction and in accordance with the contract documents. If noncompliance is discovered the General Contractor shall make or cause to be made all necessary corrections to meet the applicable codes and specifications. Immediately or as directed by Owner the work shall be completed without additional cost to the Owner and / or the contract.

Sub-Contractor: _____
(*Signature of the Authorized Agent of the Sub-Contractor*) Date

_____
(*Print Name of the Authorized Agent of the Sub-Contractor*)

General Contractor: _____
(*Signature of the Authorized Agent of the General Contractor*) Date

_____
(Print Name of the Authorized Agent of the General Contractor)

SANITARY SEWER CERTIFICATION FORM

Project	
Date	
Engineer	
General Contractor	
Utility Contractor	
Const. Mgr.	

ENGINEER CERTIFICATION (If required)
I certify that the sanitary sewer system for the above referenced project has been installed and tested in accordance with local code and Project Plans and Specifications dated _____**.**

Engineer _____
Registration No._____ Affix Seal Here (not valid unless sealed)
Date _____

GENERAL CONTRACTOR CERTIFICATION (Required)
I certify that the sanitary sewer system for the above referenced project has been installed and tested in accordance with local code and Project Plans and Specifications dated _____**.**

General Contractor _____
License No._____
Date _____

UTILITY CONTRACTOR CERTIFICATION (Required)
I certify that the sanitary sewer system for the above referenced project has been installed and tested in accordance with local code and Project Plans and Specifications dated _____**.**

Utility Contractor _____
License No._____
Date _____

***** Submit this certification form with test results, local certificates, etc.

SECTION 33 41 00

STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
1. Pipe and fittings.
2. Nonpressure transition couplings.
3. Pressure pipe couplings.
4. Expansion joints and deflection fittings.
5. Backwater valves.
6. Cleanouts.
7. Drains.
8. Encasement for piping.
9. Manholes.
10. Channel drainage systems.
11. Catch basins.
12. Stormwater inlets.
13. Stormwater detention structures.
14. Pipe outlets.
15. Dry wells.
16. Stormwater disposal systems.

1.03 STANDARDS

A. American Society For Testing and Materials (ASTM)
1. A185 – Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
2. A615 – Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
3. A760 – Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains
4. A798 – Installation of Corrugated-Steel Pipe for Sewers and Other Applications
5. A929 – Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe
6. C76 – Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
7. C443 – Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
8. C478 – Precast Reinforced Concrete Manhole Sections
9. C913 – Precast Concrete Water and Wastewater Structures
10. C1479 – Installation of Reinforced Concrete Pipe
11. C990-01A – Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
12. D1056 – Flexible Cellular Materials-Sponge or Expanded Rubber
13. D2306 – Annular Corrugated Profile Wall Polyethylene pipe and Fittings for Gravity Flow Storm Sewer and Subsurface Drainage Applications
14. D2321 – Installation of Thermoplastic Pipe for Sewer/Gravity-Flow Applications
15. D3034 – Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
16. D3212 – Joints for Drain and Sewer Plastic Pipes Using Elastomeric Seals
17. F477 – Elastomeric Seals (Gaskets) for Joining Plastic Pipe
18. F794 – Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
19. F949 – Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings
20. F2418 – Polypropylene (PP) Corrugated Wall Stormwater Collection Chambers
21. F2306 – Annular Corrugated Profile Wall Polyethylene (PE) Pipe and Fittings

22. F2562 – Steel Reinforced Thermoplastic Ribbed Pipe
23. C1504 - Precast Steel Reinforced Three Sided Concrete Structures

B. American Association of State Highway and Transportation Officials (AASHTO)
1. M36 – Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains
2. M198 – Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets
3. M252 – Corrugated Polyethylene Drainage Tubing
4. M274 – Aluminum-Coated (Type 2), for Corrugated Steel Pipe
5. M288 – Geotextile Specification for Highway Applications
6. M294 – Corrugated Polyethylene Pipe.
7. M36 – Metallic Coated Corrugated Steel Culverts and Underdrains
8. M43 – Sizes of Aggregate for Road and Bridge Construction
9. M190 – Bituminous Coated Corrugated Metal Culvert Pipe and Pipe Arches
10. M199 – Standard Specification for Precast Reinforced Concrete Manhole Sections
11. AASHTO LRFD Bridge Design Specifications Sections 3 & 12

C. American Water Works Association (AWWA)
1. C110 – Ductile-Iron and Gray-Iron Fittings, 3 in through 48 in (75 mm through 1200 mm), for Water and Other Liquids (revision of ANSI/AWWA C110/A21.10-93)
2. C111 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
3. C151 – Ductile-Iron Pipe, Centrifugally Cast, for Water

D. American Concrete Institute (ACI)
1. 301 – Structural Concrete for Buildings, Specifications for
2. 318 –Building Code Requirements for Structural Plain Concrete

1.04 SUBMITTALS

A. The General Contractor and the Subcontractor shall execute the Conformance Submittals at the end of this section:
1. Storm Drainage Conformance Submittal

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

C. Shop Drawings:
1. Manholes: Include plans, elevations, sections, details, frames, and covers.
2. Catch basins stormwater inlets and dry wells. Include plans, elevations, sections, details, frames, covers, and grates.
3. Stormwater Detention Structures: Include plans, elevations, sections, details, frames, covers, and concrete design-mix reports.

D. Product Certificates: For each type of cast-iron soil pipe and fitting, from manufacturer.

E. Field quality-control reports.

F. Project Record Drawings: Accurately record as-built locations of pipe runs, connections, catch basins, cleanouts, top elevations and invert elevations. Identify and describe unexpected variations of subsurface conditions and location of any utilities encountered.

1.05 QUALITY ASSURANCE

A. All costs associated with re-inspection due to failures shall be paid for by the Contractor at no additional expense to the Owner. Owner reserves the right to direct any inspection that is deemed necessary. Contractor shall provide free access to site for inspection activities.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic, pipe, and fittings in direct sunlight with the exception of Corrugated High Density Polyethylene Pipe and Fittings.

B. All pipe shall be protected against impact, shock and free fall, and only equipment of sufficient capacity and proper design shall be used in the handling of the pipe. Pipes and chambers shall not be rolled or dragged over gravel or rock during handling. The Contractor shall take necessary precautions to ensure the method used in lifting or placing the pipe or chambers does not induce stress fatigue in the pipe or chamber and the lifting device used uniformly distributes the weight of the pipe or chamber along the axis or circumference. Storage of pipe on the job shall be in accordance with the pipe manufacturer’s recommendations.

