

PROJECT MANUAL
(VOLUME 3 OF 3)

**FORCE MAIN
TECHNICAL SPECIFICATIONS**

**FOR THE CONSTRUCTION OF
PUMP STATION #1 & FORCE MAIN IMPROVEMENTS
SRP-W-ARP-0063**

SMITHFIELD, NORTH CAROLINA



TOWN COUNCIL:
M. Andy Moore, Mayor
Roger A. Wood, Mayor Pro-Tem
Marlon Lee, Sloan Stevens, Travis Scott, Dr. David Barbour
John A. Dunn, Stephen Rabil

Michael L. Scott, Town Manager
Elaine Andrews, Town Clerk

October 2025



Robert Bernard

ENGINEER:
Stantec
521 East Morehead Street, Suite 425
Charlotte, NC 28202

Final Specifications – For Review Purposes Only
Not Released for Construction

SECTION 022100
PROJECT CONTROLS (SURVEYING)

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Contractor shall provide and pay for field engineering services required for project; including but not limited to:
 - 1. Survey work required for project controls and layout.
 - 2. Certified as-built surveys specified herein.
 - 3. Certified as-built survey data to support record drawings as specified in Section 017839.
- B. Contractor shall retain the services of a registered land surveyor licensed in the state of North Carolina:
 - 1. Identify existing control points and property line corners indicated on the Drawings.
 - 2. Verify and record all existing structure locations in the vicinity of, or adjacent to, the proposed Work.
 - 3. Maintain an accurate record of locations of all new buried piping and existing buried piping and other buried existing facilities (conduits, and structures) encountered and/or relocated during construction of the Work.
- C. There shall be no direct payment for this item, the cost of which shall be included in pay items identified in Section 012000.

1.02 RELATED WORK

- A. Record Drawings are included in Section 017839.
- B. Contract Closeout is included in Section 017700.

1.03 SUBMITTALS

- A. Submit, to the Engineer, the name, address and state of registration and license number of proposed registered land surveyor. Show minimum of 5 years of experience on similar sized project.
- B. On request of the Owner/Engineer, submit documentation to verify accuracy of field engineering work.

1.04 QUALIFICATIONS OF SURVEYOR

- A. Registered land surveyor, licensed in North Carolina. Show minimum of 5 years of experience on similar sized project.

1.05 SURVEY REFERENCE POINTS

- A. Existing basic horizontal and vertical control points for the project are those designated on Drawings.
- B. Locate and protect control points prior to starting site work and preserve all permanent reference points during construction.
 - 1. Make no changes or relocations without prior written notice to and approval by the Owner/Engineer.
 - 2. Report to the Owner/Engineer when any reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.
 - 3. Require the registered surveyor to correctly replace project control points which may be lost or destroyed. Establish replacements based on original survey control.
 - 4. Coordinates on the plans are based on North Carolina State Plane Coordinate System: NAVD 88 Vertical Control and NAD 83 Horizontal Control unless otherwise noted. The data collection methods used for this project may be survey grade, mapping grade GPS equipment and/or a combination of both.

1.06 PROJECT SURVEY REQUIREMENTS

- A. For work contained to an individual site or property, establish a minimum of two permanent bench marks on site, referenced to data established by survey control points.
- B. For pipeline projects, establish one permanent bench mark for every one half mile of new pipe.
 - 1. Record locations, with horizontal and vertical data, on the as-built Drawings.
 - 2. Permanent benchmarks shall be installed and spaced for convenient reference and used at locations along the pipeline route.
 - 3. Benchmarks shall be installed to National Geodetic Survey standards and shall include horizontal and vertical data, as well as the installation date.
- C. Establish lines and levels; locate and lay out:
 - 1. Site improvements
 - a. Stakes for grading, fill and topsoil placement.
 - b. Utility slopes and invert elevations.
 - c. Sidewalks, pavement, fencing, storm drainage facilities, and other finish surface work.
 - 2. Batter boards for structures.
 - 3. Building foundation, column locations and floor levels.
 - 4. Controlling lines and levels required for mechanical and electrical trades.

- D. If lines, levels or layouts are lost or destroyed, or if required by the Owner/Engineer, verify layouts by same methods.
- E. Establish all lines and grades prior to construction of line work for all force mains, transmission mains, storm drainage piping, gravity sewers and other new utility lines at 100-ft increments, at defined breaks in grade, and at manholes.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 RECORDS

- A. Maintain a complete, accurate log of all control and survey work as it progresses.
- B. Update the project as-built survey on a monthly basis.
- C. Maintain an accurate record of new and existing piping, conduit and structure changes, revisions, relocations, and modifications.
- D. At the end of the project, submit the following:
 - 1. Two signed and sealed prints of all required as-built survey information.
 - 2. Digital file of all surveyed control points, including elevations, for downloading into the City's GIS.

END OF SECTION

SECTION 033000
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Footings.
 - 2. Foundation walls.
 - 3. Slabs-on-grade.
 - 4. Concrete reinforcing
 - 5. Miscellaneous concrete elements including equipment pads, thrust blocks, and other elements shown on drawings.
- B. Related Sections:
 - 1. Section 034100 "Precast Structural Concrete.
 - 2. Section 051200 "Structural Steel Framing ".

1.3 DEFINITIONS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

- D. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.
 - 1. Location of construction joints is subject to approval of the Engineer.
- E. Samples: For waterstops.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
- B. Welding certificates.
- C. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Form materials and form-release agents.
 - 4. Steel reinforcement and accessories.
 - 5. Waterstops.
 - 6. Curing compounds.
 - 7. Bonding agents.
 - 8. Adhesives.
- D. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.
- E. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
- C. Testing Agency Qualifications: An independent agency, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
- D. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 117, Standard Specifications for Tolerances for Concrete Construction and Materials; American Concrete Institute International latest revision.
 - 2. ACI 211.1, Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; American Concrete Institute International; latest revision.

3. ACI 301, Specifications for Structural Concrete for Buildings; American Concrete Institute International; latest revision.
4. ACI 302 1R , Guide for Concrete Floor and Slab Construction; American Concrete Institute International; latest revision.
5. ACI 304R, Guide for Measuring, Mixing, Transporting, and Placing Concrete; American Concrete Institute International; latest revision.
6. ACI 305R, Hot Weather Concreting; American Concrete Institute International; latest revision.
7. ACI 306R, Cold Weather Concreting; American Concrete Institute International; latest revision.
8. ACI 308R, Guide to Curing Concrete; American Concrete Institute International; latest revision.
9. ACI 318, Building Code Requirements for Structural Concrete and Commentary; American Concrete Institute International; latest revision.
10. ASTM C33/C33M, Standard Specification for Concrete Aggregates; latest revision.
11. ASTM C39/C39M, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; latest revision.
12. ASTM C94/C94M, Standard Specification for Ready-Mixed Concrete; latest revision.
13. ASTM C150/C150M, Standard Specification for Portland Cement; latest revision.
14. ASTM C173/C173M, Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; latest revision.
15. ASTM C260, Standard Specification for Air-Entraining Admixtures for Concrete; latest revision.
16. ASTM C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; latest revision.
17. ASTM E1745, Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; latest revision.

- E. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
1. Plywood, metal, or other approved panel materials.

- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.
- D. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.
- E. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- F. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- G. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
- H. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

2.3 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete.

2.4 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type I
 - a. Fly Ash: ASTM C 618, Class F or C.
- B. Silica Fume: ASTM C 1240, amorphous silica.
- C. Normal-Weight Aggregates: ASTM C 33, coarse aggregate or better, graded.
 - 1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.

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

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

2.5 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.

2. Retarding Admixture: ASTM C 494/C 494M, Type B.

3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.

4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.

5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.

6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.6 WATERSTOPS

A. Flexible Rubber Waterstops: CE CRD-C 513, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.

2.7 CURING MATERIALS

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

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

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

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

2.8 RELATED MATERIALS

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

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

2.9 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

2.10 FABRICATING REINFORCEMENT

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

2.11 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.
 - 1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
 - 2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..
 - 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Construct forms tight enough to prevent loss of concrete mortar.
- D. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
 2. Do not use rust-stained steel form-facing material.
- E. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
 - F. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
 - G. Chamfer exterior corners and edges of permanently exposed concrete.
 - H. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
 - I. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
 - J. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
 - K. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.
 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved its 28-day design compressive strength.
 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets.

3.3 SHORES AND RESHORES

- A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.

- B. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.4 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

3.5 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 - 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.

2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 2. Maintain reinforcement in position on chairs during concrete placement.
 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 4. Slope surfaces uniformly to drains where required.
 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- G. Hot-Weather Placement: Comply with ACI 301 and as follows:
1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.7 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete bases 6 inches high unless otherwise indicated; and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.

3.8 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 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. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
 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.

- a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.
4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a 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. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.9 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.
- B. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

3.10 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- B. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

3. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
4. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
5. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
 - a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
6. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
7. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
8. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
9. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M.
10. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
11. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

END OF SECTION 033000

SECTION 034100
PRECAST STRUCTURAL CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Precast structural concrete.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Design Mixtures: For each precast concrete mixture. Include compressive strength and, if required, water-absorption tests.
- C. Shop Drawings:
 - 1. Include member locations, plans, elevations, dimensions, shapes and sections, openings, support conditions, and types of reinforcement, including special reinforcement.
 - 2. Detail fabrication and installation of precast structural concrete units, including connections at member ends and to adjoining construction.
 - 3. Indicate joints, reveals, drips, chamfers, and extent and location of each surface finish.
 - 4. Indicate type, size, and length of welded connections by AWS standard symbols.
 - 5. Detail loose and cast-in hardware, lifting and erection inserts, connections, and joints.
 - 6. Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure or other construction.
 - 7. Include and locate openings larger than 10 inches. Where additional structural support is required, include header design.
 - 8. If design modifications are proposed to meet performance requirements and field conditions, submit design calculations and Shop Drawings. Do not adversely affect the appearance, durability, or strength of units when modifying details or materials and maintain the general design concept.
- D. Delegated-Design Submittal: For precast structural concrete indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, fabricator, testing agency.
- B. Welding certificates.
- C. Material Certificates: For the following:
 - 1. Cementitious materials.
 - 2. Reinforcing materials and prestressing tendons.
 - 3. Admixtures.
 - 4. Structural-steel shapes and hollow structural sections.
- D. Material Test Reports: For aggregates, by a qualified testing agency.
- E. Preconstruction test reports.
- F. Source quality-control reports.
- G. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm that assumes responsibility for engineering precast structural concrete units to comply with performance requirements. Responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
- B. Installer Qualifications: A precast concrete erector qualified and designated by PCI's Certificate of Compliance, to erect Category S1 - Simple Structural Systems.
- C. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
- D. Quality-Control Standard: For manufacturing procedures, testing requirements, and quality-control recommendations for types of units required, comply with PCI MNL 116, "Manual for Quality Control for Plants and Production of Structural Precast Concrete Products."

1.6 COORDINATION

- A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction before starting that Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Support units during shipment on nonstaining shock-absorbing material in same position as during storage.

- B. Store units with adequate bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage.
- C. Handle and transport units in a manner that avoids excessive stresses that cause cracking or damage.
- D. Lift and support units only at designated points indicated on Shop Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Design Standards: Comply with ACI 318 and with design recommendations in PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of precast structural concrete units indicated.

2.2 MOLD MATERIALS

- A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that provides continuous precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required finishes.
 - 1. Mold-Release Agent: Commercially produced form-release agent that does not bond with, stain, or adversely affect precast concrete surfaces and does not impair subsequent surface or joint treatments of precast concrete.
- B. Form Liners: Units of face design, texture, arrangement, and configuration. Furnish with manufacturer's recommended form-release agent that does not bond with, stain, or adversely affect precast concrete surfaces and does not impair subsequent surface or joint treatments of precast concrete.
- C. Surface Retarder: Chemical set retarder, capable of temporarily delaying setting of newly placed concrete mixture to depth of reveal specified.

2.3 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 116.

2.4 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150/C 150M, Type I or Type III, gray, unless otherwise indicated.
- B. Supplementary Cementitious Materials:

1. Fly Ash: ASTM C 618, Class C or F, with maximum loss on ignition of 3 percent.
 2. Metakaolin: ASTM C 618, Class N.
 3. Silica Fume: ASTM C 1240, with optional chemical and physical requirement.
- C. Normal-Weight Aggregates: Except as modified by PCI MNL 116, ASTM C 33/C 33M.
- D. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 116.
- E. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
- F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.
1. Water-Reducing Admixtures: ASTM C 494/C 494M, Type A.
 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 4. Water-Reducing and Accelerating Admixture: ASTM C 494/C 494M, Type E.
 5. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 6. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 7. Plasticizing Admixture: ASTM C 1017/C 1017M, Type I.
 8. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
 9. Corrosion-Inhibiting Admixture: ASTM C 1582/C 1582M.

2.5 STEEL CONNECTION MATERIALS

- A. Carbon-Steel Shapes and Plates: ASTM A 36/A 36M.
- B. High-Strength Bolts and Nuts: ASTM A 325 or ASTM A 490 Type 1, heavy hex steel structural bolts; heavy hex carbon-steel nuts, ASTM A 563; and hardened carbon-steel washers, ASTM F 436.
- C. Welding Electrodes: Comply with AWS standards.
- D. Precast Accessories: Provide clips, hangers, plastic or steel shims, and other accessories required to install precast structural concrete units.

2.6 GROUT MATERIALS

- A. Sand-Cement Grout: Portland cement, ASTM C 150/C 150M, Type I, and clean, natural sand, ASTM C 144 or ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 to 3 parts sand, by volume, with minimum water required for placement and hydration. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C 1218/C 1218M.

2.7 MOLD FABRICATION

- A. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes and for prestressing and detensioning operations. Coat contact surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.
 - 1. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and supports to maintain stability of liners during concrete placement. Coat form liner with form-release agent.
- B. Maintain molds to provide completed precast structural concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.

2.8 FABRICATION

- A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.
- B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing precast structural concrete units to supporting and adjacent construction.
- C. Cast-in reglets, slots, holes, and other accessories in precast structural concrete units as indicated on the Contract Drawings.
- D. Cast-in openings larger than 10 inches in any dimension.
- E. Reinforcement: Comply with recommendations in PCI MNL 116 for fabricating, placing, and supporting reinforcement.
- F. Reinforce precast structural concrete units to resist handling, transportation, and erection stresses and specified in-place loads.
- G. Comply with requirements in PCI MNL 116 and in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.
- H. Place face mixture to a minimum thickness after consolidation of the greater of 1 inch or 1.5 times the maximum aggregate size, but not less than the minimum reinforcing cover specified.
- I. Place concrete in a continuous operation to prevent cold joints or planes of weakness from forming in precast concrete units.
 - 1. Place backup concrete mixture to ensure bond with face-mixture concrete.

- J. Thoroughly consolidate placed concrete by vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air voids on surfaces. Use equipment and procedures complying with PCI MNL 116.
 - 1. Place self-consolidating concrete without vibration according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants." Ensure adequate bond between face and backup concrete, if used.
- K. Comply with PCI MNL 116 procedures for hot- and cold-weather concrete placement.
- L. Identify pickup points of precast structural concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each precast structural concrete unit on a surface that does not show in finished structure.
- M. Cure concrete, according to requirements in PCI MNL 116, by moisture retention without heat or by accelerated heat curing using live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.
- N. Discard and replace precast structural concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 116 and meet Engineer's approval.

2.9 FABRICATION TOLERANCES

- A. Fabricate precast structural concrete units to shapes, lines, and dimensions indicated so each finished unit complies with PCI MNL 116 product dimension tolerances as well as position tolerances for cast-in items.

2.10 COMMERCIAL FINISHES

- A. Standard Grade: Normal plant-run finish produced in molds that impart a smooth finish to concrete. Surface holes smaller than 1/2 inch caused by air bubbles, normal color variations, form joint marks, and minor chips and spalls are permitted. Fill air holes greater than 1/4 inch in width that occur more than once per 2 sq. in.. Major or unsightly imperfections, honeycombs, or structural defects are not permitted. Limit joint offsets to 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, bearing surface tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

- C. Do not install precast concrete units until supporting, cast-in-place concrete has attained minimum allowable design compressive strength and until supporting steel or other structure is structurally ready to receive loads from precast concrete units.

3.2 INSTALLATION

- A. Install clips, hangers, bearing pads, and other accessories required for connecting precast structural concrete units to supporting members and backup materials.
- B. Erect precast structural concrete level, plumb, and square within specified allowable tolerances. Provide temporary structural framing, shoring, and bracing as required to maintain position, stability, and alignment of units until permanent connections are complete.
 - 1. Install temporary steel or plastic spacing shims or bearing pads as precast structural concrete units are being erected. Tack weld steel shims to each other to prevent shims from separating.
 - 2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
 - 3. Remove projecting lifting devices and use plastic patch caps or sand-cement grout to fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.
 - 4. For hollow-core slab voids used as electrical raceways or mechanical ducts, align voids between units and tape butt joint at end of slabs.
- C. Connect precast structural concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.
- D. Field cutting of precast units is not permitted without approval of Engineer.
- E. Fasteners: Do not use drilled or powder-actuated fasteners for attaching accessory items to precast, prestressed concrete units.
- F. Welding: Comply with applicable requirements in AWS D1.1/D1.1M and AWS D1.4/D1.4M for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.
- G. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.
 - 1. Where slotted connections are used, verify bolt position and tightness. For sliding connections, properly secure bolt but allow bolt to move within connection slot.
 - 2. For slip-critical connections, use method and inspection procedure approved by Engineer and coordinated with inspection agency.
- H. Grouting or Dry-Packing Connections and Joints: Grout connections and joints and open spaces at keyways, connections, and joints where required or indicated on Shop Drawings. Retain flowable grout in place until hard enough to support itself. Alternatively, pack spaces with stiff dry-pack grout material, tamping until voids are completely filled.

3.3 ERECTION TOLERANCES

- A. Erect precast structural concrete units level, plumb, square, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 135.
- B. Minimize variations between adjacent slab members by jacking, loading, or other method recommended by fabricator and approved by Engineer.

3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Engage a qualified special inspector to perform special inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Visually inspect field welds and test according to ASTM E 165 or to ASTM E 709 and ASTM E 1444. High-strength bolted connections are subject to inspections.
- D. Testing agency will report test results promptly and in writing to Contractor and Engineer.
- E. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
- F. Additional testing and inspecting, at Contractor's expense, shall be performed to determine compliance of replaced or additional work with specified requirements.
- G. Prepare test and inspection reports.

3.5 REPAIRS

- A. Repair precast structural concrete units if permitted by Engineer.
 - 1. Repairs may be permitted if structural adequacy, serviceability, durability, and appearance of units have not been impaired.
- B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet.
- C. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A 780/A 780M.
- D. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.
- E. Remove and replace damaged precast structural concrete units that cannot be repaired or when repairs do not comply with requirements as determined by Engineer.

3.6 CLEANING

- A. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.
- B. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.
 - 1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's written recommendations. Protect other work from staining or damage due to cleaning operations.
 - 2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION 034100

**SECTION 036000
GROUTING**

PART 1 GENERAL

1.01 SUMMARY

- A. The Contractor shall provide grout, complete and in place, in accordance with the Contract Documents. For concrete repair material and procedures, reference Section 030100 Maintenance of Concrete.
- B. Grout provided as a base support for mechanical and electrical equipment shall conform to manufacturer's requirements and the requirements of this section.
- C. The following types of grout are covered in this Section:
 - 1. Neat Cement Grout
 - 2. Non-Shrink Grout
 - 3. High Strength Non-Shrink Grout
 - 4. Non-Shrink Epoxy Grout
 - 5. Topping Grout and Grout Fill

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. The edition of the standards applicable to the Work shall be those editions referenced by the 2021 International Building Code (IBC). If the standard is not referenced by the IBC, nor an IBC-referenced standard listed below, the edition of the standard applicable to the Work shall be the edition in effect on the date of signing and sealing of the contract specifications.
- B. Reference Specifications

013300	Submittal Procedures
033000	Cast-in-Place Concrete

- C. Reference Standards

ASTM International (ASTM)	
ASTM C109	Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens)
ASTM C307	Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing
ASTM C531	Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes

ASTM C579	Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes
ASTM C580	Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes
ASTM C827	Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures
ASTM C882	Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear
ASTM C1090	Standard Test Method for Measuring Changes in Height of Cylindrical Specimens from Hydraulic-Cement Grout
ASTM C1107	Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C1116	Standard Specification for Fiber-Reinforced Concrete
ASTM C1339	Standard Test Method for Flowability and Bearing Area of Chemical-Resistant Polymer Machinery Grouts
International Concrete Repair Institute (ICRI)	
ICRI 310.2R-2013	Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair

1.03 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with Section 013300 Submittal Procedures.
1. Certified testing lab reports for tests indicated herein.
 2. Test results and service report from the field tests and the demonstration and training session verifying the requirements indicated herein.
 3. Manufacturer's literature containing instructions and recommendations on the mixing, handling, placement, curing, and appropriate uses for each type of grout used in the Work, and location of use.
 4. Documentation indicating that the grouts contain no chlorides or other chemicals that cause corrosion.
 5. Manufacturer's Safety Data Sheet documenting composition of grouts.
 6. Submit manufacturer's written warranty as indicated herein.

1.04 QUALITY ASSURANCE

- A. Field Tests

1. Compression test specimens will be taken from the first placement of each type of grout, and at intervals thereafter selected by the Engineer. The specimens will be made by the Engineer or its representative.
 2. Compression tests and fabrication of specimens for cement based non-shrink grout will be performed in accordance with ASTM C1107 at intervals during construction selected by the Engineer.
 3. Compression tests and fabrication of specimens for topping grout and grout fill will be performed in accordance with Section 033000 Cast-in-Place Concrete at intervals during construction selected by the Engineer.
 4. Compression tests and fabrication of specimens for epoxy grouts will be performed in accordance with ASTM C579, Method B, at intervals during construction selected by the Engineer. A set of 3 specimens will be made for testing at 7 Days and each earlier time period as appropriate.
 5. The cost of laboratory tests on grout will be paid by the OWNER except where test results show the grout to be defective. In such case, the Contractor shall pay for the tests, removal and replacement of Defective Work, and re-testing, all as part of the Work.
 6. The Contractor shall assist the Engineer in obtaining specimens for testing and shall furnish materials necessary for fabricating the test specimens.
- B. Construction Tolerances: Construction tolerances shall be as indicated in Section 033000 Cast-in-Place Concrete unless indicated otherwise.
- C. Pre-Installation Demonstration and Training
1. Non-Shrink Grouts
 - a. The grout manufacturer shall give a demonstration and training session for the cement based and epoxy non-shrink grouts to be used on the project before any installation of grout is allowed.
 - b. The Contractor shall transport the test cubes to an independent test laboratory, obtain the test reports, and report these demonstration and training test cube strengths to the Engineer.

1.05 SPECIAL CORRECTION OF DEFECTS PROVISIONS

- A. Manufacturer's Warranty
1. Furnish one year warranty for Work provided under this section.
 2. Manufacturer's warranty shall not contain a disclaimer limiting responsibility to the purchase price of products or materials.

PART 2 PRODUCTS

2.01 APPLICATION

- A. Unless indicated otherwise, grouts shall be provided as listed below whether indicated on the Drawings or not.

Application	Type of Grout
Beam and column (1 or 2 story) base plates less than 16-inches in the least dimension.	Non-Shrink
Column base plates (greater than 2 story or larger than 16-inches in the least dimension)	High Strength Non-Shrink
Under precast concrete elements	High Strength Non-Shrink
Storage tanks and other non-motorized equipment or machinery under 30 horsepower	Non-Shrink
Motorized equipment over 30 horsepower and equipment under 30 horsepower but subject to severe shock loads and high vibrations	Non-Shrink Epoxy
Filling blockout spaces for embedded items such as railing posts, gate guide frames, etc.	Non-Shrink
Toppings and grout fill less than 3-inches thick	Topping Grout
Toppings and grout fill greater than 3-inches thick	Section 2.4 and Structural Concrete per Section 033000 Cast-in-Place Concrete
Anchor bolts, anchor rods and reinforcing steel required to be set in epoxy or adhesive.	Post Installed Anchors in Concrete per Section 050519 Post-Installed Concrete Anchors
Repair of holes and defects in concrete members.	Concrete Repair and Rehabilitation per Section 030100 Maintenance of Concrete

2.02 NEAT CEMENT GROUT

- A. Neat cement grout shall be composed of one 94 pound bag of cement and 5 gallons minimum to 6 gallons maximum of clean water to obtain the desired consistency.
- B. Cement material and water shall be as indicated in 033000 Cast-in-Place Concrete.

2.03 NON-SHRINK GROUTS

- A. General
1. All non-shrink grout shall be cement based unless otherwise noted.

2. Cement-based non-shrink grout shall be a prepackaged, inorganic, fluid, non-gas liberating, non-metallic, cement type grout requiring only the addition of water. Cement from kilns burning metal-rich hazardous waste fuel shall not be used.
3. Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation for each non-shrink grout shall be as recommended by the manufacturer for the particular application.
4. The manufacturer's product information shall state the acceptability of the non-shrink grout for the intended purpose and location.
5. Grout shall not contain chlorides or additives that may contribute to corrosion.
6. Grout placed in continuously wet environments or in exterior conditions shall not contain gypsum or calcium salt.
7. All cement-based non-shrink grout shall have the following general properties:
 - a. Meet the requirements of ASTM C1107.
 - b. Have a maximum early age height change of 4.0 percent expansion, and shall have no shrinkage (0.0 percent) in accordance with ASTM C827. The grout when tested shall not bleed or segregate at maximum allowed water.
 - c. No shrinkage (0.0 percent) and a maximum of 0.3 percent expansion in the hardened state when tested in accordance with ASTM C1090.
 - d. A minimum bond strength (concrete to grout) of 1900 psi per modified ASTM C882.
8. Environmental and ambient conditions shall be a factor in the selection of non-shrink grout. If a non-shrink grout is to be used in a high temperature environment or freeze/thaw environment, the manufacturer's product information shall state the acceptability for each environmental condition.
9. Grout shall be suitable for use in freeze/thaw environments.

B. Non-Shrink Grout

1. Non-Shrink Grout shall have a minimum 28 Day compressive strength of 5000 psi when mixed at a fluid consistency and tested per ASTM C109.
2. Non-Shrink Grout shall be Five Star Grout by Five Star Products, Inc., Fluid Grout 100 by Five Star Products, Inc., Sikagrout 212 by Sika Corporation, or approved equal.

C. High Strength Non-Shrink Grout

1. High Strength Non-Shrink Grout shall have a minimum 28-Day compressive strength of 10,000 psi when mixed at a fluid consistency and tested per ASTM C109.
2. High Strength Non-Shrink Grout shall be High Strength Grout by Five Star Products, Inc., Sikagrout 428 FS by Sika Corporation, or approved equal.

2.04 NON-SHRINK EPOXY GROUT

- A. Non-shrink epoxy grout shall develop a minimum compressive strength of 9000 psi in 24 hours and 13,000 psi in seven days when tested in accordance with ASTM C579, method B.
- B. Non-shrink epoxy grout shall be a flowable, non-shrink, 100 percent solids system. The epoxy grout system shall have 3 components: resin, hardener, and specially blended aggregate, each premeasured and prepackaged. The resin component shall not contain any non-reactive diluents.
- C. The manufacturer's product information shall state the acceptability of the epoxy grout for the intended purpose and location.
- D. Variation of component ratios is not permitted unless specifically recommended by the manufacturer. Manufacturer's instructions shall be printed on each container in which the materials are packaged.
- E. Resins containing butyl glycidyl ether (BGE) or other highly volatile and hazardous reactive diluents are not acceptable.
- F. Non-shrink epoxy grout shall have a negligible (less than 0.0006 in/in) length change after hardening, and a coefficient of thermal expansion less than 0.00003 in/in F when tested in accordance with ASTM C531.
- G. The effective bearing area shall be a minimum of 85 percent effective bearing area (EBA) in accordance with ASTM C1339, for bearing area and flow.
- H. The chemical formulation of the non-shrink epoxy grout shall be that recommended by the manufacturer for the particular application. Do not reduce aggregate loading or add solvents to increase flowability.
- I. Non-shrink epoxy grout shall have the following minimum properties when tested at 7 Days:
 - 1. Minimum bond strength to concrete of 3000 psi per ASTM C882 modified.
 - 2. Minimum bond strength to steel of 1700 psi per ASTM C882 modified.
 - 3. Minimum flexural strength of 2500 psi per ASTM C580.
 - 4. Minimum tensile strength of 2000 psi per ASTM C307.
- J. Non-shrink epoxy grout shall be DP Epoxy Grout by Five Star Products, Inc., MasterFlow 648 by BASF/Master Builders, Sikadur 42 Grout-Pak by Sika Corporation, or approved equal.

2.05 TOPPING GROUT AND GROUT FILL

- A. Topping grout and grout fill for built-up surfaces of tanks, channels, and basin bottoms shall be composed of cement, fine aggregate, coarse aggregate, water, and admixtures proportioned and mixed as indicated. Materials and procedures indicated for structural concrete in Section 033000 Cast-in-Place Concrete, shall apply unless indicated otherwise

- B. Topping grout used in clarifiers, or where the fill thickness is 3 inches or greater shall contain fiber reinforcing, unless otherwise shown on the Contract Documents. Fiber reinforcing shall be 100 percent virgin polypropylene fibrillated fibers specifically manufactured in a blended gradation for use as concrete secondary reinforcement. Fibers shall be added at a rate of 1.5 pounds per cubic yard of concrete. Fibers shall conform to ASTM C1116.
- C. For topping grout and grout fill thickness greater than 3-inches, ready-mix concrete may be used with the following requirements:
 - 1. Strength: Minimum compressive strength of topping grout and grout fill at 28 days shall be 4000 psi.
 - 2. Minimum of 564 pounds of cement per cubic yard with a maximum water/cement ratio of 0.45
 - 3. Coarse aggregate shall be as follows:

U.S. Standard Sieve Size	Percent By Weight Passing
1/2 in	100
3/8 in	90-100
No. 4	20-55
No. 8	5-30
No. 16	0-10
No. 30	0

- D. Final mix design shall be as determined by trial mix design as indicated in Section 033000 Cast-in-Place Concrete, except that drying shrinkage tests are not required.
- E. Topping grout and grout fill shall contain air-entraining agent per Section 033000 Cast-in-Place Concrete.

2.06 CURING MATERIALS

- A. Curing materials shall be in accordance with Section 033000 Cast-in-Place Concrete and as recommended by the manufacturer of prepackaged grouts.

2.07 CONSISTENCY

- A. The consistency of grout shall be as necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is defined such that the grout is plastic and moldable but will not flow. Where "dry pack" is called for in the Contract Documents, it shall mean a grout of that consistency; the type of grout to be used shall be as indicated herein for the particular application.
- B. The slump for topping grout and grout fill shall be adjusted to match placement and finishing conditions but shall not exceed 4-inches.

2.08 MEASUREMENT OF INGREDIENTS

- A. Measurements shall be made accurately by volume using containers. Shovel measurements are not allowed.
- B. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

PART 3 EXECUTION

3.01 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Grout shall be stored in accordance with manufacturer's recommendations.

3.02 GENERAL

- A. Contractor shall arrange for the manufacturer of prepackaged grouts to provide on-site technical assistance within 72 hours of request, as part of the Work.
- B. Grout shall not be placed until base concrete or masonry has attained its design strength, unless authorized otherwise by the Engineer.
- C. When cementitious grouts are used on concrete surfaces, the concrete surface shall be saturated with water for 24 hours prior to placement. Upon completion of the saturation period, excess water shall be removed with clean, oil free compressed air prior to grouting. Concrete substrate shall not be wet prior to placement of epoxy grouts.
- D. Surface preparation, curing, and protection of cement based grout shall be in accordance with Section 033000 Cast-in-Place Concrete. The finish of the grout surface shall match that of the adjacent concrete unless otherwise indicated.
- E. Surfaces that will be in contact with grout shall be free of dirt, loose rust, oil, wax, grease, curing compounds, laitance, loose concrete, and other deleterious materials.
- F. Shade the Work from sunlight for at least 24 hours before and 48 hours after grouting.
- G. Contact the grout manufacturer's representative for assistance on hot and cold weather grouting techniques and precautions if applicable.

3.03 GROUTING PROCEDURES

- A. General: Mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.
- B. Structural, equipment, tank, and piping support bases shall be grouted, unless indicated otherwise.
 - 1. The original concrete shall be blocked out or finished off a sufficient distance below the plate to provide for a minimum one-inch thickness of grout or other thickness if indicated.

2. After the base plate has been set in position at the proper elevation by steel wedges or double nuts on the anchor bolts, the space between the bottom of the plate and the original pour of concrete shall be filled with non-shrink-type grout through a headbox of appropriate size. The mixture shall be of a fluid consistency and poured continuously into the space between the plate and the base concrete. Forms for grout shall be tight against retaining surfaces, and joints shall be sealed as recommended by the grout manufacturer to be liquid-tight. Forms shall be coated as recommended by the grout manufacturer for easy form release. Where this method of placement is not practical or where required by the Engineer, alternate grouting methods shall be submitted by the Contractor for acceptance by the Engineer.

3. Concrete equipment pads for equipment bases that will be epoxy-grouted shall be sized so that, when the equipment base is fully grouted, the epoxy grout is stopped not less than 4-inches from the edge of the pad.

C. Topping Grout and Grout Fill

1. Mechanical, electrical, and finish Work shall be completed prior to placement of topping grout or grout fill.

2. To ensure bonding to the base slab, the base slab shall have a roughened surface to a ¼-inch amplitude. The base slab shall be thoroughly cleaned and wetted to saturated surface dry (SSD) condition per ICRI 310.2R-2013 prior to placing topping grout and grout fill. No topping grout shall be placed until the slab is completely free from standing pools or ponds of water. A thin coat of neat cement grout shall be broomed into the surface of the slab just before topping or fill placement. The neat cement grout shall not be allowed to dry before topping placement. If it does dry, it must be immediately removed using wet stiff brooms and reapplied.

