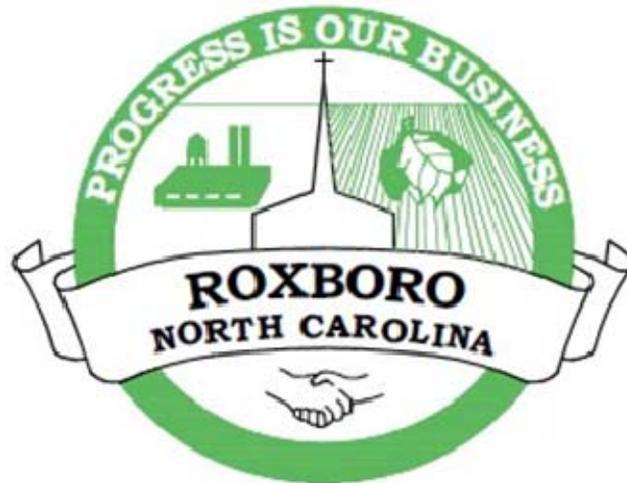


CITY OF ROXBORO



STANDARD SPECIFICATIONS AND DETAIL DRAWINGS FOR THE CONSTRUCTION OF STREETS, ROADS, ALLEYS, ETC.

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SECTION 310000 – STREET DESIGN STANDARDS

PART 1 - GENERAL DESIGN STANDARDS

1.1 SUMMARY

- A. The City of Roxboro (City) has developed these Specifications as a supplement to the NCDOT Standard Specifications for Roads and Structures (NCDOT Specifications). The NCDOT Specifications are the minimum standards for construction in the City's rights-of-way. These City of Roxboro Specifications, if more stringent, shall govern.
- B. All design, permitting, and construction related to these Street Specifications shall comply with applicable regulatory requirements, including but not limited to City, County, State, and Federal agencies such as Planning, Zoning, Erosion Control, Water, Sewer, Underground Utility, Surface and Underground Water Protection, Wetlands, Flood Protection, NCDOT, and Railroads.

1.2 CONFORMITY TO EXISTING MAPS AND PLANS:

- A. The location and width of all proposed streets shall be in conformity with the officially adopted Thoroughfare Plan for Roxboro Township, and shall be in conformity with all current plans of the Roxboro Planning Board.
- B. The proposed street system within a subdivision shall be tied in with the existing street system. The proposed street system shall also provide for the continuation of the existing City and State systems.
- C. Proposed streets, which are aligned with existing streets, shall bear the name of the existing street. In no case shall a proposed street bear a name similar to any existing street, irrespective of the Suffix (Street, Avenue, Boulevard, Drive, Place, Court, etc).
- D. Proposed streets must provide for uniformity when connecting to existing streets. When existing street design standards are exceeded by the proposed streets, the existing streets shall be upgraded to meet new standards.

1.3 UNUSABLE LAND:

- A. Land subject to flooding, land with environmental restrictions and land deemed to be unsuitable for any other reason, shall not be platted for use as public right-of-way.

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PART 2 - MINIMUM DESIGN STANDARDS

2.1 DRIVEWAY WIDTHS:

- A. Single Family: Minimum 10 feet Maximum 20 feet
- B. Multi-Family: Minimum 20 feet Maximum 36 feet

2.2 STREET SPECIFICATIONS:

Street Type	Units Served	Vehicle Volume (ADT)	Design Speed	Speed Limit
Major Street and Highway	>400	>4000	45	35
Collector	250-400	2500-4000	35	35
Minor Street	<250	<2500	25	25
Cul-de-Sac	<25	<250	25	15

2.3 MINIMUM STREET RIGHT-OF-WAY-WIDTHS:

- A. Major streets and highways 80 feet
- B. Collector streets 60 feet
- C. Minor streets 40 feet
- D. Cul-de-sacs 50 feet (Radius)

2.4 PAVEMENT WIDTHS (WITH 30-INCH CURB & GUTTER)

- A. Major streets and highways 48 feet
- B. Collector streets 40 feet
- C. Minor streets 34 feet
- D. Cul-de-sacs 37 feet (Radius)

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2.5 PAVEMENT WIDTHS (WITHOUT CURB & GUTTER)

- A. Major streets and highways 44 feet
- B. Collector streets 24 feet
- C. Minor streets 24 feet
- D. Cul-de-sacs 35 feet (Radius)

2.6 STREET SHOULDERS

- A. See Standard Street Detail drawings for required shoulder widths for Street Sections.
- B. No on-street parking will be allowed on Streets with no Curb & Gutter.

2.7 STREET GRADES

- A. Unless necessitated by exceptional topography and subject to the approval of the Public Services Director, the grades utilized on streets shall be not greater than twelve (12) percent, nor less than one-half (0.5) of one (1) percent.
- B. Grades approaching intersections shall not exceed five (5) percent for a distance of not less than 100 feet from the edge of travel of the intersecting street. All street intersections shall be designed to comply with Public Right-of-Way Accessibility Guidelines (PROWAG).

2.8 HORIZONTAL AND VERTICAL CURVES

- A. When a continuous street centerline deflects at any point by more than ten (10) degrees, a circular (horizontal) curve shall be introduced, having a radius of curvature on the centerline of not less than the following:
 - 1. Major streets and highways 300 feet
 - 2. Collector streets 200 feet
 - 3. Minor streets 200 feet
- B. A tangent of at least 100 feet long shall be provided between all reverse curves on all streets.
- C. All vertical changes in street grade shall be connected by a vertical curve of a minimum length equivalent in feet to fifteen (15) times the algebraic difference in the rates of grade for major and collector streets, and one-half this minimum for all other streets. Minimum K-Values shall be used in accordance with the most recent AASHTO Standards.

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2.9 INTERSECTIONS AND ACCESS

- A. Street intersections shall be laid out to intersect as nearly as possible at right angles and no street shall intersect any other street at an angle less than 60 degree. Curb radii shall be a minimum of 20 feet for street intersections.
 - 1. NOTE: Streets with centerline offsets of less than 125 feet shall not be permitted.
 - 2. NOTE: Major Street and highway intersection shall be a minimum of 800 feet apart.
- B. More than one point of access will be required when the number of units exceeds 50 for any portion or phase of a project. The City may also require multiple points of access when necessary for safety, interconnectivity, or future growth potential.
- C. Permanent dead end streets shall be no longer than 400 feet and shall have a circular turn-around with a minimum diameter of 35 feet.
- D. Alleys may be provided in all areas exclusive of residential areas. They shall have a minimum right-of-way of 20 feet.

END OF SECTION 310000

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SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Protecting existing trees, shrubs, groundcovers, plants and grass to remain.
2. Removing existing trees, shrubs, groundcovers, plants and grass as required on the drawings.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Disconnecting and capping or sealing site utilities.
7. Temporary erosion and sedimentation control measures.