C. Protect pipe, pipe fittings, and seals from dirt and damage.
D. Damage to Pipe or Chambers:
   1. Each length of pipe or chamber shall be inspected for defects and cracks before carefully being lowered into the trench.
   2. Bituminous coated pipe shall be handled with special care and repair of damaged coating shall conform to AASHTO M190.
   3. Pipe or chambers which are defective from any cause, including damage caused by handling, storage or any other reason as determined by the Owner to be not repairable, shall be unacceptable for installation and shall be replaced at no cost to the Owner and as directed by the Owner.
   4. Pipe or chambers that are damaged or disturbed through any cause prior to acceptance of the work shall be repaired, realigned or replaced as directed by the Owner at no expense to the Owner.
E. Handle manholes according to manufacturer's written rigging instructions.
F. Handle catch basins and stormwater inlets according to manufacturer's written rigging instructions.

1.07 PROJECT CONDITIONS

A. Removal/Relocation of Existing Utilities: The Contractor shall be responsible for removal and/or relocation of existing utilities, whether shown or not shown on the drawings, at locations where conflicts occur with proposed storm drainage improvements. Removal and relocation shall be at no additional cost to the Owner.
B. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
   1. Notify Owner no fewer than seven days in advance of proposed interruption of service.
   2. Do not proceed with interruption of service without Owner's written permission.

PART 2 - PRODUCTS

2.01 DUCTILE-IRON, CULVERT PIPE AND FITTINGS

A. Pipe: ASTM A 716, for push-on joints.
B. Standard Fittings: AWWA C110, ductile or gray iron, for push-on joints.
C. Compact Fittings: AWWA C153, for push-on joints.
D. Gaskets: AWWA C111, rubber.

2.02 ALUMINIZED PIPE AND FITTINGS

A. Aluminized Steel Type 2 Corrugated Steel Pipe 2 (CMP):
   1. Pipe shall meet requirements of ASTM A929 or AASHTO M 274 or ASTM A760
   2. Minimum gauge shall be 16 gauge for pipe diameters 10-24 inches, 14 gage for diameters 30-48 inches. Stormwater detention systems only: 12 gage for diameters 54-96 inches and 10 gauge for diameters 102 inches and larger, but not less than the diameter indicated on the drawings.
   3. Each pipe shall be clearly marked to show the class or gauge, date of manufacture and name or trademark of the manufacturer.
   4. Joints shall be fully corrugated 10” wide outside collars or coupling bands of aluminized steel angles riveted near the ends and bolted through angles to draw the bands tight for silt-tight designations. Additionally, a 7 “wide by 3/8” thick one piece continuous neoprene gasket per ASTM D1056 shall be provided at watertight designations.
   5. Maximum permitted diameter for CMP storm drainage piping is 48”
   6. CMP larger than 48”diameter is allowed for subsurface stormwater detention systems only.
B. Aluminized Steel Type 2 Spiral Ribbed Pipe (Type IR)
   1. Pipe shall meet the requirements of ASTM A929 and AASHTO M274 or ASTM A760 with ¾” x ¾” x 7-1/2” continuous external ribs in accordance with the applicable requirements of AASHTO M-36 or ASTM A760 such as “Ultra-Flo” by Contech or approved equal.

2. Minimum gauge shall be 16 gauge for pipe diameters 10-24 inches and 14 gauge for diameters 30-48 inches, but not less than the diameter indicated on the drawings.
3. Each pipe shall be clearly marked to show the class or gauge, date of manufacture and name or trademark of the manufacturer.
4. Joints shall be fully corrugated 10” wide outside collars or coupling bands of aluminized steel angles riveted near the ends and bolted through angles to draw the bands tight for silt-tight designations. Additionally, a 7 “ wide by 3/8” thick one piece continuous neoprene gasket per ASTM D1056 shall be provided at watertight designations
5. Pipe sizes, gages and corrugations shall be as shown on the project plans.
6. Maximum permitted diameter is 48”

2.03 HDPE PIPE AND FITTINGS

A. Steel Reinforced Thermoplastic Ribbed Smooth Interior Pipe

1. Pipe lengths shall be joined on site using bell and spigots reinforced with steel that is fully encased in a pressure rated high density polyethylene and shall be watertight to an internal water pressure of 15 psi when tested in accordance with ASTM D3212.
2. Gaskets shall meet the requirements of ASTM F477
3. Maximum Diameter shall be 48”

B. High Density Polyethylene Pipe (HDPE) Smooth Interior Pipe:

1. Pipe and Fittings: Shall conform to AASHTO M252 and M294 and/or ASTM F2360 unless otherwise shown on the Drawings.
2. Gaskets: Rubber gaskets shall meet requirements of ASTM F477 with joints conforming to AASHTO M294, watertight designations
3. Maximum permitted diameter is 48”.
4. See drawings for bedding details.
5. HDPE Pipe shall be NTPEP Certified.
6. Approved Manufacturers:
   a. Advance Drainage Systems, Inc., 3300 Riverside Drive, Columbus, Ohio 43221 (614) 457-3051
   b. Hancor, Inc., 401 Olive Street, Findlay, Ohio 45840 (888) 367-7473
   c. Lane Enterprises, Inc. (for Type S Lok-Tite Pipe) 3905 Hartzdale Drive, Suite 514, Camp Hill, PA 17011 (717) 761-8175
   d. Quality Culvert, Inc., 25726 County Road 561, Astatula, FL 34750 (800) 881-1100

2.04 PVC PIPE AND FITTINGS

A. PVC Cellular-Core Piping:

1. PVC Cellular-Core Pipe and Fittings: ASTM F 891, Sewer and Drain Series, PS 50 minimum stiffness, PVC cellular-core pipe with plain ends for solvent-cemented joints.
2. Fittings: ASTM D 3034, SDR 35, PVC socket-type fittings.