3. The topping and fill shall be compacted by rolling or thorough tamping, brought to established grade, and floated. Grouted fill for tank and basin bottoms where scraping mechanisms are to be installed shall be screeded by blades attached to the revolving mechanism of the equipment in accordance with the procedures outlined by the equipment manufacturer after the grout is brought to the established grade. Coat surface with evaporation retardant as needed to prevent plastic shrinkage cracks.

4. The minimum thickness of grout topping and grout fill shall be one-inch. Where the finished surface of grout fill is to form an intersecting angle of less than 45 degrees with the concrete surface it is to be placed against, a key shall be formed in the concrete surface at the intersection point. The key shall be a minimum of 3-1/2 inches wide by 1-1/2 inches deep.

5. Topping grout placed on sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement.

6. The surface shall be tested with a straight edge to detect high and low spots which shall be immediately eliminated. When the topping or fill has hardened sufficiently, it shall be steel troweled to a smooth surface free from pinholes and other imperfections. An approved type of mechanical trowel may be used as an assist in this operation, but the last pass over the surface shall be by hand-troweling. During finishing, no water, dry cement, or mixture of dry cement and sand shall be applied to the surface.

7. As soon as topping or fill finishing is completed, coat surface with curing compound. After the topping is set and sufficiently hard in clarifiers and where required by the Engineer, the tank shall be filled with sufficient water to cover the entire floor for 14 days.

3.04 CONSOLIDATION

- A. Grout shall be placed in such a manner, for the consistency necessary for each application, to assure that the space to be grouted is completely filled.

END OF SECTION

SECTION 311000 SITE CLEARING

PART 1 GENERAL

1.01 SUMMARY

- A. In its initial move onto the Site, the Contractor shall protect existing fences, houses and associated improvements, streets, and utilities downslope of construction areas from damage due to boulders, trees, or other objects dislodged during the construction process and clear, grub, strip; and regrade certain areas, in accordance with the Contract Documents. The Contractor shall also inspect the Site conditions and review maps of the Site, pipeline routes and facilities delineating the Owner's property and right-of-way lines.
- B. Contractor shall provide all labor, materials, equipment, and incidentals required to perform all clearing and grubbing as shown and as specified herein. Contractor shall pay for all disposal fees. The Work covered by this Section consists of removing and disposing of all trees, stumps, bush, roots, shrubs, vegetation, logs, rubbish, and other objectionable material from the Site, as required to perform the Work.

PART 2 EXECUTION

2.01 SITE ACCESS

- A. The Contractor shall develop any necessary access to the Site, including access barriers to prohibit entry of unauthorized persons.
- B. **Utility Interference:** Where existing utilities interfere with the Work, notify the utility owner and the Engineer before proceeding in accordance with the General Conditions.

2.02 CLEARING, GRUBBING, AND STRIPPING

- A. Limits of clearing and grubbing shall be all areas within the Contract limits, except as otherwise shown. Damage outside these limits caused by Contractor's operations shall be corrected at Contractor's expense.
- B. Construction areas shall be cleared of grass and weeds to at least a depth of 6-inches and cleared of structures, pavement, sidewalks, concrete or masonry debris, trees, logs, upturned stumps, loose boulders, and any other objectionable material of any kind which would interfere with the performance or completion of the Work, create a hazard to safety, or impair the subsequent usefulness of the Work, or obstruct its operation. Loose boulders within 10-feet of the top of cut lines shall be incorporated in landscaping or removed from the Site. Trees and other natural vegetation outside the actual lines of construction shall be protected from damage during construction.
- C. Within the limits of clearing, the areas below the natural ground surface shall be grubbed to a depth necessary to remove stumps, roots, buried logs, and other objectionable material. Septic tanks, drain fields, and connection lines and any other underground structures, debris or waste shall be removed at contractors expense if found on the Site. Objectionable material from the clearing and grubbing process shall be removed from the Site and wasted in approved safe locations.
- D. The entire area to be affected by construction shall be stripped to a depth of one foot below the existing ground contours. The stripped materials shall be stockpiled and incorporated into landscaped areas or other non-structural embankments.

- E. Stockpile topsoil in areas where it will not interfere with construction operations or existing facilities. Stockpiled topsoil shall be reasonably free of mineral subsoil, debris, and stones larger than two inches in diameter.
- F. Unless otherwise indicated, native trees larger than 3-inches in diameter at the base shall not be removed without the Engineer's approval. The removal of any trees, shrubs, fences, or other improvements outside of rights-of-way, if necessary for the Contractor's choice of means and methods, shall be arranged with the owner of the property, and shall be removed and replaced, as part of the Work.
- G. Burning on-site shall not be performed.
- H. In order to avoid additional removal or damage, existing trees and shrubs shall be trimmed as required. Trimmed or damaged trees shall be treated and repaired by persons with experience in this specialty that are approved by Engineer. Trees and shrubs intended to remain, that are damaged beyond repair or removed, shall be replaced by Contractor, at no additional cost to the Owner.
- I. Control air pollution caused by dust and dirt and comply with governing regulations.

2.03 OVEREXCAVATION, REGRADING, AND BACKFILL UNDER FILL AREAS

- A. After the fill areas have been cleared, grubbed, and excavated, the areas to receive fill will require overexcavation, regrading, and backfill, consisting of the removal and/or stockpiling of undesirable soils. The ground surface shall be recontoured for keying the fill and removing severe or abrupt changes in the topography of the Site. Overexcavated volumes shall be backfilled to a level of one foot below the existing ground contours.

2.04 PROTECTION OF EXISTING TREES

A. GENERAL

- 1. Flagging of Existing Trees: Flag trees to remain and to be removed with a bright and different colored ribbon. Notify the Engineer at least 48 hours prior to commencing of Work to verify all trees that are flagged.
- 2. Do not park any vehicles or equipment, nor store any materials or stockpiled soil, nor dispose of building materials, chemicals, petroleum products or other detrimental substances within drip line of tree. Protect trees from flame, smoke and heat. Construction access to site shall not occur beneath drip line of trees.

B. EXISTING TREES TO REMAIN

- 1. Protect root systems from smothering. Restrict foot traffic to prevent excessive compaction of soil over root systems.
- 2. Individual trees and areas shown to remain shall be protected by six (6) foot high chain link fence. Install fencing before site preparation, grading and clearing and grubbing operations.
- 3. Under no circumstances shall the Contractor remove existing trees designated to remain for his/her convenience or ease of construction.

4. Prior to installation, stake the location of protection fencing for approval by the Engineer. Location stakes or marking shall be placed not greater than ten (10) feet on-center.

C. EXCAVATION AROUND TREES

1. Excavate within drip line of trees only where shown.
2. Where trenching for utilities is required within drip line, tunnel under or around roots by hand digging. Do not cut main lateral roots or tap roots. The Contractor shall notify the Engineer prior to cutting roots over 6-inch diameter. Roots up to and including $\frac{3}{4}$ -inch shall be cut by hand saws. Do not leave roots exposed to sun or drying for more than 24 hours. Protect all exposed roots with moist organic mulch or burlap and backfill as soon as possible.
3. Where excavating for new construction is required within drip line of tree, excavate by hand to minimize damage to roots and perform as follows:
 - a. Use narrow tine spading forks and comb soil to expose roots.
 - b. If main lateral roots are immediately adjacent to location of new construction, cut roots three (3) inches from new construction.
 - c. Do not allow exposed roots to dry out before permanent backfill is placed.
 - d. Provide temporary earth cover, or pack with peat moss and wrap with burlap.
 - e. Water and maintain in moist condition until covered with backfill.

D. TRIMMING OF EXISTING TREES

1. Engage a qualified tree surgeon to remove branches from tree. No pruning unless approved and directed by the Engineer.
2. Pruning: Cut branches with sharp pruning instruments and do not break or chop. Prune flush with trunk surface.
3. Trimming: Symmetry of the tree shall be preserved; no stubs or splits or torn branches left; clean cuts shall be made close to the trunk or large branch. Spikes shall not be used for climbing live trees. All cuts over 1-1/2-inches in diameter shall be coated with an asphaltic emulsion material.

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 312000 EARTH MOVING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:

1. Excavating and filling for rough grading the Site.
2. Preparing subgrades for slabs-on-grade, walks, pavements, turf and grasses, and plants.
3. Excavating and backfilling for buildings and structures.
4. Drainage course for concrete slabs-on-grade.
5. Subbase course for concrete walks pavements.
6. Subbase course and base course for asphalt paving.
7. Excavating and backfilling trenches for utilities and pits for buried utility structures.

- B. Related Requirements:

1. Section 033000 Cast-in-Place Concrete for granular course if placed over vapor retarder and beneath the slab-on-grade.
2. Section 311000 Site Clearing for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
3. Section 329200 Restoration for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.

1.03 UNIT PRICES

- A. Work of this Section is affected by unit prices for earth moving specified in Section 012000 Measure and Payment.

1.04 DEFINITIONS

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.
- C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

- E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
- G. Fill: Soil materials used to raise existing grades.
- H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that cannot be removed without drilling and blasting, wedging, sledging, cutting, or barring for its removal.
- I. 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.
- J. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- K. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.
- L. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.05 ACTION SUBMITTALS

- A. Product Data: For each type of the following manufactured products required:
 - 1. Geotextiles.
 - 2. Controlled low-strength material, including design mixture.
 - 3. Geofoam.
 - 4. Warning tapes.
- B. Samples for Verification: For the following products, in sizes indicated below:
 - 1. Geotextile: 12 by 12 inches (300 by 300 mm).
 - 2. Warning Tape: 12 inches (300 mm) long; of each color.

1.06 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:
 - 1. Classification according to ASTM D 2487.
 - 2. Laboratory compaction curve according to ASTM D 698.
- C. Blasting plan approved by authorities having jurisdiction.
- D. Seismic survey report from seismic survey agency.
- E. Pre-excavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth-moving operations. Submit before earth moving begins.

1.07 QUALITY ASSURANCE

- A. Blasting: Comply with the Special Provisions of these Contract Specifications for Blasting.
- B. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

1.08 FIELD CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- B. Improvements on Adjoining Property: Authority for performing earth moving indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.
 - 1. Do not proceed with work on adjoining property until directed by Engineer.
- C. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth-moving operations.
- D. Do not commence earth-moving operations until temporary site fencing and erosion- and sedimentation-control measures specified in Section 311000 Site Clearing are in place.
- E. Do not commence earth-moving operations until plant-protection measures specified in Section 015639 Temporary Tree and Plant Protection are in place.
- F. The following practices are prohibited within protection zones:
 - 1. Storage of construction materials, debris, or excavated material.
 - 2. Parking vehicles or equipment.
 - 3. Foot traffic.
 - 4. Erection of sheds or structures.
 - 5. Impoundment of water.
 - 6. Excavation or other digging unless otherwise indicated.
 - 7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
- G. Do not direct vehicle or equipment exhaust towards protection zones.
- H. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 PRODUCTS

2.01 SOIL MATERIALS

- A. General: All fill material shall be non-plastic in nature and free of roots, vegetative mater, waste, construction material, rocks, organics, or other objectionable matter. Materials deemed

unsuitable by the inspector shall be removed and replaced with suitable fill. Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

- B. Satisfactory Soils: Soil Classification [**Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487**] [**Groups A-1, A-2-4, A-2-5, and A-3 according to AASHTO M 145**], or a combination of these groups; free of rock or gravel larger than **3 inches (75 mm)** in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: Soil Classification [**Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487**] [**Groups A-2-6, A-2-7, A-4, A-5, A-6, and A-7 according to AASHTO M 145**], or a combination of these groups.
 - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; with at least 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.
- E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 294/D 2940M 0; with at least 95 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.
- F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; with at least 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.
- G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; except with 100 percent passing a 1-inch (25-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) 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 (37.5-mm) sieve and zero to 5 percent passing a No. 8 (2.36-mm) sieve.
- I. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch (25-mm) sieve and zero to 5 percent passing a No. 4 (4.75-mm) sieve.
- J. Sand: ASTM C 33/C 33M; fine aggregate.
- K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

PART 3 EXECUTION

3.01 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.
- B. Protect and maintain erosion and sedimentation controls during earth-moving operations.
- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.02 DEWATERING

- A. The Contractor shall at all times provide and maintain ample means and equipment with which to remove and properly dispose of any and all water entering the excavation or other parts of the

work and keep all excavations dry until such time as pipe laying and grading is completed and structures to be built therein are completed.

- B. No water shall be allowed to rise around the pipe in unbackfilled trenches nor shall it be allowed to rise over masonry until the concrete or mortar has set (minimum 24 hours). All water pumped or drained from the work shall be disposed of in such a manner as to prevent siltation and erosion to adjacent property or other construction
- C. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.03 SHORING AND SHIELDING

- A. The Contractor shall comply with OSHA trenching and excavation regulations as revised in Subpart P of Part 1926 in the Federal Register. Shoring and/or shielding systems shall be used as specified in Subpart P to prevent caving of trench banks and to provide a safe excavation.
- B. The Contractor will be responsible for excavation safety and shall designate his "competent person" (as defined in Subpart P) for the determination of proper shielding/shoring systems.
- C. If, in the opinion of the Engineer, the trench/excavation is not in compliance with OSHA regulations, the Contractor may be directed to stop work. Continued unsafe conditions will be reported to the appropriate regulatory agency. The Contractor will be responsible for paying all fines resulting from safety violations.

3.04 BLASTING

- A. Prior to commencing any blasting operations the Contractor shall notify either the City Fire Department - Fire Prevention Section or the County Fire Administrator as applicable, and obtain blasting permits as required. The Contractor must furnish certification of Insurance specifically covering any and all obligations assumed pursuant to the use of explosives.
- B. All blasting operations shall be conducted in strict accordance with any and all decrees, rules, regulations, ordinances, and laws as may be imposed by any regulatory body and/or agency having jurisdiction over the work relative to handling, transporting, use and storage of explosives. Blasting shall be done only by competent, sober and experienced personnel whose activities shall be conducted in a workmanlike manner. Satisfactory information must be provided to the Engineer that the blaster meets or exceeds the qualifications enumerated in OSHA Regulations Part 1926, Subpart U, Section 1926.901 -Blaster Qualifications.
- C. All rock, dirt and debris from blasting shall be contained within the excavation by use of weighted mats or undisturbed overburden. The Contractor's blaster shall be fully responsible for determining the method of containment and the weight, size and placement of material required to contain the charge he is using.
- D. Charges shall be sized such that no damage to houses, structures, roadways etc., outside the limits of the excavation will occur. Where there is a possibility of such damage, the charge will initially be set at a very low level and increased in small increments until the proper charge is determined. The Contractor shall be held responsible for any and all injury to persons or damage to public or private property.
- E. Permission to Blast: The Contractor shall not be allowed to blast within any rights-of-way maintained by any agency (D.O.T., R.R., Gas, etc.) other than the City without specific approval of the controlling agency and only in accordance with their respective requirements.

3.05 EXCAVATION, GENERAL

- A. All excavations for pipe laying, manholes, piers, drainage ditches, grading and any other excavation required for the proper completion of this contract shall be included herein.
- B. Excavation within street rights-of-way shall be backfilled when left unattended for more than 1 hour unless otherwise approved by the controlling agency. Excavations within sewer/water rights-of-way shall be backfilled, fenced or otherwise protected when left unattended for more than 1 hour. Fencing or other protection methods shall be designed to reasonably prevent people and large animals from entering the excavation.
- C. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be classified as earth and rock. Do not excavate rock until it has been classified and cross sectioned by Engineer. The Contract Sum will be adjusted for rock excavation according to unit prices included in the Contract Documents. Changes in the Contract Time may be authorized for rock excavation.
 - 1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; and soil, boulders, and other materials not classified as rock or unauthorized excavation.
 - a. Intermittent drilling; blasting, if permitted; ram hammering; or ripping of material not classified as rock excavation is earth excavation.
 - 2. Rock excavation shall be defined as solid ledge rock that requires drilling and blasting, sledging, or barring for its removal. Soft, disintegrated rock that can be removed with a pick shall not be classified as solid rock.
 - a. Boulders greater than one cubic yard in volume will also be considered rock excavation. Smaller boulders and soft rock which in the opinion of the Engineer can be excavated by the use of a power shovel, without undue delay, shall not be classified as rock.
 - b. Rock shall be removed to a depth of six (6) inches below the pipe bell and to the trench widths specified for each size and type of pipe installed. Rock around structures shall be removed to the same twelve (12) inch minimum as measured between vertical planes around the structure, but only to a depth necessary to allow proper installation. Over excavation of rock due to removal methods, or for safety considerations, shall be the Contractor's responsibility.
 - c. When rock removal is necessary for pipeline installation either Type II or Type III bedding shall be installed as specified and directed by the Engineer.
 - d. All blasting shall be conducted in a manner as specified elsewhere in these Specifications

3.06 EXCAVATION FOR STRUCTURES

- A. The excavation shall be made to the lines, grades and elevations shown on the Plans and Standard Details. The area excavated shall be limited to no more than is necessary to allow the proper installation of the structure as determined by the Engineer. The excavation shall remain open no longer than is necessary to allow the proper and complete installation of the structure.
- B. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch (25 mm). If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch (25 mm). Do not disturb bottom of excavations intended as bearing surfaces.
3. Structure Pit Bottom Conformation: The pit bottom shall be true and even, and capable of supporting the structure as determined by the Engineer. If the pit bottom is inadvertently cut below grade, the Contractor shall fill it to the proper elevation with approved material capable of continually maintaining adequate supportive strength

C. Excavations at Edges of Tree- and Plant-Protection Zones:

1. Excavate by hand or with an air spade to indicated lines, cross sections, elevations, and subgrades. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Cut and protect roots according to requirements in Section 015639 Temporary Tree and Plant Protection.

3.07 EXCAVATION FOR BORE PITS

- A. The excavation shall be controlled by the limits of the existing rights-of-way and shall not exceed these without prior written approval of the current property owner. The excavation shall be made to the proper elevation, line and grade to install the casing pipe as shown on the construction plans.
- B. The pit bottom shall be true and even with adequate stabilization to maintain proper elevation and grade on the boring rig for the duration of the bore. The walls of the pit shall be shored or sloped to comply with OSHA requirements.
- C. The bore pit shall not be left open overnight on NCDOT maintained roadways without specific approval from the NCDOT. If approval is obtained, concrete median barriers are required to be placed around the bore pit within the road right-of-way.

3.08 EXCAVATION FOR WALKS AND PAVEMENTS

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

3.09 EXCAVATION FOR UTILITY TRENCHES

- A. Trench Excavation: Excavate trenches to indicated gradients, lines, depths, and elevations. No more than 100 LF of trench shall be opened in advance of the pipe laying than is necessary to expedite the work unless prior approval is given by the Engineer. Ground conditions and/or location requirements shall govern the amount of trench open at any one time as determined by the Engineer.
 1. Trench Width: The maximum trench width shall be as indicated for each type of pipe specified. If the actual trench width exceeds the specified width, due to shoring methods, the contractor must obtain approval from the Engineer. Trench width shall be measured between faces of cut at the top of the pipe bell. If the Contractor varies from this

requirement without approval of the Inspector, he shall at his own expense install Type II or Type III bedding defined in this specification.

2. Trench Bottom Conformation: The excavation shall be made to the elevations, grades, and lines shown on the Construction Plans unless otherwise approved by the Engineer. The trench bottom shall be excavated slightly above grade and cut down to the pipe grade by hand in the fine grading operation. The trench bottom shall be true and even with bell holes at each joint to provide the barrel of the pipe with soil and/or granular bedding (as applicable) support for its full length. This should prevent point loading at the bells. If the trench bottom is inadvertently cut below grade, the Contractor shall (at his own expense) fill it to grade with approved material thoroughly tamped, or with #67 bedding stone. Pipe depth and/or soil conditions may require Type II or Type III granular embedment. This bedding shall also be shaped to allow adequate support of the pipe.
3. If the trench passes either under or over another pipeline or previous excavation, the trench bottom in this area shall be tamped, if necessary, so the disturbed soil has approximately the same supportive strength as the native soil.

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

1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
3. Cut and protect roots according to requirements in Section 015639 Temporary Tree and Plant Protection.

3.10 SUBGRADE INSPECTION

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

3.11 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavations with lean concrete fill, with 28-day compressive strength of 2500 psi (17.2 MPa), or as directed by Engineer.
- B. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Engineer

3.12 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
- B. All excavated material shall be piled in a manner that will not endanger the work. Excavated material will be piled a safe distance away from the edge of the excavation allowing room for an adequate angle of repose and if shoring, sheeting, and bracing is used to protect the excavation, no material will be piled within three (3) feet of the nearest edge. Sidewalks, driveways, hydrants, valve pit covers, valve boxes, curb stop boxes, existing manholes, fire and police call boxes, or other utility controls shall be unobstructed and accessible until the work is completed. Gutters, catch basins, and natural watercourses shall not be obstructed or silted.
- C. When working in close proximity with a creek channel or natural watercourse the Contractor shall pile all excavated material on the side of his excavation away from the watercourse.

3.13 BACKFILL, GENERAL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 - 1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
 - 2. Surveying locations of underground utilities for Record Documents.
 - 3. Testing and inspecting underground utilities.
 - 4. Removing concrete formwork.
 - 5. Removing trash and debris.
 - 6. Removing temporary shoring, bracing, and sheeting.
 - 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.14 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. All backfill shall be of a non-plastic nature free from roots, vegetative matter, waste, construction material, rock larger than 3/4 cubic foot, or other objectionable material. Small rock (less than 3/4 cubic foot) shall not exceed 10% of the fill material. Rock shall not be placed within 3-feet of the pipeline or within three feet of the finished grade. Rock larger than 3/4 cubic foot will not be permitted within the trench. No objectionable or unsuitable material will be allowed in the backfill. Backfill material shall be capable of being tamped by mechanical tamps using relatively low velocity and heavy blows. The material shall have no tendency to flow or behave in a plastic manner under the tamping blows. Material deemed by the Engineer as unsuitable for backfill purposes shall be removed from the job site before backfilling operations begin.
- D. When the Engineer determines that the material excavated from the trench is unsuitable for backfill because of the material type or because it contains excessive debris, rock or organics, it shall be removed from the project and replaced with a backfill material approved by the Engineer. When the moisture content of an otherwise suitable material is too high to achieve specified compaction, as determined by a moisture content and density test, the Contractor shall replace the material as necessary to meet backfill requirements. The wet material may be dried to optimum moisture content and used for backfill in subsequent phases of the project. Should

an otherwise suitable material be found too dry to achieve compaction requirements, water may be added to the material to raise the moisture content to optimum.

- E. Borrow material placed at the direction of the Engineer shall be clean earth at optimum moisture content, concord (pit) gravel or ABC stone.
- F. Backfill shall be accomplished immediately after the pipe is laid. Backfill around pipe and to an elevation of one (1) foot above the pipe bell shall be done only by hand and in layers not exceeding six (6) inches with each and every layer thoroughly tamped. The first three (3) feet of fill shall be completely free of rocks. Successive layers of backfill shall be compacted in place as specified below.
- G. Under no circumstances shall water be permitted to rise in unbackfilled trenches after the pipe has been placed. Should water rise in an unbackfilled ditch after the pipe has been placed, the Engineer may require the Contractor to remove the pipe, muck the trench and follow the procedure for either Type II or Type III Granular Embedment when relaying the pipe.
 - 1. Backfill of trenches within utility rights-of-way: Trenches excavated outside existing roadway and railway right-of-way may be backfilled, above the initial one (1) foot, by mechanical means in layers up to twelve (12) inches thick unless otherwise directed by the Engineer.
 - 2. Backfill of trenches within road and railway rights-of-way: Trenches excavated within existing road and railway rights-of-way shall be backfilled in layers not to exceed six (6) inches and each successive layer shall be thoroughly tamped, as specified.
- H. Backfill voids with satisfactory soil while removing shoring and bracing.
- I. Warning Tape: Install warning tape directly above utilities, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.15 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
 - 1. Under grass and planted areas, use satisfactory soil material.
 - 2. Under walks and pavements, use satisfactory soil material.
 - 3. Under steps and ramps, use engineered fill.
 - 4. Under building slabs, use engineered fill.
 - 5. Under footings and foundations, use engineered fill.
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.16 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
 - 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.

2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.17 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Compaction shall be attained by the use of mechanical tamps only. Each layer of backfill shall be placed loose and thoroughly compacted in place. Heavy rollers, vehicles or other equipment shall not be used for compacting pipeline and structure backfill nor allowed to cross over completed work except at points adjudged capable of adequately protecting the pipeline. Pneumatic tamps, gasoline ram type tamps or vibrating tamps with sheepsfoot rollers will be required to meet the specifications of "Mechanical Tamp". Variances shall only be with the explicit approval of the Engineer.
 1. Compaction Within Sewer Rights-of-way: Trenches excavated outside existing road and railway rights-of-way shall be backfilled as hereinbefore specified and tamped thoroughly:
 - a. All material shall have an in-place density of at least 85% of maximum dry density or as approved by the Engineer.
 - b. Should any public or private roadways, service roads, drives, etc. be encountered during this construction, the Contractor shall at the Engineer's direction comply with those compaction requirements specified below for work within road and railway rights-of-way.
 2. Compaction Within Road and Railway Rights-of-Way: Unless otherwise approved by the controlling agencies, trenches excavated within existing road and railway rights-of-way and all structure excavation regardless of location shall be backfilled as hereinbefore specified and thoroughly tamped:
 - a. Unless otherwise directed by the Engineer, all material from the bottom of trench to within six (6) inches of the subgrade shall have an in-place density of 95% of the maximum dry density as defined by a standard proctor curve for the material.
 - b. All material within six (6) inches of the subgrade level shall have an in place density of 100% of the maximum dry density.
 - c. On roadway shoulders, all material shall have an in place density of 95% of the maximum dry density. The Contractor shall remove and replace all material failing to meet these requirements with suitable material. The extent of this removal shall be determined by the Engineer.
 3. Compaction for Pump Station Vault Structures: Suitable backfill around all pump station vault structures shall be compacted to 95% of max. dry density as determined by the standard Proctor curve (ASTM D-698). Foundation subgrade for these structures shall be compacted to 100% of Max. dry density.
- B. Compaction Testing: Moisture content and density testing of backfill will be performed by a third party soils technician. Tests will be performed within all street, highway and railway rights-of-way to insure that the specified compaction requirements are met. The Contractor will cooperate fully with the soils technicians in providing access to backfill at any requested depth for the purpose of performing moisture content/density testing. When requested, the Contractor shall excavate a backfilled ditch to any specified depth for a compaction test and shall insure that

the ditch meets all OSHA safety standards before the technician enters to perform the test. A "standard proctor curve" which establishes the relationship between moisture content and dry density for soil will be determined by the method described in ASTM D-698 or by AASHTO Method T-99. Field density tests will be performed using either the sand cone method or a nuclear moisture/density gauge. Any backfill which does not meet the specified compaction will be re-tamped, or removed and replaced as approved by the Engineer.

3.18 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1. Provide a smooth transition between adjacent existing grades and new grades.
 - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:
 - 1. Turf or Unpaved Areas: Plus or minus 1 inch (25 mm).
 - 2. Walks: Plus or minus 1 inch (25 mm).
 - 3. Pavements: Plus or minus 1/2 inch (13 mm).
- C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch (13 mm) when tested with a 10-foot (3-m) straightedge.

3.19 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

- A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:
 - 1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 - 2. Place base course material over subbase course under hot-mix asphalt pavement.
 - 3. Shape subbase course and base course to required crown elevations and cross-slope grades.
 - 4. Place subbase course and base course 6 inches (150 mm) or less in compacted thickness in a single layer.
 - 5. Place subbase course and base course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
 - 6. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.
- C. Pavement Shoulders: Place shoulders along edges of subbase course and base course to prevent lateral movement. Construct shoulders, at least 12 inches (300 mm) wide, of satisfactory soil

materials and compact simultaneously with each subbase and base layer to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.20 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

- A. Place drainage course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
 - 1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 - 2. Place drainage course 6 inches (150 mm) or less in compacted thickness in a single layer.
 - 3. Place drainage course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
 - 4. Compact each layer of drainage course to required cross sections and thicknesses to not less than **95** percent of maximum dry unit weight according to ASTM D 698.

3.21 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 - 1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
 - 2. Determine that fill material classification and maximum lift thickness comply with requirements.
 - 3. Determine, during placement and compaction, that in-place density of compacted fill complies with requirements.
- B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.
- C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- D. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Engineer.
- E. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2937, and ASTM D 6938, as applicable. Tests will be performed at the following locations and frequencies:
 - 1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 200 sq. ft. (186 sq. m) or less of paved area or building slab but in no case fewer than three tests.

2. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet (46 m) or less of trench length but no fewer than two tests.
- F. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.22 PROTECTION

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

3.23 DISPOSAL OF SURPLUS AND WASTE MATERIALS

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

END OF SECTION

**SECTION 312319
DEWATERING**

PART 1 GENERAL

1.01 SUMMARY

- A. Design, installation, operation, and removal of dewatering system shall comply with current safety and environmental regulations.
- B. The Contractor shall lower and control groundwater levels and hydrostatic pressures to permit construction work to be performed in the dry in accordance with the Contract Documents. Control of surface water shall be considered as part of the work under this specification.
- C. The Contractor shall secure all necessary permits to complete the requirements of this Section of the Specifications.
- D. The Contractor shall be responsible for providing all materials, equipment, labor, and services necessary for dewatering in a manner compatible with construction methods and site conditions.
- E. The Contractor shall implement an erosion and sedimentation control plan before excavation work begins.

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Reference Specifications

013300	Submittal Procedures
312000	Earth Moving

1.03 REQUIREMENT

- A. Dewater system shall be of sufficient size and capacity necessary to lower and maintain groundwater level to an elevation at least one foot below the lowest excavation depth and to allow material to be excavated in a reasonably dry condition.
- B. Maintain stability of excavation sides and base.
- C. Prevent loss of fines, seepage, boils, quick conditions or softening of foundation strata.
- D. Maintain dry and stable subgrade for subsequent construction operations.
- E. Provide adequate control of surface and subsurface water such that:
 - 1. Stability of sides and base of excavation is not adversely affected.
 - 2. Erosion is controlled.
 - 3. Flooding of excavations or damage to structures does not occur.
 - 4. Surface water drains away from excavations and other work areas.

- F. Preclude damage to adjacent properties, buildings, structures, utilities, installed facilities and other work.
- G. Assume sole responsibility for the dewatering system and for any loss or damage resulting from inadequacy or failure of the system. Perform work necessary to repair the damages at no additional cost to the Owner.

1.04 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with Section 013300 Submittal Procedures.
- B. All required permits.
- C. Prior to commencement of excavation, the Contractor shall submit a detailed plan and operation schedule for dewatering of excavations. The detailed plan shall include mitigation measures to prevent settlement of nearby structures and a contingency plan for restoring nearby structures if settlement is observed as a result of the Contractor's dewatering operations. The Contractor may be required to demonstrate the system proposed and to verify that adequate equipment, personnel, and materials are provided to dewater the excavations at all locations and times. The Contractor's dewatering plan is subject to review by the Engineer. The plan shall be signed and sealed by a qualified Professional Engineer licensed in North Carolina and include the following:
 - 1. Drawings and data showing the dewatering system, monitoring program, and erosion and sedimentation control plan to be employed.
 - 2. Detailed description of the dewatering system, including arrangement, location, depth and capacities of the system components, installation details, and operation and maintenance procedures.
 - 3. Description of the monitoring program, including instrument type, location, installation details, monitoring criteria, and operation and maintenance procedures.
 - 4. A written report including control procedures to be adopted if dewatering problems arise.
 - 5. Design calculations demonstrating adequacy of the dewatering system and selected equipment for intended applications.
 - 6. Description of methods to be employed for disposal of removed water.

1.05 QUALITY CONTROL

- A. It shall be the sole responsibility of the Contractor to control the rate and effect of the dewatering in such a manner as to avoid all objectionable settlement and subsidence.
- B. All dewatering operations shall be adequate to assure the integrity of the finished project and shall be the responsibility of the Contractor.

- C. All structures or facilities that are located within the radius of influence of the Contractor's dewatering operation shall have reference points established and observed at frequent intervals to detect any settlement which may develop. The responsibility for conducting the dewatering operation in a manner which will protect adjacent structures and facilities rests solely with the Contractor. The Contractor shall survey, record and report the reference points on a daily basis, and submit the written log to the Engineer at the completion of construction. The Engineer shall be immediately notified should any sign of settlement is observed. The cost of repairing any damage to adjacent structures and restoration of facilities shall be the responsibility of the Contractor.
- D. The dewatering field supervisor shall have a minimum of five years of experience related to dewatering work and have completed at least three projects of similar scope and complexity.

PART 2 PRODUCTS

2.01 EQUIPMENT

- A. Dewatering, where required, may include the use of well points, sump pumps, temporary pipelines for water disposal, rock or gravel placement, and other means. Sufficient standby pumping equipment and other materials shall be maintained on the Site to ensure continuous dewatering operation.

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

- A. The Contractor shall provide all equipment necessary for dewatering. It shall have on hand, at all times, sufficient pumping equipment and machinery in good working condition and shall have available, at all times, competent workmen for the operation of the pumping equipment. Adequate standby equipment shall be kept available at all times to insure efficient dewatering and maintenance of dewatering operation during power failure.
- B. Install a dewatering system with sufficient capacities to lower and control groundwater level in order to permit excavation, structure construction, and backfilling to be performed in dry conditions. Ensure the dewatering system is adequate to pre-drain water-bearing strata and to maintain groundwater table below the bottom of structure foundations, utilities, and other excavations.
- C. Dewatering for structures and pipelines shall commence when groundwater is first encountered, and shall be continuous until such times as water can be allowed to rise and dewatering is no longer required in accordance with the provisions of this Section or other requirements.
- D. At all times, site grading shall promote drainage. Surface runoff shall be diverted from excavations. Water entering the excavation from surface runoff shall be collected in shallow ditches around the perimeter of the excavation, drained to sumps, and be pumped or drained by gravity from the excavation to maintain a bottom free from standing water.
- E. Dewatering shall at all times be conducted in such a manner as to preserve the undisturbed bearing capacity of the subgrade soils at proposed bottom of excavation.
- F. If foundation soils are disturbed or loosened by the upward seepage of water or an uncontrolled flow of water, the affected areas shall be excavated and replaced with drain rock.