B. The City of Roxboro (OWNER) has developed these Specifications as a supplement to the NCDOT Standard Specifications for Roads and Structures (NCDOT Specifications). The NCDOT Specifications are the minimum standards for construction in the City's rights-of-way. These City of Roxboro Specifications, if more stringent, shall govern.

1.2 MATERIAL OWNERSHIP

A. Except for stripped topsoil to be used on the Project Site, or other materials indicated to remain as Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.3 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 the City of Roxboro and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

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

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- C. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.
- D. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.
- E. Note that on plans specific trees are labeled to be left in place.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Locate and clearly flag trees and vegetation to remain or to be relocated.
- C. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to sediment and erosion control Drawings.
- B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TREE PROTECTION

- A. Erect and maintain temporary fencing around tree protection zones before starting site clearing. Remove fence when construction is complete.
- B. Do not excavate within tree protection zones, unless otherwise indicated.

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- C. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Engineer.

3.4 UTILITIES

- A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
 - 1. Arrange with utility companies to shut off indicated utilities.

- B. 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 the Engineer not less than 7 days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without the Engineer's written permission.

3.5 CLEARING AND GRUBBING

- A. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
 - 1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.
- C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.

3.7 SITE IMPROVEMENTS

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

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3.8 DISPOSAL

- A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off the Project Site.
 - 1. Separate recyclable materials produced during site clearing from other non-recyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

END OF SECTION 311000

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SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Preparing subgrades for walks, pavements, lawns and grasses, and exterior plants.
2. Subbase course for concrete walks and pavements.
3. Subbase and base course for asphalt paving.
4. Excavating and backfilling for utility trenches.

B. The City of Roxboro (OWNER) has developed these Specifications as a supplement to the NCDOT Standard Specifications for Roads and Structures (NCDOT Specifications). The NCDOT Specifications are the minimum standards for construction in the City's rights-of-way. These City of Roxboro Specifications, if more stringent, shall govern.

1.2 DEFINITIONS

A. Backfill: Soil material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

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

C. Bedding Course: Course 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: Course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

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- F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
 - 1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions changes in the Work.
 - 2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.
- G. Fill: Soil materials used to raise existing grades.
- H. Undercut Excavation: Shall consist of the removal and disposal of unsuitable materials below the subgrade for footings and pavement sections and the replacement and compaction of suitable materials.
- I. Open rock excavations: Includes removal and disposal of materials and obstructions encountered that cannot be effectively loosened or broken down by ripping in a single pass with a late model tractor-mounted hydraulic ripper equipped with one digging point of a standard manufacturer's design and adequately sized for use with and propelled by a D-8 CAT (min), having a draw bar pull of 65,000 lbs at 1MPH
 - 1. Typical of materials classified as rock are boulders 1 cu. yd. or more in volume, solid rock, rock in ledges, and rock-hard cementitious aggregate deposits.
 - 2. Intermittent drilling, or ripping performed to increase production and not necessary to permit excavation of material encountered will be classified as earth excavation.
- J. Trench rock excavation: Includes removal and disposal of materials and obstructions encountered that cannot be effectively loosened or broken by a CAT 330 (min) equipped with a 1.0 cu. yd. Rock bucket with a minimum breakout force of 25,700 pounds at a rate of 10 cu. Yd. Per hour.. Boulders in excess of 0.75 cu. yd. will be classified as trench rock. Trenches in excess of 10 feet in width and pits in excess of 30 feet in either length or width are classified as open rock excavation.
- K. 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.
- L. Subbase Course: Course placed between the subgrade and base course for hot-mix asphalt pavement, or course placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- M. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

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

1.3 SUBMITTALS

- A. Product Data: For each type of the following manufactured products required:
 - 1. Geotextiles
 - 2. Controlled low-strength material (flowable fill), including design mixture
 - 3. Warning tapes
- B. Material Test Reports: For each soil material proposed for fill and backfill:
 - 1. Classification according to ASTM D2487
 - 2. Laboratory compaction curve according to ASTM D698
- C. Blasting Plan – if blasting is authorized, including pre-blast survey, notification schedules, and seismograph monitoring, as approved by the City of Roxboro.

1.4 QUALITY ASSURANCE

- A. Approved Plans, Specifications, and Project Permits shall be available on-site during the construction of the Project
- B. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.
- C. Blasting: Blasting may be permitted, with express written authorization by the City of Roxboro. When authorized, blasting shall comply with applicable requirements in NFPA 495 Explosive Materials Code, and all other authorities with jurisdiction of the Project Site.

1.5 PROJECT CONDITIONS

- A. Utility locations shall be performed before beginning earth-moving operations to verify locations of all existing utilities on the Project Site.
- B. Interference with areas near construction activities (roads, streets, walks, etc.) shall be minimized. Closures of roads, streets, walks, etc. shall be performed only after receipt of written approval by the City of Roxboro and the specific regulatory agency (such as NCDOT for state-owned roadways). Alternative routes for closed roads, streets, walks, etc. will be provided as required by the City of Roxboro.
- C. No warranty or guarantee is made that the site earthwork will balance. Borrow material may be required to be brought to the site to achieve the proposed grades. Excess material may be required to be removed from the site to achieve the proposed grades. No warranty or guarantee is made that the existing soil proposed to be excavated from

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the site will be suitable for reuse on the site. The Contractor shall, at no additional cost to the Owner, import or export material from the site to reach the proposed grades. If materials excavated from the site above grade are unsuitable for reuse on the site, the Contractor will, at no additional cost to the Owner, remove them from the site and replace them with borrow material as required. The Owner will only provide additional compensation for unsuitable materials below the proposed subgrade. The top soil will be stripped and an amount as necessary for landscape and grass areas will be stockpiled for later use. The Owner and Engineer may permit the final elevation of the landscape beds to be adjusted up or down to accommodate soil volume, to be determined on a site by site basis; however, the design cross slope and general stormwater drainage will be maintained.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations. Note that soil for landscape beds at the social hall and entry area are to be imported.
- B. Satisfactory Soils: Non-highly plastic soil with a plasticity indices of 25 or less; free of rock or gravel larger than 6 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: Highly plastic soil with a plasticity indices greater than 25, or soils not considered satisfactory.
 - 1. Unsatisfactory soils also include satisfactory soils not maintained within 3 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 sieve and not more than 12 percent passing a No. 200 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 sieve and not more than 8 percent passing a No. 200 sieve.
- F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

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- G. 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 sieve and not more than 8 percent passing a No. 200 sieve.
- H. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.
- I. Topsoil for landscape beds at social hall and campus entry: equal parts sand, topsoil, and compost. This mix is to be a minimum of 6" thickness in all planting beds in this area.