B. PVC Corrugated Sewer Piping:

1. Pipe: ASTM F 949, and ASTM F 794 PVC, corrugated pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM F 949, PVC molded or fabricated, socket type.
3. Gaskets: ASTM F 477, elastomeric seals with joints conforming to ASTM D3212
4. Approved Manufacturers:
   a. Contech “A2000”, 1001 Grove Street, Middletown, OH 45044

2.05 CONCRETE PIPE AND FITTINGS

A. Reinforced-Concrete Pipe and Fittings: ASTM C 76 (ASTM C 76M).

1. Bell-and-spigot or tongue-and-groove ends and gasketed joints with ASTM C 443 (ASTM C 443M), rubber gaskets or sealant joints with ASTM C 990 (ASTM C 990M), bitumen or butyl-rubber sealant for silt-tight designations.
2. Class III, unless otherwise indicated on the Drawings.

2.06 NONPRESSURE TRANSITION COUPLINGS

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

B. Sleeve Materials:
   1. For Concrete Pipes: ASTM C 443 (ASTM C 443M), rubber.
   2. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
   3. For Fiberglass Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
   4. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
   5. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

C. Unshielded, Flexible Couplings:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on the Drawings.

D. Shielded, Flexible Couplings:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings

E. Ring-Type, Flexible Couplings:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings

2.07 DRAINS

A. Sub Drains:
   1. Shall be perforated PVC or HDPE unless otherwise indicated on the Drawings. Installation shall be as shown on the drawings.

2.08 CLEANOUTS AND PLUGS

A. Installation shall be as shown on the details and at locations shown on the drawings.

B. All cleanouts shall have a 2’ x 2’ x 6” thick concrete apron.

2.09 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105.

B. Material: Linear low-density polyethylene film of 0.008-inch (0.20-mm) minimum thickness.

C. Form: Sheet or tube.

D. Color: Black.

2.10 MANHOLES

A. Standard Precast Concrete Manholes:
   1. Description: ASTM C 478 (ASTM C 478M) and AASHTO M199, precast, reinforced concrete, of depth indicated, with provision for sealant joints. Heavy-duty traffic rated in accordance with Department of Transportation Standards in which project is located.
   2. Diameter: 48 inches (1200 mm) minimum unless otherwise indicated.
   3. Ballast: Increase thickness of precast concrete sections or add concrete to base section as required preventing flotation.
   4. Base Section: 6-inch (150-mm) minimum thickness for floor slab and 4-inch (102-mm) minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
   5. Riser Sections: 4-inch (102-mm) minimum thickness and lengths to provide depth indicated.
   6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated, and top of cone of size that matches grade rings.
   7. Joint Sealant: ASTM C 990 (ASTM C 990M), bitumen or butyl rubber.
   8. Resilient Pipe Connectors: ASTM C 923 (ASTM C 923M), cast or fitted into manhole walls, for each pipe connection.
   9. Steps: Individual FRP steps; FRP ladder; or ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor

steps into sidewalls at 16-inch (400-mm) intervals. Omit steps if total depth from floor of manhole to finished grade is less than 42 inches (1050 mm).

10. Grade Rings: Reinforced-concrete rings, 6- to 9-inch (150- to 225-mm) total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope.

B. Designed Precast Concrete Manholes:
   1. Description: ASTM C 913; designed according to ASTM C 890 for A-16 (AASHTO HS20-44), heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for sealant joints.
   2. Ballast: Increase thickness of one or more precast concrete sections or add concrete to manhole as required preventing flotation.
   3. Joint Sealant: ASTM C 990 (ASTM C 990M), bitumen or butyl rubber.
   4. Resilient Pipe Connectors: ASTM C 923 (ASTM C 923M), cast or fitted into manhole walls, for each pipe connection.
   5. Steps: Individual FRP steps; FRP ladder; or ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 16-inch (400-mm) intervals. Omit steps if total depth from floor of manhole to finished grade is less than 42 inches (1050 mm).
   6. Grade Rings: Reinforced-concrete rings, 6- to 9-inch (150- to 225-mm) total thickness, to match diameter of manhole frame and cover, and of height required to adjust manhole frame and cover to indicated elevation and slope.

C. Manhole Frames and Covers:
   1. Description: As shown on the Drawings, otherwise provide ferrous; 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser with 4-inch- (102-mm-) minimum width flange and 26-inch-(660-mm-) diameter security bolted cover.
   2. Material: ASTM A 536, Grade 60-40-18 ductile iron unless otherwise indicated.

2.11 BEDDING AND BACKFILL MATERIAL

A. Bedding material shall be as specified by trenching and bedding details shown on the drawings.

B. Where the foundation material is found to be of poor supporting value or of rock, the Owner may make minor adjustments in the location of the pipe to provide a more suitable foundation. Where this is not practical, the foundation shall be conditioned by removing the existing foundation material by undercutting to the depth as directed by the geotechnical engineer and backfilling with either a suitable local material secured from unclassified excavation or borrow excavation at the nearest accessible location along the project, or foundation conditioning material consisting of crushed stone or gravel or a combination of sand and crushed stone or gravel approved by geotechnical engineer as being suitable for the purpose intended. The selection of the type of backfill material to be used for foundation conditioning will be made by the geotechnical engineer.

2.12 CONCRETE

A. General: Cast-in-place concrete according to ACI 318, ACI 350/350R (ACI 350M/350RM), and the following:
   1. Cement: ASTM C 150, Type II.
   2. Fine Aggregate: ASTM C 33, sand.
   3. Coarse Aggregate: ASTM C 33, crushed gravel.
   4. Water: Potable.

B. Portland Cement Design Mix: (28 day compressive strength) 4000 psi (27.6 MPa) minimum, with 0.45 maximum water/cementitious materials ratio.
   1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
   2. Reinforcing Bars: ASTM A 615/A 615M, Grade 40 or 60 (420 MPa) deformed steel.

C. Manhole, Catch Basin and Storm Inlet Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi (27.6 MPa) minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.

1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
    a. Invert Slope: 1 percent through manhole unless otherwise detailed on the Drawings.
2. Benches: Concrete, sloped to drain into channel.
    a. Slope: 4 percent unless otherwise detailed on the drawings..