- G. The Contractor shall maintain the water level below the bottom of excavation in all work areas where groundwater occurs during excavation construction, backfilling, and up to acceptance.
- H. Flotation shall be prevented by the Contractor by maintaining a positive and continuous removal of water. The Contractor shall be fully responsible and liable for all damages which may result from failure to adequately keep excavations dewatered.
- I. If well points or wells are used, they shall be adequately spaced to provide the necessary dewatering and shall be sandpacked and/or other means used to prevent pumping of fine sands or silts from the subsurface. A continual check by the Contractor shall be maintained to ensure that the subsurface soil is not being removed by the dewatering operation.
- J. The Contractor shall dispose of water from the Work in a suitable manner without damage to adjacent property and negatively impacting work areas. Contractor shall be responsible for obtaining any permits that may be necessary to dispose of water. No water shall be drained into work built or under construction without prior consent of the Engineer. Water shall be filtered using an approved method to remove sand and fine-sized soil particles before disposal into any drainage system.
- K. The Contractor shall utilize all necessary erosion and sediment control measures to avoid construction related degradation of the natural water quality.
- L. The Contractor shall implement correction measures if dewatering requirements are not satisfied due to inadequacy or failure of the dewatering system.
- M. The Contractor shall immediately repair damages to adjacent facilities caused by dewatering operations.
- N. The Contractor shall remove the dewatering system and monitoring instruments as directed by the Engineer when groundwater control is no longer required. The Contractor shall ensure compliance with all conditions of regulating permits and obtain written approval from the Engineer before discontinuing operation of dewatering system.
- O. The release of groundwater to its static level shall be performed in such a manner as to maintain the undisturbed state of the natural foundation soils, prevent disturbance of compacted backfill and prevent flotation or movement of structures, pipelines, and sewers.
- P. Dewatering of trenches and other excavations shall be considered as incidental to the construction of the Work and all costs thereof shall be included in the various contract prices in the Bid Forms unless a separate bid item has been established for dewatering.

END OF SECTION

**SECTION 321216
ASPHALT PAVING**

PART 1 GENERAL

1.01 SUMMARY

- A. Asphalt paving base course, binder course, and wearing course.

1.02 REFERENCES

- A. North Carolina Department of Transportation (NCDOT) “Standard Specifications for Roads and Structures,” latest edition.

1.03 SUBMITTALS

- A. Material Certificates: Provide copies of materials certificates signed by material producer and Contractor, certifying that each material item complies with, or exceeds, specified requirements.

1.04 QUALITY ASSURANCE

- A. Perform Work in accordance with NCDOT or CLDSM standard specifications.
- B. Obtain materials from same source throughout.
- C. Saw cutting of edges of existing pavement is necessary for pavement addition and renovation. This work will be performed by the more stringent method as either specified by NCDOT standard specifications Section 250-2, Pavement Removal and Disposal, or as indicated in this specification under Part 3, Execution.

1.05 ENVIRONMENTAL REQUIREMENTS

- A. Do not place asphalt mixture when ambient air or base surface temperature is less than 40 degrees F, or surface is wet or frozen.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Asphalt Cement: in accordance with NCDOT standard specifications.
- B. Binder: In accordance with NCDOT standard specifications.
- C. Tack Coat: In accordance with NCDOT standard specifications.

2.02 AGGREGATE MATERIALS

- A. Base: General Aggregate Base Course in accordance with NCDOT standard specifications.

PART 3 EXECUTION

3.01 GENERAL

- A. All removal and restoration of pavement and road surfaces will be in accordance with the specifications approved by the Town of Smithfield or the North Carolina Department of Transportation and Safety, Division of Highways, whichever applies.
- B. All restored bituminous and concrete pavements shall be placed to existing cross-section and ride quality. Restored pavement will in all instances be flush and level with existing pavement at the sawed edges, and at existing gutter lines where applicable unless otherwise approved by the Engineer. When pavement repairs do not meet the above criteria or are not performed in a workmanship manner as determined by the Engineer, or North Carolina Department of Transportation, whichever applies, the contractor will remove and re-perform the restoration as specified.
- C. When cuts are to be made in street rights-of-way under maintenance by the Town of Smithfield, the Contractor shall contact the Superintendent of Streets or his designated representative before each separate pavement cut is made and secure a permit.
- D. Pavement will be replaced as follows. In all pavement cuts either the permanent pavement or a temporary pavement consisting of 1" of black asphaltic concrete (later to be replaced permanently) will be placed immediately upon completion of the subgrade unless otherwise approved by the Engineer.
 - 1. Specifications for Cutting Pavement: Unless otherwise approved or required, concrete pavement shall be removed to the nearest expansion or contraction joint. The Contractor will contact the Superintendent of Streets and/or D.O.T.'s District Engineer for a determination of the limits of concrete replacement and location of joints. Where sawed joints are allowed, the depth of the sawed cut shall be at least one (1) inch and shall extend at least 1/5 of the depth of the concrete. More depth may be required if necessary to prevent damage to surrounding pavement. Bituminous pavement shall be cut in a smooth and straight line. Sawing is required on asphaltic concrete. The width of pavement left between the edge of the ditch and the existing edge of the pavement or the front line of the gutter, shall be at least 2 feet. Residual strips of pavement less than 2 feet in width must be removed and replaced. Existing pavement shall be removed on each side of the trench for at least 12 inches beyond top of trench. The Contractor shall remove and replace pavement which, in the opinion of the Engineer, has been cracked or displaced by the operation of the Contractor.
 - 2. Specification For Restoring Concrete Pavement: The concrete used to restore pavement shall have a minimum 28 day compressive strength of 3600 P.S.I. The concrete as placed shall conform to the shape, grade, and finish of the existing pavement and will be one (1) inch deeper than the original pavement including base, but in no instance less than six (6) inches.
 - 3. Specification For Restoring Asphalt Pavement: All material above the sub-base level shall be hot-mix bituminous concrete conforming to North Carolina Department of Transportation Standard Specifications for Roads and Structures for both mix design and placement. The asphalt pavement as placed shall be one (1) inch deeper than the

original pavement including base, but in no instance less than eight (8) inches within City maintained roadways or eight (8) inches within state maintained roadways. The asphalt shall be placed in lifts not greater than 4 inches and shall be hot mix bituminous concrete binder Type H. The last two (2) inches in either instance shall be bituminous plant mix (I-2) suitable to the appropriate controlling agency. I-2 asphalt pavement resurfacing will be placed with paving machines and/or rollers of a size and type currently approved by the North Carolina Department of Transportation for use on resurfacing contracts. If a bituminous surfacing overlays a concrete base, the Contractor, at the option of the Engineer, shall replace the concrete to its original thickness, or to a level 2 inches below the finished surface. The Engineer may direct the Contractor to omit all concrete and to replace the pavement with bituminous materials. Tack coats shall be employed with each lift. Tack coats shall be placed on both horizontal and vertical surfaces (pavement cuts or face of concrete gutters). Under normal conditions, asphalt binder will be placed in pavement cuts at the end of each work day. I-2 shall be replaced weekly or within five days following completion of pipeline construction along a continuous section of pavement. During inclement weather, the Engineer may permit the use of temporary asphalt (cold mix) to seal the trench until permanent asphalt can be placed.

3.02 EXAMINATION

- A. Verify compacted subgrade is dry and ready to support paving and imposed loads.
- B. Verify gradients and elevations of base are correct.

3.03 TACK COAT

- A. Apply tack coat in accordance with NCDOT standard specifications.
- B. Apply tack coat to contact surfaces of curbs, gutters and drainage structures.
- C. Coat surfaces of manhole and catch basin frames with oil to prevent bond with asphalt paving. Do not tack coat these surfaces.

3.04 SINGLE COURSE ASPHALT PAVING

- A. Install Work in accordance with NCDOT or CLDSM standard specifications.
- B. Place asphalt within 24 hours of applying primer or tack coat.
- C. Place to compacted thickness indicated on Drawings.
- D. Install drainage structures and valve boxes in correct position and elevation.

3.05 ERECTION TOLERANCES

- A. Flatness: Maximum variation of 1/4 inch measured with 10 foot straight edge.
- B. Scheduled Compacted Thickness: Within 1/4 inch.
- C. Variation from Indicated Elevation: Within 1/2 inch

3.06 FIELD QUALITY CONTROL

- A. Take samples and perform tests in accordance with NCDOT standard specifications.

3.07 PROTECTION OF FINISHED WORK

- A. Immediately after placement, protect paving from mechanical injury for 7 days or until surface temperature is less than 140 degrees

END OF SECTION

**SECTION 321313
CONCRETE PAVING**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes Concrete Paving including the following:
 - 1. Curbs and gutters.
 - 2. Walks

1.03 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash, slag cement, and other pozzolans.
- B. W/C Ratio: The ratio by weight of water to cementitious materials.
- C. NCDOT: North Carolina Department of Transportation

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer of stamped detectable warnings, ready-mix concrete manufacturer, and testing agency.
- B. Material Certificates: For the following, from manufacturer:
 - 1. Cementitious materials.
 - 2. Steel reinforcement and reinforcement accessories.
 - 3. Fiber reinforcement.
 - 4. Admixtures.
 - 5. Curing compounds.

6. Applied finish materials.
 7. Bonding agent or epoxy adhesive.
 8. Joint fillers.
- C. Material Test Reports: For each of the following:
1. Aggregates: Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.
- D. Field quality-control reports.

1.06 QUALITY ASSURANCE

- A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").
- B. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

1.07 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified independent testing agency to perform preconstruction testing on concrete paving mixtures.

1.08 FIELD CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
- B. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
 2. Do not use frozen materials or materials containing ice or snow.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

- C. Hot-Weather Concrete Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Cover steel reinforcement with water-soaked burlap, so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
 3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

PART 2 PRODUCTS

2.01 CONCRETE, GENERAL

- A. ACI Publications: Comply with ACI 301 unless otherwise indicated.

2.02 FORMS

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

2.03 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.
- 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; zinc coated (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:
 - 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.

2.04 CONCRETE MATERIALS

- A. Cementitious Materials: Use the following cementitious materials, of same type, brand, and source throughout Project:
 - 1. Portland Cement: ASTM C 150/C 150M, gray portland cement Type I/II.
 - 2. Fly Ash: ASTM C 618, Class C or Class F.
 - 3. Slag Cement: ASTM C 989/C 989M, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C 33/C 33M, Class 4M, uniformly graded. Provide aggregates from a single source with documented service-record data of at least 10 years' satisfactory service in similar paving applications and service conditions using similar aggregates and cementitious materials.
 - 1. Maximum Coarse-Aggregate Size: 1 inch nominal.

2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Exposed Aggregate: Selected, hard, and durable; washed; free of materials with deleterious reactivity to cement or that cause staining; from a single source, with gap-graded coarse aggregate as follows:
1. Aggregate Sizes: 3/4 to 1 inch nominal.
- D. Air-Entraining Admixture: ASTM C 260/C 260M.
- E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
- F. Water: Potable and complying with ASTM C 94/C 94M.

2.05 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry or cotton mats.
- 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, dissipating.

2.06 RELATED MATERIALS

- A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork in preformed strips.

- B. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.
- C. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy-Bonding Adhesive: ASTM C 881/C 881M, two-component epoxy resin capable of humid curing and bonding to damp surfaces; of class suitable for application temperature, of grade complying with requirements, and of the following types:
 - 1. Types I and II, nonload bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- E. Chemical Surface Retarder: Water-soluble, liquid, set retarder with color dye, for horizontal concrete surface application, capable of temporarily delaying final hardening of concrete to a depth of 1/8 to 1/4 inch.
- F. Pigmented Mineral Dry-Shake Hardener: Factory-packaged, dry combination of portland cement, graded quartz aggregate, color pigments, and plasticizing admixture. Use color pigments that are finely ground, nonfading mineral oxides interground with cement.
 - 1. Color: As indicated by manufacturer's designation.
- G. Rock Salt: Sodium chloride crystals, kiln dried, coarse gradation with 100 percent passing 3/8-inch sieve and 85 percent retained on a No. 8 sieve.

2.07 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
 - 2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that comply with or exceed requirements.
- B. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
 - 1. Air Content: 2-1/2 percent plus or minus 1-1/2 percent for 1-1/2-inch nominal maximum aggregate size.
 - 2. Air Content: 3 percent plus or minus 1-1/2 percent for 1-inch nominal maximum aggregate size.
 - 3. Air Content: 3-1/2 percent plus or minus 1-1/2 percent for 3/4-inch nominal maximum aggregate size.

- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.
- D. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
- E. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.0 lb/cu. yd..
- F. Concrete Mixtures: Normal-weight concrete.
 - 1. Compressive Strength (28 Days):
 - a. 4,000 p.s.i. for concrete endwalls.
 - b. 3,000 p.s.i. for curb and gutter, aprons, sidewalks, and concrete paved drainage channels.
 - 2. Maximum W/C Ratio at Point of Placement: 0.45.
 - 3. Slump Limit: 4 inches, plus or minus 1 inch.

2.08 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M. Furnish batch certificates for each batch discharged and used in the Work.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.
 - 1. For concrete batches of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
 - 2. For concrete batches larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..
 - 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.
 - 1. Completely proof-roll subbase in one direction. Limit vehicle speed to 3 mph.
 - 2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
 - 3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Section 312000 Earth Moving.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

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

3.03 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.04 STEEL REINFORCEMENT INSTALLATION

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install welded-wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
- E. Zinc-Coated Reinforcement: Use galvanized-steel wire ties to fasten zinc-coated reinforcement. Repair cut and damaged zinc coatings with zinc repair material.

- F. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M.
- G. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

3.05 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
 - 1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
 - 1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
 - 2. Provide tie bars at sides of paving strips where indicated.
 - 3. Butt Joints: Use epoxy-bonding adhesive at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - 4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
 - 5. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
 - 1. Locate expansion joints at intervals of 50 feet unless otherwise indicated.
 - 2. Extend joint fillers full width and depth of joint.
 - 3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
 - 4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
 - 5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.

6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows, to match jointing of existing adjacent concrete paving:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.
 - a. Tolerance: Ensure that grooved joints are within [3 inches] either way from centers of dowels.
 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
 - a. Tolerance: Ensure that sawed joints are within 3 inches either way from centers of dowels.
 3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.06 CONCRETE PLACEMENT

- A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.
- B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.
- F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

- G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
 - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels and joint devices.
- H. Screed paving surface with a straightedge and strike off.
- I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- J. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.
- K. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.
 - 1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

3.07 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Float Finish: Begin the second floating operation when bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
 - 1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
 - 2. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture.
 - 3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.

3.08 DETECTABLE WARNING INSTALLATION

- A. Stamped Detectable Warnings: Install stamped detectable warnings as part of a continuous concrete paving placement and according to stamp-mat manufacturer's written instructions.
 - 1. Before using stamp mats, verify that the vent holes are unobstructed.
 - 2. Apply liquid release agent to the concrete surface and the stamp mat.

3. Stamping: After application and final floating of pigmented mineral dry-shake hardener, accurately align and place stamp mats in sequence. Uniformly load, gently vibrate, and press mats into concrete to produce imprint pattern on concrete surface. Load and tamp mats directly perpendicular to the stamp-mat surface to prevent distortion in shape of domes. Press and tamp until mortar begins to come through all of the vent holes. Gently remove stamp mats.
4. Trimming: After 24 hours, cut off the tips of mortar formed by the vent holes.
5. Remove residual release agent according to manufacturer's written instructions, but no fewer than three days after stamping concrete. High-pressure-wash surface and joint patterns, taking care not to damage stamped concrete. Control, collect, and legally dispose of runoff.

3.09 CONCRETE PROTECTION AND CURING

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

3.10 PAVING TOLERANCES

- A. Comply with tolerances in ACI 117 and as follows:
1. Elevation: 3/4 inch.
 2. Thickness: Plus 3/8 inch, minus 1/4 inch.
 3. Surface: Gap below 10-feet-long; unleveled straightedge not to exceed 1/2 inch.
 4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.
 5. Lateral Alignment and Spacing of Dowels: 1 inch.
 6. Vertical Alignment of Dowels: 1/4 inch.
 7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of dowel.
 8. Joint Spacing: 3 inches.
 9. Contraction Joint Depth: Plus 1/4 inch, no minus.
 10. Joint Width: Plus 1/8 inch, no minus.

3.11 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor is required to hire a qualified testing agency to perform tests and inspections.
- B. Testing Services: Testing and inspecting of composite samples of fresh concrete obtained according to ASTM C 172/C 172M shall be performed according to the following requirements:
1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C 231/C 231M, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.

5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at 28 days.
 - a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.
- C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
- D. Test results shall be reported in writing to Engineer, Town of Smithfield, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by The Engineer, or NCDOT but will not be used as sole basis for approval or rejection of concrete.
- F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by the Engineer, Town of Smithfield, or NCDOT.
- G. Concrete paving will be considered defective if it does not pass tests and inspections.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- I. Prepare test and inspection reports.

3.12 REPAIR AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by the Engineer, Town of Smithfield, or NCDOT.
- B. Drill test cores, where directed by the Engineer, Town of Smithfield, or NCDOT, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.
- C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

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

END OF SECTION

SECTION 323113
CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Chain-link fences.
 - 2. Swing gates.
 - 3. Privacy slats.
- B. Related Requirements:
 - 1. Section 033000 Cast-in-Place Concrete.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Fence and gate posts, rails, and fittings.
 - b. Chain-link fabric, reinforcements, and attachments.
 - c. Accessories: Barbed wire, privacy slats.
 - d. Gates and hardware.
- B. Shop Drawings: For each type of fence and gate assembly.
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Include accessories, hardware, gate operation, and operational clearances.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For factory-authorized service representative.
- B. Product Certificates: For each type of chain-link fence and gate.

- C. Product Test Reports: For framework strength according to ASTM F 1043, for tests performed by manufacturer and witnessed by a qualified testing agency.
- D. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For gate operators to include in emergency, operation, and maintenance manuals.

1.06 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing fence grounding; member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.
- B. Emergency Access Requirements: According to requirements of authorities having jurisdiction for gates with automatic gate operators serving as a required means of access.

1.07 FIELD CONDITIONS

- A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

1.08 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace components of chain-link fences that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure to comply with performance requirements.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 CHAIN-LINK FENCE FABRIC

- A. General: Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist according to "CLFMI Product Manual" and requirements indicated below:
 - 1. Fabric Height: 96 inches.
 - 2. Steel Wire for Fabric: Wire diameter of 0.148 inch.

- a. Mesh Size: 2 inches.
 - b. Zinc-Coated Fabric: ASTM A 392, Type II, Class 1, 1.2 oz./sq. ft. with zinc coating applied before weaving.
 - c. Coat selvage ends of metallic-coated fabric before the weaving process with manufacturer's standard clear protective coating.
3. Selvage: Twisted top and knuckled bottom.

2.02 FENCE FRAMEWORK

- A. Posts and Rails: ASTM F 1083 for framework, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness according to ASTM F 1083 based on the following:
- 1. Fence Height: 96 inches.
 - 2. Heavy-Industrial-Strength Material: Group IA, round steel pipe, Schedule 40.
 - a. Line Post: 2.375 inches in diameter.
 - b. End, Corner, Gate, and Pull Posts: 2.875 inches in diameter.
 - c. Top Rail and Braces: 1.660 inches in diameter.
 - d. Double Swing Gate Posts: 4.0 inches in diameter.
 - e. Personnel Gate Posts: 3.0 inches in diameter.
 - 3. Horizontal Framework Members: Intermediate rails according to ASTM F 1083.
 - 4. Brace Rails: ASTM F 1083.
 - 5. Metallic Coating for Steel Framework:
 - a. Type A: Not less than minimum 2.0-oz./sq. ft. average zinc coating according to ASTM A 123/A 123M or 4.0-oz./sq. ft. zinc coating according to ASTM A 653/A 653M.
 - b. Type B: Zinc with organic overcoat, consisting of a minimum of 0.9 oz./sq. ft. of zinc after welding, a chromate conversion coating, and a clear, verifiable polymer film.
 - c. External, Type B: Zinc with organic overcoat, consisting of a minimum of 0.9 oz./sq. ft. of zinc after welding, a chromate conversion coating, and a clear, verifiable polymer film. Internal, Type D, consisting of 81 percent, not less than 0.3-mil-thick, zinc-pigmented coating.
 - d. Type C: Zn-5-Al-MM alloy, consisting of not less than 1.8-oz./sq. ft. coating.
 - e. Coatings: Any coating above.

2.03 TENSION WIRE

- A. Metallic-Coated Steel Wire: 0.177-inch-diameter, marcelled tension wire according to ASTM A 817 or ASTM A 824, with the following metallic coating:
 - 1. Type II: Zinc coated (galvanized) by hot-dip or electrolytic process, with the following minimum coating weight:
 - a. Class 4: Not less than 1.2 oz./sq. ft. (366 g/sq. m) of uncoated wire surface.

2.04 SWING GATES

- A. General: ASTM F 900 for gate posts and single or double swing gate types.
 - 1. Double Swing Gate: Two (2) panels at 10'-0" each, 20' total width.
 - 2. Personnel Gate: single panel, 10' width.
 - 3. Framework Member Sizes and Strength: Based on gate fabric height of 96 inches.
- B. Pipe and Tubing:
 - 1. Zinc-Coated Steel: ASTM F 1083; protective coating and finish to match fence framework.
 - 2. Gate Posts for Double Swing Gate: 4.0" diameter round tubular steel.
 - 3. Gate Posts for Personnel Gate: 3.0" diameter round tubular steel.
 - 4. Gate Frames and Bracing: Round tubular steel, 1-5/8" diameter for Personnel Gate Frame; 2.0" diameter for Double Swing Gate Frame.
- C. Frame Corner Construction: Welded.
- D. Extended Gate Posts and Frame Members: Fabricate gate posts and frame end members to extend 12 inches above top of chain-link fabric at both ends of gate frame to attach barbed wire assemblies.
- E. Hardware:
 - 1. Hinges: 180-degree inward and 180-degree outward swing.
 - 2. Latch: Permitting operation from both sides of gate.

2.05 FITTINGS

- A. Provide fittings according to ASTM F 626.
- B. Post Caps: Provide for each post.
 - 1. Provide line post caps with loop to receive tension wire or top rail.

- C. Rail and Brace Ends: For each gate, corner, pull, and end post.
- D. Rail Fittings: Provide the following:
 - 1. Top Rail Sleeves: round-steel tubing not less than 6 inches long.
 - 2. Rail Clamps: Line and corner boulevard clamps for connecting intermediate rails to posts.
- E. Tension and Brace Bands: Pressed steel.
- F. Tension Bars: Steel length not less than 2 inches shorter than full height of chain-link fabric. Provide one bar for each gate and end post, and two for each corner and pull post, unless fabric is integrally woven into post.
- G. Truss Rod Assemblies: Steel, hot-dip galvanized after threading rod and turnbuckle or other means of adjustment.
- H. Barbed Wire Arms: Pressed steel or cast iron with clips, slots, or other means for attaching strands of barbed wire, and means for attaching to posts, integral with post cap, for each post unless otherwise indicated, and as follows:
 - 1. Provide line posts with arms that accommodate top rail or tension wire.
 - 2. Provide corner arms at fence corner posts unless extended posts are indicated.
 - 3. Single-Arm Type: In accordance with SJAFB standards.
- I. Tie Wires, Clips, and Fasteners: According to ASTM F 626.
 - 1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, according to the following:
 - a. Hot-Dip Galvanized Steel: 0.148-inch-; galvanized coating thickness matching coating thickness of chain-link fence fabric.
- J. Finish:
 - 1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz./sq. ft. of zinc.
 - a. Polymer coating over metallic coating.
 - 2. Aluminum: Mill finish.

2.06 PRIVACY SLATS

- A. PVC Slats, color to be brown, redwood or Owner's selection.

2.07 BARBED WIRE

- A. Steel Barbed Wire: ASTM A 121, three-strand barbed wire, 0.099-inch-diameter line wire with 0.080-inch-diameter, four-point round barbs spaced not more than 5 inches o.c.

1. Zinc Coating: Type Z, Class 3.

2.08 GROUT AND ANCHORING CEMENT

- A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout, recommended in writing by manufacturer, for exterior applications.
- B. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating, and that is recommended in writing by manufacturer for exterior applications.

2.09 GROUNDING MATERIALS

- A. Comply with requirements of existing SJAFB perimeter fence grounding requirements.
- B. Connectors and Grounding Rods: Listed and labeled for complying with UL 467.
 1. Connectors for Below-Grade Use: Exothermic welded type.
 2. Grounding Rods: Copper-clad steel, 5/8 by 96 inches.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for a certified survey of property lines and legal boundaries, site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.
 1. Do not begin installation before final grading is completed unless otherwise permitted by Government.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.03 CHAIN-LINK FENCE INSTALLATION

- A. Installation shall be limited to fence companies that have had a minimum five years experience in installing commercial or industrial chain link fences.
- B. Install chain-link fencing according to ASTM F 567 and more stringent requirements specified.
 1. Install fencing where indicated on drawings.

- C. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.
- D. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.
 - 1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
 - 2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
 - a. Exposed Concrete: Extend 2 inches above grade; shape and smooth to shed water.
 - b. Concealed Concrete: Place top of concrete 2 inches below grade to allow covering with surface material.
 - c. Posts Set into Sleeves in Concrete: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed according to anchoring material manufacturer's written instructions. Finish anchorage joint to slope away from post to drain water.
 - d. Posts Set into Holes in Concrete: Form or core drill holes to dimensions indicated on drawings. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed according to anchoring material manufacturer's written instructions. Finish anchorage joint to slope away from post to drain water.
 - 3. Mechanically Driven Posts: Drive into soil to depth as indicated on drawings. Protect post top to prevent distortion.
- E. Terminal Posts: Install terminal end, corner, and gate posts according to ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment as indicated on Drawings. For runs exceeding 500 feet, space pull posts an equal distance between corner or end posts.
- F. Line Posts: Space line posts uniformly at 10 feet o.c.
- G. Post Bracing and Intermediate Rails: Install according to ASTM F 567, maintaining plumb position and alignment of fence posts. Diagonally brace terminal posts to adjacent line posts with truss rods and turnbuckles. Install braces at end and gate posts and at both sides of corner and pull posts.
 - 1. Locate horizontal braces at midheight of fabric 72 inches or higher, on fences with top rail, and at two-third fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.
- H. Tension Wire: Install at top and bottom according to ASTM F 567, maintaining plumb position and alignment of fence posts. Pull wire taut, without sags. Fasten fabric to tension wire with 0.148-inch-diameter hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches o.c. Install tension wire in locations indicated before stretching fabric. Provide horizontal tension wire at the following locations:

1. Extended along top and bottom of fence fabric. Install top tension wire through post cap loops. Install bottom tension wire within 6 inches of bottom of fabric and tie to each post with not less than same diameter and type of wire.
- I. Top Rail: Install according to ASTM F 567, maintaining plumb position and alignment of fence posts. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.
 - J. Intermediate Rails. Secure to posts with fittings.
 - K. Chain-Link Fabric: Apply fabric to inside of enclosing framework. Leave 2-inch (3-inch maximum) bottom clearance between finish grade or surface and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.
 - L. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts, with tension bands spaced not more than 15 inches o.c.
 - M. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric according to ASTM F 626. Bend ends of wire to minimize hazard to individuals and clothing.
 1. Maximum Spacing: Tie fabric to line posts at 15 inches o.c. and to braces at 24 inches o.c.
 - N. Fasteners: Install nuts for tension bands and carriage bolts on the side of fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts.
 - O. Barbed Wire: Install barbed wire uniformly spaced, angled toward security side of fence as indicated on Drawings. Pull wire taut, install securely to extension arms, and secure to end post or terminal arms.

3.04 GROUNDING AND BONDING

- A. Comply with requirements of existing SJAFB perimeter fence grounding requirements.
- B. Fence and Gate Grounding:
 1. Ground for fence and fence posts shall be a separate system from ground for gate and gate posts.
 2. Install ground rods and connections at maximum intervals of 1500 feet.
 3. Fences within 100 Feet of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of 750 feet.
 4. Ground fence on each side of gates and other fence openings.
 - a. Bond metal gates to gate posts.

- b. Bond across openings, with and without gates, except openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least 18 inches below finished grade.
- C. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at a ground rod located a maximum distance of 150 feet on each side of crossing.
- D. Fences Enclosing Electrical Power Distribution Equipment: Ground according to IEEE C2 unless otherwise indicated.
- E. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is 6 inches below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at grounding location.
 - 1. Make grounding connections to each barbed wire strand with wire-to-wire connectors designed for this purpose.
 - 2. Make grounding connections to each barbed tape coil with connectors designed for this purpose.
- F. Connections:
 - 1. Make connections with clean, bare metal at points of contact.
 - 2. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 - 3. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
 - 4. Make above-grade ground connections with mechanical fasteners.
 - 5. Make below-grade ground connections with exothermic welds.
 - 6. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- G. Bonding to Lightning Protection System: Ground fence and bond fence grounding conductor to lightning protection down conductor or lightning protection grounding conductor according to NFPA 780.

3.05 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Government's maintenance personnel to adjust, operate, and maintain chain-link fences and gates.

END OF SECTION

**SECTION 329200
TURF AND GRASSES**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. General Restoration.
 - 2. Work Within North Carolina Department of Transportation Rights-of-Way

1.03 DEFINITIONS

- A. Finish Grade: Elevation of finished surface of planting soil.
- B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- C. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- D. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See drawing designations for planting soils.
- E. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For landscape Installer.
- B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.
- C. Product Certificates: For fertilizers, from manufacturer.
- D. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf establishment.
 - 1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
 - 2. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
 - 3. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network:
 - a. Landscape Industry Certified Technician - Exterior.
 - b. Landscape Industry Certified Lawncare Manager.
 - c. Landscape Industry Certified Lawncare Technician.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.
- B. Bulk Materials:
 - 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
 - 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
 - 3. Accompany each delivery of bulk materials with appropriate certificates.

1.07 FIELD CONDITIONS

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

PART 2 PRODUCTS

2.01 PLANTING PERIOD: SEPTEMBER 15 – MARCH 1

- A. Maintained/Established Lawns or road rights-of-way
 - 1. 6# Kentucky Fescue No.31

2. 2# Rye Grain
3. 30# Fertilizer (10-10-10)
4. 100# Line
5. 12# Superphosphate

B. Open Field (Anything other than an established lawn):

1. 4# Kentucky Fescue No. 31
2. 2# Rye Grain
3. 20# Fertilizer (5-10-10)
4. 100# Line
5. 12# Superphosphate

C. Open Field For Slopes 2:1 or greater or areas subject to erosion:

1. 2# Kentucky Fescue No. 31
2. 4# Sericea Lespedeza (Unscarified)
3. 2# Rye Grain
4. 30# Fertilizer (5-10-10)
5. 100# Line
6. 12# Superphosphate

D. The Engineer will be consulted prior to seeding for a determination of appropriate seed mixture. All rates are in pounds per 1000 square feet and any rates listed above may be cut by 1/2 for temporary erosion control measures only. Unless otherwise required by the North Carolina Department of Transportation or the Engineer, seeding within road rights-of-way will be as specified for established lawns.

2.02 PLANTING PERIOD: FEBRUARY 1 – OCTOBER 15

A. Maintained/Established Lawns or road rights-of-way:

1. 8# Kentucky Fescue No. 31
2. 30# Fertilizer (10-10-10)
3. 100# Line
4. 12# Superphosphate

B. Open Field (Anything other than an established lawn):

1. 6# Kentucky Fescue No. 31
2. 2# Sudangrass (May, June, and July only)
3. 20# Fertilizer (5-10-10)
4. 100# Line
5. 12# Superphosphate

C. Open Field For Slopes 2:1 or greater or areas subject to erosion:

1. 2# Kentucky Fescue No. 31
2. 4# Sericea Lespedeza (Scarified)
3. 2# Sudangrass (May, June, and July only)
4. 20# Fertilizer (5-10-10)
5. 100# Line
6. 12# Superphosphate

D. The Engineer will be consulted prior to seeding for a determination of appropriate seed mixture. All rates are in pounds per 1000 square feet and any rates listed above may be cut by 1/2 for temporary erosion control measures only. Unless otherwise required by the North Carolina Department of Transportation or the Engineer, seeding within road rights-of-way will be as specified for established lawns.

PART 3 EXECUTION

3.01 PREPARATION

- A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.
 2. Protect grade stakes set by others until directed to remove them.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.02 GENERAL

- A. All surfaces and structures (both public and private) within and adjacent to the construction operations shall be restored to a condition comparable to that existing prior to construction or as specified in the special provisions.