2.2 GEOTEXTILE MATERIALS

- A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins; with elongation greater than 50%; complying with AASHTO M288 and the following, measured per test methods referenced:
 - 1. Survivability: Class 2; AASHTO M 288
 - 2. Survivability: as follows:
 - a. Grab Tensile Strength: 157 lb; ASTM D4632
 - b. Sewn Seam Strength: 142 lb; ASTM D4632
 - c. Tear Strength: 56 lb; ASTM D4533
 - d. Puncture Strength: 56 lb; ASTM D4833
 - 3. Apparent Opening Size: No. 60 sieve, maximum; ASTM D4751
 - 4. Permittivity: 0.2 per second, minimum; ASTM D4491
 - 5. UV Stability: 50% after 500 hours exposure; ASTM D4355
- B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50%; complying with AASHTO M288 and the following, measured per test methods referenced:
 - 1. Survivability: Class 2; AASHTO M 288
 - 2. Survivability: as follows:
 - a. Grab Tensile Strength: 247 lb; ASTM D4632
 - b. Sewn Seam Strength: 222 lb; ASTM D4632
 - c. Tear Strength: 90 lb; ASTM D4533
 - d. Puncture Strength: 90 lb; ASTM D4833

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3. Apparent Opening Size: No. 60 sieve, maximum; ASTM D4751
4. Permittivity: 0.2 per second, minimum; ASTM D4491
5. UV Stability: 50% after 500 hours exposure; ASTM D4355

2.3 ACCESSORIES

Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, colored as follows:

1. Red: Electric
2. Yellow: Gas, Oil, Steam, and dangerous materials
3. Orange: Telephone and other communications
4. Blue: Water systems
5. Green: Sewer systems

- B. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with a metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30" deep; colored as follows:

1. Red: Electric
2. Yellow: Gas, Oil, Steam, and dangerous materials
3. Orange: Telephone and other communications
4. Blue: Water systems
5. Green: Sewer systems

PART 3 - EXECUTION

3.1 LINES AND GRADES

- A. Identify required lines, levels, contours, and datum.
1. City reserves the right to make changes in alignment and grade when changes are required for Project conditions.
 2. Lines and grades shall be established by the Contractor.
 3. Structures: Offset stakes shall be provided at each structure (manholes, curb inlets, etc.) to indicate the line and grade of the proposed line.
 4. Any changes to the approved plans shall require written approval by the City of Roxboro.

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3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, trees, and vegetation and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Architect and then only after arranging to provide temporary utility services according to requirements indicated.
- C. Temporary Traffic Control: Establish Temporary Traffic Control (and detours as applicable) for streets, roads, walkways, etc. when excavation impacts existing routes. Reroute traffic and relocate controls as required during the progress of construction.
- D. Access and/or Haul Roads: Any grading or excavation required for equipment travel during the course of construction as well as erosion control, access or haul road construction or removal, restoration, seeding, and ground cover shall be provided at the Contractor's expense.
- E. Construction Staging: The Contractor shall obtain written permission from property owner(s) for use of staging areas located outside of the public rights-of-way, easements, or construction limits shown on the approved drawings. The written permission shall include provisions for the use and the restoration of the staging areas.
- F. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Division 31 Section "Site Clearing."
- G. Protect and maintain erosion and sedimentation controls, which are specified in Division 31 Section "Site Clearing." during earthwork operations.
- H. Protected Areas: The following activities are prohibited in protected areas:
 - 1. Storage of construction materials, debris, or excavated materials;
 - 2. Parking of vehicles or equipment;
 - 3. Foot traffic;
 - 4. Erection of sheds or structures;
 - 5. Impoundment of water;
 - 6. Excavation;
 - 7. Attachment of signs or other materials to plants or trees unless expressly authorized.

3.3 DEWATERING

- A. Provide dewatering system(s) as needed of sufficient scope, size, and capacity to control hydrostatic pressure and to lower, control, remove, and dispose of groundwater and to permit excavation and construction to proceed on dry, stable subgrades.

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- B. Prevent surface water and groundwater from entering excavations, from ponding on prepared subgrades, and from flooding Project Site and surrounding area(s).
- 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.
- D. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.

3.4 EXPLOSIVES

- A. Obtain written permission from authorities having jurisdiction before bringing explosives to the Project Site and before using explosives on the Project Site.
 - 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-practical disturbance to the rock that will remain.

3.5 EXCAVATION

- A. General Excavation: Excavation, removal and/or disposal of pavements and other obstructions visible on surface; underground structures utilities and other items indicated to be demolished and/or removed; together with soil, boulders and other materials encountered that are not classified as rock, unsuitable soil, or unauthorized excavation.
 - 1. Intermittence drilling and blasting to increase production and not necessary to permit excavation of material encountered will be considered general excavation.
 - 2. Soil (regardless of nature) or other debris encountered above proposed subgrade elevations shall be considered general excavation unless determined by the Engineer to meet the definition of rock.
- B. Unsuitable Soil Excavation: Removal and disposal of soil materials or other debris encountered at or below proposed subgrade elevations which is deemed to unsuitable to remain in place by the Engineer or Owner's Independent Testing Agency.

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1. Soil and/or other debris encountered above proposed subgrade elevations shall be considered general excavation.
2. Soil material which, in the opinion of the Engineer, can be repaired by scarifying, drying, and recompacting or material which is made unsuitable by delay of work, lack of protection, or other actions of the Contractor or his Sub-contractors shall not be considered as unsuitable soil and shall be repaired or replaced by the Contractor at no additional cost to the Owner.
3. Any material moved or removed without measurement and approval by the Engineer or Owner will be considered as general excavation.

3.6 EXCAVATIONS AT EDGES OF TREE- AND PLANT-PROTECTION ZONES

- A. Excavate by hand or with an air spade to indicated lines, cross-sections, elevations, and subgrades. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop roots. Do not use mechanical equipment that rips, tears, or pulls roots.

3.7 EXCAVATION FOR WALKS AND PAVEMENTS

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

3.8 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
- B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.
 1. Clearance: 12 inches each side of pipe or conduit.
- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
 1. For excavations in rock or other unyielding materials, excavate trenches an additional depth of 6 inches to provide the ability to place bedding stone under the pipe.
 2. For materials requiring specific bedding, excavate additional depth (to match required bedding depth) to allow for bedding course.

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3.9 SUBGRADE INSPECTION

- A. Proof-roll subgrade below all pavements with a fully loaded tandem axel dump truck at a minimum to identify soft pockets and areas of excess yielding in the presence of the Engineer or independent testing agency. Do not proof-roll wet or saturated subgrades.
- B. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Engineer or Independent Testing Agency, without additional compensation.