D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi (20.7 MPa) minimum, with 0.58 maximum water/cementitious materials ratio.
1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

2.13 CATCH BASINS

A. Standard Precast Concrete Catch Basins:
1. Description: ASTM C 478 (ASTM C 478M), precast, reinforced concrete, heavy duty (H20), of depth indicated, with provision for sealant joints.
2. Base Section: 6-inch (150-mm) minimum thickness for floor slab and 6-inch (150-mm) minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
3. Riser Sections: 6-inch (150-mm) minimum thickness, 48-inch (1200-mm) diameter, and lengths to provide depth indicated.
4. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
5. Joint Sealant: ASTM C 990 (ASTM C 990M), bitumen or butyl rubber.
6. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch (150- to 225-mm) total thickness, that match 24-inch- (610-mm-) diameter frame and grate.
7. Steps: Individual FRP steps; FRP ladder; or ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 16-inch (400-mm) intervals. Omit steps if total depth from floor of manhole to finished grade is less than 42 inches (1050 mm).
8. Pipe Connectors: ASTM C 923 (ASTM C 923M), resilient, of size required, for each pipe connecting to base section.

B. Designed Precast Concrete Catch Basins: ASTM C 913, precast, reinforced concrete; designed according to ASTM C 890 for A-16 (ASSHTO HS20-44), heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for joint sealants.
1. Joint Sealants: ASTM C 990 (ASTM C 990M), bitumen or butyl rubber.
2. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch (150- to 225-mm) total thickness, that match 24-inch- (610-mm-) diameter frame and grate.
3. Steps: Individual FRP steps; FRP ladder; or ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 16-inch (400-mm) intervals. Omit steps if total depth from floor of manhole to finished grade is less than 42 inches (1050 mm).
4. Pipe Connectors: ASTM C 923 (ASTM C 923M), resilient, of size required, for each pipe connecting to base section.

C. Grate and Frame: Per details shown on the drawings. Provide hood with stencil or casting “Dump No Waste – Drains to Waterways” or equal. Provide local casting if required. Provide 6 inch thick rectangular concrete apron, with 18 inch minimum width measured from the edge of structure frame to the end of the concrete apron, around all structure frames located in asphalt pavement areas. Provide saw cuts from each corner of the concrete apron to the frame of the structure as shown on the plan.
1. Rectangular Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, heavy duty (H20) structural loading. Include flat grate with small square or short-slotted drainage openings.
    a. Size: 24 by 24 inches (610 by 610 mm) minimum unless otherwise indicated.
    b. Grate Free Area: Approximately 50 percent unless otherwise indicated.

2. Round, Manhole Type Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, heavy duty (H20) structural loading. Include 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser with 4-inch (102-mm) minimum width flange, and 26-inch- (660-mm-) diameter flat grate with small square or short-slotted drainage openings.
   a. Grate Free Area: Approximately 50 percent unless otherwise indicated.

2.14 STORMWATER INLETS

A. Curb Inlets: Made with vertical curb opening of materials and dimensions according to the details shown on the Drawings.

B. Gutter Inlets: Made with horizontal gutter opening of materials and dimensions according to the details shown on the Drawings. Include heavy-duty frames and grates.

C. Combination Inlets: Made with vertical curb and horizontal gutter openings of materials and dimensions according to the details shown on the Drawings. Include heavy-duty frames and grates.

D. Frames and Grates: Heavy duty and according to the details shown on the Drawings.

2.15 STORMWATER DETENTION STRUCTURES

A. Cast-in-Place Concrete, Stormwater Detention Structures: Constructed of reinforced-concrete bottom, walls, and top; designed according to ASTM C 890 for A-16 (AASHTO HS20-44), heavy-traffic, structural loading; of depth, shape, dimensions, and appurtenances indicated.
   1. Ballast: Increase thickness of concrete as required preventing flotation.
   2. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch (150- to 229-mm) total thickness, that match 24-inch- (610-mm-) diameter frame and cover.
   3. Steps: Individual FRP steps; FRP ladder; or ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 16-inch (400-mm) intervals. Omit steps if total depth from floor of manhole to finished grade is less than 42 inches (1050 mm).

B. Corrugated Aluminized Steel Detention Systems:
   1. Piping shall comply with AASHTO M36 for diameters 12”-144”
   2. The material shall be Aluminized Steel Type 2 conforming to AASHTO M274
   3. All fittings shall be reinforced per ASTM A998

C. Precast Concrete Three Sided Detention Systems:
   1. Precast Concrete Detention Structures shall be manufactured per ASTM C1504
   2. Concrete shall be 4,000 psi mix and reinforcing steel shall have a minimum yield strength of 600 ksi

D. Manhole Frames and Covers: ASTM A 536, Grade 60-40-18, ductile-iron castings designed for heavy-duty service. Include 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser with 4-inch (102-mm) minimum width flange, and 26-inch- (660-mm-) diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."

2.16 PIPE OUTLETS

A. Head Walls: Construction shall be according to details shown on the drawings. Headwalls shall be cast-in-place reinforced concrete, with apron and tapered sides unless otherwise indicated.

B. Riprap Aprons: Broken, irregularly sized and shaped, graded stone according to Department of Transportation specifications for the state in which the project is located or by using NSSGA's "Quarried Stone for Erosion and Sediment Control”. Unless otherwise shown on the drawings the median stone size used shall be 6 inches (150 mm). Riprap apron will be constructed of stone shaped according to the detail on the Drawings with an underlayment of medium weight non-woven geotextile fabric.
   1. Average Size: NSSGA No. R-6, screen opening 6 inches (150 mm).

C. Concrete Lined Channels: Construction shall be in accordance with details shown on the drawings.

D. Flared-End Sections: Shall meet Department of Transportation standards for the state in which the project is located unless otherwise indicated on the drawings.

2.17 DRY WELLS

A. Description: ASTM C 913, precast, reinforced, perforated concrete rings. Include the following:
   1. Floor: Cast-in-place concrete.
   2. Cover: Liftoff-type concrete cover with cast-in lift rings.
   3. Wall Thickness: 4 inches (102 mm) minimum with 1-inch (25-mm) diameter or 1-by-3-inch-(25-by-76-mm-) maximum slotted perforations arranged in rows parallel to axis of ring.
      a. Total Free Area of Perforations: Approximately 15 percent of ring interior surface.
      b. Ring Construction: Designed to be self-aligning.
   4. Filtering Material: ASTM D 448, Size No. 24, 3/4- to 2-1/2-inch (19- to 63-mm) washed, crushed stone or gravel.

B. Description: Manufactured PE side panels and top cover that assemble into 50-gal. (190-L) storage capacity units.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings.
   2. Side Panels: With knockout ports for piping and seepage holes.
   3. Top Cover: With knockout port for drain.
   4. Filter Fabric: As recommended by unit manufacturer.
   5. Filtering Material: ASTM D 448, Size No. 24, 3/4- to 2-1/2-inch (19- to 63-mm) washed, crushed stone or gravel.