- B. All surplus materials shall be disposed of in a manner acceptable to the Engineer, and the construction area shall be left in a neat condition, with special attention called to proper drainage, smoothness of surface, and general clean up. No machinery or equipment shall be left or stored on the job site after the project is completed.
- C. Unless otherwise specified, complete restoration to include fertilizing, seeding, and mulching of any and all areas disturbed during construction shall be completed within thirty (30) working days following the initial ground disturbing activity.
1. Water meters, valve boxes, drain pipes, and other structures encountered shall be reset or relaid to match or clear surface grade and/or water main pipe grade as applicable.
 2. All shoulder areas shall be restored, stabilized, and maintained to their original condition. Concrete, asphalt, gravel, and dirt walks, drives and roadways are to be replaced to their original shape and serviceability. Unless otherwise approved by the Engineer all areas (shoulders, side streets, drive, parking areas, etc.) which exhibit a gravel surface at the time of construction will be re-graveled with a minimum depth of six (6) inches of C.A.B.C stone compacted-in-place for the width and length of the disturbed area and then feathered gradually into the existing cross section. When a driveway is finished with other than C.A.B.C stone, a one inch finish coating to match existing gravel gradation and appearance shall be placed. The Contractor should note that all existing side streets and drives which are either dirt or gravel will be restored as specified for graveled areas.
 3. Refuse Burial: The Contractor shall not bury rock, broken concrete/asphalt, construction material, timber, etc. within the street or water main right-of-way.
 4. Rip-Rap: The Contractor shall place stone rip-rap as specified in those areas subject to severe water action where directed by the Engineer. Placement of rip-rap as shown on the Construction Plans shall be considered a guide only, with final determination made at the time of construction by the Engineer. Either the addition or deletion of quantities may be required. Stone rip-rap will be placed as indicated on the Standard Details immediately following pipe installation and will be installed no steeper than a 2:1 slope except when specifically approved by the Engineer. Grading will be required as necessary to insure continuous even flow. The rip-rap installation shall include all earthwork necessary to stabilize the creek bank and to provide cover for the water line.
 5. Jute Netting/Erosion Blanket: The Contractor shall install jute netting or Erosion Control Blanket in areas subject to high runoff velocities, areas subject to concentrated runoff and on steep slopes as shown on the plans and/or as directed by the Engineer.
 6. Fertilizing, Seeding, and Mulching: Established lawns and landscaped areas damaged by construction shall be restored to their former condition by seeding, unless the type and condition of the existing sod warrants it being cut, removed, preserved, and replaced. All areas, regardless of previous condition, damaged by construction shall be fertilized, seeded, and mulched as outlined below.
 - a. Seed Bed Preparation: The seed bed shall be prepared by pulverizing the soil in an approved manner to a depth of three (3) inches for field conditions or slopes that are 3:1 or flatter and to a depth of one (1) to three (3) inches, as determined on site for slopes steeper than 3:1. The soil shall be tilled until a well pulverized, firm, reasonably uniform seed bed is prepared conforming substantially to ground

elevations as shown on the Plans and/or as existed prior to construction. The disturbed area shall blend uniformly into adjacent topography. Good surface drainage must be provided, allowances for settlement made and ground elevations adjusted accordingly. Visible ponding will not be allowed. All stones, roots, sticks, rubbish, and other objectionable material shall be removed.

- b. Soil Improvements: Soil additives shall be incorporated in an approved manner into the top soil at the following rates:
 - 1) Fertilizer - 20 pounds per 1000 square feet of 5-10-10 fertilizer generally and 30 pounds per 1000 square feet of 10-10-10 fertilizer for established lawn areas.
 - 2) Lime - 100 pounds per 1000 square feet.
 - 3) Superphosphate (0-20-0) - 12 pounds per 1000 square feet.
- c. Seeding: Seeding must be done within thirty (30) calendar days after the initial ground disturbing activity:
 - 1) The seed bed must be in good, friable condition and not muddy or hard at the time seeding is performed.
 - 2) Seed shall be applied at the rate specified and raked or tilled into the topsoil with the resulting furrows running across the natural slope of the ground. Under no circumstances will any tilling activity be allowed parallel with said slope. Slopes steeper than 3:1 shall require the use of hydraulic seeding unless otherwise specifically approved by the Engineer.
- d. Mulching: After fertilizing, seeding and raking, dried straw shall be spread uniformly over the area at a rate of 90 pounds per 1000 square feet. Approximately 1/4 of the ground should remain visible to avoid smothering seedlings. The straw shall be sprayed with liquid asphalt to bond it together and anchor it in place within road right-of-way and areas subject to erosion:
 - 1) Liquid asphalt, thinned with kerosene, shall be used during freezing weather and shall be either rapid or medium curing. It shall be applied at a rate of 200 gallons per ton of straw or approximately 9 gallons per 1000 square feet.
 - 2) Emulsified asphalt, thinned with water shall be used when temperatures are less severe, shall be rapid curing only, and shall be applied at a rate of 150 gallons per ton of straw or approximately 7 gallons per 1000 square feet.
- e. Maintenance: The Contractor shall maintain the seeded areas until there is a uniform growth three (3) inches high. Maintenance shall consist of watering, weed and pest control within established lawns, fertilization, erosion repair, reseeding and all else necessary to establish a vigorous healthy and uniform stand of grass. All areas and spots which do not show a uniform stand of grass, for any reason, shall be treated repeatedly until a uniform stand is attained:

3.03 WORK WITHIN NORTH CAROLINA DEPARTMENT OF TRANSPORTATION RIGHTS-OF-WAY

- A. Construction is permitted within the rights-of-way of the North Carolina Department of Transportation (DOT), Division of Highways in accordance with their Policies And Procedures For Accommodating Utilities On Highway Rights-Of-Way as amended. Town of Smithfield is required to enforce this entire document as it relates to this work. All bidders are required to become familiar with the document and any amendments which are available from the Manager of Right-of-Way, North Carolina Department of Transportation, Division of Highways, Raleigh, North Carolina.
1. Town of Smithfield has entered into an encroachment agreement with the North Carolina Department of Transportation (DOT) which grants the right for any work within the Department of Transportation's rights-of-way. The encroachment agreement for any work within DOT rights-of-way under this project is included in this contract. A copy of the approved encroachment has been attached to this contract or will be supplied to the Contractor prior to construction. A copy of the encroachment agreement must be kept at the construction site at all times.
 2. Certain notices are required in writing before any work can proceed within the Department of Transportation's rights-of-way. Upon notice by the Contractor, the Engineer will make this notification.
 3. Proper signing before, during, and after construction in conformance with the manual on Uniform Traffic Control Devices for Streets and Highways will be required. In addition, warning signs as related to soft and/or low shoulders and broken pavement may be required by the Engineer.
 4. Piling and/or storage of excavated material upon the pavement and on some types of shoulders is prohibited unless special permission is granted by the Department of Transportation's Division Engineer. Any material spilled, tracked or placed on the pavement is to be cleaned and damaged pavement repaired subject to stoppage of all work by Town of Smithfield. Drainage ditches are to be protected from siltation as specified in the EP Section and must be opened at the end of each workday or as weather conditions require.
 5. Open trenches are prohibited between dusk and dawn and at designated peak traffic hours unless special permission is received from the Department of Transportation's Division Engineer.
 6. When cutting of pavement is permitted, only one-half of the road width shall be opened at any time. Full traffic flow is to be maintained between dusk and dawn and at other peak hours of traffic as required by the encroachment agreement or other Special Provision.
 7. The Contractor and his suppliers are directed to contact the North Carolina Department of Transportation to verify axle load limits on State maintained roads and bridges which will be used for hauling of equipment or materials for this project. The Contractor and his suppliers shall do all that is necessary to satisfy the Department of Transportation requirements and will be responsible for any damage to roads and bridges resulting from this project.

3.04 CLEANUP AND PROTECTION

- A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Town of Smithfield's property.
- C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.
- D. Remove nondegradable erosion-control measures after grass establishment period.

END OF SECTION

SECTION 330509.13
COUPLINGS FOR UTILITY PIPE

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Dismantling Joint

1.03 SUBMITTALS

- A. Submit detailed product data and descriptive literature including dimensions, weights, capacity data, pressure rating and materials of construction.
- B. Provide shop drawings which clearly illustrate the general arrangement of the equipment and cross-sectional views of the components.

1.04 QUALITY ASSURANCE

- A. Supplier shall have been manufacturing dismantling joints for a period of at least ten (10) years and shall, at the Engineer's request, provide a list of installations involving equipment of similar size and application.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Romac Industries Inc., Smith-Blair, Inc., or approved equal.

2.02 DISMANTLING JOINT

- A. Provide Steel Follower made of Carbon Steel C1020 per ASTM A576 and A36 with factory applied fusion bonded epoxy finish.
- B. Provide Sleeve Weldment consisting of Carbon Steel Sleeve per ASTM A283C with factory applied fusion bonded epoxy finish and Carbon Steel Flange per ASTM A36 and AWWA C207 Class D, meeting requirements of ANSI Class 125 and 150 bolt circles.
- C. Provide Spool Weldment consisting of Carbon Steel Sleeve per ASTM A283C with factory applied fusion bonded epoxy finish and Carbon Steel Flange per ASTM A36 and AWWA C207 Class D, meeting requirements of ANSI Class 125 and 150 bolt circles.
- D. Provide Nitrile (Buna-N) Gasket per ASTM D2000

- E. Provide Carbon Steel Anchor Loop per ASTM A36.
- F. Provide High Strength Low Alloy Bolts meeting requirements of ASTM A588 and AWWA C111/A21.11.
- G. Provide Carbon Steel Nuts meeting requirements of ASTM A194 Grade 2H.
- H. Provide Carbon Steel Washers meeting requirements of ASTM F844.
- I. Provide High Strength Carbon Steel Tie/Restraint Rods meeting requirements of ASTM A193 B7.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine joint interior for cleanliness, freedom from foreign matter, and corrosion.

3.2 JOINT INSTALLATION

- A. Dismantling Joint shall be installed in accordance with the manufacturer's written Installation and Operation Manual and approved submittals.
- B. Install Dismantling Joint in locations as indicated on the construction drawings.

END OF SECTION

SECTION 330523.13
UTILITY DIRECTIONAL DRILLING

PART 1 GENERAL

1.01 SUMMARY

- A. This Specification covers the installation of pipe or conduit by horizontal directional drilling. Horizontal directional drilling is a trenchless excavation method which is accomplished in three phases. The first phase consists of drilling a small diameter pilot hole following the design alignment and profile. The second phase consists of enlarging the pilot hole to a diameter suitable for installation of the pipe or conduit. The final phase consists of pulling the pipe or conduit(s) into the enlarged hole. Horizontal directional drilling is accomplished using a specialized horizontal drilling rig with ancillary tools and equipment.
- B. The Contractor shall furnish all labor, equipment, and materials necessary to install Steel pipeline by horizontal directional drilling (HDD) as indicated on the Project Drawings.

1.02 GLOSSARY AND ABBREVIATIONS

Term	Definition
Horizontal Directional Drilling (HDD)	A surface-to-surface pipeline installation technique used to install pipelines or conduits along pre-determined straight and curved alignments in soil and rock environments. The installation technique is comprised of four primary stages including pilot bore drilling, reaming pass(es), swab pass, and product pipe installation. Tracking of the drilling string is achieved using downhole wireline survey tools that may be augmented with an energized wire grid at the ground surface.
Pilot Bore	The first stage of the installation process whereby a guided and steerable pilot bore is drilled along a planned alignment from an entry location to an exit location.
Bent Sub	A bent sub is a section of drill pipe behind the cutting tools that is inclined at an angle from the axis of the bore in the desired direction of steering. The bent sub allows steering while rotating the cutting tools.
Reaming Pass(es)	The second stage of the installation process whereby a reamer(s) is used to increase the diameter of the bore to its final diameter. This shall include multiple reaming passes/diameters where necessary.
Annular Space	The space between the excavated HDD final reamed bore diameter and the product pipe or the space between product pipe and conductor casing.
Swab Pass	The third stage of the installation process whereby the reamed hole is prepared for product pipe installation by making a pass through the hole with tooling to collect residual cuttings and loose materials in the hole that may impede pipe installation.
Conductor Casing	A steel casing pipe installed at the entry and/or exit locations of the borehole to stabilize the borehole
Product Pipe Installation	The final stage of the installation process whereby the product pipe is installed within the bore.
Drilling Fluid/Mud	A mixture of water, bentonite and/or polymers specially designed for HDD operations and continuously pumped through the drilling

Term	Definition
	equipment to facilitate the installation process and stabilize the bore.
Frac-out	The fracturing or failure of the soil around the bore hole as a result of excessive drilling fluid pressure generally resulting in drilling mud being released to the surface.
Settlement Point	A point with elevation and spatial location established prior to construction and re-surveyed periodically to monitor ground movements. The point may be a nail, pin, subsurface settlement rod or borehole extensometer.
Pullback Loads	The tensile load or force that is applied to the drill string and product pipe and required to install the product pipe.
API	American Petroleum Institute
ARO	Abrasion Resistant Overcoat
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
Aavg	Total Change in Inclination over LDrilled
EDR	Electronic Drill Recorder
EPP	Environmental Protection Plan
FBE	Fusion Bonded Epoxy
HDD	Horizontal Direction Drilling
LDrilled	Length drilled over three joints of drill pipe
MSDS	Material Safety Data Sheet
SMYS	Specified Minimum Yield Strength

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Reference Specifications

013216	Construction Scheduling
013300	Submittals
036000	Grouting
333000	Sanitary Sewerage Utilities (for Gravity Pipeline Testing)
333000	Sanitary Sewerage Utilities (for Pressure Pipe Testing and Disinfection)
330533.23	Polyethylene Pressure Pipe (AWWA C901)
333000	Sanitary Sewerage Utilities (for Chlorinated Polyvinyl Chloride Process Pipe)

B. Reference Standards

Installation of Pipelines by Horizontal Directional Drilling: An Engineering Design Guide (2008). Pipeline Research Council International, PR-227-03110.
--

Installation of Pipelines Beneath Levees Using Horizontal Directional Drilling (1998). US Army Corp of Engineers, Construction Productivity Advancement Research (CPAR) Program, CPAR-GL-98-1.
Horizontal Directional Drilling Good Practices Guidelines, 2008, 2004, 2001, HDD Industry Consortium, 300pp.
ASCE Manual of Practice No. 108 Pipeline Design for Installation by Horizontal Directional Drilling.
API Bulletin 130, 1985. Bulletin on the Rheology of Oil-Well Drilling Fluids, Second Edition, Dallas, Texas, American Petroleum Institute.
API Recommended Practice 13B-1, 1990. Standard Procedures for Field Testing Water-Based Drilling Fluids, First Edition, Dallas, Texas, American Petroleum Institute.
ASTM F 1962 Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit Under Obstacles, Including River Crossings.
Installation of Pipelines Beneath Levees Using Horizontal Directional Drilling, US Army Corps of Engineers, Waterways Experiment Station, Final Report, CPAR-GL-98-1, April 1998.
API Specification 13A, 1993. Specification for Drilling Fluid Materials, Fifteenth Edition, Dallas, Texas. American Petroleum Institute.
IADC Drilling Manual, 1992. Eleventh Edition, Houston, Texas, International Association of Drilling Contractors.
Pressure Pipeline Design for Water and Wastewater, American Society for Civil Engineers, 2nd ed., 1992.
Tables for Hydraulic Design of Pipes and Sewers, American Society for Civil Engineers, 5th ed., 1990.

1.04 SUBMITTALS

- A. Submit the following in accordance with the requirements of Section 0130 - Submittal Procedures, providing sufficient detail to allow determination of whether the proposed equipment, materials, and procedures meet the Contract requirements. Review of submitted details and data will be based on consideration of requirements for the completed work, utilities, and the possibility of unnecessary delays in the execution of the Work to be constructed under this Contract. Review and acceptance of the submittals shall not be construed in any way as relieving the Contractor of its responsibilities under this Contract.
- B. All procedure or material descriptions requiring Engineer approval shall be submitted not less than three weeks prior to commencing any horizontal directional drilling activities at the crossing location.
- C. Horizontal Directional Drilling Work Plan: Submit an HDD Work Plan complete with drawings and written description identifying all details of the proposed method of construction and the sequence of operations to be performed during construction. The work plan shall also include details of the proposed method of construction for the conductor/starter casing (if used), and sequence of operations. A separate work plan shall be submitted for each individual bore.
- D. Environmental Protection Plan: When required the Contractor shall prepare and submit an environmental protection plan specifying any environmental requirements regarding containment of lubricants, fuel and drilling fluids, and any spill containment measures and collection equipment to be on site in the event of inadvertent release of drilling fluids.

- E. Qualifications: Contractor shall provide resumes of key personnel including site superintendent(s), drill rig operator(s), project manager and guidance/steering hand in accordance with submittal requirements herein.
- F. Shop Drawings: The drawings shall include all equipment, equipment setup areas, pipe layout areas, access routes, and any excavations or mud recirculating pits. The Contractor shall confirm that all operations shall be completely contained within the temporary construction easement shown on the Drawings.
- G. Schedule: In accordance with 013216 Construction Progress Schedule, the Contractor shall submit a detailed schedule for each HDD bore installation showing all major construction activities and durations, with starting and completion dates shown. The schedule shall be updated at least every 2 weeks or more frequently, and include:
 - 1. Calling 811 or other Local/Regional utility location service for utility location requests and visual confirmation of a crossing utilities and all parallel utilities within twenty (20) feet laterally of the bore centerline.
 - 2. Site preparation.
 - 3. Rig mobilization and setup.
 - 4. Conductor casing, installation, where applicable.
 - 5. Coil installation / Calibration of locate system
 - 6. Pilot bore drilling.
 - 7. Pre-reaming and reaming.
 - 8. Layout and welding of pipe.
 - 9. Pressure testing of pipe prior to pullback.
 - 10. Swab pass
 - 11. Pullback of pipe.
 - 12. Post installation testing (e.g., sizing plate, pressure test), if applicable.
 - 13. Cleanup, surface restoration, and demobilization.
- H. Description of Methods, Equipment and Materials: The Contractor shall submit detailed descriptions of all methods, equipment, and materials to be used for the pipeline installation. Descriptions of drilling fluid additives shall be accompanied by Materials Safety Data Sheets (MSDS) and manufacturers' descriptions and warranties. Descriptions of equipment shall include manufacturers' specifications, calibrations, appropriate drawings, photographs, and descriptions of any modifications since manufacture.
- I. Surveying, Equipment and Procedures: The Contractor shall submit records of equipment calibrations and certifications for all equipment used for downhole surveys and tracking of the drill head. Procedures for operating the downhole survey tools shall be described, including measures to verify the accuracy of the equipment readings.
- J. If surface coil is required, the Contractor will submit a surface coil placement shop drawing.

- K. Drilling and Reaming Rates: The Contractor shall submit maximum anticipated drilling and reaming rates for pilot bore and each reaming pass and confirm that pump capacity is adequate for these anticipated drilling rates for the drilling fluid weights anticipated.
- L. Pipe Filling Methods: The Contractor shall submit methods and procedures for filling the pipe with clean potable water during pull back ('buoyancy control' plan). The submittal shall also include methods and procedures for disposal of any water drained from the filled pipe.
- M. Equipment Layout: The Contractor shall submit dimensioned sketches depicting the layout and locations of equipment within the rig side work area and pipe side work area, including any proposed drilling fluid containment and recirculation pits.
- N. Calculations for Pullback: The Contractor shall submit calculations for pullback loads for the conditions and operating practices anticipated. All assumptions used in the calculations shall be provided. These calculations shall be made and stamped by a licensed Professional Engineer registered in the region in which the project take place.
- O. Pipe Stress Calculations: The Contractor shall submit calculations for pipe stresses expected to result from the pullback, bending, fluid buckling loads, earth loads, groundwater loads, break-over stresses during entry into the bore, and any other installation and service loads expected to be exerted on the pipe. All assumptions used in the calculations shall be provided. These calculations shall be made and stamped by a licensed Professional Engineer registered in the region in which the project take place.
- P. Calculations of Maximum Allowable Drilling Fluid Pressure: The Contractor shall submit calculations identifying the critical downhole pressure that would cause hydrofracture (Frac-Out) or inadvertent drilling fluid returns. The calculations shall identify the critical points in the alignment. The calculations shall identify all parameters used and state all assumptions made. The Contractor shall submit an annular pressure diagram for the length of the alignment based on the drill path depth, anticipated pumping rate, anticipated return drilling fluid viscosity, and the diameter of the borehole. The pressure diagram shall show upper and lower bound pressures indicating maximum allowable pressure and minimum pressure required for maintaining fluid circulation through the borehole. The calculations shall be sealed and stamped by a licensed Professional Engineer registered region in which the project take place.
- Q. Downhole Fluid Pressure and Pullback Load Monitoring: The Contractor shall submit information for the down-hole fluid pressure monitoring device including: equipment calibrations, pressure limits and certifications, and list of HDD projects where the pressure tool has been used.
- R. Frac-Out and Surface Spill Contingency Plan: The Contractor shall submit a Frac-Out and Surface Spill Contingency Plan describing procedures for preventing drilling fluid losses or spills into water ways and/or fluid returns to the surface. The plan shall address roles and responsibilities of involved parties, monitoring, prevention, containment, cleanup, and documentation procedures, and observations to be made and plans for containment and cleanup, if spills or hydrofracture occur. The plan shall also address changes that may be required to Contractor's operations to avoid recurrences. Containment and cleanup equipment shall be provided at both entry and exit locations and shall include at a minimum:
1. Sand bags
 2. Shovels
 3. Geotek filter bags
 4. Splash board

5. Several 5-gallon hard plastic pails
 6. Heavy duty push brooms and several flat blade shovels.
 7. Silt fence (minimum 50 ft) and T post (minimum 8)
 8. Straw logs
 9. Portable pumps (2 minimum)
 10. Hoses (at least 100 ft)
 11. Vacuum truck (available for response within one (1) hour of a frac out event)
- S. Rig Capacity: The Contractor shall submit details on the capacity of the drill rig verifying that the pullback capacity is greater than the required pullback calculated and submitted by the Contractor with a minimum safety factor of 2.0.
- T. Power Supply: The Contractor shall submit details on the power supply/generators to be used for the entry site. Including manufacturer's specifications, capacity, noise, and emissions data.
- Separation plant for drilling fluid returns: The Contractor shall submit details on the mud pump, shaker screens and hydrocyclones. Include dimensions, manufacturer's specifications, pump capacity, noise rating, and soundproofing details on the system.
1. Mud supply pump capacity should be specified for water at sea level elevation and adjusted for actual elevation and fluid viscosity.
 2. Provide details on the generator, including dimensions, noise ratings at twenty-five (25) feet, and soundproofing.
 3. Provide manufacturer-rated cleaning capacity of the mud separation plant in gallons per minute (gpm).
- U. Radius of Curvature: The Contractor shall confirm that the bore can be completed using the radius of curvature shown on the Drawings along with calculations showing that installation stresses do not exceed allowable pipe stresses.
- V. Plans for Disposal of Spoils and Drilling Fluids: The Contractor shall submit plans for disposal of waste materials resulting from the pipeline construction, including drilling fluids, cuttings, waste oil, fuel, discharge water, etc. The Contractor shall identify the disposal site and submit a letter indicating willingness and legal authority to accept the described and anticipated waste products.
- W. Contingency Plans for Potential Problems: The Contractor shall submit contingency plans for remediation of potential problems that may be encountered during the drilling operations. The contingency plans shall address the observations that would lead to the discovery of the problem and the methods that would be used to mitigate the problem. Potential problems that shall be addressed include:
1. Natural and man-made obstructions encountered (such as boulders, etc.).
 2. Utility strike.
 3. Loss of circulation or decreased drilling fluid circulation.

4. Deviation from planned bore path in excess of allowable tolerances.
 5. Inability to advance drill or product pipe.
 6. Loss of tooling downhole.
 7. Hydrolock.
 8. Drill or product pipe twisted off or broken off in borehole.
 9. Pipe collapses or pipe deformations exceed maximum allowable tolerances.
 10. Excessive ground settlement/heave or formation of a sink hole above/in proximity to the alignment.
 11. Pulling force exceeding 80% of the product pipe allowable pull force.
 12. Frac-out.
- X. Survey Measurements: Survey measurements of points shall be submitted to the Engineer by noon of the day following the shift for which the measurements were taken. Measurements shall be made at least once per day or as required by the project permits and included here.
- Y. Protection of Adjacent Structures: Provide details on measures to be taken to monitor and protect adjacent utilities, structures, and roadways.
- Z. Safety Plan: The Contractor shall submit a Safety Plan, including the name of the Site Safety Representative, emergency telephone numbers for medical facilities, and precautions for handling and disposal of any hazardous or flammable materials. The Safety Plan shall include a code of safe practices and an emergency plan in accordance with OSHA requirements.
- AA. The following shall be submitted as construction progresses and at the completion of construction.
1. Daily Logs and Records: The Contractor shall submit complete, legible, written daily logs and records as required herein, by noon of the following day to which the records correspond.
 2. Variations in Plan and Profile: The Contractor shall document any variations between the actual plan and profile of the bore path and the location shown on the Drawings and specifications herein. The Contractor shall notify the Engineer immediately upon discovery of any deviations that exceed design tolerances. Design tolerance is plus or minus 10 feet horizontally, plus 5 feet vertically and minus 10 feet vertically.
 3. Mud Properties: The Contractor shall submit measured drilling fluid viscosity and density at least three (3) times per shift with at least two (2) hours between readings, using calibrated Marsh funnel and mud balance. Measurements shall be made during each stage of the drilling process. Additional measurements shall be made when changes in the soil formation are suspected or when changes are made to the mud mix. These measurements shall be included in daily logs submitted to the Engineer. The Contractor shall document modifications to the drilling fluids, by noting the types and quantities of drilling fluid additives and the dates and times when introduced. The reason for the addition of drilling fluid additives or other modifications shall be documented and reported.
 4. Pipe Pressure Test Records: The Contractor shall submit all pipe pressure test records for all tests within 48 hours of any tests.

5. Pilot Bore As-Built Profile: The Contractor shall submit a digital as-built profile of the pilot bore to the Engineer for review within 24 hours of completion of the pilot bore. The profile shall be in the form of an AutoCAD file or approved equal. Design stations and corresponding elevations shall be used in the as-built file.

1.05 EXISTING FACILITIES AND UTILITIES

- A. Contractor shall undertake the following steps prior to commencing drilling operations in this project location that contains existing underground facilities.
- B. Contact the utility location/notification service, for the construction area.
- C. Positively locate and stake all existing lines, cables, or other underground facilities including exposing any facilities which are located within 15-feet on either side of the designed drilled path.
- D. Modify drilling practices and downhole assemblies to prevent damage to existing facilities.
- E. Contractor shall be responsible for locating any and all underground facilities regardless of any previous efforts in this regard. Contractor shall be responsible for all losses and repairs occasioned by damage to underground facilities resulting from drilling operations.

1.06 QUALITY ASSURANCE

- A. Qualifications and Experience of Personnel: The Contractor shall have met the minimum experience qualifications established within the contract documents. The Contractor shall employ skilled, experienced superintendent(s), drillers, steering hands/locators and personnel. Contractor personnel shall have met the experience qualifications established within Bidder's Qualifications.
- B. Contractor shall prepare and maintain a quality assurance/quality control plan and document management plan throughout the project. All applicable documentation and records shall be compiled in accordance with provisions of this plan.
- C. Daily Logs and Records:
 1. Daily logs and records shall be maintained by the Contractor and shall include drilling lengths, location of drill head/reamer, installation loads, drilling fluid pressures and flow rates, annular pressure readings, drilling fluid losses, inadvertent returns, drilling times required for each pipe joint, any instances of retraction and re-drilling of the pilot bore or segments thereof, and any other relevant observations, including any hard drilling zones, steering problems, circulation problems, observed settlement, heave, frac-outs, or surface spills.
 2. The drilling and installation readings shall be measured and recorded at the entry point for the entire length for all phases of the pilot bore and any pilot re-bore, and recorded at least once per drill pipe length or every 30 feet, whichever is more frequent.
 3. Drilling fluid annular pressures shall be continuously recorded and monitored for the duration of the pilot bore. These records shall be maintained and provided daily. The position of the drill head shall be continuously tracked during the pilot bore and recorded by a downhole wireline tracking locator system (or another approved guidance system) Where feasible utilize an energized wire grid at the surface.

4. During the pilot bore, reaming passes, and pipe pullback the Contractor shall electronically record the following information once per drill pipe or every 30 feet, whichever is more frequent.
 - a. Rate of Penetration
 - b. Rotational Torque
 - c. Thrust/Pullback
 - d. Pump Rates
 - e. Calculated Depth
 - f. Annular Pressure (pilot bore only)
 - g. Flow (Meter Returns in Supply Line)
 - h. If torque and thrust are recorded as gage pressures, the conversion factors for pound-feet of torque and pounds force of thrust/pullback shall be provided.
 5. The information shall be submitted to the Engineer by noon of the day following the shift for which the records were taken.
 6. Contractor shall sign and date the information provided and certify that to the extent of his knowledge, the information is true and accurate, and that the supervisory personnel for the HDD operations will be directly involved with this project for the duration.
 7. Contractor shall provide adequate personnel to supervise all aspects of the directional drilling process. Owner has the right to reject any supervisory personnel changes during construction. Contractor shall submit 72-hour notification of any supervisory personnel changes during construction to Owner for prior approval.
- D. Advance Notice and Inspections: The Contractor shall provide written notice at least 48 hours in advance of the planned inception of major drilling activities, including conductor casing (if applicable), beginning the pilot bore, , reaming, swabbing, and pipe pullback. The Contractor shall immediately notify the Engineer, in writing, when any significant problems are encountered or if ground conditions are considered by the Contractor to be materially and significantly different from those represented within the Contract Documents. All work by the Contractor shall be performed in the presence of the Engineer unless Engineer grants prior written approval to perform such work in Engineer's absence.
- E. Pipe: The drill pipe shall be certified by the Contractor as meeting all requirements of the specifications.

1.07 DESIGN CRITERIA

- A. Equipment: The Contractor shall provide all equipment, materials, and personnel necessary for completing the installation as shown on the Drawings and specified herein. The equipment and materials shall include but are not limited to:

1. Directional drilling rig with all ancillary equipment, including drill pipe, drilling fluid, cutting tools, reaming bits, swivels, expanders, downhole motors, generator, pumps, hoses, mixing equipment, drilling fluid processing equipment (cuttings separation equipment), downhole survey equipment, energized surface grid, fluid pressure and flow rate monitoring equipment, spare parts, pipe handling equipment, crane, backhoe, roller, side boom tractors, control cabin, control equipment, and office equipment.
 2. Drilling fluids, water, fuel, lubricant, polymers, or other additives.
 3. Any other expendable or reusable materials, supplies, and equipment needed for the installation.
- B. The drilling equipment shall be capable of advancing through the geologic conditions to be encountered at the site as depicted in the Geotechnical Report and as anticipated by the Contractor.
- C. The rig anchor shall be sufficient to allow the full capacity of the HDD rig during drilling operations. The HDD rig thrust block shall be fully removed upon completion of the installation process
- D. Contractor shall use an Owner approved tracking system (for example, ParaTrack II, Slimdril gyroscopic tooling, or equivalent) and an approved downhole steering system. The Contractor shall provide technicians and directional drillers experienced in the operation of the above equipment. The Contractor shall also provide sufficient spares for the above equipment to maintain directional capability at all times.
- E. Any clearing, grubbing or other ground preparation for the guidance system shall be solely the responsibility of the Contractor. All such surface preparations shall be in accordance with the Contract Documents and shall require Owner approval. The drilling fluid shall be designed for the geologic conditions to be encountered at the site as depicted in the Geotechnical Report and as anticipated by the Contractor.
- F. The capacity of the directional drilling rig used by the Contractor to pull back the pipe shall be adequate to install the specified pipeline, with adequate factor of safety
- G. The pump used by the Contractor shall be adequate to always supply the required flow rate and pressures at the anticipated drilling fluid viscosity. Drilling speeds shall not exceed pump capacity.
- H. The drilling system shall include a fluid pump and separation plant that can achieve the rates of drilling fluid pumping, spoil separation, and slurry cleaning required by the Contractor to achieve planned production rates for the soils anticipated by the Contractor. Shaker screens, hydrocyclones, and centrifuges may be required for efficient separation of spoils. The Contractor is advised that the separation plant must fit within the allowable work areas shown on the Drawings.
- I. All spoil and slurry must be contained in trucks, tanks, approved recirculation pits, or other containers at all times. Dumping of spoil or slurry on the ground, discharge into sewers, or discharge into the water bodies shall not be permitted. All spoils shall be transported and disposed of off-site at an approved disposal facility.
- J. Perform all work within work areas shown on the Drawings.
- K. Any deviation to the radii of curvatures or entry and exit angles shown on the Drawings should be submitted in writing to the Engineer for approval.

- L. Pipe rollers and lifters shall be used to help the transition of the carrier pipe into the bore. The number of pipe rollers and lifters shall be determined by the Contractor.
- M. Surface settlement, or heave, of the ground surface or utilities and/or other features above the HDD centerlines and within the zone influenced by the HDD construction shall be limited to values that avoid damage. The Contractor shall repair any damage resulting from settlement or heave caused by HDD activities at no additional cost to the Owner. The Contractor shall grout any voids caused by or encountered during drilling as specified in Section 03 60 00- Grouting.

1.08 INSTRUMENTATION

- A. Contractor shall at all times provide and maintain instrumentation which will accurately locate the pilot hole, measure drill string axial and torsional loads, and measure drilling fluid discharge rate and pressure. The Engineer and the Inspector shall have access to these instruments and their readings at all times.

1.09 PHYSICAL CONDITIONS REFERENCE DOCUMENTS

- A. The Contractor is responsible for satisfying himself as to the soil conditions associated with the HDD installation. Owner may provide Contractor with documentation of geotechnical/soil borings or subsurface investigations for Contractor reference only. Contractor is responsible for determining suitability of Owner-supplied documentation, and Owner is not responsible for the completeness and accuracy of such documentation.

PART 2 PRODUCTS

2.01 PIPE

- A. The pipe thickness must conform to the most conservative design with respect to design calculations for the critical combination of internal and external pressure, pullback, and bending as determined by the Contractor. Minimum pipe wall thickness shall be as shown in the Contract Documents.

2.02 WATER

- A. The Contractor shall secure a suitable source of water, and shall be responsible for transporting, storing, and disposing of any water required for the operation of the site and the preparation of the drilling fluids

2.03 DRILLING FLUIDS

- A. The Contractor shall select drilling fluid mixture proportions to ensure continuous circulation, bore stability, reduce drag on the pipe, and completely fill the annular space between the bore and the pipe to control settlement. Management and disposal of drilling fluids shall be the Contractor's responsibility.
- B. Drilling fluids, including makeup water, bentonite, polymers, or other additives shall be designed for the anticipated geologic conditions along the bore.
- C. Composition: The composition of all drilling fluids proposed for use shall be submitted to the Engineer for approval. No fluid will be approved or utilized that does not comply with permit requirements and environmental regulations.