3.10 STORAGE OF 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 any remaining trees.**
- B. Geotextile Fabric shall be protected from mud, dirt, dust, sunlight, and debris during transport and storage. Geotextile Fabric for subsurface installation shall not be exposed to direct sunlight for more than 24 hours before or during installation

3.11 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice. Coordinate backfilling with compaction testing.
- 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. Place and compact initial backfill of satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the utility pipe or conduit.
 - 1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit.
- D. Place and compact backfill in lifts not to exceed 4" (when hand operated compaction equipment is used) or 8" (when rammax or larger compaction equipment is used).
- E. Place and compact final backfill of satisfactory soil to final subgrade elevation.
- F. Install warning tape directly above all utilities, except RCP storm sewers, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

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3.12 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
 - 1. Under grass and planted areas, use satisfactory soil material.
 - 2. Under walks and pavements, use satisfactory soil material.
 - 3. Under steps and ramps, use satisfactory soil material.

3.13 SOIL MOISTURE CONTROL

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

3.14 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers. Moisture content during fill placement shall be kept within 2% of the optimum moisture.
- 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 (Standard Proctor).
 - 1. Under pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 100 percent.
 - 2. Under walkways, scarify and recompact top 12 inches below subgrade and compact each layer of backfill or fill soil material at 98 percent.
 - 3. Under lawn or unpaved areas, scarify and recompact top 12 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent.
 - 4. For utility trenches in paved areas, compact each layer of initial and final backfill soil material at 100 percent.
 - 5. For utility trenches in unpaved areas, compact each layer of initial and final backfill soil material at 98 percent.

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3.15 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated. Provide smooth transitions between adjacent existing grades and new grades.
- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
 - 1. Lawn or Unpaved Areas: Plus or minus 1 inch.
 - 2. Walks: Plus or minus 1/2 inch.
 - 3. Pavements: Plus or minus 1/2 inch.

3.16 SUBBASE AND BASE COURSES

- A. Place subbase and/or base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase and base course under pavements and walks as follows:
 - 1. Proof roll prepared subgrade surface with a fully loaded tandem axel dump truck at a minimum to identify soft pockets and areas of excess yielding in the presence of the Engineer or independent testing agency. The width of the subgrade testing shall be approximately 24" wider than the required base course (12" in each direction). Unacceptable areas will be undercut and repaired as directed by the Engineer.
 - 2. Shape subbase and base course to required crown elevations and cross-slope grades.
 - 3. Compact subbase 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 ASTM D 698 and the final 12" below subgrade to 100%.
 - 4. Compact base course and gravel pavement at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 100 percent of maximum dry unit weight as determined by AASHTO method T-180 as modified by NCDOT.
 - 5. When thickness of compacted base course is 6 inches or less, place material in a single layer.
 - 6. When thickness of compacted base course is 6 inches or more, place materials in equal layers, with no layer more than 6 inches thick or less than 3 inches thick when compacted.
 - 7. Following compaction testing and within 48 hours prior to the application of asphalt or concrete pavement, the base course will be proof rolled with a fully loaded dual wheel tandem axel dump truck or similar construction equipment. The proof roll shall be observed by the Engineer and/or the Independent Testing Agency. Should any areas fail the proof roll, the base course will be scarified,

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moistened or aerated, recompact, and the proof roll will be repeated until all areas are acceptable.

3.17 FIELD QUALITY CONTROL

- A. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.
- B. Testing agency will test compaction of soils in place according to ASTM D-698, ASTM D 1556, ASTM D 2167, ASTM D 2922, ASTM D 2937, and ASTM D6938 as applicable. Compaction tests shall be performed at the following locations and frequencies described in the latest edition of the NCDOT Standard Specifications for Roads and Structures.
- C. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.18 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.19 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION 312000

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SECTION 315000 - EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes temporary excavation support and protection systems.

- B. The City of Roxboro (OWNER) has developed these Specifications as a supplement to the NCDOT Standard Specifications for Roads and Structures (NCDOT Specifications). The NCDOT Specifications are the minimum standards for construction in the City's rights-of-way. These City of Roxboro Specifications, if more stringent, shall govern.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project Site
 - 1. Review geotechnical report.
 - 2. Review existing utilities and subsurface conditions.
 - 3. Review coordination for interruption, shutoff, capping, and continuation of utility services.
 - 4. Review proposed excavations.
 - 5. Review proposed equipment.
 - 6. Review monitoring of excavation support and protection system.
 - 7. Review coordination with waterproofing.
 - 8. Review abandonment or removal of excavation support and protection system.

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1.3 SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, performance properties, and dimensions of individual components and profiles, and calculations for excavation support and protection system.
- B. Shop Drawings: For excavation support and protection system, prepared by or under the supervision of a qualified professional engineer.
 - 1. Include plans, elevations, sections, and details.
 - 2. Show arrangement, locations, and details of soldier piles, piling, lagging, tiebacks, bracing, and other components of excavation support and protection system according to engineering design.
 - 3. Indicate type and location of waterproofing.
 - 4. Include a written plan for excavation support and protection, including sequence of construction of support and protection coordinated with progress of excavation.
- C. Delegated-Design Submittal: For excavation support and protection systems, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Contractor Calculations: For excavation support and protection system. Include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- E. Existing Conditions: Using photographs, show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by inadequate performance of excavation support and protection systems. Submit before Work begins.

1.4 CLOSEOUT SUBMITTALS

- A. Record Drawings: Identify locations and depths of capped utilities, abandoned-in-place support and protection systems, and other subsurface structural, electrical, or mechanical conditions.

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1.5 FIELD CONDITIONS

- A. Interruption of Existing Utilities: Do not interrupt any utility-serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:
 - 1. Do not proceed with interruption of utility without the Engineer's written permission.
 - 2. Notify the Engineer no fewer than 7 days in advance of proposed interruption of utility.
- B. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks, and record existing elevations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer to design excavation support and protection systems to resist all lateral loading and surcharge, including but not limited to, retained soil, groundwater pressure, adjacent building loads, adjacent traffic loads, construction traffic loads, material stockpile loads, and seismic loads, based on the following as applicable:
 - 1. Compliance with OSHA Standards and interpretations, 29 CFR 1926, Subpart P.
 - 2. Compliance with AASHTO Standard Specification for Highway Bridges or AASHTO LRFD Bridge Design Specification, Customary U.S. Units.
 - 3. Compliance with requirements of authorities having jurisdiction.
 - 4. Compliance with utility company requirements.
 - 5. Compliance with railroad requirements.

2.2 MATERIALS

- A. Provide materials that are either new or in serviceable condition.

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- B. Structural Steel: ASTM A 36/A 36M, ASTM A 690/A 690M, or ASTM A 992/A 992M.
- C. Steel Sheet Piling: ASTM A 328/A 328M, ASTM A 572/A 572M, or ASTM A 690/A 690M; with continuous interlocks.
- D. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness as required by approved design.
- E. Shotcrete: Comply with Section 033713 "Shotcrete" for shotcrete materials and mixes, reinforcement, and shotcrete application.
- F. Cast-in-Place Concrete: ACI 301, of compressive strength required for application.
- G. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- H. Tiebacks: Steel bars, ASTM A 722/A 722M.
- I. Tiebacks: Steel strand, ASTM A 416/A 416M.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.
 - 1. Shore, support, and protect utilities encountered.