C. Description: Constructed-in-place aggregate type. Include the following:
   1. Lining: Concrete blocks or precast concrete rings with notches or weep holes.
   2. Filtering Material: ASTM D 448, Size No. 24, 3/4- to 2-1/2-inch (19- to 63-mm) washed, crushed stone or gravel.
   3. Cover: Precast, reinforced-concrete slab designed for structural loading according to ASTM C 890 and made according to ASTM C 913. Include slab dimensions that will extend 12 inches (300 mm) minimum beyond edge of excavation, with bituminous coating over entire surface. Cast cover with opening for manhole in center.
   4. Manhole: 24-inch- (610-mm-) diameter, reinforced-concrete access lid with steel lift rings. Include bituminous coating over entire surface.

2.18 STORMWATER DISPOSAL SYSTEMS

A. Chamber Systems:
   1. Chambers shall meet the requirements of ASTM F2418 and meet the safety factors recommended by Section 12.12 of the AASHTO LRFD Bridge Design Specifications. Loads for design shall be calculated in accordance with Section 3 of the AASHTO LRFD Bridge Design Specifications.
   2. The chamber manufacturer shall provide design data in accordance with ASTM F2418. Installation shall be in accordance with the details shown on the Drawings.
   3. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
      a. Advanced Drainage Systems. 4640 Trueman Blvd., Hilliard, Ohio 43026 (800) 433-7473
      b. CULTEC, Inc. 878 Federal Road, PO Box 280, Brookfield, CT 06804 (800) 4-CULTEC.
      c. Hancor Inc. 401 Olive Street, Findlay, OH 45840 (800) 848-3546.
      d. StormTech LLC. 20 Beaver Road, Wetheresfield , CT 06109 (888) 892-2694
   4. Storage and Leaching Chambers: Chamber rows shall provide continuous, unobstructed internal space with no internal support panels in order to provide ease of access for inspection and maintenance. Include number of chambers, distribution piping, end plates, and other standard components as required for system total capacity.
   5. Geotextile: Shall be enclosed in geotextile fabric for sediment capture and maintenance. Fabric shall be located per manufacturer's details.
      a. Geotextile woven or spun filter fabric, in one or more layers, for minimum total unit weight of 4 oz./sq. yd. (135 g/sq. m).
      b. Fabric between chamber bottom and the stone foundation shall be AASHTO M288 Class 1 woven for stabilization and filtration.
      c. Fabric between the top of the chamber and the embedment stone shall be AASHTO M288 Class 2 non-woven for separation.

6. Filtering Material: ASTM D 448, Size No. 24, 3/4- to 2-1/2-inch (19- to 63-mm) washed, crushed stone or gravel.

B. Pipe Systems:

1. Perforated manifold, header, and lateral piping complying with AASHTO M 252M for NPS 10 (DN 250) and smaller, AASHTO M 294M for NPS 12 to NPS 60 (DN 300 to DN 1500). Include proprietary fittings, couplings, seals, and filter fabric.
2. 360 Degree Perforated Aluminized Steel Type 2 Recharge/Detention System conforming to AASHTO M274. All fittings to be reinforced per ASTM A998
3. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   a. Advanced Drainage Systems. 4640 Trueman Blvd., Hilliard, Ohio 43026 (800) 433-7473
   b. Hancor Inc. 401 Olive Street, Findlay, OH 45840 (800) 848-3546.
   c. CONTECH Construction Products, Inc. 9025 Centre Pointe Drive, West Chester, Ohio 45069 (336) 854-2177

PART 3 - EXECUTION

3.01 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.02 PIPING INSTALLATION

A. Locations and Arrangements: Contractor shall install all drainage structures, pipe and chambers in the locations shown on the drawings and/or as approved by the Owner. Pipe shall be of the type and sizes specified on the drawings and shall be laid accurately to line and grade. Structures shall be accurately located and properly oriented. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, on prepared foundation, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Lap joint pipes shall be laid with the inside circumferential laps pointing downstream and with the longitudinal laps at the side or quarter points.

C. Install chambers in accordance with manufacturer’s guidelines. Rows of chambers shall be laid out using spacers or appropriate measurements and markings to ensure proper spacing between rows for proper backfill and compaction as specified by the manufacturer.

D. Manholes, catch basins and drain inlets shall be constructed as soon as the pipe laying reaches the location of the structures. If the Contractor continues pipe installation without making provisions for completion of the structures the Owner shall have the authority to stop the pipe installation until the structure is completed.

E. Any structure which is miss-located or oriented improperly shall be removed and reconstructed at its proper location, alignment and orientation without cost to the Owner.

F. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing storm drainage is indicated.

G. Precast drainage structures shall be assembled in accordance with the manufacturer’s instructions to form a sound structural unit.

H. Cast-in-Place drainage structures shall be installed in accordance with the details or referenced specifications shown on the drawings. Concrete shall comply with the requirements of this section.

I. Solid concrete brick masonry structures shall be installed in accordance with the details or referenced specifications shown on the drawings. Only solid masonry units may be used. Minimum wall thickness shall be 8 inches and minimum bottom slab thickness shall be 6 inches and extended a minimum of 6 inches outside the structure.

J. Fittings and Connections: Pipe connections to drainage structures shall be made so that the pipe does not project beyond 3 inches inside the wall of the drainage structure and shall be grouted as necessary to make smooth and uniform surfaces on the inside of the structure. Connection

material shall not include large stone, broken block or other deleterious material. Bottom invert connections shall be constructed of concrete form smooth to provide a bench between pipe inverts unless otherwise detailed on the plans.

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

L. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of micro-tunneling.

M. Install gravity-flow, non-pressure drainage piping according to the following:
   1. Install piping pitched down in direction of flow.
   2. Install piping NPS 6 (DN 150) and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place concrete supports or anchors.
   3. Install piping with 24-inch (610-mm) minimum cover.
   4. Install hub-and-spigot, cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
   5. Install hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
   6. Install ductile-iron piping and special fittings according to AWWA C600 or AWWA M41.
   7. Install corrugated steel piping according to ASTM A798 and 798M.
   8. Install HDPE piping according to pipe manufacturer’s installation guidelines for heavy duty drainage applications and ASTM D 2321.
   9. Install PVC profile gravity sewer piping according to ASTM D 2321 and ASTM F 1668.
   10. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."