- D. Water: Contractor is responsible for obtaining, transporting, and storing water required for drilling fluids. Water used for preparation of drilling fluid will be either potable water or water obtained from an approved intake location. Saline water shall not be used in the preparation of the drilling fluids.
- E. Recirculation: Contractor shall maximize recirculation of drilling fluid surface returns. Contractor shall provide solids control and fluid cleaning equipment of a configuration and capacity that can process surface returns and produce drilling fluid suitable for reuse. The Contractor will be solely responsible for solids control and cleansing equipment performance or for treatment of excess drilling fluid and drilled spoil.
- F. Disposal: Disposal of excess drilling fluids and cuttings is the responsibility of Contractor and shall be conducted in compliance with all environmental regulations, right-of-way and workspace agreements, and permit requirements.
- G. Inadvertent Returns: Contractor shall employ his best efforts to maintain full annular circulation of drilling fluids. Drilling fluid returns at locations other than the entry and exit points shall be minimized. If annular circulation is lost, Contractor shall take steps to restore circulation. If inadvertent surface returns of drilling fluids occur, they shall be immediately contained with hand placed barriers (i.e. hay bales, sandbags, silt fences, etc.) and collected using pumps as practical. If the amount of the surface return is not great enough to allow practical collection, the affected area shall be diluted with fresh water and the fluid will be allowed to dry and dissipate naturally. If the amount of the surface return exceeds that which can be contained with hand placed barriers, small collection sumps (less than 5 cubic yards) may be used. If the amount of the surface return exceeds that which can be contained and collected using small sumps, drilling operations shall be suspended until surface return volumes can be brought under control.

2.04 DRILL PIPE

- A. The Contractor shall provide high quality drill pipe that has been inspected and determined to be adequate for the project requirements. Bent, cracked, or fatigued drill pipes shall not be used. Threads must be in good condition. On crossings 2000' or longer, the drill pipe used shall be double white banded (remaining wall > 80% of specified new wall) shall be used.

2.05 DRILLING DATA

- A. Contractor shall provide and maintain electronic data recorder (EDR) instrumentation that will continuously and accurately monitor (at a minimum) tank pit volumes, mud flow (pump and return), pressure (annular pressure/standpipe), instantaneous rate of penetration, drill pipe axial and torsional loads (push/pull force and rotary torque), bit depth, and drill string rotations per minute. The electronic information shall be accessible to the Owner representative onsite and will form part of the records required at the end of the project. Data files including all electronically recorded data shall be provided to the Owner. Online access shall be provided to the Owner or its representative. The EDR shall record each of the above listed parameters on a one (1) minute basis or at least every 4 inches, whichever is more frequent

PART 3 EXECUTION

3.01 GENERAL

- A. The Contractor shall not initiate HDD until all submittals are received, reviewed, and approved.
- B. The Contractor shall not initiate HDD until all required permits are obtained.

- C. The Contractor shall have the equipment listed in the submitted and approved Frac-Out and Surface Spill Contingency Plan prior to commencing drilling operations.

3.02 WORK STAGING AREA

- A. **WORK STAGING:** The Contractor shall limit staging and work operations to the areas shown on the Drawings, or as otherwise accepted in writing by the Engineer, for storage of equipment and materials, parking, pipe layout, drilling, and other work.
- B. **CONTROL OF DRILLING FLUIDS:** The Contractor shall follow all requirements of the Frac-Out and Surface Spill Contingency Plan and control operational pressures, drilling mud weights, drilling speeds, and any other operational factors required to avoid hydrofracture fluid losses into the surrounding formations, and control drilling fluid spillage. This includes any spillages, inadvertent fluid, or slurry returns at entry and exit locations or at any intermediate point. All inadvertent returns or spills shall be promptly contained and cleaned up. The Contractor shall maintain on-site mobile spill containment and removal equipment at the HDD entry and exit location at all times. The Contractor shall be capable of quickly containing and removing spills. The Contractor shall immediately notify ENGINEER of any inadvertent returns or spills and immediately clean up the inadvertent return or spill.
- C. **COMBUSTIBLE MATERIALS:** Combustible materials (fuel, oil, lubricants, etc.) shall be stored off-site or in a well-ventilated storage facility removed from the immediate vicinity of the drilling area by at least twenty (20) feet.
- D. **SITE SECURITY:** The Contractor shall install an enclosure fence around the entry and exit work areas. The enclosure fence shall include a lockable gate and should prevent entry of unauthorized persons. Contractor may install enclosure fence around pipe stringing area at Contractor's own discretion.

3.03 MOBILIZATION

- A. The Contractor shall mobilize all equipment, materials, and personnel necessary to construct the pipe product/conduit(s) using the HDD process at the locations shown on the Drawings.
- B. **ENTRY AREA:** The Contractor shall set up temporary workspace within the areas delineated on the Drawings. Appropriate precautions and measures shall be employed by the Contractor to prevent erosion, surface drainage, and spillage of drilling fluids or other materials that could adversely impact the environmental quality of the site. Silt fences, hay wattles, and hay bales shall be used to line the work area to minimize erosion and contain any spillages or runoff.
- C. **EXIT AREA:** The exit area shall have a drilling fluid pit for containing drilling fluids and cuttings. Hay bales, silt fences, or wattles shall be used to line the exit area to minimize erosion and runoff.
- D. **PIPE LAYOUT AREA:** Layout area shall be free of stones, wood, debris and obstructions. Pipe rollers shall be provided by the Contractor to facilitate pipe pullback.

3.04 HORIZONTAL DIRECTIONAL DRILLING

- A. **BORE TRACKING AND MONITORING:**
 - 1. **DOWNHOLE WIRELINE AND SURFACE GRID TRACKING SYSTEM:**

- a. Contractor shall monitor and record x, y, and z coordinates relative to an established surface survey benchmark, from downhole survey data using a downhole wireline system. Tru-tracker energized surface grid, or equivalent, shall be installed where feasible, and used on both sides of any waterway to augment the downhole wireline tracking system. The grids shall be surveyed to establish horizontal and vertical position to 0.1 feet accuracy. The data shall be continuously monitored and recorded at least once per drill pipe length or at thirty (30) feet or thirty (30) minute intervals during drilling, whichever is most frequent. The completed borehole shall be surveyed with the downhole locating system after all reaming is completed and prior to pullback of the pipe. This information shall be collected and provided to the Owner prior to commencement of pullback.
 - b. Deviations between the recorded and design bore path shall be calculated and reported on the daily report. If the deviations exceed tolerances listed herein, such occurrences shall be reported immediately. The Contractor shall undertake all necessary measures to correct deviations and return to design line and grade.
2. DRILLING FLUID PRESSURES AND FLOW RATES: Drilling fluid pressures and flow rates shall be continuously monitored and recorded by the Contractor. The pressures shall be monitored at the pump and in the annulus using a down-hole annular pressure sensor. These measurements shall be made during pilot bore drilling. Maximum allowable drilling speeds shall be calculated for pilot boring and each reaming pass and shall not be exceeded for pilot boring or reaming passes. Annular pressure measurements shall be continuous and shall be recorded using a data logging system.
 3. DRILLING FLUID VISCOSITY AND DENSITY (MUD WEIGHT): The Contractor shall measure and record drilling fluid viscosity and density at least three (3) times per shift with at least two (2) hours between readings, using calibrated Marsh funnel and mud balance. These measurements shall be included in the daily log submittals.
- B. LOCATION OF ENTRY AND EXIT POINTS: Entry and exit points shall be as shown on the Drawings, unless otherwise approved in writing. The Contractor shall employ licensed, experienced surveyors to locate the entry and exit points, and to establish horizontal and vertical datums for the bore and the pipe layout and fabrication areas.
- C. ENTRY AND EXIT ANGLES: Drill entrance and exit angles shall be as shown on the Drawings, unless otherwise approved in writing.
- D. CONDUCTOR CASING: Steel conductor casings shall be installed as deemed necessary by the Contractor. The casing shall meet the following minimum requirements:
1. The Contractor shall ensure the casing is installed at the designed entry angle along the designed drill path.
 2. Methods used to install the conductor casing shall prevent settlement or heave of surface features and subsurface utilities.
 3. Conductor casing thickness shall be determined by the Contractor and shall have a minimum wall thickness of 0.75 inches.
 4. Following completion of the crossing the conductor casing will be extracted by the Contractor, unless directed otherwise by the Owner in writing.
- E. PILOT BORE: The pilot bore shall follow the design path of the bore shown on the Drawings.
1. Horizontal and Vertical Tolerances: As noted herein.

2. The pilot hole shall be drilled along the path shown on the plan and profile drawings to the tolerances listed. However, in all cases, right-of-way restrictions shall take precedence over the listed tolerances. Regardless of the tolerance achieved, no pilot hole will be accepted if it will result in any or all of the pipeline being installed in violation of right-of-way restrictions. In all cases, concern for adjacent utilities and/or structures shall take precedence over the listed tolerances. Listing of tolerances does not relieve Contractor from responsibility for safe operations or damage to adjacent utilities and structures.
3. Curve Radius: Curves shall be drilled at radii which fall within the tolerances listed. The drilled radius will be calculated over any 3 joint (range 2 drill pipe) segment using the following formula:

$$R_{\text{drilled}} = (L_{\text{drilled}} / A_{\text{avg}}) * 57.32$$

Where:

R_{drilled} = drilled radius over L_{drilled}

L_{drilled} = length drilled, no less than 75-feet and no greater than 100-feet

A_{avg} = total change in angle over L_{drilled}

4. As-Built Survey: At the completion of pilot hole drilling, Contractor shall provide a tabulation and sealed drawings of coordinates, referenced to the drilled entry point, which accurately describe the location of the pilot hole.

F. REAM AND PULL BACK

1. Hydrostatic Pretest: If applicable, the entire pull section shall be subjected to a 4-hour hydrostatic test, unless otherwise is specified in the Contract Documents, prior to being installed in the hole. The test pressure shall be equal to or exceed that required for final certification. The hydrostatic pretest shall be conducted and documented in accordance with the applicable Specification.
2. Pulling Loads: The maximum allowable tensile load imposed on the pull section shall be equal to 80 percent of the product of the specified minimum yield strength of the pipe and the area of the pipe section. If more than one value is involved for a given pull section, the lesser shall govern.
3. Torsional Stress: A swivel shall be used to connect the pull section to the reaming assembly to minimize torsional stress imposed on the section.
4. Pull Section Support: The pull section shall be supported as it proceeds during pull back so that it moves freely and the pipe and corrosion coating are not damaged.
5. Breakover Section: The pull section shall be supported in a manner that ensures that the minimum bending radius associated with the pipe product installed is not violated as the pipe is pulled into the borehole.
6. External Collapse Pressure: The pull section shall be installed in the reamed hole in such a manner that external pressures are minimized. Any damage to the pipe resulting from external pressure during installation shall be the responsibility of Contractor.
7. Buoyancy Modification: Buoyancy modification shall be used at the discretion of Contractor. Any buoyancy modification procedure proposed for use shall be submitted to the Engineer for approval. No procedure shall be used which has not been approved. Contractor is responsible for any damage to the pull section resulting from buoyancy modification.

8. Contractor shall provide a sufficient number of rollers, cradles and motorized equipment to support the pipe and prevent over-stressing due to sags or bends during the pullback procedure.
9. Entry and Exit Tolerances: The location of the entry and exit points shall be within the tolerances shown on the Drawings. The Contractor shall be solely responsible for all work necessary to correct excessive deviations from line and grade, including re-drilling, redesigning connections, and acquiring additional easement, at no additional cost and without schedule extension.
10. PRE-REAMING AND REAMING: The pilot bore shall be pre-reamed and reamed using equipment and methods submitted by the Contractor. The Contractor shall completely ream the bore to the final diameter prior to pullback.
11. SWAB PASS: The Contractor shall complete a swab pass of the entire bore length prior to pullback of the pipe. Swab pass reamer shall have an outside diameter that is larger than the product pipe outside diameter.
12. HYDROSTATIC TEST: The Contractor shall perform hydrostatic water pressure test in accordance with 33 05 05.50 - Pressure Pipe Testing and Disinfection prior to pipe pullback and after HDD pipe is installed. The Contractor shall repair any defects discovered during these tests and repeat until the pipe passes the test.
13. PIPE PULLBACK:
 - a. The pipe shall be installed by pulling it into the reamed bore hole behind a final reaming tool selected by the Contractor.
 - b. The pipe shall be isolated from excessive torsional and axial stresses by a swivel device.
 - c. The welded pipe shall be filled with water in accordance with approved submittal as it enters the bore to reduce pullback loads.
 - d. The Contractor shall monitor and inspect pipe rollers and method for suspending pipe during the pullback operation.
 - e. The Contractor shall monitor and record installation loads once per drill pipe or every 30 feet, whichever is more frequent.
 - f. When applicable, the Contractor shall submit a lift plan for the drag section, including lift calculations and associated drawings for cranes and/or other mechanical lifting equipment, for review and approval by the Engineer.
 - g. The Contractor shall cease operations if the pipe is damaged and shall remove the pipe from the bore and repair the pipe using the manufacturer's recommended procedure or replace the damaged pipe before resuming installation.
 - h. Damage to the pipe resulting from installation or grouting of the annulus is the responsibility of the Contractor, including costs for replacement and labor and materials. To confirm no damage to the pipe, the Contractor shall perform a sizing plate test to confirm the internal diameter and roundness of the pipe.

14. CONTACT GROUTING (When Applicable):

- a. When applicable, the Contractor shall grout the annular space between the bore and the outer diameter of the pipe. Grouting shall be completed within 48 hours of completion of the final post installation hydrostatic test. Grouting is to be completed using materials in accordance with Section 03 60 00 - Grouting.
 - b. Grouting procedures shall be in accordance with approved submittals. The grouting operations shall ensure that the annulus is filled with grout for the 50 feet nearest the entry point and exit point unless otherwise noted. Grouting may be accomplished using tremie pipes inserted 50 feet into the bore from each end after pipe pullback, hydrostatic test and sizing plate and other specified testing are completed. Grout shall be injected in sufficient volume to completely fill the annulus as the tremie pipe is withdrawn. Grouting pressures shall be carefully controlled and monitored to avoid applying excessive pressure to the pipe and to avoid heave or hydrofracture. The grouting apparatus used to complete the annular space grouting shall be capable of delivering grout concurrently at multiple injection points around the carrier pipeline. The Contractor is responsible for ensuring damage to the pipe does not occur during all grouting operations.
15. SITE RESTORATION AND DEMOBILIZATION: The Contractor shall remove all equipment, materials, drilling fluids, muck, waste, and debris from the site and restore the site to its original condition upon completion of the installation as defined in the contract documents.
16. SHEETING AND SHORING
- a. The Contractor shall be responsible for the design, installation, maintenance and removal of any sheeting and shoring necessary for the drilling operation, including fluid containment and permitted disposal practices.
17. NOISE ABATEMENT
- a. The Contractor is required to furnish, install and maintain noise control barriers at the site as required to meet the project's permits, approvals and/or local noise bylaws, and shall remove them upon the completion of the WORK. Generator and rig engine shall be enclosed with insulated noise barriers, as required. When applicable, the Contractor shall equip all machinery and equipment used for construction with enclosures as well as noise mitigation devices such as mufflers, muffling sleeves, and spark arrestors or other suitable noise suppressors. Air compressors shall be of a quiet type such as a "whisperized" compressor.
 - b. Noise produced by construction operations shall be kept to a minimum. Noisy operations shall be conducted wherever possible during daylight hours and scheduled to minimize duration. The Contractor shall comply with all applicable Federal, State, and local noise pollution control regulations.
 - c. Noisy equipment shall be kept as far as possible from noise sensitive site boundaries. Equipment shall be properly maintained to reduce noise from excessive vibration, faulty mufflers, or other sources. No equipment shall be left idling unnecessarily. Noisy operations shall be limited to daylight hours and scheduled to minimize their duration.

- d. To determine whether the noise limits are being met, the Contractor shall use a portable sound level meter meeting the requirements of the ANSI S1.2 for Type 2 sound level meters. Sound levels shall be recorded at a minimum of 4 times daily and submitted to the Engineer as part of the daily report. If non-complying noise levels are found, the Contractor shall be responsible for monitoring and correction of excessive noise levels. The Contractor is required to respond immediately and positively to provide corrective action required to meet the sound attenuation specification.

END OF SECTION

SECTION 330523.16
UTILITY BORING AND JACKING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Miscellaneous Steel
 - 2. Concrete

1.2 SUBMITTALS

- A. Required submittals for product approval include, but are not limited to, the following:
 - 1. Product brochures
 - 2. Catalog cut sheets
 - 3. Shop drawings including dimensions and part/material lists
 - 4. Certification of compliance
 - 5. Prior product acceptance test reports
 - 6. Reference contact data
 - 7. Shipping tickets and purchase invoices
- B. Provide product data for the following:
 - 1. Miscellaneous Steel
 - 2. Concrete
- C. Shop Drawings
- D. Product Certificates: Required for all products.
- E. Qualification Data: For qualified testing agency.
- F. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:
 - 1. Classification according to ASTM D 2487.
 - 2. Laboratory compaction curve according to ASTM D 698.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall be responsible for the safe storage of materials furnished by or to them, and accepted by them and intended for the work, until they have been incorporated in the completed project. Handling and storage of all project materials are to be in compliance with the manufacturer's recommendations for handling and storage. The interior of all pipes, manholes and other accessories shall be kept free from dirt and foreign materials at all times.
- B. Transportation of Materials and Equipment: The Contractor and their Suppliers are directed to contact the North Carolina Department of Transportation to verify axle load limits on State maintained roads (and bridges) which would be used for hauling of equipment and materials for

this project. The Contractor and their Suppliers shall do all that is necessary to satisfy the Department of Transportation requirements and will be responsible for any damage to said roads which may be attributed to this project. All materials required to construct this project shall be furnished by the Contractor and shall be delivered and distributed at the site by the Contractor or their material supplier.

- C. Loading and Unloading Materials: All pipe and accessories shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Under no circumstances shall such materials be dropped. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground.
- D. Responsibility for Materials on Site: In distributing the material at the site of the work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench. Each piece shall be redundantly chocked at each end to prevent movement or rolling. Pedestrian or vehicular traffic shall not be unduly inconvenienced in placing of material along the streets or right-of-way, as applicable.

The Contractor will string in advance no more than the amount of pipe and material that can be installed within two (2) weeks unless approved by the Engineer. All the materials shall be placed in such a manner as not to hinder access, endanger or impede traffic, create a public nuisance or endanger the public.

Materials strung through residential areas (or any area with maintained lawns) shall be placed in such a manner as not to restrict normal lawn maintenance and must either be installed within two (2) weeks or removed to an approved storage yard, as required by the Engineer.

- E. Material and Equipment Storage Sites: Unless otherwise shown on the plans, the Contractor will be responsible for locating and providing storage areas for construction materials and equipment. Unless prior written consent from the owner of the proposed storage area is received by the Town of Smithfield, the Contractor will be required to store all equipment and materials within the limits of the project site, or the limits of the sanitary sewer right-of-way and temporary construction easement provided. The materials and equipment storage shall comply with all local and state ordinances throughout the construction period. Material and equipment may only be stored within road right-of-way if approved by the controlling agency. Bulk storage of stacked materials shall not be permitted in or along road rights-of-way.

Storage sites shall be fenced with adequate protection to reasonably prevent the public from entering the site. The Contractor shall be responsible for the safeguarding of materials and equipment against fire, theft, and vandalism and in a manner which does not place the public at risk and shall not hold the City responsible in any way for the occurrence of same.

PART 2 - PRODUCTS

2.1 MISCELLANEOUS STEEL

- A. Steel Encasement Pipe
 - 1. Steel Encasement Pipe: Steel pipe shall be fully welded or seamless, smooth wall or spiral weld, consisting of Grade "B" steel as specified in ASTM A-139.
 - 2. Minimum yield strength shall be 35,000 PSI; and pipe thickness shall be as specified for each individual job.
 - 3. Pipe design shall be in accordance with AWWA M11 considering the following:
 - a. Internal pressure
 - b. External pressure

- c. Special physical loading
 - d. Practical requirements
 - e. Minimum wall thickness of 0.25 inch
4. All pipe shall be furnished with push-on joint pipe, or beveled ends prepared for field welding of circumferential joints. All burrs at pipe ends shall be removed.
 5. Encasement pipe must be approved by the appropriate controlling agency (D.O.T., R.R., etc.) and the Engineer prior to ordering.
 6. Permalok steel casing pipe may be used as an alternative steel casing pipe joining system. All steel used in the manufacture of Permalok steel pipe shall conform to the requirements of ASTM A-36, ASTM A515, grade 60 or ASTM A572, grade 42. All welding shall be performed by qualified welding operators in accordance with the requirements of ANSI/AWS D1.1. One reduced section tension test specimen shall be evaluated for each lot of 1000' of each size and wall thickness, and shall show a tensile strength not less than 95% of the minimum strength specified for the grade of steel used, unless waived by the purchaser. All Permalok pipe shall be clearly marked with the manufacturers' name, manufacturer's job number, customer name, O.D., wall thickness, and weight per foot.
 7. Casing Spacers
 - a. Bands: Casing spacer bands shall be made of High-Density Polyethylene (HDPE), UV resistant non-metallic virgin polypropylene, heavy duty two-piece #304 Stainless Steel (minimum 14 gauge), or Carbon Steel.
 - b. Risers: HDPE, UV resistant non-metallic virgin polypropylene, #304 Stainless Steel, #10 gauge, or Carbon Steel.
 - c. Liner: Ribbed PVC extrusion or Thermoplastic Rubber (TPR).
 - d. Runners: Integrally molded solid core, ultra-high molecular weight polymer, or glass reinforced plastic. All spacers shall have full length, integrally molded skids extending beyond the bell or mechanical joint of the carrier pipe.
 - e. Applicable Standards: The following standards apply as applicable: ASTM D-695, ASTM D-621, ASTM D-638, ASTM D-149/61, ASTM 149/64, ASTM B117.
 - f. Acceptable Manufacturers:
 - 1) Raci Spacers of North America
 - 2) CCI Pipeline Systems, LLC
 - 3) BMW Company
 - 4) Cascade Waterworks Mfg
 - 5) GPT
 - 6) Approved equal
 8. End Seals
 - a. Provide one of the following end seals, as required by the project specific plans and construction documents:
 - 1) Masonry Seals: Ensure drainage of encasement by leaving a 1-inch diameter weep hole in the seal of the lower end of the encasement. Clay or shale masonry shall meet the requirements of ASTM C62 Grade SW. Concrete

brick masonry shall meet the requirements of ASTM C55 for Grade S-II, except that absorption of brick shall not exceed 10 lbs./cf. All masonry units shall be free from cracks and flaws with straight and parallel sides and square corners burned hard and true. Brick masonry mortar shall be Type S masonry cement meeting ASTM C270.

- 2) Watertight Rubber Seals: Provide wrap around or pull-on rubber end seals. Provide end seals by one of the following:
 - a) CCI Piping Systems, LLC
 - b) Garlock
 - c) Konex International
 - d) Approved equal

B. Stainless Steel Straps and Anchors

1. Straps for concrete piers, inside drops, and outside drops: Stainless Steel ASTM A240 Type 304 or Type 304L.
2. Straps or painted carbon steel straps for vent pipes. Stainless Steel ASTM A240 Type 304 or Type 304L.
3. For stainless steel anchors, bolts, and washers (hardware): Stainless Steel ASTM A240 Type 316 or Type 316L.
4. Epoxy Adhesive Anchorage: Adhesive anchors shall consist of a two-component structural epoxy injection gel meeting the requirements of ASTM C881, stainless steel screen tubes of hollow base materials. Minimum adhesive anchor embedment shall be 4-inches (5-inches minimum for frame and cover) unless otherwise indicated. Provide epoxy adhesive anchors by Hilti Corporation HIT-HY 200, ITW Red Head A7+ Quick-Dure Adhesive, Powers Fasteners Pure 150-Pro Epoxy, or pre-approved equal.

a. Cartridge Injection Adhesive Anchors

- 1) Threaded steel rod, inserts or reinforcing dowels, complete with nuts, washers, polymer or hybrid mortar adhesive injection system, and manufacturer's installation instructions. Type and size as indicated on Drawings.
- 2) Interior and Exterior Use: As indicated on the Drawings, provide stainless steel anchors. Stainless steel anchors shall be AISI Type 316 stainless steel provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. All nuts shall conform to ASTM F594 unless otherwise specified. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals.
- 3) When indicated on the project drawings, or specified by the Standard Details, deformed reinforcing dowels shall be A615 Grade 60.

b. Capsule Anchors

- 1) Threaded steel rod, inserts and deformed reinforcing dowels with 45-degree chisel point, complete with nuts, washers, glass or foil capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator,

and manufacturer's installation instructions. Type and size as indicated on Drawings.

- 2) Interior and Exterior Use: As indicated on the Drawings, provide chisel-pointed stainless steel anchors. Stainless steel anchors shall be AISI Type 316 stainless steel provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. All nuts shall conform to ASTM F594 unless otherwise specified. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals.
 - 3) Deformed reinforcing dowels shall be A615 Grade 60, with 45-degree chisel-points at embedded end.
5. Anti-seize/anti galling lubricant: Apply anti-seize/anti-galling lubricant on all bolt and nut threads as recommended by manufacturer for each application. Install nuts and bolts on process piping using an anti-seize/anti-galling lubricant. Minimize seizing and galling by installing nuts at slow speeds to reduce friction heat and using clamps, not bolts, to pull joints together. If nut begins to bind before tightening the joint down, stop immediately. Wait a minute or two to allow any heat to dissipate and then back the fastener off. Inspect the threads for damage and remove any debris before proceeding with a new nut. Anti-seize/anti-galling lubricant shall be MRO Solutions LLC Solution 1000; Permatex Anti-Seize Lubricant, Finish Line Anti-seize Assembly Lube, USS Ultra Tef-Gel, Loctite Heavy Duty Anti-Seize, Loctite LB 771 by Henkel or pre-approved equal.

C. Steel Reinforcing For Concrete:

1. Bars: All reinforcement bars shall conform to the Standard Specifications for billet-steel bars for concrete reinforcement, ASTM A-615, or low alloy steel deformed and plain bars for concrete reinforcement, ASTM A-706. All bars shall be deformed and of structural Grade 60.
2. Wire: All reinforcement wire fabric shall conform to the Standard Specifications for welded steel wire fabric for concrete reinforcement, ASTM A-185 and steel wire, plain, for concrete reinforcement, ASTM A-82. Minimum yield strength shall be 65,000 PSI and minimum tensile strength shall be 75,000 psi.

D. Casing Vent Pipe

1. Vent Pipe: Unless otherwise specified, shall be located at each end of the casing pipe as shown on the Standard Details. The vent pipe shall be galvanized steel per ASTM A-53, Type E, Grade "B", Schedule 40.
2. All steel shall be Grade "B" only, with a minimum yield strength of 35,000 P.S.I.
3. Pipe design shall be in accordance with AWWA M11 considering the following:
 - a. Internal pressure
 - b. External pressure
 - c. Special physical loading
 - d. Practical requirements
 - e. Minimum wall thickness of 0.25 inch

4. The steel pipe shall have an inside lining - minimum 20 mils dry film thickness of Induron Protecto 401, Tnemec Perma-Shield PL Series 431, or approved equal, or shall have fusion-bonded epoxy coating in accordance with AWWA C213. Surface preparation and supplication shall be as recommended by Induron or Tnemec. Lining applicator shall be an Induron or Tnemec approved certified applicator.
5. Outside surface of the pipe exterior coating shall be fusion-bonded epoxy coating in accordance with AWWA C213 as per Induron or Tnemec or approved equal. Surface preparation and application shall be as recommended by Induron or Tnemec or approved equal. The coating applicator shall be an Induron or Tnemec or approved equal certified applicator.
 - a. Exterior coating shall be forest green or olive green, as approved by the Engineer.
6. Vent pipe shall be equipped with a screen to guard from insects, debris, and animals as indicated on the Standard Details. Screen shall be sized to fit and installed securely inside the hub or coupling of the vent pipe. Screen shall be constructed of 0.009" thick 316 stainless steel 18 x 18 mesh with 0.047" openings.

2.2 CONCRETE

- A. Portland Cement: All concrete shall conform to the Standard Specifications for READY MIXED CONCRETE, ASTM C-94. An air-entraining admixture, conforming to ASTM C-260, shall be added to either Type II, or Type III Portland Cement. Fly Ash conforming to ASTM C-618 for Class F Fly Ash may be added to the concrete mix but shall not be considered as replacement for more than 25% of the cement therein (strengths shall not be less than hereinafter required). Type IL Portland-limestone cement, meeting ASTM C-595, shall be allowed in lieu of Type II Portland-cement.
 1. Types III and IIIA Portland Cement shall only be used for manhole inverts, concrete encasement, concrete blocking, and/or as directed by the Engineer and shall conform to ASTM C-150.
 2. Types II and IIA Portland Cement shall be used in precast manholes, cast in place structures, reinforced concrete piers and concreteas directed by the Engineer, and shall conform to ASTM C-150 except that Tricalcium Aluminate content shall not exceed 8%. Portland-limestone cement Type IL(MS), conforming to ASTM C-595, shall be allowed in lieu of Types II and IIA.
- B. Aggregates: All aggregates used for concreting shall conform to ASTM C-33 and shall be checked daily for any variances in moisture content. Said variances shall be corrected and/or taken into consideration for each batch.
 1. Coarse Aggregates: Shall be uniformly and evenly graded for each application in accordance with A.C.I. Standard 318. Unless otherwise approved, aggregate shall be sound, crushed, angular granitic stone. Flat or elongated aggregate or smooth round stones shall not be acceptable.
 2. Fine Aggregates: Shall consist of natural sand, manufactured sand or a combination thereof. Fine aggregates shall conform to the sieve analysis as specified in paragraph 4.1 of ASTM C-33 except that the percent passing a No. 50 sieve shall not exceed 5% and the percent passing a No. 100 sieve shall be 0% as provided for in paragraph 4.2 of ASTM C-33.
- C. Mix Design: Concrete shall be watertight, resistant to freeze-thaw cycles and moderate sulfate attack, abrasion resistant, workable, and/or finishable. These qualities may be met through the use of admixtures (if and only if approved in the mix design as hereinafter specified) conforming to the

appropriate ASTM with the exception of the use of calcium chloride, which shall be limited to no more than 1% by cement weight - thoroughly mixed to insure uniform distribution within the mix. If the concrete is used with reinforcing steel, no calcium chloride will be allowed. The Contractor shall assume responsibility for concrete mixture. When required by the Engineer, and prior to beginning construction, the Contractor, at their expense, shall obtain from an approved commercial testing laboratory a design for a suitable concrete mix and submit same with their list of materials and material suppliers for approval. The concrete shall be proportioned to meet the following requirements: (Note: This mix does not apply "in total" to precast manhole or reinforced concrete pipe).

1. Compressive Strength: Minimum 3,600 psi
 2. Water-Cement Ratio By Weight: Maximum 0.50
 3. Slump: Minimum 3", Maximum 5"
 4. Superplasticizer Slump: 6" – 8"
 5. Air Content (Entrained and Entrapped): Minimum 4%, Maximum 6%
 6. Coarse Aggregate: $\frac{3}{4}$ " - 1 $\frac{1}{2}$ " (as required by the application)
- D. Curing Compound: All concrete curing compounds shall conform to the standard specifications for LIQUID MEMBRANE - FORMING COMPOUNDS FOR CURING CONCRETE, ASTM C-309, Type 2. Curing compounds shall be applied if forms are stripped when concrete is to remain exposed to atmosphere.
- E. Grouts: All grouts shall be of a non-shrink nature (as may be achieved through additives or proportioning) and depending upon application range from plastic to flowable cement water paste. Testing as specified above for concrete may be required for acceptance of grouts to include frequent checks for consistency by a time-of-flow measurement. Expansion grouts shall be either MasterFlow 648 epoxy grout by BASF, or 1428HP Grout by W.R. Meadows, or approved equal. Grouts shall be mixed (if applicable) and placed in accordance with the manufacturer's current recommendations, for each specific application. Expansion grouts shall be used only as directed by the Engineer. Acceptable range of testing requirements:
1. Compressive Strength: 10,500 psi to 12,500 psi.
 2. Bond Strength: 1,350 psi to 1,700 psi.
 3. Percent Expansion: + 0.025% to + 0.75%
- F. Mortar: Mortar used in sanitary sewer manholes shall be hydraulic cement mortar in accordance with ASTM C-398. Mortar used in sewer manholes shall be Type M mortar in accordance with ASTM C-270.
- G. Lightweight Cellular Concrete Fill: For Use In Annular Spaces Inside Casing Pipe And Tunneling Pipes.
1. Qualifications: The Contractor must be capable of developing a mix design, batching, mixing, handling, and placing cellular concrete. The Contractor shall be certified by the manufacturer of the foaming agent and regularly engaged in the production and placement of cellular concrete. The Contractor shall have fully qualified workers who are thoroughly trained and experienced in the production, placement and quality control of cellular concrete. Certificates verifying their qualifications and training will be required as part of the submittal for approval.
 2. Conformance: Cellular concrete supplier must provide independent, third-party testing that confirms the proposed cellular concrete meets:

- a. ASTM C495, Standard Test Method for Compressive Strength of Lightweight Insulating Concrete.
 - 1) Slump: 10" to 11"
 - 2) Air Content: 75%
 - 3) Unit Weight: 28 - 35 PCF
 - 4) Design Compressive Strength of 150 psi at 28 days or 80 psi at 56 days.
 - b. ASTM C666, modified Procedure B as per ACI 523.1 - Standard for freeze thaw cycles with relative dynamic modulus of elasticity (E) not less than 70% of its original value after 120 cycles.
3. Materials: Blast furnace slag shall conform to ASTM C 989. The percentage of blast furnace slag, if used, shall range from 20% to 30% depending on application. Fly ash, if utilized, must conform to ASTM C 618.
4. Foaming agents shall conform to the requirements of ASTM C 869 when tested in accordance with the provisions of ASTM C 796.
- H. Flowable/Excavatable Fill (CLSM): Contractor shall furnish and place flowable fill i.e. controlled low strength (CLSM) backfill where shown in the drawings.
 1. Cement: All cement used shall be Type II Portland cement which shall conform to the requirements of ASTM C150.
 2. Fly Ash: ASTM C618, Class F.
 3. Aggregates: Fine aggregate shall conform to the grading and quality requirements of ASTM C33. Coarse aggregate shall conform to the grading and quality requirements of ASTM C33 for size No. 476, No. 57, or No. 67.
 4. Water: The batch mixing water and mixer washout water shall conform to the requirements of ASTM C94.
 5. Flowable Fill Properties:
 - a. CLSM shall have a maximum fifty-six (56) day compressive strength of one hundred and fifty (150) psi when molded and cured as in conformance with ASTM D4832.
 - b. CLSM shall have a minimum cement content of fifty (50) pounds per cubic yard. The water-cementitious materials ratio of the mix shall not exceed three and one-half to one (3.5:1).
 - c. CLSM shall be air entrained to a total air content of approximately five percent (5%).
 - d. The minimum slump shall be six (6) inches and the maximum slump shall be eight (8) inches when tested in accordance with ASTM D6103.
 - e. Fine aggregate shall be between fifty percent (50%) and sixty percent (60%) by volume of the total aggregates in the CLSM mix.
 - f. The consistency of the CLSM slurry shall be such that the material flows easily into all openings between the pipe and the lower portion of the trench. When trenches are on a steep slope, a stiffer mix of slurry may be required to prevent excavatable flowable fill from flowing down the trench. When a stiffer mix is used, vibration shall be performed to ensure that the excavatable flowable fill slurry completely fills all spaces between the pipe and the lower portion of the trench.