3.2 INSTALLATION - GENERAL

- A. Locate excavation support and protection systems clear of permanent construction, so that construction and finishing of other work is not impeded.

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- B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from the City of Roxboro and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- C. Install excavation support and protection systems without damaging existing buildings, structures, and site improvements adjacent to excavation.

3.3 SOLDIER PILES AND LAGGING

- A. Install steel soldier piles before starting excavation.
 - 1. Extend soldier piles below excavation grade level to depths adequate to prevent lateral movement, per approved design.
 - 2. Space soldier piles at regular intervals not to exceed allowable flexural strength of wood lagging, per approved design.
- B. Install wood lagging within flanges of soldier piles as excavation proceeds.
 - 1. Trim excavation as required to install lagging.
 - 2. Fill voids behind lagging with soil, and compact.
- C. Install wales horizontally at locations indicated on Drawings and secure to soldier piles.

3.4 SHEET PILING

- A. Before starting excavation, install one-piece sheet piling lengths and tightly interlock vertical edges to form a continuous barrier.
- B. Accurately place the piling using templates and guide frames unless otherwise recommended in writing by the sheet piling manufacturer.
 - 1. Limit vertical offset of adjacent sheet piling per the approved design.

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- C. Cut tops of sheet piling to uniform elevation at top of excavation.

3.5 TIEBACKS

- A. Drill, install, grout, and tension tiebacks.
- B. Test load-carrying capacity of each tieback, and replace and retest deficient tiebacks.
 - 1. Have test loading observed by a qualified professional engineer responsible for design of excavation support and protection system.
- C. Maintain tiebacks in place until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.6 BRACING

- A. Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move brace, install new bracing before removing original brace.
 - 1. Do not place bracing where it will be cast into or included in permanent concrete work unless otherwise approved by Architect.
 - 2. Install internal bracing if required to prevent spreading or distortion of braced frames.
 - 3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.7 MAINTENANCE

- A. Monitor and maintain excavation support and protection system.
- B. Prevent surface water from entering excavations by grading, dikes, or other means.
- C. Continuously monitor vibrations, settlements, and movements to ensure stability of excavations and constructed slopes and to ensure that damage to permanent structures is prevented.

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3.8 FIELD QUALITY CONTROL

- A. Survey-Work Benchmarks: Resurvey benchmarks during installation of excavation support and protection systems, excavation progress, and for as long as excavation remains open.
 - 1. Maintain an accurate log of surveyed elevations and positions for comparison with original elevations and positions.
 - 2. Promptly notify Architect if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.
- B. Promptly correct detected bulges, breakage, or other evidence of movement to ensure that excavation support and protection system remains stable.
- C. Promptly repair damages to adjacent facilities caused by installation or faulty performance of excavation support and protection systems.

3.9 REMOVAL AND REPAIRS

- A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and earth and hydrostatic pressures.
 - 1. Remove in stages to avoid disturbing underlying soils and rock or damaging structures, pavements, facilities, and utilities.
 - 2. Remove excavation support and protection systems to a minimum depth of 48 inches below overlying construction, and abandon remainder.
 - 3. Fill voids immediately with approved backfill compacted to density specified in Section 312000 "Earth Moving."
 - 4. Repair or replace, as approved by Engineer, adjacent work damaged or displaced by removing excavation support and protection systems.

END OF SECTION 315000

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SECTION 321216 - ASPHALT PAVING

PART 1 - GENERAL

1.1 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.

- B. The City of Roxboro (OWNER) has developed these Specifications as a supplement to the NCDOT Standard Specifications for Roads and Structures (NCDOT Specifications). The NCDOT Specifications are the minimum standards for construction in the City's rights-of-way. These City of Roxboro Specifications, if more stringent, shall govern.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

1. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.
2. Job-Mix Designs: For each job mix proposed for the Work.

- B. Material Certificates: For each paving material, from manufacturer.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturers shall be registered with and approved by the North Carolina Department of Transportation

- B. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of the North Carolina Department of Transportation for asphalt paving work.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

- C. Preinstallation Conference: Conduct conference at Project site.

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1.4 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:
 - 1. Tack Coat: Minimum surface temperature of 60 deg F.
 - 2. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
 - 3. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

PART 2 - PRODUCTS

2.1 AGGREGATES

- A. Coarse Aggregate: ASTM D 692, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.
- B. Fine Aggregate: ASTM D 1073 or AASHTO M 29, sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.
- C. Mineral Filler: ASTM D 242 or AASHTO M 17, rock or slag dust, hydraulic cement, or other inert material.

2.2 ASPHALT MATERIALS

- A. Asphalt Binder: AASHTO M 320 or AASHTO MP 1a.
- B. Tack Coat: ASTM D 977 or AASHTO M 140 emulsified asphalt, or ASTM D 2397 or AASHTO M 208 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

2.3 AUXILIARY MATERIALS

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

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2.4 MIXES

- A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction; 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.
 2. Base Course: B-25.0B unless otherwise specified.
 3. Intermediate Course: I-19.0B unless otherwise specified.
 4. Surface Course: S-9.5B unless otherwise specified.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. 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.
- B. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 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.

3.3 PATCHING

- A. 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 into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.
- B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseat concrete pieces firmly.
1. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.

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- C. 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.
 - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
- D. Patching: Fill excavated pavements with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

3.4 SURFACE PREPARATION

- A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
- B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.
- C. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd.
 - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.5 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. Spread mix at minimum temperature of 250 deg F.
 - 2. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.
- 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.

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3.6 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.
1. Clean contact surfaces and apply tack coat to joints.
 2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
 3. Offset transverse joints, in successive courses, a minimum of 24 inches.
 4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."

3.7 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.
1. Complete compaction before mix temperature cools to 185 deg F.
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
1. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent nor greater than 96 percent.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
- F. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- G. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

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3.8 INSTALLATION TOLERANCES

- A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:
 - 1. Base Course: Plus or minus 1/2 inch.
 - 2. Surface Course: Plus 1/4 inch, no minus.

- B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:
 - 1. Base Course: 1/4 inch.
 - 2. Surface Course: 1/8 inch.
 - 3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Owner and/or Builder/Developer will engage a qualified testing agency as directed by the City of Roxboro or NCDOT to perform tests and inspections.

- B. Replace and compact **hot-mix asphalt** where core tests were taken.

- C. Remove and replace or install additional hot-mix asphalt as directed by the Engineer where test results or measurements indicate that it does not comply with specified requirements.

3.10 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.