N. Install corrosion-protection piping encasement over the following underground metal piping according to ASTM A 674 or AWWA C105:
   1. Hub-and-spigot, cast-iron soil pipe and fittings.
   2. Hubless cast-iron soil pipe and fittings.
   3. Ductile-iron pipe and fittings.
   4. Expansion joints and deflection fittings.

3.03 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure drainage piping according to the following:
   1. Join hub-and-spigot, cast-iron soil piping with gasketed joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
   2. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
   3. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
   4. Join ductile-iron culvert piping according to AWWA C600 for push-on joints.
   5. Join ductile-iron piping and special fittings according to AWWA C600 or AWWA M41.
   6. Join corrugated steel sewer piping according to ASTM A 798/A 798M.
   7. Join HDPE pipe according to ASTM D 2321
   8. Join PVC cellular-core piping according to ASTM D 2321 and ASTM F 891 for solvent-cemented joints.
   9. Join PVC corrugated sewer piping according to ASTM D 2321 for elastomeric-seal joints.
   10. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasketed joints.
   11. Join PVC profile gravity sewer piping according to ASTM D 2321 for elastomeric-seal joints or ASTM F 794 for gasketed joints.
   12. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasketed joints.
   13. Join dissimilar pipe materials with nonpressure-type flexible couplings.

3.04 BACKWATER VALVE INSTALLATION

A. Install horizontal-type backwater valves in piping where indicated.

B. Install combination horizontal and manual gate-valve type in piping and in manholes where indicated.
C. Install terminal-type backwater valves on end of piping and in manholes where indicated.

3.05 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
   1. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.
B. Set cleanout frames and covers in cast-in-place concrete, 24 by 24 by 6 inches (600 by 600 by 150 mm) deep. Set with tops flush with adjacent grade. At pavement areas and at roads set frames and covers with tops flush pavement surface.

3.06 DRAIN INSTALLATION

A. Install type of drains in locations indicated.
   1. Use Heavy-Duty, top-loading classification drains in vehicle service areas.
B. Install drains according to details on the plans and manufacturer's installation requirements..
C. Fasten grates to drains if indicated.
D. Set drain frames and covers with tops flush with pavement surface.
E. Assemble trench sections with flanged joints.

3.07 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated.
B. Install precast concrete manhole sections with sealants according to ASTM C 891.
C. Where specific manhole construction is not indicated, follow manhole manufacturer's written instructions.
D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches (76 mm) above finished surface elsewhere unless otherwise indicated.

3.08 CATCH BASIN INSTALLATION

A. Construct catch basins to sizes and shapes indicated.
B. Frames, Grates and Hoods
   1. Set frames and grates to elevations indicated.
   2. Firmly embedded in mortar approximately 1 inch thick and aligned to fit the top section of the structure.
   3. Brick set in mortar used to adjust the frame to finished grade shall be limited to no more than four (4) courses for precast structures and have a minimum wall thickness of eight (8) inches.

3.09 STORMWATER INLET AND OUTLET INSTALLATION

A. Construct inlet head walls, aprons, and sides of reinforced concrete, as indicated.
B. Construct riprap of broken stone, as indicated.
C. Install outlets that spill onto grade, anchored with concrete, where indicated.
D. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.
E. Construct energy dissipaters at outlets, as indicated.

3.10 MODIFICATION OF EXISTING STRUCTURES

A. General: The Contractor shall alter, reconstruct and/or convert existing structures where and as shown on the drawings, and/or as approved by the Owner. Alterations shall be performed with the same type, grade and quality material as used in the original construction unless otherwise indicated on the drawings or approved by the Owner.
B. Damage to Existing Structures: The Contractor shall exercise care during all alterations, reconstructions or conversions so as not to damage any portion of the existing structures or pipe to remain. Any damage caused by the Contractor shall be repaired by the Contractor at its own expense and to the satisfaction to the Owner.

3.11 ROOF DRAINS AND LEADERS

A. The site Contractor shall install roof downspout leaders as shown on the drawings to within five (5) feet of the building limits. If work by others is complete then the Contractor shall complete the connection. If future connections will be required by others, the Contractor shall install plugging and material apparatus as necessary to protect and mark the location of its work.

B. All roof drain leader piping connections shall utilize watertight prefabricated fittings and drainage structures.

3.12 DRY WELL INSTALLATION

A. Excavate hole to diameter of at least 6 inches (150 mm) greater than outside of dry well. Do not extend excavation into ground-water table.

B. Install precast, concrete-ring dry wells according to the following:
   1. Assemble rings to depth indicated.
   2. Extend rings to height where top of cover will be approximately 8 inches (203 mm) below finished grade.
   3. Backfill bottom of inside of rings with filtering material to level at least 12 inches (300 mm) above bottom.
   4. Extend effluent inlet pipe 12 inches (300 mm) into rings and terminate into side of tee fitting.
   5. Backfill around outside of rings with filtering material to top level of rings.
   6. Install cover over top of rings.

C. Install manufactured, PE dry wells according to manufacturer's written instructions and the following:
   1. Assemble and install panels and cover.
   2. Backfill bottom of inside of unit with filtering material to level at least 12 inches (300 mm) above bottom.
   3. Extend effluent inlet pipe 12 inches (300 mm) into unit and terminate into side of tee fitting.
   4. Install filter fabric around outside of unit.
   5. Install filtering material around outside of unit.

D. Install constructed-in-place dry wells according to the following:
   1. Install brick lining material dry and laid flat, with staggered joints for seepage. Build to diameter and depth indicated.
   2. Install block lining material dry, with staggered joints and 20 percent minimum of blocks on side for seepage. Install precast concrete rings with notches or weep holes for seepage. Build to diameter and depth indicated.
   3. Extend lining material to height where top of manhole will be approximately 8 inches (203 mm) below finished grade.
   4. Backfill bottom of inside of lining with filtering material to level at least 12 inches (300 mm) above bottom.
   5. Extend effluent inlet pipe 12 inches (300 mm) into lining and terminate into side of tee fitting.
   6. Backfill around outside of lining with filtering material to top level of lining.
   7. Install manhole over top of dry well. Support cover on undisturbed soil. Do not support cover on lining.