PART 3 - EXECUTION

3.1 DRY BORE WITH STEEL ENCASEMENT

- A. Bore Pits (or Tunnel Pits): Bore or tunnel pits shall be safed-up, shored, well marked, lighted, and not left unattended except as approved by the controlling agency. Requirements for stabilization and dewatering of bore pits shall be as specified in Sections 3.6 and 3.7 herein. The angle of repose method (sloping pit walls) for creating a safe working area shall be prohibited.
- B. Pits adjacent to roadways shall be protected using interlocking precast concrete traffic barrier walls. Subject to approval of the Engineer, pits protected by existing traffic barrier walls or steel guardrails may not require temporary concrete traffic barrier walls.
- C. Pits within the 1:1 slope distance from the edge of pavement, or greater than 20 in depth, or when required by the Engineer or the Controlling Agency shall be designed by a geotechnical/structural Professional Engineer. The Contractor shall be responsible for providing a pit design and details signed and sealed by a Professional Engineer licensed in North Carolina, and subject to approval of the Controlling Agency.
- D. The pits and shoring shall be removed (if ground conditions allow) at the conclusion of construction. If ground conditions prevent the safe removal of the pit shoring, as determined by the pit design engineer or the Controlling Agency, the shoring shall remain in place. The top of the shoring shall be removed to a distance 2-feet below finish grade.
- E. Installation: Smooth wall or spiral weld steel pipe may be jacked through dry bores slightly larger than the pipe, bored progressively ahead of the leading edge of the advancing pipe as spoil is mucked by the auger back through the pipe. As the dry boring operation progresses, each new section of encasement pipe shall be fully and completely butt- welded to the section previously jacked into place. Continuous checks shall be made as to the elevation, grade and alignment of each successive section of encasement as well as the tracks (rails) upon which the boring rig travels.
 - 1. Steel encasement pipe shall have minimum thickness as provided below as specified by the controlling agencies. The actual thickness required must be calculated based on site conditions and actual depth of cover.

PIPE DIMENSIONS, INCHES PIPE TYPE - STEEL STANDARD - ASTM A 53 AND A 139				
Carrier Pipe Size (inches)	Casing Pipe Minimum Thickness (inches)			Minimum Tunnel Size (inches)
	Casing Pipe Size (inches)	NCDOT	Rail Roads	
4	12	0.250	0.250	36
6	12	0.250	0.250	36
8	18	0.250	0.312	48
10	20	0.250	0.344	48
12	24	0.250	0.375	48
16	30	0.312	0.469	48
18	30	0.312	0.469	48
24	36	0.375	0.532	54
30	48	0.500	0.750	60
36	54	0.500	0.781	72
42	60	0.500	0.844	84
48	66	0.625	0.938	90
54	72	0.625	1.000	96

- F. If voids are encountered or occur outside the encasement pipe, grout holes shall be installed in the top section of the encasement pipe at ten (10) foot centers and the voids filled with Portland Cement grout at sufficient pressure to prevent settlement in the roadway/railway. The water-cementitious materials ratio of the mix shall not exceed three and one-half to one (3.5:1).
- G. Boring operations shall be continuous, around the clock, to their completion, and unnecessary or prolonged stoppages shall not be allowed.
- H. In the event an obstruction is encountered during the boring and jacking operations, the auger is to be withdrawn and the excess pipe is to be cut off, capped, and filled with 1:3 Portland Cement Grout at sufficient pressure to fill all voids before reapplying to the Controlling Agency for permission to open cut, bore at an alternate location, or install a tunnel.
- I. Installation shall be to the limits specified by the Controlling Agency and/or as delineated in their encroachment issued to the City. (Copy of the encroachment agreement must be kept at the site throughout boring operations).
- J. The completed casing installation shall be such as to prevent the formation of a waterway under the road or railbed. Ends of the casing shall be sealed with eight-inch (8") solid brick masonry walls. Weep holes will be provided on the downstream end for drainage. Ends of casing may also be sealed with synthetic rubber end seals.

- K. The Controlling Agency shall have full authority to require remedial measures and/or to stop all work if, in its opinion, said work will cause any damage to the roadway/railway section or endanger traffic. In all instances the Controlling Agencies reserve the right to sample, test, and approve all materials and methods used.
- L. The Contractor shall notify the Controlling Agency through the Engineer and acknowledgement shall be received a minimum of five (5) working days prior to beginning any work within roadway or railway rights-of-way. If required, 24-hours notice will be given prior to completion to allow the controlling agency to inspect the installation prior to backfill operations.
- M. Casing Spacers/Isolators: Upon completion of the installation of the steel casing pipe, casing spacers/isolators shall be installed on any carrier pipe passing through the steel casing pipe. They shall be designed to support and protect the carrier pipe, and electrically isolate the carrier pipe from the casing. Casing spacers shall be installed at each end of the pipe, within 2 feet of the joint, and at intervals not greater than seven (7) feet, as determined by the spacer manufacturer, based on pipe diameter and loads.

3.2 STEEL CASING INSTALLATION BY TUNNEL AND JACK METHOD

- A. The Contractor will provide all materials equipment and labor necessary to guarantee the complete installation of a steel casing as shown on the construction plans. The Contractor will provide an installation method acceptable to the Controlling Agency based on the conditions encountered. The Contractor shall be responsible for determining the site conditions based on his own investigations prior to construction. See Dry Bore With Steel Encasement – Bore Pits, above, for pit requirements.
- B. The casing shall be installed by jacking, with simultaneous removal of spoil. The spoil removal shall not proceed more than 18-inches ahead of the casing. The diameter of the excavated hole shall be no larger than necessary to keep the casing moving freely and lubricant may be used to reduce the jacking forces. Casing sections shall be joined by full and complete butt welds. The butt weld shall be watertight and shall develop 100 percent of the strength of the steel pipe wall. Permalok steel casing pipe may be used as an alternative steel casing pipe joining system.
- C. The completed casing installation shall be such as to prevent the formation of a waterway under the road or railbed. Ends of the casing shall be sealed with eight-inch (8-inch) solid brick masonry walls. Weep holes will be provided on the downstream end for drainage. Ends of casing may also be sealed with synthetic rubber end seals - See Standard Details.
- D. The Controlling Agency shall have full authority to inspect entire operation, require disposition of remedial measures, and to stop all work if, in its opinion, the work will cause any damage to the roadway/railway section or endanger traffic.
- E. The Contractor shall notify the Controlling Agency through the Engineer and acknowledgement shall be received a minimum of five (5) working days prior to beginning any work within roadway or railway rights-of-way. If required, 24-hours notice will be given prior to completion to allow the controlling agency to inspect the installation prior to backfill operations.
- F. After the casing is jacked in place, 2-inch grout holes shall be used to pump a 1:3 Portland cement grout to fill the void outside the casing. Sufficient pressure should be applied to force grout out of the adjacent grout hole. Grout holes shall be a maximum of ten feet apart at the top of the casing.

The casing size and thickness shall be as shown on the Plans or Special Provisions.

- G. Casing Spacers/Isolators: Upon completion of the installation of the steel casing pipe, casing spacers/isolators shall be installed on any carrier pipe passing through the steel casing pipe. They shall be designed to support and protect the carrier pipe, and electrically isolate the carrier pipe from the casing. Casing spacers shall be installed at each end of the pipe, within 2 feet of the joint, and at intervals not greater than 7 feet, as determined by the spacer manufacturer, based on pipe diameter and loads.
- H. Casing End Seals: The ends of the casing pipe shall be sealed with synthetic rubber casing end seals or solid brick masonry walls, as specified, as shown on the Standard Details, and as approved by the Controlling Agency.

3.3 STEEL ENCASEMENT

- A. Casing installation within NCDOT Rights-of-Way shall conform to provisions of approved utility encroachment agreements for the project. Unless specifically indicated otherwise by the encroachment agreement, the annular void between carrier pipes and casing pipes 24 inches in diameter or larger shall be pumped with flowable fill; grout; or Class III, Class IV or Class V select materials in accordance with NCDOT Standard Specifications for Roads and Structures Section 1540 Encasement 1540-3 (E).
- B. Interpretation of soil investigation reports and data, investigating the site and determination of the site soil conditions prior to bidding is the sole responsibility of the Contractor. Any subsurface investigation by the Bidder or Contractor must be approved by the appropriate authority having jurisdiction over the site. Rock and/or water, if encountered, shall not entitle the Contractor to additional compensation.
- C. Casing construction shall be performed so as not to interfere with, interrupt or endanger roadway surface and activity thereon, and minimize subsidence of the surface, structures, and utilities above and in the vicinity of the casing. Support the ground continuously in a manner that will prevent loss of ground and keep the perimeters and face of the casing, passages and shafts stable. The Contractor shall be responsible for all settlement resulting from casing operations and shall repair and restore damaged property to its original or better condition at no cost to the Town of Smithfield.
- D. Face Protection: The face of the excavation shall be protected from the collapse of the soil into the casing.
- E. Casing Design: Design of the bore pit and required bearing to resist jacking forces is the responsibility of the Contractor. The excavation method selected shall be compatible with expected ground conditions. The lengths of the casing shown on the Drawings are the minimum lengths required. The length of the casing may be extended for the convenience of the Contractor, at no additional cost to the Town of Smithfield.
- F. Groundwater Control
 - 1. See requirements for Dewatering in the Excavation and Backfill specification.
 - 2. The Contractor shall control the groundwater throughout the construction of the casing.
 - 3. Methods of dewatering shall be at the option and responsibility of the Contractor. Maintain close observation to detect settlement or displacement of surface facilities due to dewatering. Should settlement or displacement be detected, notify the Engineer immediately and take such action as necessary to maintain safe conditions and prevent damage.

4. When water is encountered, provide and maintain a dewatering system of sufficient capacity to remove water on a 24-hour basis keeping excavations free of water until the backfill operation is in progress. Dewatering shall be performed in such a manner that removal of soil particles is held to a minimum.

G. Safety

1. Provide all necessary bracing, bulkheads and shields to ensure complete safety to all traffic, persons and property at all times during the work. Perform the work in such a manner as to not permanently damage the roadbed or interfere with normal traffic over it.
2. Observe all applicable requirements of the regulations of the authorities having jurisdiction over this site. Conduct the operations in such a manner that all work will be performed below the level of the roadbed.
3. Perform all activities in accordance with the Occupational Safety and Health Act of 1970 (PL-596), as amended, applicable regulations of the Federal Government, OSHA 29CFR 1926.650, 29CFR 1926.651, 29CFR 1926.652, and 29CFR 1926.800, and applicable criteria of ANSI A10.16 (latest edition), "Safety Requirements for Tunnels, Shafts, and Caissons".

H. Boring and Jacking

1. Bore Pits and Receiving Pits
 - a. Conduct boring and jacking operations from a pit excavated at one end of the section to be bored. Where conditions and accessibility are suitable, place the pit on the downstream end of the bore.
 - b. The pit shall be rectangular and excavated to a width and length required for ample working space.
 - c. The walls of the pit shall be properly shored on all sides in compliance with OSHA requirements. Pit sheeting shall be timber or steel piling of ample strength to safely withstand all structural loadings of whatever nature due to site and soil conditions. Keep preparations dry during all operations. Perform pumping operations as necessary.
 - d. The bottom of the pit shall be firm and unyielding to form an adequate foundation upon which to work. In the event the pit bottom is not stable, excavate to such additional depth as required and place a gravel sub-base or a concrete sub-base if directed by the Engineer due to soil conditions.
2. Jacking Rails and Frame
 - a. Set jacking rails to proper line and grade within the pit. Secure rails in place to prevent settlement or movement during operations. The jacking rails shall cradle and hold the casing pipe on true line and grade during the progress of installing the casing.
 - b. Place backing between the heels of jacking rails and the rear of the pit. The backing shall be adequate to withstand all jacking forces and loads.
 - c. The jacking frame shall be of adequate design for the magnitude of the job. Apply thrust to the end of the pipe in such a manner to impart a uniformly balanced load to the pipe barrel without damaging the joint ends of the pipe.
3. Boring and jacking of casing pipes shall be accomplished by the dry auger boring method without jetting, sluicing or wet-boring.

4. Auger the hole and jack the casing through the soil simultaneously.
5. Bored installations shall have a bored-hole diameter essentially the same as the outside diameter of the casing pipe to be installed.
6. Execute boring ahead of the casing pipe with extreme care, commensurate with the rate of casing pipe penetration. Boring may proceed slightly in advance of the penetrating pipe and shall be made in such a manner to prevent any voids in the earth around the outside perimeter of the pipe. Make all investigations and determine if the soil conditions are such as to require the use of a shield.
7. As the casing is installed, check the horizontal and vertical alignment frequently. Make corrections prior to continuing operation. For casing pipe installations over 100 feet in length, the auger shall be removed, and the alignment and grade checked at minimum intervals not greater than 60 feet.
8. Any casing pipe damaged in jacking operations shall be repaired, if approved by the Engineer, or removed and replaced at Contractor's own expense.
9. Lengths of casing pipe, as long as practical, shall be used except as restricted otherwise. Joints between casing pipe sections shall be Permalok® joints or full circumference butt joints with complete joint penetration, single groove welds, for the entire joint circumference, in accordance with the American Welding Society (AWS) recommended procedures. Prior to welding the joints, the Contractor shall ensure that both ends of the casing sections being welded are square.
10. The Contractor shall prepare a contingency plan allowing the use of a casing lubricant, such as bentonite, in the event excessive frictional forces jeopardize the successful completion of the casing installation.
11. Once the jacking procedure has begun, it should be continued without stopping until completed, subject to weather and conditions beyond the control of the Contractor.
12. Care shall be taken to ensure that casing pipe installed by boring and jacking method will be at the proper alignment and grade.
13. The Contractor shall maintain and operate pumps and other necessary drainage system equipment to keep work dewatered at all times.
14. Adequate sheeting, shoring and bracing for embankments, operating pits and other appurtenances shall be placed and maintained to ensure that work proceeds safely and expeditiously. Upon completion of the required work, the sheeting, shoring and bracing shall be left in place, cut off or removed, as designated by the Engineer.
15. All surplus material shall be removed from the right-of-way and the excavation finished flush with the surrounding ground.
16. Grout backfill shall be used for unused holes or abandoned pipes.
- I. Ventilation and Air Quality: Provide, operate and maintain for the duration of casing project a ventilation system to meet safety and OSHA requirements.
- J. Installation of Pipe
 1. After construction of the casing is complete, and has been accepted by the Engineer, install the pipeline in accordance with the Drawings and Specifications.
 2. Check the alignment and grade of the casing and prepare a plan to set the pipe at proper alignment, grade and elevation, without any sags or high spots.

3. The pipe shall be supported within the casing by use of casing spacers sized to limit radial movement to a maximum of 1-inch. Provide a minimum of three (3) casing spacers per nominal length of pipe. Casing spacers shall be attached to the pipe at maximum seven (7) foot intervals. Casing spacers shall also be provided within two feet of each end of the carrier pipe within the casing.

K. End Seals

1. Masonry/Brick End Seals

- a. Close the ends of the casing pipe with masonry brick and mortar seal, minimum 8-inches thick, at both ends of casing.
- b. Leave a weephole opening at the bottom of the lowest bulkhead end for drainage of the annular space.

2. Lightweight Cellular Concrete Fill (For casings only)

- a. Prior to installation, the ground surface shall be cleared of organic top soils, debris, sharp objects, and trees. Tree stumps shall be either removed or cut to the level of the ground surface. All wheel tracks or ruts in excess of 3 in. (75 mm) in depth shall be graded smooth or otherwise filled with soil to provide a reasonable smooth surface.
- b. The lightweight cellular concrete fill shall be placed according to the approved installation procedures provided by the manufacturer.
- c. There shall be no standing water in the area to be filled. If necessary, dewatering shall be continuous during the time the lightweight cellular concrete fill is constructed. Lightweight cellular concrete fill shall not be placed during or when periods of precipitation are expected unless placed in an enclosed, covered area and the ground water is diverted away from the lightweight cellular concrete fill.
- d. If any items are to be encased in the fill, the items shall be set to the final location both horizontally and vertically prior to installation of the lightweight cellular concrete fill.
- e. Mixing and placement of the lightweight cellular concrete fill shall be done as follows:
 - 1) After mixing, the materials shall be promptly placed in the final location.
 - 2) No mechanical vibration of the lightweight cellular concrete fill shall be permitted.
 - 3) The material shall be placed to prevent segregation. Intermediate lifts shall be placed horizontal while only the top lift shall be sloped to grade. The final surface elevation of the lightweight cellular concrete fill shall be within ± 1.5 inches of the plan elevation.
 - 4) Limit the area of placement to the volume that can be placed within 1 hour, up to the maximum lift height. Stagger placements such that the vertical joints are at least 10 ft (3 m) apart.
 - 5) The cellular concrete shall be placed with a hose. The discharge hose length shall not exceed 800 ft (244 m) in length. Discharge from the hose shall not be allowed to flow more than 30 ft (9 m) from where it is deposited to its final position.

- 6) Heavy construction equipment or other unusual loading of the lightweight cellular concrete fill shall not be permitted.
 - 7) Construction activities on any recently placed lift will not be permitted until at least 12 hours has elapsed and a minimum compressive strength of 8 psi has been achieved. However, if any work on the recently placed lightweight cellular concrete fill resulting in cracking or indentations of more than an 0.125 inch, the contractor shall discontinue construction, revise their wait time, mix strength or equipment used and submit to the Engineer for approval.
 - 8) Sawing or ripping of the lightweight cellular concrete fill for utilities, drains or other conflicts will be by methods approved by the Engineer of Record and lightweight cellular concrete fill Manufacturer.
- f. Where required, formwork should be designed and installed to withhold cellular concrete and may require lining with poly sheeting or similar impermeable membrane to prevent leakage.
 - g. Cellular concrete may be placed during freezing conditions, provided measures are taken to prevent damage to the cellular concrete until sufficient strength has been attained. Care should be taken to avoid freezing before initial set. Cellular concrete must not be placed during heavy or prolonged precipitation.
 - h. Concrete can be placed with a maximum slope of 1%. Slopes greater than 1% will require profiling by creating steps for the Cellular Concrete with formwork or can be mechanically graded to slopes in excess of 1% by means of grader, bulldozer or milling machine.
- L. Sheeting Removal: Remove sheeting used for shoring from the shaft and off the job site. The removal of sheeting, shoring and bracing shall be done in such a manner as not to endanger or damage either new or existing structures, private or public properties and also to avoid cave-ins or sliding in the banks.
 - M. Coatings: Unless otherwise shown on the construction plans, casing pipe installed under State and/or City maintained roadways shall not require a protective coating.

3.4 CONCRETE PLACEMENT

- A. Ready mix concrete will not be accepted without the inspector receiving the plant dispatch ticket.
- B. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by the Engineer.
- D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- E. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 - 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.

2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- F. Forms: Forms may be made of wood, plywood, metal, or any other material approved by the Engineer. Forms shall be mortar tight, of material strong enough to resist noticeable deflection or bulging between supports, and the interior dimensions of the forms shall be such that the finished concrete shall be of the form and dimensions shown on the Plans. The design of the forms shall take into account the effect of vibration of concrete as it is placed and also the rate of speed at which the forms will be filled. Forms shall be coated with a lubricant as approved by the Engineer. Mechanical vibrators, of an approved type, and continuous spading and/or rodding of concrete shall be used to produce proper contact of concrete with forms and reinforcing steel in piers and with forms and pipe in monolithic inverts insuring a compact, dense and impervious artificial stone of uniform texture.
- G. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When average high and low temperature is expected to fall below 40 deg F for three successive days. Maximum temperature in concrete after placement shall not exceed 160°F (70°C). Maximum temperature difference between center and surface of placement shall not exceed 35°F (19°C).
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
 4. Do not place concrete until the foundation, the adequacy of the forms, the placing of reinforcement and other embedded items have been inspected and approved.
 5. Place concrete in daylight unless an approved lighting system is provided.
 6. Remove all debris from the interior of forms in preparation for placing concrete. Moisten earth or base course surfaces on which concrete is to be placed immediately before placing concrete. Do not place concrete on excessively wet or frozen surfaces.
 7. Place concrete in its final position in the forms within the time stipulated in Subarticle 1000-3(E) of NCDOT'S 2024 Standard Specifications for Roads and Structures.

ELAPSED TIME FOR PLACING CONCRETE		
Air or Concrete Temperature, whichever is higher.	Maximum Elapsed Time	
	No Retarding Admixture Used	Retarding Admixture Used
90°F or above	30 minutes	1 hr. 15 minutes
80°F through 89°F	45 minutes	1 hr. 30 minutes
79°F or below ^A	60 minutes	1 hr. 45 minutes
70°F through 79°F ^B	60 minutes	1 hr. 45 minutes
69°F or below ^B	1 hr. 30 min	2 hr. 15 minutes

8. Place concrete to avoid segregation of the materials and the displacement of the reinforcement. Thoroughly work the concrete during placement. Bring mortar against the forms to produce a smooth finish, substantially free from water and air pockets or honeycombs.
9. Do not place concrete when the air temperature, measured at the location of the concrete operation in the shade away from artificial heat, is below 35°F unless permission is otherwise granted by the Engineer. When such permission is granted, uniformly heat the aggregates and water to a temperature no higher than 150°F. Place the heated concrete at a temperature of at least 55°F and no more than 80°F.
10. All concrete shall be protected from freezing by the Contractor during the initial 7 days of curing. The Contractor shall submit an anti-freezing plan for review. Frozen concrete shall be removed and replaced at the Contractor's expense.

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

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

I. Finishing: Provide the type of finish required by the contract directly applicable to the work being constructed

1. Ordinary Surface Finish: Remove all form ties or metal spacers to a depth of at least 1 inch below the surface of the concrete and clean and fill the resulting holes or depressions with grout. Metal devices with exposed cross-sectional area not exceeding approximately 0.05 sq. inches on surfaces permanently in contact with earth fill may be broken off flush with the surface of the concrete.

Remove all fins caused by form joints and other projections. Remove stains and discoloration. Clean all pockets and fill with grout as directed. Thoroughly soak the surface of all concrete with water before the application of a grout repair.

Use grout consisting of one part cement and two parts sand. Use cement from the same source as originally incorporated in work. Cure the grout for at least 3 days. After the grout has thoroughly hardened, rub the patch with a carborundum stone as required to match the texture and color of the adjacent concrete.

On surfaces that are to be backfilled or surfaces that are enclosed, the removal of form marks, fins and pockets; the rubbing of grouted areas to uniform color; and the removal of stains and discoloration will not be required.

2. Sidewalk Finish: Strike off fresh concrete and compact until a layer of mortar is brought to the surface. Finish the surface to grade and cross section with a float, trowel smooth and finish with a broom.
 3. Rubbed Finish: After the ordinary surface finish has been completed, thoroughly wet and rub the entire surface. Use a coarse carborundum stone or other equally good abrasive to bring the surface to a smooth texture and remove all form marks. Carefully stroke the surface with a clean brush to finish the paste formed by rubbing. Alternatively, spread the paste uniformly over the surface and allow it to take a reset. Finish by floating with a canvas, carpet-faced or cork float or rub down with dry burlap.
 4. Float Finish: Finish the surface with a rough carpet float or other suitable device leaving the surface even but distinctly sandy or pebbled in texture.
- J. Curing: Cure concrete according to ACI 308.1, by one or a combination of the following methods:
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. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
 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.
 - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.
 4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a 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. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

K. Flowable Fill

1. Use straps, soil anchors or other approved means of restraint to ensure correct alignment when flowable fill is used as backfill for pipe or where flotation or misalignment may occur.
2. Protect flowable fill from freezing for a period of 36 hours after placement.
3. Place flowable fill to the designated fill line without vibration or other means of compaction.
4. Flowable fill may be placed during freezing conditions, provided measures are taken to prevent damage to the cellular concrete until sufficient strength has been attained. Care should be taken to avoid freezing before initial set. Cellular concrete must not be placed during heavy or prolonged precipitation.
5. Take all necessary precautions to prevent any damages caused by the hydraulic pressure of the fill during placement prior to hardening. Provide the means to confine the material within the designated space.

L. Testing: The following tests will be performed by a Testing Laboratory selected by the Town of Smithfield to ensure the concrete quality. The costs for performing the tests will be paid for by the Town of Smithfield when the test results are in conformity with the specifications below. For Developer Donated projects, testing shall be performed by a third party and paid for by the developer. However, those which show no conformity, or a failure will be paid for by the Contractor. It shall be the responsibility of the Contractor to properly inform the Testing Laboratory as to when the concrete will be placed into the forms. For developer projects, the testing laboratory shall be approved by the Engineer, and shall be a sub consultant to the developer's consulting engineer. All cost of testing shall be paid by the developer.

1. Compressive strength in accordance with ASTM C-31 and ASTM C-39. Test cylinders which are formed in the field will be left in the field until compression testing (7-day, 14-day, 28-day) is completed thereby more closely approximate the curing conditions of the field placed concrete.
2. Slump Test in accordance with ASTM C-143.
3. Air Content Test in accordance with either ASTM C-173 or ASTM C-231.
4. A strength test shall be the average of the strengths of at least two 6 x 12 in. cylinders or at least three 4 x 8 in. cylinders made from the same sample of concrete and tested at 28 days or at test age designated for f'c.
5. Cellular concrete unit weight testing shall be in accordance with ASTM C496, ASTM C796 and ASTM C869.
6. The testing agency performing acceptance testing shall comply with ASTM C1077.
7. Samples for preparing strength test specimens of each concrete mixture placed each day shall be taken in accordance with (a) through (c):
 - a. At least once a day.
 - b. At least once for each 150 CY of concrete.
 - c. At least once for each 5,000 SF of surface area for slabs or walls.

8. Engineer shall be consulted if exemption from testing is requested.

END OF SECTION

**SECTION 330562
PRECAST CONCRETE VAULTS**

PART 1 GENERAL

1.01 SUMMARY

- A. The Contractor shall provide precast concrete vaults, complete and in place, in accordance with the Contract Documents.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Reference Specifications

013300	Submittals
033000	Cast-in-Place Concrete

B. Reference Standards

American Society for Testing and Materials (ASTM) Standards	
ASTM A48	Gray Iron Castings
ASTM C150	Portland Cement
ASTM C443	Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C478/C478M	Standard Specifications for Circular Precast Reinforced Concrete Manhole Sections
ASTM C913	Standard Specification for Precast Concrete Water and Wastewater Structures
ASTM C923	Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals

1.03 CONTRACTOR SUBMITTALS

- A. General: Furnish submittals in accordance with Section 01 33 00– Submittal Procedures.

B. Shop Drawings

1. Show dimensions, locations, lifting inserts, reinforcement, and joints.
2. Structural design calculations for vaults, signed by a registered engineer.

- C. Manufacturer's Certification for Vaults: Written certification that the vault complies with the requirements of this Section.

1.04 QUALITY ASSURANCE

- A. Inspection: After installation, the Contractor shall demonstrate that vaults have been properly installed, level, with tight joints, at the correct elevations and orientations, and that the backfilling has been carried out in accordance with the Contract Documents.

PART 2 PRODUCTS

2.01 VAULTS

- A. The Contractor shall provide precast vaults designed for the indicated applications and of the sizes indicated.
- B. The minimum structural member thickness for vaults shall be 5-inches. Cement shall be Type V portland cement as specified in ASTM C150. The minimum 28-day concrete compressive strength shall be 4,000 psi (27.5 MPa). All reinforcing steel shall be embedded in the concrete with a minimum clear cover as recommended by ACI 318.
- C. Design Loading: Vaults in areas subject to vehicular traffic shall be designed for H-20 traffic loading. Vaults in other areas shall be designed for a vertical live load of 300 psf Lateral loads on vaults in all areas shall be calculated from:

$$L = 90 \times h \text{ (27.44} \times h\text{)}, \text{ plus surcharge of 240 psf in areas of vehicular traffic}$$

Where: L = loading in psf (kPa)

h = depth of fill in feet (meter)

- D. Where joints are designed in pre-cast concrete vaults, such joints shall be interlocking to secure proper alignment between members and prevent migration of soil through the joint. Structural sections at joints shall be sized sufficiently to reinforce the section against localized distress during transportation and handling and against excess contact bearing pressures through the joint.
- E. Where openings for access to the vault are required, the full clear space opening indicated shall be provided, without obstructions from brackets or supports. For large openings where brackets or supports are designed to protrude into the opening for support of required covers, such brackets or supports shall be designed to be easily removed and replaced with a minimum of effort and without cutting or welding.
- F. Covers for access openings shall be provided. Frames for covers shall be fabricated from steel, galvanized after fabrication, and shall be integrally cast into the vault concrete sections. All covers shall be tight fitting to prevent the entrance of dirt and debris. Where edge seams are permitted, no gaps greater than 1/16-inch (1.6 mm) between edges will be accepted. All covers, except round, heavy weight, cast iron manhole covers, shall have securing mechanisms to hold the covers firmly in place against the effects of repetitious live loads such as pedestrian or vehicle traffic.
- G. Where penetration of the pre-cast concrete vault is required for piping, conduit, or ducts, such penetrations shall be accommodated through pre-cast openings or thin-wall knock-out sections. All openings for penetrations shall be smooth and free of surface irregularities and without exposed steel reinforcing. Vaults need not be designed to resist thrust from piping passing through the vault.
- H. Warning Signs
 - 1. The entrance to every manhole and vault shall be fitted with a permanently affixed, plastic warning sign, located above and centered on the top step. Each sign shall be in accordance with Section 10 14 00 - Signage
 - 2. Sign Manufacturer,

- 1) W. H. Brady Company
- 2) Seton Nameplate Corporation
- 3) or Approved Equal

PART 3 EXECUTION

3.01 GENERAL

- A. Pre-cast concrete sections shall be transported and handled with care in accordance with the manufacturer's written recommendations. Where lifting devices are provided in pre-cast sections, such lifting devices shall be used as intended. Where no lifting devices are provided, the Contractor shall follow the manufacturer's recommendations for lifting procedures to provide proper support during lifting.
- B. Buried pre-cast concrete vaults shall be assembled and placed in excavations on properly compacted soil foundations or bedding as indicated. Pre-cast concrete vaults shall be set to grade and oriented to provide the required dimensions and clearances from pipes and other structures.
- C. Prior to backfilling, all cracks and voids in pre-cast concrete vaults shall be filled with non-shrink grout or polyurethane sealant, or both. Around pipe and conduit penetrations, openings shall be sealed with polyurethane sealant or link seal. With the authorization of the Engineer, grout or a closed-cell flexible insulation may be used as filler material prior to placing a final bed of polyurethane sealant.

END OF SECTION

**SECTION 333000
SANITARY SEWERAGE UTILITIES**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Ductile-iron, gravity sewer pipe and fittings.
 - 2. Ductile-iron, pressure pipe and fittings.
 - 3. PVC pipe and fittings.
 - 4. Nonpressure-type transition couplings.
 - 5. Pressure-type pipe couplings.
 - 6. Expansion joints and deflection fittings.
 - 7. Manholes.
 - 8. Steel Encasement.
 - 9. Concrete.

1.03 DEFINITIONS

- A. ANSI: American National Standards Institute
- B. ASTM: American Society for Testing and Materials
- C. AWWA: American Water Works Association
- D. NSF: National Sanitation Foundation

1.04 ACTION SUBMITTALS

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

- B. Shop Drawings: For manholes. Include plans, elevations, sections, details, and frames and covers.