END OF SECTION 321216

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SECTION 321313 - CONCRETE PAVING

PART 3 - GENERAL

3.40 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. Colored concrete walkways.

- B. The City of Roxboro (OWNER) has developed these Specifications as a supplement to the NCDOT Standard Specifications for Roads and Structures (NCDOT Specifications). The NCDOT Specifications are the minimum standards for construction in the City's rights-of-way. These City of Roxboro Specifications, if more stringent, shall govern.

3.41 SUBMITTALS

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

- B. Design Mixtures: For each concrete pavement mixture.

3.42 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.

PART 4 - PRODUCTS

4.40 CONCRETE MATERIALS

- A. Cementitious Material: Use one of the following cementitious materials, of the same type, brand, and source throughout the Project:

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1. Portland Cement: ASTM C 150, Type I or II.
 - a. Fly Ash: ASTM C 618.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C 33 coarse aggregate, uniformly graded. Provide aggregates from a single source.
- C. Water: ASTM C 94/C 94M.
- D. Air-Entraining Admixture: ASTM C 260.
- E. Chemical Admixtures: ASTM C 494/C 494M, of type suitable for application, 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.

4.41 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
 1. Use rigid forms for straight sections of the pour.
 2. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less.
 3. Do not use notched or bent form material.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.3 STEEL REINFORCEMENT

- A. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, fabricated from galvanized steel wire into flat sheets.
- B. Deformed-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, flat sheet.
- C. Epoxy-Coated Welded-Wire Reinforcement: ASTM A 884/A 884M, Class A, plain steel.

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- D. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.
- E. Galvanized Reinforcing Bars: ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A 615/A 615M, Grade 60 deformed bars.
- F. Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M or ASTM A 934/A 934M; with ASTM A 615/A 615M, Grade 60 deformed bars.
- G. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60 deformed bars; assembled with clips.
- H. Plain-Steel Wire: ASTM A 1064/A 1064M, galvanized.
- I. Deformed-Steel Wire: ASTM A 1064/A 1064M.
- J. Epoxy-Coated-Steel Wire: ASTM A 884/A 884M, Class A; coated, deformed.
- K. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 plain-steel bars: galvanized after fabrication according to ASTM A 767/A 767M, Class I coating. Cut bars true to length with ends square and free of burrs.
- L. Epoxy-Coated, Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60 plain-steel bars.
- M. Tie Bars: ASTM A 615/A 615M, Grade 60; deformed.
- N. Hook Bolts: ASTM A 307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.
- O. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded-wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:

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1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
- P. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.
- Q. Zinc Repair Material: ASTM A 780/A 780M.

2.4 FIBER REINFORCEMENT

- A. Synthetic Fiber: Monofilament polypropylene fibers engineered and designed for use in decorative concrete paving, complying with ASTM C 1116/C 1116M, Type III, ½ inch to 1½ inches long.
- B. Synthetic Fiber: Fibrillated polypropylene fibers engineered and designed for use in decorative concrete paving, complying with ASTM C 1116/C 1116M, Type III, ½ inch to 1½ inches long.

2.5 COLOR ADDITIVES

- A. Colored Admixture for Integrally Colored Concrete:
1. Admixture shall be a colored, water-reducing, admixture containing no calcium chloride with coloring agents that are limeproof and ultra-violet resistant.
 2. Colored admixture shall conform to the requirements of ACI 303.1, ASTM C979, ASTM C494 and ASSHTO M194.
 3. Raw pigments are not an equivalent and may not be substituted.
- B. Color: To be chosen by owner from Scofield Admixture chart of standard colors.
- C. SUBSTITUTIONS: The use of products other than those specified may be considered providing that the Contractor requests its use in writing. This request shall be accompanied by the following:
1. A certificate of compliance from material manufacturer stating that proposed products meet or exceed requirements of this Section, including standards ACI 303.1, ASTM C979, ASTM C494 and AASHTO M194.
 2. Documented proof that proposed materials have a 10-year proven record of performance, confirmed by at least 5 local projects that the Engineer can examine.

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2.6 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth.
- 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 Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
- F. White Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B.

2.7 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- B. 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.

2.8 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301, with the following properties unless otherwise specified:
 - 1. Compressive Strength (28 Days): 4000 psi.
 - 2. Slump Limit: 4 inches, plus or minus 1 inch.
 - 3. Air Content: 5-1/2 to 4-1/2 percent plus or minus 1.5 percent.
- B. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions.

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2.9 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Proof-roll prepared subbase surface below concrete pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding.

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

3.3 JOINTS

- A. General: Form construction, isolation, and contraction 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.
- 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.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.
- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness.
- E. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

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- F. Locate expansion joints at 40' on center, unless otherwise indicated on the plans. Extend joint fillers full width and depth of joint, not less than 1/2" or more than 1" below finished surface where joint sealers are indicated. If no joint sealer is called for, place top of joint filler flush with concrete surface.

3.4 STEEL REINFORCEMENT INSTALLATION

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install welded-wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
- E. Zinc-Coated Reinforcement: Use galvanized-steel wire ties to fasten zinc-coated reinforcement. Repair cut and damaged zinc coatings with zinc repair material.
- F. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M.
- G. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 18-inch overlap of adjacent mats.

3.5 CONCRETE PLACEMENT

- A. Moisten subbase to provide a uniform dampened condition at time concrete is placed.
- B. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

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- C. 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.
- D. Screed pavement surfaces with a straightedge and strike off.
- E. 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.

3.6 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
 - 1. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.
- C. Slip-Resistive Aggregate Finish: Before final floating, spread slip-resistive aggregate finish on pavement surface according to manufacturer's written instructions.
 - 1. Cure concrete with curing compound recommended by slip-resistive aggregate manufacturer. Apply curing compound immediately after final finishing.
 - 2. After curing, lightly work surface with a steel wire brush or abrasive stone and water to expose nonslip aggregate.

3.7 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

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- E. Curing Methods: Cure concrete by moisture curing, moisture retaining cover curing, curing compound, or a combination of these, as follows:
1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 2. Moisture Retaining Cover Curing: Cover concrete surfaces with moisture retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears 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.

3.8 PAVEMENT TOLERANCES

- A. Comply with tolerances of ACI 117 and as follows:
1. Elevation: 1/4 inch.
 2. Thickness: Plus 3/8 inch, minus 1/4 inch.
 3. Surface: Gap below 10-foot long, unlevelled straightedge not to exceed 1/4 inch.
 4. Joint Spacing: 3 inches.
 5. Contraction Joint Depth: Plus 1/2 inch, no minus.
 6. Joint Width: Plus 1/8 inch, no minus.

3.9 PAVEMENT MARKING

- A. See Section 321723 PAVEMENT MARKINGS.