3.13 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318 and ACI 350R..

B. No concrete or masonry shall be placed when the temperature is below 40 degrees Fahrenheit, or when indications are for lower temperatures within 24 hours, unless protection of concrete and masonry is approved by the Owner. Damage to the structure because of freezing shall be corrected by the Contractor at the Contractor’s sole expense and to the satisfaction of the Owner.

3.14 STORMWATER DISPOSAL SYSTEM INSTALLATION

A. Chamber Systems: Excavate trenches of width and depth, and install system and backfill according to chamber manufacturer's written instructions. Include storage and leaching chambers, filtering material, and filter mat.

B. Piping Systems: Excavate trenches of width and depth, and install piping system, filter fabric, and backfill, according to piping manufacturer's written instructions.

3.15 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping in building's storm building drains specified in Division 22 Section "Facility Storm Drainage Piping."

B. Connect force-main piping to building's storm drainage force mains specified in Division 22 Section "Facility Storm Drainage Piping." Terminate piping where indicated.

C. Compliance with Existing Facilities:

1. Connections made into existing drainage facilities shall be performed in accordance with the requirements of the Owner of the facility. Construction within a public right-of-way will conform to all requirements of the regulatory authority having jurisdiction. The Contractor will be required to comply with all such requirements, including securing all required permits and paying all associated costs related to securing the permits. Costs associated with connections shall be included in the Contract Sum.
2. The contractor shall make all required connections of the proposed drainage facilities into existing drainage facilities where a d as shown on the drawings and/or as approved by the Owner.

D. Make connections to existing piping and underground manholes.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch (150-mm) overlap, with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).
2. Make branch connections from side into existing piping, NPS 4 to NPS 20 (DN 100 to DN 500). Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).
3. Make branch connections from side into existing piping, NPS 21 (DN 525) or larger, or to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 3 inches (76 mm) of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, encase entering connection in 6 inches (150 mm) of concrete for minimum length of 12 inches (300 mm) to provide additional support of collar from connection to undisturbed ground.
   a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi (20.7 MPa) unless otherwise indicated.
   b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.
4. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

E. Connect to sediment interceptors specified in Section "Sanitary Sewer."

F. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
   a. Shielded flexible couplings for same or minor difference OD pipes.
   b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
   c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.
2. Use pressure-type pipe couplings for force-main joints.

3.16 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:

1. Close open ends of piping with at least 8-inch- (203-mm-) thick, brick masonry bulkheads.

2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

B. Abandoned Manholes and Structures: Excavate around manholes and structures as required and use one procedure below:
   1. Remove manhole or structure and close open ends of remaining piping.
   2. Remove and backfill manhole locations as recommended in the geotechnical report and as indicated on the Drawings.
   3. If not indicated in the geotechnical report or on the Drawings, remove top of manhole or structure down to at least 36 inches (915 mm) below final grade. Fill to within 12 inches (300 mm) of top with stone, rubble, or gravel. Fill to top with concrete.

C. Backfill to grade according to Division 31 Section "Earth Moving."

3.17 IDENTIFICATION

A. Materials and their installation are specified in Division 31 Section "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.
   1. Use detectable warning tape over all storm drainage piping and over edges of underground structures.

3.18 PROTECTION AND CLEANING

A. The Contractor shall maintain all pipe and chamber installations and drainage structures in a condition such that they will function continuously and shall be kept clean of silt, debris and other deleterious substances until the project has achieved final acceptance.

B. The Contractor shall use all erosion and sediment control measures necessary to assure construction sediments (or other pollutants) do not reach stormwater pipe and/or chamber installations.

3.19 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches (610 mm) of backfill is in place, and again at completion of Project (See 3.20 Post Installation Inspection).
   1. Submit separate reports for each system inspection.
   2. Defects requiring correction include the following:
      a. Alignment: Less than full diameter of inside of pipe is visible between structures.
      b. Deflection: Flexible piping with deflection exceeding 5%.
      c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
      d. Infiltration: Water leakage into piping.
      e. Exfiltration: Water leakage from or around piping.
   3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
   4. Re-inspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
   1. Do not enclose, cover, or put into service before inspection and approval.
   2. Test completed piping systems according to requirements in Section 3.20.
   3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
   4. Submit separate report for each test.
   5. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
      a. Exception: Piping with soil tight joints unless required by authorities having jurisdiction.
      b. Option: Test plastic piping according to ASTM F 1417.
      c. Option: Test concrete piping according to ASTM C 924 (ASTM C 924M).
   6. Force-Main Storm Drainage Piping: Perform hydrostatic test after thrust blocks, supports, and anchors have hardened. Test at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than 150 psig (1035 kPa).

a. Ductile-Iron Piping: Test according to AWWA C600, "Hydraulic Testing" Section.
b. PVC Piping: Test according to AWWA M23, "Testing and Maintenance" Chapter.

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

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

3.20 POST INSTALLATION INSPECTIONS

A. Upon completion of the work and before final acceptance by the Owner, the entire drainage system shall be subject to a final inspection in the presence of the Owner and/or the Project Engineer. The work shall not be considered complete until all requirements for line, grade, cleanliness, workmanship and final inspections have been completed. Final inspection of the completed pipe installations will be performed after the embankment and/or trench fill is in place and all non-asphalt bases and/or sub-grades have been completed for at least 30 days.

B. Second Final Post Installation Inspection: (If required for the Project) The Owner shall require a second final post installation inspection.
1. Final post installation inspections (if required) shall be conducted no sooner than 2 months before the end of the one year warranty.
2. Final post installation inspections shall utilize a video camera and laser profiler/deflectometer or a video camera and go-no-go Mandrel. Lasers shall be calibrated to the pipe diameter as shown on the construction plans.

C. Initial and final post installation inspections shall be performed and reported, at the Contractor's expense, by a National Association of Sewer Service Companies (NASSCO) Certified Pipe Inspector. Reports of storm pipe assessments shall be submitted to the Project Engineer for review and appraisal.

D. The initial and post installation inspection report shall include: a copy of all video taken (if required), pipe location identification, equipment used for inspection, inspector name, deviation from design grade, deviation from line, deflection of pipe system, inspector notes, condition of joints, condition of pipe wall (e.g. Distress, cracking, wall damage dents, bulges, creases, tears, holes, etc…), ovality and flow capacity.