1.05 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of pipe and fitting.
- B. Field quality-control reports.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Handle manholes according to manufacturer's written rigging instructions.
- D. The Contractor shall be responsible for the safe storage of materials furnished by or to him, and accepted by him and intended for the work, until they have been incorporated in the completed project. The interior of all pipe, fittings and other accessories shall be kept free from dirt and foreign materials at all times.
- E. Transportation of Materials and Equipment: The Contractor and his Suppliers are directed to contact the North Carolina Department of Transportation to verify axle load limits on State maintained roads (and bridges) which are to be used for hauling equipment and materials for this project. The Contractor and his Suppliers shall do all that is necessary to satisfy the Department of Transportation requirements and will be responsible for any damage to roads which may be attributed to this project. All materials required to construct this project shall be furnished by the contractor and shall be delivered and distributed at the site by the Contractor or his material supplier.
- F. Loading/Unloading Materials: Ductile iron pipe and cast iron accessories shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Concrete pipe, clay pipe, PVC pipe and precast manholes will be unloaded with hoists and/or as recommended by the respective manufacturers. Under no circumstances shall such materials be dropped. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground.
- G. Responsibility for Materials on Site: In distributing the material at the site of the work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench. Each piece shall be redundantly chocked at each end to prevent movement or rolling. Pedestrian or vehicular traffic shall not be unduly inconvenienced in placing of material along the streets or right-of-way, as applicable. The Contractor will string in advance no more than the amount of pipe and material that can be installed within two (2) weeks unless approved by the Engineer. All the materials shall be placed in such a manner as not to hinder access, endanger or impede traffic, create a public nuisance or endanger the public. Materials strung through residential areas (or any area with maintained lawns) shall be placed in such a manner as not to restrict normal lawn maintenance, and must either be installed within two (2) weeks or removed to an approved storage yard, as required by the Engineer.
- H. Material and Equipment Storage: The Contractor will be responsible for locating and providing storage areas for construction materials and equipment. Unless prior written consent from the

owner of the proposed storage area is received by this Department, the Contractor will be required to store all equipment and materials within the limits of the project site or the limits of the right-of-way and temporary construction easement provided. The materials and equipment storage shall comply with all local and state ordinances throughout the construction period. Material and equipment may only be stored within road right-of-way if approved by the controlling agency. Bulk storage of stacked materials shall not be permitted in or along road rights-of-way. Storage sites shall be fenced with adequate protection to reasonably prevent the public from entering the site. The Contractor shall be responsible for the safeguarding of materials and equipment against fire, theft, and vandalism and in a manner which does not place the public at risk, and shall not hold the City responsible in any way for the occurrence of same.

- I. Care of Coatings and Linings: Pre-cast manholes, pipe and fittings, including rings and covers, steps, straps, etc., shall be so handled that the coating or lining will not be damaged. If, however, any part of the coating or lining is damaged, the repair shall be made by the Contractor at his expense in a manner satisfactory to the Engineer.

1.07 FIELD CONDITIONS

- A. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 1. Notify Engineer and Owner no fewer than three days in advance of proposed interruption of service.

PART 2 PRODUCTS

2.01 DUCTILE-IRON, GRAVITY SEWER PIPE AND FITTINGS

- A. Pipe: ASTM A 746, for push-on joints.
- B. Standard Fittings: AWWA C110/A21.10, ductile or gray iron, for push-on joints.
- C. Compact Fittings: AWWA C153/A21.53, ductile iron, for push-on joints.
- D. Gaskets: AWWA C111/A21.11, rubber.

2.02 DUCTILE-IRON, PRESSURE PIPE AND FITTINGS

- A. Push-on-Joint Piping:
 1. Pipe: AWWA C151/A21.51, pressure class 350 (12-inch diameter and smaller), pressure class 250 (16-inch diameter and larger).
 2. Standard Fittings: AWWA C110/A21.10, ductile or gray iron, with cement mortar lining in accordance with AWWA C104.
 3. Compact Fittings: AWWA C153/A21.53, with cement mortar lining in accordance with AWWA C104.
 4. Gaskets: AWWA C111/A21.11, rubber, of shape matching pipe and fittings.

B. Mechanical-Joint Piping:

1. Pipe: AWWA C151/A21.51, with bolt holes in bell, pressure class 350 (12-inch diameter and smaller), pressure class 250 (16-inch diameter and larger).
2. Standard Fittings: AWWA C110/A21.10, ductile or gray iron, with bolt holes in bell, with cement mortar lining in accordance with AWWA C104.
3. Compact Fittings: AWWA C153/A21.53, with bolt holes in bells, with cement mortar lining in accordance with AWWA C104.
4. Glands: Cast or ductile iron; with bolt holes and high-strength, cast-iron or high-strength, low-alloy steel bolts and nuts.
5. Gaskets: AWWA C111/A21.11, rubber, of shape matching pipe, fittings, and glands.

2.03 PVC PIPE AND FITTINGS

A. PVC Corrugated Sewer Piping:

1. Pipe: ASTM F 949, PVC corrugated pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM F 949, PVC molded or fabricated, socket type.
3. Gaskets: ASTM F 477, elastomeric seals.

B. PVC Profile Sewer Piping:

1. Pipe: ASTM F 794, PVC profile, PS 46 minimum stiffness, gravity sewer pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM D 3034, PVC with bell ends.
3. Gaskets: ASTM F 477, elastomeric seals.

C. PVC Type PSM Sewer Piping:

1. Pipe: ASTM D 3034, SDR 26, PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM D 3034, PVC with bell ends.
3. Gaskets: ASTM F 477, elastomeric seals.

D. PVC Gravity Sewer Piping:

1. Pipe and Fittings: ASTM F 679, PS 46 minimum stiffness, PVC gravity sewer pipe with bell-and-spigot ends and with integral ASTM F 477, elastomeric seals for gasketed joints.

E. PVC Pressure Piping:

1. Pipe: AWWA C900, Class 200, SDR 14 or less, PVC pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: AWWA C900, Class 200 PVC pipe with bell ends.
3. Gaskets: ASTM F 477, elastomeric seals.

2.04 EXPANSION JOINTS AND DEFLECTION FITTINGS

A. Ductile-Iron, Flexible Expansion Joints:

1. Flexible expansion joints shall be installed in the locations indicated on the drawings and shall be manufactured of ductile iron conforming to the material requirements of ASTM A536 and ANSI/AWWA C153/A21.53. Foundry certification of material shall be readily available upon request.
2. Each flexible expansion joint shall be pressure tested prior to shipment against its own restraint to a minimum of 350 psi (250 psi for flexible expansion joints 2 inch and 30 inches diameter and larger.) A minimum 2:1 safety factor, determined from the published pressure rating, shall apply. Factory Mutual Approval for the 3 inch through 12 inch sizes is required.
3. Each flexible expansion joint shall consist of an expansion joint designed and cast as an integral part of a ball and socket type flexible joint, having a minimum per ball deflection of: 20°, 2"-12"; 15°, 14"-36"; 12°, 42"-48" and 4-inches minimum expansion. Additional expansion sleeves shall be available and easily added or removed at the factory or in the field. Both standardized mechanical joint and flange end connections shall be available.
4. All internal surfaces (wetted parts) shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213. Sealing gaskets shall be constructed of EPDM. The coating shall meet ANSI/NSF-61.
5. Exterior surfaces shall be coated with a minimum of 6 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C116/A21.16.
6. Appropriately sized polyethylene sleeves, meeting ANSI/AWWA C105/A21.5, shall be included for direct buried applications.

B. Ductile-Iron Deflection Fittings:

1. Flexible ball joints shall be installed in the locations indicated on the drawings and shall be manufactured of ductile iron conforming to the material properties of ANSI/AWWA C153/A21.53.
2. Flexible joints shall consist of a ball and socket type joint capable of 15° minimum deflection. Each flexible ball joint shall be pressure tested against its own restraint to 350 PSI for sizes 3 inch through 24 inch and 250 PSI for sizes 30 inch or greater.
3. MEGALUG® joint restraint shall be provided with each mechanical joint connection. All internal surfaces (wetted parts) shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213.

4. Sealing gaskets shall be constructed of EPDM. The coating shall meet ANSI/NSF-61.
5. Exterior surfaces shall be coated with a minimum of 6 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C116/A21.16.

2.05 MANHOLES

A. Standard Precast Concrete Manholes:

1. All sewer manholes shall be constructed of precast concrete sections only in conformance with the following specifications and Town of Smithfield Standard Detail Drawings. Special cast in place manhole structures shall be as shown on the plans and shall comply with the various other applicable sections in these specifications.
2. Manholes shall be furnished with pre-cast bottom slabs and flexible watertight boots for 15-inch and smaller pipe. The boots shall be cast in as integral parts of the base or installed in cored openings with stainless steel compression bands, and shall conform to ASTM C-923. Manholes for 18-inch and larger pipe may be furnished with precast bottom slabs and flexible boots, flexible seals, or concrete collars. The flexible seals shall be A-Lok or Contour Seal. Flexible connectors shall conform to ASTM C-923. The concrete collars shall be according to the applicable Standard Detail.
3. Sections: All precast reinforced concrete manholes shall conform to specifications and plans and to ASTM C-478. The following minimum standards shall also apply:
 - a. Wall thickness shall be 1/12th of the inside diameter with a minimum thickness of five (5") inches.
 - b. Base sections shall be cast monolithically or have a waterstop cast in the cold joint between the walls and the base slab.
 - c. Cone sections shall normally be eccentric with the inside face of one side vertical and flush with the inside face of the barrel section. Eccentric cones with bolt down frame and cover shall have a minimum vertical height, as measured from the top of the cone to the bottom of the bell, of 32 inches. Eccentric cones without bolt down frame and cover to be installed flush to finish grade may have a minimum vertical height of 24-inches. Concentric cones with a vertical height of 20-inches may be used on manholes less than five (5') feet deep (4' diameter manhole only). Transition cone sections may be provided for an eccentric transition from a 60-inch riser to a 48-inch cone section to be placed directly beneath the 48-inch cone.
 - d. Transition slabs may be placed a minimum of five (5) feet above the invert shelf for six (6) feet and larger diameter manholes where the slab will be buried. Flat top slabs may be used for six (6) feet and larger diameter manholes, unless the manhole is located within pavement or maintained lawns.
 - e. Joints between sections shall be manufactured in accordance with ASTM C-443. Joints may be sealed with rubber gaskets in accordance with ASTM C- 443 or with butyl rubber sealants conforming to Federal Specification SS-S- 210A and AASHTO M-198, Type B.

- f. All markings required by ASTM C-478 shall be clearly stamped on the inside of each section.
 - g. Aggregate shall be sound, crushed, angular granitic stone only, substantially in accordance with ASTM C-33, except that the requirement for gradation in that standard shall not apply. Smooth or rounded stone (river rock) shall not be acceptable.
 - h. The cement shall be Type II with a maximum tricalcium aluminate (content 8%.) In lieu of Type II cement and granitic aggregate, precast manhole sections may be furnished of Type III cement with calcareous (limestone) aggregate. The manufacturer will submit lab tests certifying the amount of Alkalinity (minimum 78%) present in the complete mix.
 - i. Manhole riser sections, transition slabs, flat top slabs, and cone sections shall be designed for H-20 loadings.
 - j. The manufacturer shall furnish the Engineer with test results on compression and absorption for one section in every twenty-five sections poured, and certification from cement manufacturer and aggregate supplier certifying chemical content. The Engineer reserves the right to pick random sections for the required testing.
- 4. Steps: Manhole steps will be furnished in accordance with Standard Detail Drawings ASTM C-478 and current OSHA regulations. In addition to the testing requirements of ASTM C-478 each step installed in pre-cast manholes will be tested to resist a 1000 lb pullout. The manhole manufacturer will furnish certification of each test with each shipment showing manhole location, date of test, and results.
 - 5. PVC Liner: Where indicated on the plans or elsewhere in these specifications, manholes shall be furnished with a PVC Liner for resistance to corrosive sewers. The liner shall be as hereinbefore specified for RCP.

B. Manhole Frames and Covers:

- 1. Frames, Covers, And Grates: All manhole frames and covers shall conform to ASTM A-48, Class 30 and shall be manufactured in domestic foundries. Dimensions shall conform to those indicated in specifications and plans.
- 2. Manhole frames and covers shall be furnished with the common contact surfaces between frame and cover machined. Frames and covers shall be Dewey Brothers RCR 2010, Vulcan VM-83, U.S. Foundry or approved equal
- 3. Where watertight frames and covers are specified, the watertight seal between frame and cover shall be accomplished by means of a rubber gasket. Watertight frames and covers shall be Dewey Brothers RCR 2010W, Vulcan VM 1383, U.S. Foundry or approved equal

2.06 MISCELLANEOUS STEEL

A. Steel Encasement Pipe

1. Steel Encasement Pipe: Steel pipe shall be welded or seamless, smooth wall or spiralweld, consisting of Grade "B" steel as specified in ASTMA-139.
2. Minimum yield strength shall be 35,000 PSI; and pipe thickness shall be as specified for each individual job.
3. All pipe shall be furnished with beveled ends prepared for field welding of circumferential joints. All burrs at pipe ends shall be removed.
4. Encasement pipe must be approved by the appropriate controlling agency (D.O.T., R.R., etc.) and the Engineer prior to ordering.

B. Steel Vent Pipe

1. Steel Vent Pipe: Unless otherwise specified, steel vents shall be Schedule 40 five- inch (5") diameter steel pipe, consisting of Grade "B" steel as specified in ASTM A- 139.
2. All steel shall be Grade "B" only, with a minimum yield strength of 35,000 P.S.I.
3. The steel pipe shall have an inside coal tar lining 3/32-inch minimum thickness in accordance with AWWA C-203 or a coal tar epoxy lining conforming to that required for steel (aerial creek crossing) pipe.
4. Outside surface of pipe shall be sand or grit blasted to commercial standard and have one (1) coat of zinc chromate primer applied in accordance with Federal Specification TT-86a.
5. Pipe shall be furnished with two (2) evenly applied coats of rust inhibiting enamel paint, either Koppers Glamortex No. 501 Enamel (Olive Green), Southern Coatings Rustaloy No. 0537 Enamel (Garden Green), or equal.

2.07 CONCRETE

- A. Portland Cement: All concrete shall conform to the Standard Specifications for READY MIXED CONCRETE, ASTM C-94. An air-entraining admixture, conforming to ASTM C-260, shall be added to either Type I, Type II, or Type III Portland Cement. Fly Ash conforming to ASTM C-618 for Class C Fly Ash may be added to the concrete mix but shall not be considered as replacement for more than 10% of the cement therein (strengths shall not be less than hereinafter required).
1. Types I, IA, III and IIIA Portland Cement shall only be used for manhole inverts, concrete encasement, concrete blocking, and/or as directed by the Engineer, and shall conform to ASTM C-150.
 2. Types II and IIA Portland Cement shall be used in precast manholes, cast in place manhole structures, reinforced concrete pipe, reinforced concrete piers and concrete or reinforced concrete rip-rap as directed by the Engineer, and shall conform to ASTM C-150 except that Tricalcium Aluminate content shall not exceed 8%.
- B. Aggregates: All aggregates used for concreting shall conform to ASTM C-33 and shall be checked daily for any variances in moisture content. Said variances shall be corrected and/or taken into consideration for each batch

1. Coarse Aggregates: Shall be uniformly and evenly graded for each application in accordance with A.C.I. Standard 318. Unless otherwise approved, aggregate shall be sound, crushed, angular granitic stone. Smooth or rounded stone (river rock) shall not be acceptable.
 2. Fine Aggregates: Shall consist of natural sand, manufactured sand or a combination thereof. Fine aggregates shall conform to the sieve analysis as specified in paragraph 4.1 of the standard except that the percent passing a No. 50 sieve shall not exceed 5% and the percent passing a No. 100 sieve shall be 0% as provided for in paragraph 4.2 of the standard.
- C. Mix Design: Concrete shall be watertight, resistant to freeze-thaw cycles and moderate sulfate attack, abrasion resistant, workable, and/or finishable. These qualities may be met through the use of admixtures (if and only if approved in the mix design as hereinafter specified) conforming to the appropriate ASTM with the exception of the use of calcium chloride, which shall be limited to no more than 1% by cement weight - thoroughly mixed to insure uniform distribution within the mix. If the concrete is used with reinforcing steel, no calcium chloride will be allowed. The Contractor shall assume responsibility for concrete mixture. When required by the Engineer, and prior to beginning construction, the Contractor, at his expense, shall obtain from an approved commercial testing laboratory a design for a suitable concrete mix and submit same with his list of materials and material suppliers for approval. The concrete shall be proportioned to meet the following requirements: (Note: This mix does not apply "in total" to precast manhole or reinforced concrete pipe).
1. Compressive Strength: Minimum 3600 psi
 2. Water-Cement Ratio By Weight: Maximum 0.50
 3. Slump: Minimum 3", Maximum 5"
 4. Air Content (Entrained and Entrapped): Minimum 4%, Maximum 6%
 5. Course Aggregate: $\frac{3}{4}$ " - 1 $\frac{1}{2}$ " (as required by the application)
- D. Curing Compound: All concrete curing compounds shall conform to the standard specifications for LIQUID MEMBRANE - FORMING COMPOUNDS FOR CURING CONCRETE, ASTM C-309, Type 2. Curing compounds shall be applied as forms are stripped.
- E. Grouts: All grouts shall be of a non-shrink nature (as may be achieved through additives or proportioning) and depending upon application range from plastic to flowable cement water paste. Testing as specified above for concrete may be required for acceptance of grouts to include frequent checks for consistency by a time-of-flow measurement. Expansion grouts shall be either Gilco pre-mixed or Supreme non-metallic grout as manufactured by Gifford-Hill and Company, Incorporated, or Embeco 636 grout as manufactured by Master Builders or equal. Grouts shall be mixed (if applicable) and placed in accordance with the manufacturer's current recommendations, for each specific application. Expansion grouts shall be used only as directed by the Engineer. Acceptable range of testing requirements:
1. Compressive Strength: 10,500 psi to 12,500 psi.
 2. Bond Strength: 1,350 psi to 1,700 psi.

3. Percent Expansion: + 0.025% to + 0.75%

- F. Mortar: Mortar used in sanitary sewer manholes shall be hydraulic cement mortar in accordance with ASTM C-398. Mortar used in water meter vaults and water valve vaults shall be Type M mortar in accordance with ASTM C-270.

PART 3 EXECUTION

3.01 EARTHWORK

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

3.02 EXISTING UTILITIES

- A. The Contractor will be required to excavate to determine the precise location of utilities, or other underground obstructions, which are shown on the Construction Plans. Such location and excavation shall be at least 500 feet ahead of construction or as noted in the Special Provision Section of this document.
- B. All utility owners will be notified prior to excavation as required by the 1985 Underground Damage Prevention Act. Owners who are members of ULOCO may be notified in accordance with current ULOCO procedures. The Contractor will be fully responsible for damage to any utilities if the owners have not been properly notified as required by the Underground Damage Prevention Act.
- C. Utility owners may, at their option, have representatives present to supervise excavation in the vicinity of their utilities. The cost of such supervision, if any, shall be borne by the Contractor.
- D. Conflicts with underground utilities may necessitate changes in alignment and/or grade of this construction. All such changes will be approved by the Engineer before construction proceeds.
- E. When underground obstructions not shown on the Construction Plans are encountered, the Contractor shall promptly report the conflict to the Engineer and shall not proceed with construction until the conflict is resolved by the Engineer.
- F. When a PVC water main crosses other buried pipeline utilities (storm drain, gas, encased or capped telephone conduit, etc.) 12-inches clearance must be maintained between the waterline and utility and the water main shall receive Type III stone bedding. If this clearance requires the water main to be deeper than 5 feet, the Contractor may install a DIP (galvanized steel pipe for 2-inch mains) water main over the utility with less than 12-inches clearance provided there is 3 feet cover over the water main.
- G. Whenever a sewer main crosses over other utility lines (storm drain, gas, encased or capped telephone conduit, etc.) the following will apply:
1. For VCP sewer lines - The sewer line shall be DIP from one foot outside the utility trench with a minimum length of 10 feet.
 2. For PVC sewer lines - There shall be one foot clearance from the top of the utility to the bottom of the sewer. If this clearance is not possible the sewer line shall be ductile iron pipe from one foot outside the utility trench with a minimum length of 10 feet.

3.03 SEWER LINE / WATER LINE CLEARANCE

- A. When a sewer main or lateral crosses or is parallel to an existing water main, the Contractor shall install ductile iron pipe (including laterals) for the sewer main and water main as described below:
1. Vertical Separation Of Sewer Lines & Water Lines: Whenever it is necessary for a sewer main to cross under a water main with less than 18-inches of vertical separation, the sewer main and water main shall be constructed of ductile iron pipe, with joints meeting water main standards, for a distance of 10 feet on each side of the point of crossing. Whenever it is necessary for a sewer main to cross over a water main, the sewer main and water main shall be constructed of ductile iron pipe, with joints meeting water main standards, for a distance of 10 feet on each side of the point of crossing.
 2. Horizontal Separation of Sewer Lines and Water Lines: Sewer mains shall be laid at least 10 feet horizontally from existing or proposed water mains unless local conditions or barriers prevent a 10-foot horizontal separation. In that case, the sewer main will be laid in a separate trench, with the elevation of the bottom of the water main at least 18-inches above the top of the sewer. When these conditions are not met, the sewer main and water main shall be constructed of Ductile Iron Pipe with joints meeting water main standards.
 3. Horizontal Separation Of Sewer Lines and Water Wells: Sewer lines shall be installed at least 100 feet from water wells. Where this separation is not possible the sewer line shall be ductile iron pipe. Sewer lines shall not be installed within 25 feet of any private well or within 50 feet of any community well.

3.04 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details to indicate general location and arrangement of underground sanitary sewer piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. In all instances pipe shall be laid in a workmanlike manner, true to line and grade, with bell ends facing up-grade in the direction of laying. The various pipes referred to herein shall be handled, belled up and laid in accordance with the manufacturer's requirements and good engineering practices as defined in the various publications referenced in this document. The following requirements and/or standards of the Town of Smithfield Department shall govern this construction unless exceeded by other regulatory bodies.
- 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 proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.

F. Pipe Bedding: Unless otherwise specified or noted on the Plans the following bedding classes are as commonly required by this Department. When granular material embedment is required, the Contractor will follow the layered procedure specified in Type I for soil placement, above the granular bedding, to an elevation one (1) foot above the top of the pipe bell.

1. Type I - Shaped Bottom Bedding: The trench bottom shall be shaped so the pipe bears uniformly upon undisturbed native earth. Soil shall then be placed by hand around the pipe and completely under the pipe haunches in uniform layers not exceeding six (6) inches in depth up to an elevation one (1) foot above the top of the pipe bell. Each layer shall be placed and then carefully and uniformly tamped, so that the pipe is not damaged nor the alignment disturbed.
2. Type II - Granular Material Embedment: The trench bottom shall be undercut a minimum of six (6) inches below the pipe barrel grade and filled with an approved stone to an elevation such that the pipe will be completely and uniformly bedded to a vertical height of one-third the outside diameter of the pipe bell for the pipe's entire length and for the entire width of the ditch. Depending upon soil and ground water conditions, greater depths (undercut) may be required to create a stable condition. Type II granular material embedment shall be used as directed by the Engineer.
3. Type III - Granular Material Embedment: The trench bottom shall be undercut a minimum of six (6) inches below the pipe barrel grade and filled with an approved stone to an elevation such that the pipe will be completely and uniformly bedded to vertical height of one-half the outside diameter of the pipe bell for the pipe's entire length and for the entire width of the ditch. Depending upon soil and ground water conditions, greater depths (undercut) may be required to create a stable condition. Type III granular material embedment shall be used as directed by the Engineer.
4. Stone Stabilization: When the bottom of the trench is not sufficiently stable to prevent vertical or lateral displacement of the pipe after installation with Type II or Type III bedding, stone stabilization will be required to develop a non- yielding foundation for the bedding and pipe. When such conditions are encountered, the trench will be excavated to a depth determined by the Engineer, and #467 crushed stone will be placed to an elevation six-inches below the bottom of the pipe. The pipe will then be laid with Type II or Type III bedding as directed by the Engineer.
5. Concrete Encasement and Cradles: Shall be as designed for each individual case and will be noted on the Plans and in the Special Provisions when applicable.

G. Install gravity-flow, non-pressure piping according to the following:

1. Installation Depth Limitations: The following are limitations and bedding requirements for supportive strength and shall be adhered to at all times. Granular material embedment may still be required for lesser depths of cover should groundwater and/or soil conditions warrant its use, as determined by the Engineer. Deviations from the standard trench width shall be as approved by the Engineer. Trench widths must be maintained constant as measured at the top of the pipe. Deviation from the standard trench width will necessitate an increase in the stone bedding around the pipe and/or a change in the type or class of pipe being installed at the Contractor's expense.

- a. The standard trench width for 8"-15" pipe shall be limited to the nominal pipe size plus 30-inches.
 - b. The standard trench width for 18"-30" pipe shall be limited to the nominal pipe size plus 36-inches.
 - c. The standard trench width for 36" and larger pipe shall be limited to the nominal pipe size plus 42-inches.
2. All pipes regardless of bedding or pipe type shall require adequate tamping of backfill as specified for Type I, Shaped Bottom Bedding.
- a. Ductile Iron Pipe: Installation of Ductile Iron Pipe shall be installed subject to the bedding limitations specified below, based on a deflection limit of three (3) percent for cement lining. Greater depths of cover may be achieved by using a higher pressure classification and/or using pipe with a flexible lining.
 - 1) 10-inch diameter pipe (Class 350) maximum depth of cover: 20' (Type I Bedding), 34' (Type II Bedding), 50' (Type III Bedding).
 - 2) 16-inch diameter pipe (Class 250) maximum depth of cover: 15' (Type I Bedding), 24' (Type II Bedding), 34' (Type III Bedding).
 - 3) 24-inch diameter pipe (Class 250) maximum depth of cover: 15' (Type I Bedding), 20' (Type II Bedding), 29' (Type III Bedding).
 - b. Poly Vinyl Chloride (PVC) Pipe: PVC pipe shall be installed with a minimum of 3.0 feet of cover and a maximum of 20 feet of cover. When the cover is less than 3.0 feet or more than 20 feet, Ductile Iron Pipe must be used subject to the specified limits. PVC pipe shall be installed in accordance with ASTM D-2321 with the following limitations:
 - 1) All PVC pipe shall be installed using Type III Granular Embedment. The bedding shall extend from the pipe to the trench wall or to two and one half pipe diameters (OD) on each side of the pipe, whichever is less.
3. Grade and Line For Pipe: As a minimum, centerline hubs will be set at each manhole and offset stakes set at each manhole, and if required at 100 foot intervals between manholes. Cut sheets will show the vertical distance from the offset stakes to the inlet and outlet pipe invert at each manhole and to the pipe invert at each offset stake. Grade and line may be transferred to "batter boards" set at intervals not to exceed fifty (50) feet. Unless otherwise approved by the Engineer, three (3) batter boards will be in place at all times while pipe laying is in progress. Each joint shall be checked with a grade rod and plumb line with care being taken to keep the string line taut at all times. Laser beams may be used to set line and grade when the Contractor provides adequate and accurate equipment for the Engineer to check his line and grade at each cut stake (lock levels shall not be considered adequate). If laser equipment is used, the grade shall be checked at each manhole and at benchmarks every 500 feet. The Contractor shall keep close check of his laser for variations in line and grade. No variations between manholes shall be corrected without relaying that portion of line which has deviated from line or grade unless otherwise approved by the Engineer.

H. Install force-main, pressure piping according to the following:

1. Depth of Pipe Installation: Unless otherwise indicated on Plans, or required by existing utility location, all pipe will be installed with the top of the pipe at least 3.0' below the edge of adjacent roadway pavement or 3.0' below the ground at the pipe, whichever is greatest. The Contractor is instructed to check the construction plans and blow-up views for additional requirements. The maximum depth of cover for the previously specified pressure classifications shall be as follows:
 - a. Type I Bedding: 10 feet
 - b. Type II Bedding: 15 feet
 - c. Type III Bedding: 20 feet
2. The Contractor may be required to vary the depth of pipe to achieve minimum clearance from existing utilities while maintaining the minimum cover specified whether or not the existing pipelines, conduits, cables, mains, etc. are shown on the Plans.
3. Alignment and Grade: The pipe shall be installed as shown on the plans unless an obstruction prevents such alignment or grade. The Contractor will be required to adjust the location of the pipe where possible to avoid such conflicts as specified and as directed by the Engineer. All construction layout and surveying which may be required for construction shall be provided by the Contractor and any costs associated shall be included in the various pay items of the proposal. The Contractor is responsible for determining the amount of construction layout and surveying that may be required to complete construction.
4. Installation and Assembly: Proper implements, tools, and facilities satisfactory to the Engineer shall be provided and used by the Contractor for the safe and convenient prosecution of the work. All pipe, fittings, valves and hydrants shall be carefully lowered into the trench piece by piece by means of a backhoe or other suitable means, in such a manner as to prevent damage to protective coatings and linings. Under no circumstances shall pipe materials be dropped or dumped into the trench.
5. Inspection of Material: The pipe and fittings shall be inspected for defects.
6. Cleaning Pipe and Fittings: All lumps, blisters and excess coatings shall be removed from the bell and spigot ends of each pipe, and the outside of the spigot and the inside of the bell shall be wire-brushed and wiped clean and dry and free from oil and grease before the pipe is laid.
7. Laying Pipe: Pipe shall be laid with bell ends facing in the direction of laying, unless otherwise approved by the Engineer. Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed. If the pipe laying crew cannot put the pipe into the trench and in place without getting earth into it, the Engineer may require that before lowering the pipe into the trench, a heavy, tightly woven canvas bag of suitable size shall be placed over each end and left there until the connection is to be made to the adjacent pipe. During laying operations, no debris, tools, clothing or other materials shall be placed in the pipe. After placing a length of pipe in the trench, the spigot end shall be centered in the bell and the pipe forced home and brought to correct line

and grade. The pipe shall be secured in place with approved backfill material tamped under it except at the bells. Precautions shall be taken to prevent dirt from entering the joint space. At times when pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug or other means approved by the Engineer. This provision shall apply during the noon hours as well as overnight. If water is in the trench, the seal shall remain in place until the trench is pumped completely dry.

8. Permissible Deflection of Joints: Wherever it is necessary to deflect pressure pipe from a straight line, either in the vertical or horizontal plane, to avoid obstruction or plumb valve stems, or where long radius curves are permitted, the amount of deflection allowed shall not exceed that required for satisfactory sealing of the joint as recommended by the manufacturer, and shall be approved by the Engineer.
9. Installation of Push-On Joint Pipe: The gasket groove and bell socket shall be cleaned and lubricated, and the gasket inserted as specified by the pipe manufacturer. Sterile lubricant, as furnished or specified by the manufacturer shall be applied to the gasket and beveled spigot end of the pipe. The beveled spigot end of pipe shall be pushed straight into bell using either a bar, jack, lever puller, or backhoe. A timber header will be placed between the jack or backhoe bucket and the pipe to prevent damage to the pipe. At no time will the joint be made by swinging the pipe. The pipe will be deflected, if required, after the joint is made.
10. Installing Mechanical Joint Pipe and Fittings: All spigots shall be centrally located in the bell and adequate anchorage shall be provided where abrupt change in direction and dead ends occur. All pipe surfaces with which the rubber gasket seals come into contact will be brushed with a wire brush just prior to assembly in order to remove all loose rust or foreign material and to provide a clean surface for the installation of the gasket. The pipe surface with which the gasket comes into contact and the gasket will be brushed with soapy water just prior to the installation of the gasket and the making up of the joint. Torque loads shall be applied to the standard cast iron bolts used in making the joint as follows:
 - a. 5/8" Bolt: 40-60 Ft lbs. of Torque
 - b. 3/4" Bolt: 60-90 Ft lbs. of Torque
 - c. 1" Bolt: 70-100 Ft lbs. of Torque
 - d. 1-1/4" Bolt: 90-120 Ft lbs. of Torque
11. The above torque loads may be applied with torque measuring or indicating wrenches. Torque wrenches may be used to check the application of approximate torque loads applied by men trained to give an average pull on a definite length of regular socket wrench. The following lengths of wrenches should satisfactorily produce the above ranges of torques when used by the average man:
 - a. 5/8" Bolt: 8" wrench length
 - b. 3/4" Bolt: 10" wrench length
 - c. 1" Bolt: 12" wrench length

- d. 1-1/4" Bolt: 14" wrench length
- 12. When tightening bolts, the gland will be brought up toward the pipe flange evenly, maintaining approximately the same distance between the gland and the face of the flange at all points around the socket.
- 13. Bend and Fitting Location: The Contractor is advised that the bends and fittings indicated on the plans are for a guide only. The Contractor will be required to furnish additional bends and fittings as needed to complete all installations.
- 14. Cutting Pipe: The cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or cement lining and so as to leave a smooth end at right angles to the axis of the pipe. Cut ends of a pipe shall be beveled before installation in a push-on joint bell. When making connections to existing mains which require water mains to be removed from service, automatic traveling pipe cutting machines will be required on pipe 16- inch and larger. At other times, hand-held pipe saws may be used provided the pipe is marked, prior to cutting, such as to provide a cut at right angles to the axis of the pipe. Handheld pipe saws may be used in all applications for cutting pipe smaller than 16- inch. Flame cutting of pipe with an acetylene torch will not be allowed.
- 15. PVC Pipe Installation: PVC pipe shall be installed in accordance with the Recommended Practice for the Installation of PVC Pressure Pipe UNI-B-3 and AWWA C-900. Backfill shall be as specified elsewhere in these specifications.
- 16. Force main shall remain ductile iron pipe until outside of station fencing area.
- I. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

3.05 PIPE JOINT CONSTRUCTION

- A. Join gravity-flow, non-pressure, drainage piping according to the following:
 - 1. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
 - 2. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
 - 3. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
 - 4. Join ductile-iron, gravity sewer piping according to AWWA C600 for push-on joints.
 - 5. Join ABS sewer piping according to ASTM D 2321 for elastomeric-seal joints.
 - 6. Join PVC cellular-core sewer piping according to ASTM D 2321 and ASTM F 891 for solvent-cemented joints.