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3.10 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.
- 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

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SECTION 321373 - CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Expansion and contraction joints within cement concrete pavement.
 - 2. Joints between cement concrete and asphalt pavement.
- B. The City of Roxboro (OWNER) has developed these Specifications as a supplement to the NCDOT Standard Specifications for Roads and Structures (NCDOT Specifications). The NCDOT Specifications are the minimum standards for construction in the City's rights-of-way. These City of Roxboro Specifications, if more stringent, shall govern.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For each type and color of joint sealant required.
- C. Product certificates.
- D. Compatibility and Adhesion Test Reports: From sealant manufacturer.

1.3 QUALITY ASSURANCE

- A. Preconstruction Compatibility and Adhesion Testing: Submit samples of materials that will contact or affect joint sealants to joint-sealant manufacturers for testing according to ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

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PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.
- B. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

2.2 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.
 - 1. 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.
- B. Colors of Exposed Joint Sealants: As selected by the Engineer from manufacturer's full range.

2.3 COLD-APPLIED JOINT SEALANTS

- A. Type NS Silicone Sealant for Concrete: Single-component, low-modulus, neutral-curing, nonsag silicone sealant complying with ASTM D 5893 for Type NS.
- B. Type SL Silicone Sealant for Concrete and Asphalt: Single-component, low-modulus, neutral-curing, self-leveling silicone sealant complying with ASTM D 5893 for Type SL.

2.4 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 Cold- and Hot-Applied Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

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- C. Backer Strips for Cold- and Hot-Applied Sealants: ASTM D 5249; Type 2; of thickness and width required to control sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.
- D. Round Backer Rods for Cold-Applied Sealants: ASTM D 5249, Type 3, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

PART 3 - EXECUTION

3.1 INSTALLATION

- 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.
- C. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- D. Install backer materials to support sealants during application and at position required to produce optimum sealant movement capability. Do not leave gaps between ends of backer materials. Do not stretch, twist, puncture, or tear backer materials. Remove absorbent backer materials that have become wet before sealant application and replace them with dry materials.
- E. Install sealants at the same time backings are installed to completely fill recesses provided for each joint configuration and to produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Non-sag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
- G. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

END OF SECTION 321373

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SECTION 321723 - PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes painted markings applied to asphalt and concrete pavements.

- B. The City of Roxboro (OWNER) has developed these Specifications as a supplement to the NCDOT Standard Specifications for Roads and Structures (NCDOT Specifications). The NCDOT Specifications are the minimum standards for construction in the City's rights-of-way. These City of Roxboro Specifications, if more stringent, shall govern.

1.2 SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include technical data and tested physical and performance properties.

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of City of Roxboro and NCDOT for pavement-marking work.

1.4 FIELD CONDITIONS

- A. Environmental Limitations: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of at least 55 deg F, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers shall be products expressly for pavement marking on asphalt and concrete.

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2.3 GLASS BEADS

- A. Glass Beads: AASHTO M 247, Type 1.

2.4 THERMOPLASTIC MARKINGS

- A. Thermoplastic Markings: Thermoplastic pavement markings will meet NCDOT requirements and specifications.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that pavement is dry and in suitable condition to begin pavement marking according to manufacturer's written instructions.
- B. Proceed with pavement marking only after unsatisfactory conditions have been corrected.

3.2 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Engineer.
- B. Allow paving to age for a minimum of 30 days before starting pavement marking.
 - 1. Paving may be marked in less than 30 days, in which case a second coat is required after the 30-day period.
- 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.
 - 2. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to pavement. Mask an extended area beyond edges of each stencil to prevent paint application beyond the stencil. Apply paint so that it cannot run beneath the stencil.
 - 3. Broadcast glass beads uniformly into wet pavement markings at a rate of 6 lb/gal..

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- E. All pavement markings within NCDOT right-of-way will be thermoplastic meeting all requirements and current specifications published by NCDOT.

3.3 PROTECTING AND CLEANING

- A. Protect pavement markings from damage and wear during remainder of construction period.
- B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 321723

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SECTION 329200 - TURF AND GRASSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Seeding.

- B. The City of Roxboro (OWNER) has developed these Specifications as a supplement to the NCDOT Standard Specifications for Roads and Structures (NCDOT Specifications). The NCDOT Specifications are the minimum standards for construction in the City's rights-of-way. These City of Roxboro Specifications, if more stringent, shall govern.

1.2 DEFINITIONS

- A. Finish Grade: Elevation of finished surface of planting soil.

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

- C. 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.

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

- E. Weeds: Includes Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy, Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimbleweed, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

1.3 SUBMITTALS

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

- B. Product certificates.

- C. Planting Schedule: Indicating anticipated planting dates.

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D. Maintenance Instructions.

1.4 REGULATORY REQUIREMENTS

A. Comply with regulatory agencies for fertilizer and herbicide composition.

1.5 QUALITY ASSURANCE

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

B. Provide seed mixtures in containers clearly labeled and listing percentages, year of production, weight, germination, date and location of packaging.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Seed: 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. Fertilizer: Deliver in waterproof bags showing weight, analysis and manufacturer.

C. SCHEDULING

D. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit.

1.7 MAINTENANCE INSTRUCTIONS

A. Provide Owner with continuing maintenance instructions.

B. Maintenance instructions shall include cutting methods and heights, fertilizer types, application frequency and amounts.

PART 2 - PRODUCTS

2.1 SEED

A. 100% Turf Type Fescue, improved drought resistance cultivars.

1. Blend of 40% "Arid" Tall Fescue; 40% "Rebel" Tall Fescue; 20% "Wrangler" Tall Fescue.

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- B. Seed Species: State-certified seed.

2.2 INORGANIC SOIL AMENDMENTS

- A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent.

2.3 FERTILIZERS

- A. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 4 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. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.

2.4 PLANTING SOILS

- A. TOPSOIL:
 - 1. Topsoil: ASTM D 5268 topsoil, with pH range of 5.5 to 7, a minimum of 2 percent organic material content; and free of stones, sticks debris or other extraneous materials one inch (1") or larger in any dimension.
 - 2. Provide topsoil which is friable, fertile, natural loam high in organic content and free of lumps, rocks, weeds, brush, roots, stumps or any toxic matter injurious to plants. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches deep; do not obtain from agricultural land, bogs or marshes.
 - 3. Topsoil obtained from the Project Site may be used if it meets the Project Specifications. If acceptable topsoil is not available at the site, it shall be imported from off-site.

2.5 MULCHES

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

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2.6 HERBICIDES

- A. Herbicide, registered and approved by EPA, and of type recommended by manufacturer for application.

2.7 WATER:

- 1. Clean, fresh, and free of substances or matter which could inhibit vigorous growth of grass.

PART 3 - EXECUTION

3.1 SEEDING

- A. Sow seed at a total rate shown on the plans, evenly in two intersecting directions. Do not seed more area than can be mulched the same day.
- B. Rake seed lightly into top 1/8 inch of topsoil, roll lightly, and water with fine spray.
- C. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.