E. For RCP: seal cracks having a width greater than .010 inches. Repair or replace pipes exhibiting spalls or de-lamination.

F. For CMP and HDPE: initial and post installation inspection deflection shall not exceed 5%; final post installation (warranty) deflection shall not exceed 7%. Replace locations where deflections exceed these requirements; re-rounding of pipe is not allowed.

3.21 CLEANING

A. Clean interior of piping of dirt and superfluous materials. Flush with water**.**

END OF SECTION 334100

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CONFORMANCE SUBMITTAL
SECTION 334100 – STORM UTILITY DRAINAGE PIPING

Project Location _____
(*City, State*)

General Contractor: _____
(*Company Name, Phone Number*)

_____
(*Address*)

Sub-Contractor: _____
(*Company Name, Phone Number*)

_____
(*Address*)

The following products have been selected (check one box) for use in this project from the list of acceptable products specified:

Concrete Pipe, ASTM C76, Butyl mastic joint sealant ASTM C990-01a for silt-tight designations or rubber gaskets meeting the material and joint configuration requirements of ASTM C443 for watertight designations:
☐ Tongue and Groove RCP, Class _____
☐ Bell and Spigot RCP, Class _____

High Density Polyethylene (HDPE) Pipe, AASHTO M252, M294, Rubber Gasket Joints ASTM F477, silt-tight or watertight designations as specified:
☐ ADS Pipe
☐ Hancor Pipe
☐ Type S Lok-Tite Pipe
☐ Quality Culvert Pipe
☐ DuroMaxx
☐ All underground connections will be made with pre-fabricated HDPE fittings

Polyvinyl Chloride (PVC) Pipe, Rubber Gasket Joints ASTM F477:
☐ PVC Pipe, ASTM D3034, SDR 35
☐ Corrugated PVC Pipe, Contech "A2000"
☐ All underground connections will be made with pre-fabricated PVC fittings

Aluminized Steel Type 2 Corrugated Steel Pipe (CMP), AASHTO M274 or ASTM A929, silt-tight or watertight designations as specified:
☐ Aluminized Steel Type2 Corrugated Steel Pipe

Aluminized Steel Type 2 Spiral Ribbed Pipe (Type IR), AASHTO M274 or ASTM A929 and AASHTO M36 or ASTM A760, silt-tight or watertight designations as specified:
☐ Aluminized Steel Type 2 Spiral Ribbed Pipe (Type IR) such as "Ultra Flo" by Contech or approved equal

Ductile Iron Pipe (DIP), AWWA C151, Fittings AWWA C110, Gaskets AWWA C111:
☐ DIP

Stormwater Collection Chambers ASTM F2418
☐ StormTech
☐ Hancor
☐ CULTEC
☐ StormTech by ADS

Stormwater Detention or Recharge System
☐ Aluminized Steel CMP Detention by CONTECH
☐ 360 Degree Perforated CMP Detention/Recharge by CONTECH
☐ Precast Concrete Detention System

Drainage Boxes (Must be pre-cast unless approved by Owner):
☐ Pre-cast Concrete, per specifications by: ☐DOT #_____, ☐City #_____, ☐Other _____
☐ Cast-in-place Concrete, per specifications by: ☐DOT #_____, ☐City #_____, ☐Other_____
☐ Solid Concrete Brick Masonry, per specifications by: ☐DOT # _____,
☐City #_____, ☐Other _____

Cast Iron Frames, Grates, and Hoods:
Manhole lids, per specifications by: ☐DOT #_____, ☐City #_____, ☐Other_____
Curb Inlets, per specifications by: ☐DOT #_____, ☐City #_____, ☐Other_____
Drop Inlets, per specifications by: ☐DOT #_____, ☐City #_____, ☐Other_____

Detention Pond As-built Survey:
☐ I recognize that an as-built survey of all detention ponds and structures shall be completed prior to project acceptance in accordance with Section 017300 – Field Engineering and Surveying

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I represent to Owner/City/Engineer that the products selected will be installed in compliance with the applicable codes for the authorities having jurisdiction and in accordance with the contract documents. If noncompliance is discovered the General Contractor shall make or cause to be made all necessary corrections to meet the applicable codes and specifications. Immediately or as directed by Owner the work shall be completed without additional cost to the Owner and / or the contract.

Sub-Contractor: _____
(*Signature of the Authorized Agent of the Sub-Contractor*) Date

_____
(*Print Name of the Authorized Agent of the Sub-Contractor*)

General Contractor: _____
(*Signature of the Authorized Agent of the General Contractor*) Date

_____
(Print Name of the Authorized Agent of the General Contractor)

TRENCH DRAIN CONFORMANCE SUBMITTAL
SECTION 334100 – STORM UTILITY DRAINAGE PIPING

Project Location _____
(*City, State*)

General Contractor: _____
(*Company Name, Phone Number*)

_____
(*Address*)

Sub-Contractor: _____
(*Company Name, Phone Number*)

_____
(*Address*)

Product Verification:

The trench drains installed in this store will meet the product guidelines of Section 334100-2.13 "POLYMER-CONCRETE, CHANNEL DRAINAGE SYSTEMS"

Trench Drain Manufacturer & Model Number: _____

Grate Model Number: _____

Trench Drain Manufacturer & Model Number: _____

Grate Model Number: _____

General Contractor's Affidavit:
I represent to Owner that the product selected will be installed in compliance with the applicable codes for the authorities having jurisdiction and in accordance with the project specification. If noncompliance is discovered the General Contractor shall make or cause to be made all necessary corrections to meet the applicable codes and Owner specifications. The work shall be completed immediately as directed by Owners without additional cost to Owner and/or the contract.

General Contractor: _____
(*Signature of the Authorized Agent of the General Contractor*) (Date)

_____
(*Print Name of the Authorized Agent of the General Contractor*)

Sub-Contractor's Affidavit:
I represent to Owner that the product selected will be installed in compliance with the applicable codes for the authorities having jurisdiction and in accordance with the project specification. If noncompliance is discovered the Sub-Contractor shall make or cause to be made all necessary corrections to meet the applicable codes and owners specifications. The work shall be completed immediately as directed by owner and/or the General Contractor without additional cost to owner and/or the contract.

Sub-Contractor: _____
(*Signature of the Authorized Agent of the Sub-Contractor*) (Date)

_____
(*Print Name of the Authorized Agent of the Sub-Contractor*)