3.3 LAWN PREPARATION

- A. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 6 inches . Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property. Repeat cultivation in areas where spreading and hauling equipment has compacted subsoil.
- B. Spread topsoil to a minimum depth of 2 inches over areas to be seeded. Incorporate into subsoil by tilling to 5" depth. Rake until smooth.
- C. 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 of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit fine grading to areas that can be planted in the immediate future. Ensure positive drainage.
- D. Fertilize all areas to be grassed with 10-10-10 at a rate of 25 lbs per 1000 sq. ft. and dolomitic lime at a rate of 40lbs/1000 sq. ft.
- E. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

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- F Restore areas if eroded or otherwise disturbed after finish grading and before planting.

3.4 TURF MAINTENANCE

- A. Begin maintenance immediately after each area is planted and continue until acceptable lawn is established, but for not less than the following periods:
 - 1. Seeded Lawns: 3 months days from date of Substantial Completion.
- B. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain height appropriate for species without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowings.
- C. Trim edges and hand clip as necessary.
- D. Remove clippings immediately after mowing.
- E. Water to prevent grass and soil from drying out.
- F. Control weed growth with herbicides and mechanical means.
- G. Reseed bare areas.

3.5 SATISFACTORY TURF

- A. Notify Engineer when landscape work is completed to request an inspection to determine acceptability.
- B. Turf installations shall meet the following criteria as determined by Engineer:
 - 1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.
- C. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

END OF SECTION 329200

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SECTION 334100 - STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes exterior, gravity-flow, nonpressure storm drainage, with the following components:
 - 1. Precast concrete manholes.
 - 2. Catch basins, yard inlets, and curb inlets.
 - 3. Reinforced concrete pipe.
 - 4. High density polyethylene (HDPE) pipe

- B. The City of Roxboro (OWNER) has developed these Specifications as a supplement to the NCDOT Standard Specifications for Roads and Structures (NCDOT Specifications) and as a supplement to the City of Roxboro Supplemental Specifications and Detail Drawings for Wastewater Force Mains, Stormwater Drainage, Wastewater Pumping Systems, Miscellaneous Materials for Utilities, and Record Drawing Checklist. The NCDOT Specifications are the minimum standards for construction in the City's rights-of-way. The City of Roxboro Specifications, if more stringent, shall govern.

1.2 PERFORMANCE REQUIREMENTS

- A. Gravity-Flow, Nonpressure, Drainage-Piping. Piping, storm drainage materials, and installations shall meet or exceed the requirements of the City of Roxboro and the North Carolina Department of Transportation.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For pipe, manholes, and catch basins. Include plans, elevations, sections, details, and manhole frames and covers and catch basin frames and grates.
- C. Coordination Drawings: Show pipe sizes, locations, and elevations.
- D. Field quality-control test reports. Product Data: For each type of product indicated.

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PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, fitting, and joining materials.

2.2 REINFORCED CONCRETE PIPE

- A. Pipe and Fittings: ASTM C 76, Class III, unless otherwise noted.
- B. Gasket and Joint: Watertight per ASTM C 443
- C. Meet all aspects of the requirements of N.C. Department of Transportation.
- D. Flared End Sections (FES) will be in conformance with Section 1032-9(D) of the latest edition of the NCDOT Standard Specifications for Roads and Structures

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service class Service and Extra-Heavy classes Extra-Heavy class.
- B. Gaskets: ASTM C 564, rubber.
- C. Caulking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.4 HDPE PIPE AND FITTINGS

- A. Corrugated PE Drainage Pipe and Fittings NPS 10 and Smaller: AASHTO M 252M, Type S, with smooth waterway for coupling joints and silt tight joints or better.
- B. Corrugated PE Pipe and Fittings NPS 12 and Larger: AASHTO M 294M, Type S, with smooth waterway for coupling joints and silt tight joints or better.

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2.5 MANHOLES

- A. Standard Precast Concrete Manholes: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
1. Diameter: 48 inches minimum, unless otherwise indicated.
 2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
 3. Base Section: 6-inch minimum thickness for floor slab and 5-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
 4. Riser Sections: 5-inch minimum thickness, and of length to provide depth indicated.
 5. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
 6. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
 7. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
 8. Steps: Individual FRP steps, FRP ladder, or ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches.
 9. Manhole Frames and Covers: Ferrous meeting the requirements for sanitary sewer manholes except for words equivalent to "STORM SEWER."

2.6 CONCRETE

- A. General: Cast-in-place concrete according to ACI 318/318R, ACI 350R, 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. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water-cementitious materials ratio.
1. Reinforcement Fabric: ASTM A 1064/A 1064M, steel, welded wire fabric, plain.
 2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

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2.7 CATCH BASINS

- A. Standard Precast Concrete Catch Basins: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
 - 1. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
 - 2. Top Section: Eccentric-cone type unless flat-slab-top type is indicated.
 - 3. Joint Sealant: ASTM C 990, bitumen or butyl rubber.

- B. Brick Catch Basins
 - 1. Brick Catch Basins built in place, per NCDOT Standards, Specifications, and Standard Drawings.

- C. Frames and Grates: Cast iron suitable for structural loading.
 - 1. Grate Free Area: Approximately 50 percent, unless otherwise indicated.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Gravity-Flow, Nonpressure Sewer Piping: Use the following pipe materials for each size range:
 - 1. Class 3 reinforced concrete pipe, unless otherwise noted.

3.2 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take design considerations into account. 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.

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- C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
- D. Install gravity-flow, nonpressure drainage piping according to the following:
 - 1. Install piping pitched down in direction of flow, at minimum slope of 1 percent, unless otherwise indicated.
 - 2. All pipe will be installed per Section 300 of the NCDOT Standard Specifications for Roads and Structures, latest edition.
- E. Clear interior of piping and manholes of dirt and superfluous material as work progresses.

3.3 PIPE JOINT CONSTRUCTION

- A. Join gravity-flow, nonpressure drainage piping according to the following:
 - 1. Install RCP and HDPE pipe in accordance with City of Roxboro and NCDOT requirements.

3.4 MANHOLE INSTALLATION

- A. General: Install manholes, complete with appurtenances and accessories indicated.
- B. Install precast concrete manhole sections with sealants according to ASTM C 891.
- C. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 1 inch above finished surface elsewhere, unless otherwise indicated.

3.5 CATCH BASIN INSTALLATION

- A. Set frames and grates to elevations indicated.

3.6 CONNECTIONS

- A. Make connections to existing piping and underground manholes.

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3.7 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
1. Submit separate report for each system inspection.
 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 95 percent of piping diameter.
 - c. Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 4. Reinspect and repeat procedure until results are satisfactory.

END OF SECTION 334100