7. Join PVC corrugated sewer piping according to ASTM D 2321.
 8. Join PVC profile sewer piping according to ASTM D 2321 for elastomeric-seal joints or ASTM F 794 for gasketed joints.
 9. Join PVC Type PSM sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints.
 10. Join PVC gravity sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints.
 11. Join fiberglass sewer piping according to ASTM D 4161 for elastomeric-seal joints.
 12. Join nonreinforced-concrete sewer piping according to ASTM C 14 (ASTM C 14M) and ACPA's "Concrete Pipe Installation Manual" for rubber-gasket joints.
 13. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasket joints.
 14. Join dissimilar pipe materials with non-pressure-type, flexible[**or rigid**] couplings.
- B. Join force-main, pressure piping according to the following:
1. Join ductile-iron pressure piping according to AWWA C600 or AWWA M41 for push-on joints.
 2. Join ductile-iron special fittings according to AWWA C600 or AWWA M41 for push-on joints.
 3. Join PVC pressure piping according to AWWA M23 for gasketed joints.
 4. Join PVC water-service piping according to ASTM D 2855.
 5. Join dissimilar pipe materials with pressure-type couplings.

3.06 MANHOLE INSTALLATION

- A. General: Install manholes complete with appurtenances and accessories indicated.
- B. All manholes outside street rights-of-way or landscaped areas shall be constructed to a height of two (2) feet above the adjacent ground unless otherwise indicated on the Plans or by the Special Provisions. Manholes within street rights-of-way or landscaped areas shall have finished rim elevations flush with the pavement or adjacent finished grade. After final inspection is complete and all deficiencies have been corrected, the Contractor shall seal all manholes (rings to covers) with penetration type asphaltic cement No. AC-20 as manufactured by Exxon Oil Company or equal.
1. Precast Reinforced Concrete Structures: All precast manhole sections shall conform to the Material Specifications and Standard Details. Precast manholes shall be treated similar to reinforced concrete pipe for installation. That is, if ground water and/or soil conditions require stabilization for pipe installation comparable measures will be required for precast

manhole installation. Under no circumstances will a precast base section be placed on unstable soil as solely determined by the Engineer. Jointing of precast sections will be done in accordance with the manufacturer's recommendation, with special attention called to the amount of force used. All backfill around structures shall be thoroughly tamped in layers as specified for placing backfill. Regardless of the type manhole construction used, the Contractor will do that which is necessary to stabilize the soil intended to support the structure. A stable condition shall only be so adjudged by the Construction Engineer or his authorized representative. Any cost incurred by the Contractor in stabilizing the area to support a manhole shall be considered incidental to the manhole construction.

2. Outside Drops: When design considerations dictate a large elevation change across a manhole, an outside drop shall be constructed. Depending on the particular fittings used, elevation differences of 2.0 to 2.5 feet are required to accommodate an outside drop. When there is not sufficient elevation difference to permit construction of an outside drop, the grade of the influent pipe shall be lowered such that the vertical separation of the influent and effluent pipes is 0.2 feet, as measured at the center of the manhole when the grades of both pipes are projected to that point. Outside drops shall not enter the cone section of precast manholes.
3. Inside Drops: When connecting a proposed sewer main to an existing manhole at an elevation significantly higher than the existing invert elevation, and where safety considerations or working space limitations preclude building an outside drop, the connection may be made with an inside drop constructed in conformance with the Standard Details. Inside drops will be used only where shown on the plans or specifically approved by the Engineer. They may not be used in lieu of outside drops shown on the plans. Inside drops shall not enter the manhole in the cone section. Inside drops are not allowed on four (4) feet diameter manholes.
4. Installation Of Frames And Covers: The frame shall be installed on the manhole with anchor bolts on all manholes that are not flush with the ground. 8-inch tall or 4-inch tall frames may be used for manholes with bolt down frames. These frames shall have four (4) holes in the support flange to permit installation on the cone with anchor bolts. Holes shall be equally spaced in the flange. Complete anchor bolt assemblies shall be zinc plated steel and shall consist of a drive in type anchor sleeve, a threaded stud and two nuts. Anchors shall be installed in field drilled holes in the cone. Minimum diameter of the threaded stud shall be 1/2 inch. The Contractor shall seal the frame to the manhole by installing a length of butyl rubber joint sealant to form a gasket between frame and manhole. The butyl rubber joint sealant shall have a one inch cross section, and shall make two full circles when placed on the cone section, and shall be compressed by the frame with the anchor bolts. Butyl rubber joint sealant shall be "Rubber Seal" as manufactured by Ru Van, Inc., or approved equal. Cement mortar grouting of the frame shall be required. Brick may not be used to adjust rim elevations of above grade manholes. Manholes that are installed flush with pavement or grade shall have frames attached to the manhole with a bed of cement mortar grout. 8-inch tall frames are required for all manholes that are flush with pavement or finished grade unless otherwise approved. Standard size brick or reinforced concrete grade rings may be used to adjust the finished rim elevation of such manholes. This adjustment may not exceed 21-inches in height.
5. Manhole Step Testing: The Contractor will furnish a hydraulic driven system consisting of cylinder, connecting hose and above ground pump with gauge to test manhole steps to exceed 1000 lbs. of resistance of pullout. All field installed steps will be tested. In lieu of

field testing steps installed at the plant, certified shop reports by the manufacturer showing that each step passed the required 1000 lb. pullout will be accepted. The certificates will be furnished to the Inspector prior to field installation. Unless the Contractor can furnish the manufacturer's certification on step tests, the Contractor will be required to test 10% of the plant installed steps. An additional 10% will be tested for each failure.

6. False Walls: False walls shall be constructed in manholes when specified on the Plans. Holes of the appropriate size shall be cored or blocked out in the manhole wall at the elevation and alignment shown on the Plans. A four-inch thick masonry wall shall be constructed in the opening. Inverts shall be constructed to match proposed pipe elevations and alignments and permit installation of the future extension without demolition work other than removal of the false wall.
7. Steel Vent Pipes: Steel vent pipes will be installed in accordance with the Standard Details. Shop drawings of strap on vents, mounting straps, and anchor bolts will be subject to approval of the Engineer. Material shall be as specified in the Materials Specification Section.

- C. Form continuous concrete channels and benches between inlets and outlet.

3.07 STEEL ENCASEMENT

- A. Interpretation of soil investigation reports and data, investigating the site and determination of the site soil conditions prior to bidding is the sole responsibility of the Contractor. Any subsurface investigation by the Bidder or Contractor must be approved by the appropriate authority having jurisdiction over the site. Rock and/or water, if encountered, shall not entitle the Contractor to additional compensation.
- B. Casing construction shall be performed so as not to interfere with, interrupt or endanger roadway surface and activity thereon, and minimize subsidence of the surface, structures, and utilities above and in the vicinity of the casing. Support the ground continuously in a manner that will prevent loss of ground and keep the perimeters and face of the casing, passages and shafts stable. The Contractor shall be responsible for all settlement resulting from casing operations and shall repair and restore damaged property to its original or better condition at no cost to the Owner.
- C. Face Protection: The face of the excavation shall be protected from the collapse of the soil into the casing.
- D. Casing Design: Design of the bore pit and required bearing to resist jacking forces is the responsibility of the Contractor. The excavation method selected shall be compatible with expected ground conditions. The lengths of the casing shown on the Drawings are the minimum lengths required. The length of the casing may be extended for the convenience of the Contractor, at no additional cost to the Owner.
- E. Groundwater Control
 1. The Contractor shall control the groundwater throughout the construction of the casing.
 2. Methods of dewatering shall be at the option and responsibility of the Contractor. Maintain close observation to detect settlement or displacement of surface facilities due

to dewatering. Should settlement or displacement be detected, notify the Engineer immediately and take such action as necessary to maintain safe conditions and prevent damage.

3. When water is encountered, provide and maintain a dewatering system of sufficient capacity to remove water on a 24 hour basis keeping excavations free of water until the backfill operation is in progress. Dewatering shall be performed in such a manner that removal of soil particles is held to a minimum.

F. Safety

1. Provide all necessary bracing, bulkheads and shields to ensure complete safety to all traffic, persons and property at all times during the work. Perform the work in such a manner as to not permanently damage the roadbed or interfere with normal traffic over it.
2. Observe all applicable requirements of the regulations of the authorities having jurisdiction over this site. Conduct the operations in such a manner that all work will be performed below the level of the roadbed.
3. Perform all activities in accordance with the Occupational Safety and Health Act of 1970 (PL-596), as amended, applicable regulations of the Federal Government, OSHA 29CFR 1926 and applicable criteria of ANSI A10.16-81, "Safety Requirements for Construction of Tunnel Shafts and Caissons".

G. Boring and Jacking

1. Shaft

- a. Conduct boring and jacking operations from a shaft excavated at one end of the section to be bored. Where conditions and accessibility are suitable, place the shaft on the downstream end of the bore.
- b. The shaft shall be rectangular and excavated to a width and length required for ample working space. If necessary, sheet and shore shaft properly on all sides. Shaft sheeting shall be timber or steel piling of ample strength to safely withstand all structural loadings of whatever nature due to site and soil conditions. Keep preparations dry during all operations. Perform pumping operations as necessary.
- c. The bottom of the shaft shall be firm and unyielding to form an adequate foundation upon which to work. In the event the shaft bottom is not stable, excavate to such additional depth as required and place a gravel sub-base or a concrete sub-base if directed by the Engineer due to soil conditions.

2. Jacking Rails and Frame

- a. Set jacking rails to proper line and grade within the shaft. Secure rails in place to prevent settlement or movement during operations. The jacking rails shall cradle and hold the casing pipe on true line and grade during the progress of installing the casing.

- b. Place backing between the heels of jacking rails and the rear of the shaft. The backing shall be adequate to withstand all jacking forces and loads.
 - c. The jacking frame shall be of adequate design for the magnitude of the job. Apply thrust to the end of the pipe in such a manner to impart a uniformly balanced load to the pipe barrel without damaging the joint ends of the pipe.
- 3. Boring and jacking of casing pipes shall be accomplished by the dry auger boring method without jetting, sluicing or wet-boring.
- 4. Auger the hole and jack the casing through the soil simultaneously.
- 5. Bored installations shall have a bored-hole diameter essentially the same as the outside diameter of the casing pipe to be installed.
- 6. Execute boring ahead of the casing pipe with extreme care, commensurate with the rate of casing pipe penetration. Boring may proceed slightly in advance of the penetrating pipe and shall be made in such a manner to prevent any voids in the earth around the outside perimeter of the pipe. Make all investigations and determine if the soil conditions are such as to require the use of a shield.
- 7. As the casing is installed, check the horizontal and vertical alignment frequently. Make corrections prior to continuing operation. For casing pipe installations over 100 feet in length, the auger shall be removed and the alignment and grade checked at minimum intervals of 60 feet.
- 8. Any casing pipe damaged in jacking operations shall be repaired, if approved by the Engineer, or removed and replaced at Contractor's own expense.
- 9. Lengths of casing pipe, as long as practical, shall be used except as restricted otherwise. Joints between casing pipe sections shall be butt joints with complete joint penetration, single groove welds, for the entire joint circumference, in accordance with AWS recommended procedures. Prior to welding the joints, the Contractor shall ensure that both ends of the casing sections being welded are square.
- 10. The Contractor shall prepare a contingency plan allowing the use of a casing lubricant, such as bentonite, in the event excessive frictional forces jeopardize the successful completion of the casing installation.
- 11. Once the jacking procedure has begun, it should be continued without stopping until completed, subject to weather and conditions beyond the control of the Contractor.
- 12. Care shall be taken to ensure that casing pipe installed by boring and jacking method will be at the proper alignment and grade.
- 13. The Contractor shall maintain and operate pumps and other necessary drainage system equipment to keep work dewatered at all times.
- 14. Adequate sheeting, shoring and bracing for embankments, operating pits and other appurtenances shall be placed and maintained to ensure that work proceeds safely and

expeditiously. Upon completion of the required work, the sheeting, shoring and bracing shall be left in place, cut off or removed, as designated by the Engineer.

15. All surplus material shall be removed from the right-of-way and the excavation finished flush with the surrounding ground.

16. Grout backfill shall be used for unused holes or abandoned pipes.

H. Ventilation and Air Quality: Provide, operate and maintain for the duration of casing project a ventilation system to meet safety and OSHA requirements.

I. Installation of Pipe

1. After construction of the casing is complete, and has been accepted by the Engineer, install the pipeline in accordance with the Drawings and Specifications.

2. Check the alignment and grade of the casing and prepare a plan to set the pipe at proper alignment, grade and elevation, without any sags or high spots.

3. The pipe shall be supported within the casing by use of casing spacers sized to limit radial movement to a maximum of 1-inch. Provide a minimum of two casing spacers per nominal length of pipe. Casing spacers shall be attached to the pipe at maximum 18 to 20 foot intervals. Casing spacers shall also be provided within two feet of each end of the casing.

4. Close the ends of the casing pipe with masonry brick and mortar seal, minimum 8-inches thick, at both ends of casing.

5. Leave a weephole opening at the bottom of the lowest bulkhead end for drainage of the annular space.

J. Sheeting Removal: Remove sheeting used for shoring from the shaft and off the job site. The removal of sheeting, shoring and bracing shall be done in such a manner as not to endanger or damage either new or existing structures, private or public properties and also to avoid cave-ins or sliding in the banks.

K. Coatings: Unless otherwise shown on the construction plans, casing pipe installed under State and/or City maintained roadways shall not require a protective coating.

3.08 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318.

B. Acceptance of Concrete: Concrete shall be accepted on the basis of its meeting the requirements listed under the Material Specifications and Detail Specifications Section of this contract. The Inspector will accept no ready mix concrete without the plant dispatch ticket. The Engineer shall make or require any tests as he deems necessary to insure that the concrete meets specifications. Such tests may be performed by materials technicians hired by the Contractor or the Engineer may require the test to be performed by an independent testing laboratory at the Contractor's expense.

- C. Placement: Concrete will not be accepted if it cannot be placed within ninety (90) minutes of the dispatch time. Time requirements may fluctuate marginally due to temperature. Concrete shall be deposited in such a manner so as to prevent contamination by foreign material and segregation due to rehandling or flowing. Segregated concrete and/or concrete containing foreign material will not be accepted. Depositing will not be permitted when temperature has not exceeded 35 and rising by 10:00 A.M. Depositing shall cease when the descending air temperature in the shade falls below 40 F. It shall not resume until the ascending air temperature rises to 35 F. All concrete shall be kept from freezing by the Contractor. Frozen concrete shall be replaced at the Contractor's expense. Free fall shall not exceed 3 feet in any case.
- D. Forms: Forms may be made of wood, plywood, metal, or any other material approved by the Engineer. Forms shall be mortar tight, of material strong enough to resist noticeable deflection or bulging between supports, and the interior dimensions of the forms shall be such that the finished concrete shall be of the form and dimensions shown on the Plans. The design of the forms shall take into account the effect of vibration of concrete as it is placed and also the rate of speed at which the forms will be filled. Forms shall be coated with a lubricant as approved by the Engineer. Mechanical vibrators, of an approved type, and continuous spading and/or rodding of concrete shall be used to produce proper contact of concrete with forms and reinforcing steel in piers and with forms and pipe in monolithic inverts insuring a compact, dense and impervious artificial stone of uniform texture.
- E. Curing: All concrete will be cured for a seven (7) day period after placement according to the following procedure:
1. Forms will normally be left in place for the entire seven (7) day period. Exposed surfaces not covered by forms will be kept moist continuously for the entire seven day period or will be cured through use of an approved curing compound which will be applied after all surface water has disappeared.
 2. At the discretion of the Engineer, forms may be removed after the initial set and before the end of the seven day period. In such cases, the areas previously covered by forms shall be cured as described above.
 3. At the discretion of the Engineer, forms may be removed after the initial set and before the end of the seven day period. In such cases, the areas previously covered by forms shall be cured as described above.
- F. At the discretion of the Engineer, forms may be removed after the initial set and before the end of the seven day period. In such cases, the areas previously covered by forms shall be cured as described above
- G. Testing: The following tests will be performed by third party technicians to ensure the concrete quality
1. Compressive strength in accordance with ASTM C-31 and ASTM C-39. Test cylinders which are formed in the field will be left in the field until compression testing (7 day, 14 day, 28 day) is completed thereby more closely approximate the curing conditions of the field placed concrete.
 2. Slump Test in accordance with ASTM C-143.

3. Air Content Test in accordance with either ASTM C-173 or ASTM C-231.

3.09 CONNECTIONS TO EXISTING SEWERS

- A. Tie-ins to existing activated sewer lines will be allowed when proper precautions are taken to protect the existing main. Tie-ins to existing unactivated sewer lines not installed under the same contract will not be allowed without written approval from all parties involved (Town of Smithfield, contractors, contract holders, etc.). The Contractor will be required to install watertight masonry plugs in the proposed pipeline at the existing manhole and at the first proposed manhole until all construction is completed and testing begun. If the proposed sewer does not begin at an existing manhole, a straddle type manhole as shown on the Standard Details will be constructed over (and around) the undisturbed existing pipeline and the proposed pipeline plugged as specified. The existing pipeline will not be broken-out and the new invert formed until all testing has been successfully completed. Any connection with 18-inch and smaller pipe at an existing precast or cast-in-place manhole will require the Contractor to core the necessary opening through the manhole wall. Connections to existing manholes with 21-inch and larger pipe may be cored or sawed as approved by the Engineer.
 1. Temporary Watertight Plugs: The Contractor shall install temporary watertight plugs in the proposed sewer line at any manhole that is incomplete, at the open end of the pipeline prior to leaving the job site daily and elsewhere as dictated by good engineering and construction practices. All installed pipe shall be backfilled or otherwise securely tied down to prevent flotation in the event water enters or rises in the trench. The plugs as installed shall prevent infiltration or the introduction of any foreign material into either the existing or proposed systems. The City will not accept any pipeline or manhole which contains any silt, sedimentation or other foreign material, within. The Contractor shall at his own expense flush, or otherwise cause the line (and manholes) to be cleaned out without any discharge into the existing system. Upon completion of all construction, the Contractor will be responsible for the complete removal of all watertight plugs, in the sequence necessary to allow testing and subsequent activation, all under the direction of the Engineer.
 2. Scheduling: When the flow of an existing sewer must be interrupted and/or bypassed, the Contractor shall, before beginning any construction, submit a work schedule which will minimize the interruption and/or bypassing of wastewater flow during construction. This schedule must be approved by the appropriate controlling agencies and Engineer and may require night, holiday, and/or weekend work.
 3. Bypass Pumping: If pumping is required, an identical standby pump shall be on site in the event of failure of the primary pump. If, at any time during construction, effluent from the existing sewer is not fully contained by the bypass system, gravity service will be restored by a temporary tie to the new construction and work shall be suspended until the problem is resolved to the satisfaction of the Engineer. The Contractor shall be responsible for any fines levied as a result of effluent reaching the creek. The Contractor will be required to verify his method of handling sewer flows during construction by pumping at peak flows for 1 hour as approved by the Engineer.

3.10 CLOSING ABANDONED SANITARY SEWER SYSTEMS

- A. The following requirements shall apply for proposed abandonment of existing facilities unless otherwise shown on the plans or approved by the Engineer. All areas disturbed by abandonment will be restored.

1. Abandonment Of Existing Manholes: Manholes which are to be abandoned will first have both influent and effluent lines plugged inside the manhole with watertight masonry. The manhole will then be filled with non-compressible material (#67 stone or as approved), to a point three feet (3'-0") below the finish grade. The remainder of the manhole shall be broken down and removed. Then the excavation shall be filled to finish grade with suitable soil compacted in place.
2. Abandonment Of Mains At Manholes Which Remain In Service: Abandoned mains at active manholes shall be completely disconnected from the manhole by cutting the pipe outside the manhole and then plugging the abandoned main and the manhole wall with watertight masonry. The invert shall then be rebuilt to conform with the standard details.
3. Abandonment Of Exposed Pipe: Exposed sections of abandoned mains shall be removed to a point not less than 5 feet into the adjacent banks. The remaining ends of the pipe shall be plugged with watertight masonry. Concrete piers or collars in the creek channel shall be removed completely. Concrete piers or collars not located in the creek channel shall be removed to a point three feet (3'-0") below the finish grade. Steel piers shall be cut off three feet (3'-0") below finishgrade.
4. Abandonment Of Existing Pump Stations: Pumps, motors, controls, etc., shall be salvaged and transported by the Contractor to the sewer maintenance yard at 3001 Wilmont Road. All influent and effluent pipes shall be plugged with watertight masonry. The pump chamber and wetwell (if abandoned) will be filled with non- compressible material (#67 stone or as approved), to a point three feet (3'-0") below the finish grade. The remainder of the structure shall be broken down and removed. Then the excavation shall be filled to finish grade with suitable soil compacted in place. All above ground structures associated with the pump station, including fencing and the access road shall be removed and the area restored.

B. Backfill to grade according to Section 312000 Earth Moving.

3.11 PIPE MARKING AND IDENTIFICATION

- A. The installation of tracer wire is required on all underground pipe installed under this contract, including both sewer and water. Tracer wire shall be installed on all water and all wastewater pipe regardless of pipe material including: water distribution, wastewater collection, wastewater force main, low pressure sewer and gray water systems and shall also include all water and sewer service laterals.
- B. Sewer and force main tracer wire – all sewer and force mains, regardless of size or pipe material, shall be installed with a tracer wire. The tracer wire shall be AWG #12 gauge solid copper tracer wire with 30 mils green HDPE insulation. The wire shall begin at the connections to the pump station and shall extend along the entire length of new pipe installed.
 1. Splicing or Joining: When joining two sections of tracer wire they are to be joined by a double overhand knot.
 2. When joining two sections of tracer wire a weatherproof wire not will be used to connect each end.
 3. Tracer wire will be placed at the crown of each pipe.

4. Tracer wire will be secured to the pipe every 10'.
5. A 24" pigtail will be provided in each manhole, vault, valve box or any structure exposed to daylight.

3.12 GRAVITY SEWER, MANHOLE, AND FORCE MAIN TESTING AND INTERNAL INSPECTION

- A. Sewer Lines and Manholes: The Contractor shall provide proper ventilation of sewer lines and manholes during any test or inspection procedure. The Contractor shall be responsible for providing all equipment and personnel necessary to comply with OSHA confined spaces regulations.
1. Gravity Sewer Pipe Leakage Testing: No sooner than 10 days following completion of backfill, the Contractor along with the project inspector will be required to determine the level of the ground water table. If the level of ground water table is above the top of the pipe, the sewer line shall be tested for infiltration. If there is no ground water above the top of the pipe the sewer line shall be low pressure air tested. Each test shall be performed as follows:
 - a. Infiltration: Weirs are to be furnished by Town of Smithfield and installed by the Contractor. The infiltration shall not exceed 100 gallons per day per inch diameter per mile as measured for a reach of pipe the same diameter up to one mile long. However, when excessive infiltration can be isolated to a particular section (manhole-manhole) the limit will be applied to that section. There shall be no visible points of infiltration. Any section (manhole-manhole) must be isolated and tested separately if so directed by the Engineer. The Town of Smithfield Department reserves the right to TV any sewer line to detect sources of infiltration.
 - b. Low Pressure Air Test: Tests shall be performed in accordance with ASTM C- 828 and C-924 on sewer lines 42-inches in diameter and smaller. Test pressure will be measured by gauges furnished by Town of Smithfield and installed by the Contractor above ground at the manhole opposite the air supply. The Contractor shall furnish all other test equipment required including connecting hoses at the Town of Smithfield supplied gauge. Sewer lines larger than 42-inches in diameter shall be tested for infiltration as specified above and each joint shall be visually inspected by a Town of Smithfield representative.
 2. Manhole Leakage Testing: Manholes shall be tested by plugging the inlet and outlet pipes with airtight plugs and using one of the following procedures:
 - a. Exfiltration: Fill the manhole to the rim with water and allow the level to equalize due to saturation. Refill the manhole and mark the level to begin the test. The test shall last at least 2 hours and allowable leakage shall be 3 gallons per hour. The Engineer will select 25% of the manholes on the project to be tested. If any manhole fails, an additional manhole will be tested. Manholes that fail the test shall be repaired as specified and retested until they pass.
 - b. Vacuum Air: Manhole vacuum air testing shall be performed in accordance with ASTM C-1244. The Engineer will select 25% of the manholes on the project to be tested. Manholes that fail the test shall be repaired as specified and retested until they

pass. Manholes that show leaks and are repaired prior to testing shall be tested as specified.

3. Deflection Testing of PVC Pipe: Not less than 30 days following completion of backfill, the pipe shall be tested for deflection with a 5% mandrel sized as defined in ASTM D- 3034. Mandrels shall be furnished by Town of Smithfield. The mandrel shall be pulled through each section of pipe from manhole to manhole. The mandrel must slide freely through the pipe with only a nominal hand force applied. No mechanical device shall be used in pulling the mandrel. Any pipe which refuses the mandrel shall be removed and replaced or re-rounded and the bedding shall be properly constructed as specified to prevent excessive deflection. Such sections shall be re-tested for deflection after completion of backfill.
- B. Force Mains: Required testing of pipelines and valves shall be done under the direct supervision of the Project Inspector. Field testing shall not negate the requirements for material certifications as contained in the material specification section of this contract. Unless otherwise directed by the Engineer, all testing and disinfection will be completed prior to connection to any existing line. The Contractor shall provide open ventilation of confined spaces. The Contractor shall be responsible for providing all equipment and personnel necessary to comply with OSHA confined spaces regulations.
1. Hydrostatic and Leakage Tests: On completion of the line or sections of the lines, connections and appurtenances, the line shall be filled and hydrostatically tested. The water for this purpose can be taken from existing lines under the supervision of the Engineer's Inspector and leakage will be measured by the Inspector with a meter furnished by Town of Smithfield. All leaks and any defective material shall be repaired or replaced to the satisfaction of the Engineer and the tests repeated until the requirements of this specification are met. Any special equipment, pumps, etc. required to make the test shall be furnished and operated by the contractor as directed by the Inspector. The Contractor shall use great care to be sure that all air is expelled from each section under test. If fire hydrants or other openings are not available for the purpose of expelling air, the Contractor shall provide air releases of sufficient size (as determined by the Engineer) in accordance with City Standard Drawings, at his expense. Specific procedures for testing mains are as follows:
 - a. Test pressure will be 200 PSI at the low point of the section under test. When testing against butterfly valves, the differential pressure at the valve must not exceed 150 PSI for valves rated at 150 PSI. If the test cannot be made with differential pressure of 150 PSI, 250 PSI valves will be specified. Differential pressures across gate valves may be up to 200 PSI.
 - b. Allowable leakage will be determined by Table 6, AWWA C-600 or by the formula $L = .000106SD$ where S is the length of pipe under test and D is the pipe diameter.
 - c. Pressure and leakage tests will be run concurrently and for a duration of four hours except as modified below.
 - d. The Contractor will pressurize the line and verify that it is within allowable leakage before the official test is started.

- e. The Inspector will begin the test and remain at the job for the first hour, making sure that the test pressure is maintained within ± 5 PSI. The Contractor is to maintain the pressure within ± 5 PSI for the duration of the test period. At the end of the first hour, with the line pumped to full test pressure, he will read the meter and record the first hour leakage. If the first hour leakage is within allowable, he will return at the end of the fourth hour and again read the meter. If the total leakage for the four hour period does not exceed four times the first hour leakage, the test will be terminated. If the total leakage exceeds four times the first hour leakage, but is still within allowable, the test will be held an additional hour. If the fifth hour leakage does not exceed the average hourly leakage for the first four hours, the test will be terminated at the end of the fifth hour. Otherwise, the test will be held until the leakage is non-increasing and within allowable for two consecutive hours.
 - f. If leakage exceeds allowable for the four hour test, the test will be terminated and re-scheduled after the Contractor has verified that actual leakage is within the allowable leakage, but no earlier than the next work day.
 - g. If the first hour leakage does not exceed 10% of the allowable, or if the allowable leakage rate does not exceed .4 gal/hr., the test may be terminated at the end of two hours provided the second hour leakage does not exceed the first hour leakage. If the second hour leakage exceeds the first hour leakage, the test will be held for an additional period as described in Paragraph (e) above.
 - h. The maximum length of pipe tested in one test shall be 5,000 feet or as close to 5,000 feet as possible depending on valve spacing.
- C. Repairs: All leaks shall be repaired by identifying and exposing the defective section of pipe and completing repairs as follows:
- 1. PVC, VCP or Ductile Iron Pipe: Defective or damaged pipe including leaking joints shall be removed and replaced with sound new pipe. The pipe shall be re-connected with approved couplings as specified in the MS Section of this document.
 - 2. Manholes: Any damage to the interior wall of the manhole resulting from penetration of the lift holes shall be repaired with non-shrink cement grout. Leaks through manhole joints or walls or around pipe collars, may be repaired from inside the manhole with non-shrink cement grout. If the size of the leak, or the external water pressure, prevents such repairs, the manhole shall be excavated and repaired from outside. Leaks around boots or gaskets used to join pipe to manholes shall be repaired by external concrete collars or as approved by the Engineer.

3.13 CLEANING

- A. Clean dirt and superfluous material from interior of piping.

END OF SECTION

SECTION 333001
TEMPORARY BYPASS PUMPING SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION AND SCOPE

- A. The Contractor shall furnish, construct, maintain and operate bulkheads, containment system, plugs, hoses, piping, and pumps to bypass sewage flow around the project area for the duration of the project. The bypass system shall, at all times, prevent backup or overflow onto streets, yards and unpaved areas or into buildings, adjacent ditches, storm sewers, and waterways. The Contractor shall design and provide the bypass system with sufficient firm pumping capacity to pump the existing sewer being bypassed flowing full and/or to convey the flows specified further herein. Firm capacity is defined as the capacity of the pumping system when the largest pump is out of service. The Contractor is advised that during rain events the flow in the existing sewers will increase rapidly and will fill the pipe and, in many cases, surcharge the pipe.
- B. Spills of any type, including but not limited to all spills and/or leaks caused by the operation of bypass pumps or other operations of the Contractor, are strictly prohibited at all times; notwithstanding such prohibition, any such occurrence shall be reported to Town of Smithfield immediately after discovery and all costs, associated with the overflow and overflow clean up, including any fines and legal costs incurred by Town of Smithfield and costs associated with property damage as a result of the overflow, shall be paid for solely by the Contractor. Costs of damage to real or personal property as a result of an overflow, and any other direct, indirect, incidental or consequential damages resulting therefrom or related thereto, shall be the sole responsibility of the Contractor, for which the Contractor will defend, indemnify and hold Town of Smithfield harmless. In addition to these responsibilities of the Contractor, any spill that reaches a natural stream caused by the negligent operations of the Contractor may be deemed to be a substantial violation of the Contract Documents and a basis for termination under the General Conditions of this Contract.
- C. The Contractor is forewarned of the potential for sewer surges which cause rapid increases in sewer discharges, in particular during rain events and from upstream pump station on/off operations. The Contractor's bypass equipment and set up shall be adequate to prevent overflows under these surge conditions. The Contractor shall provide ample free board and wet well volume as required to contain the sewage. If risers to assist with sewage containment are proposed by the Contractor, the risers shall be coordinated with the upstream system to prevent any backups, overflows, or any other problems.

1.4 BYPASS PUMPING SYSTEM – DESIGN REQUIREMENTS

- A. The bypass pumping systems shall have sufficient capacity to pump a peak flow of the line segment to be bypassed as specified herein. The Bypass Contractor shall provide all pipeline plugs, pumps of adequate size to handle peak flow during a 10-year storm event, and temporary discharge piping to ensure that the total flow of the main can be safely diverted around the project area. The bypass pumping system will be required to be operated 24 hours a day.

- B. The Contractor shall provide back-up pump(s) equal in capacity to the largest primary pump. Back-up pumps shall be on-line but isolated from the primary system by a valve. Contractor and pump supplier shall determine system pressure requirements based on proposed bypass piping size and layout and shall submit the proposed system curve for the pumping system as designed.
- C. The bypass pumping system shall pump the following flows:
 - 1. The pumping system shall meet the firm capacity as defined as the capacity of the pumping system when the largest pump is out of service. This flow represents the peak flow during a 10-year rain event measured in the upstream sewer system over the last several years per flow metering data. If flow monitoring for the upstream sewer system is not available, it is the responsibility of the contractor to perform flow monitoring for a duration of up to 3 months minimum to size the pumping system. Flow projections shall be developed by licensed NC PE and submitted to Town of Smithfield for review and approval.
- D. If multiple force mains are used, the discharge piping shall be manifolded so the flow can be diverted to each specific pipe or any combination of pipes by quickly opening and/or closing valves. This will also allow a pipe to be isolated to make any necessary repairs.
- E. The Bypass Contractor shall have adequate standby equipment available and ready for immediate operation and tied into the bypass system for use in the event of an emergency or breakdown.
- F. Flow from all connecting sewers must be accommodated. Connecting sewers larger than 24" shall utilize hard piping and must have primary and standby sound-attenuated diesel auto-priming pumps. If connecting to the main bypass discharge line, the connection must have an isolating gate valve.
- G. Suction and Discharge Manholes: Existing manholes to be used as suction manholes and discharge manholes shall be modified by the Contractor as required. The suction manholes are subject to flooding during rain events - all modifications shall provide a leak tight manhole to prevent inflow into the manholes during flood conditions. The discharge manholes shall be sealed and protected per Paragraph 2.4C.
- H. Plugging of Flows: A minimum of two (2) plugs shall be used at each location where sewers are being plugged for bypass operations, meaning one plug shall be installed in the outgoing pipe of the manhole where the plugging occurs and then a second plug installed in the next downstream manhole in the incoming pipe. This will provide redundancy in the plugging operation for added safety. All plugs shall be restrained and reinforced to prevent movement and blowouts. The contractor shall tie-off and/or anchor plugs such that in a blowout event, the plug cannot be transported downstream.
- I. A light tower shall be provided at each suction manhole/pump setup for pump watch during overnight hours.

1.5 QUALITY ASSURANCE

- A. Any violations resulting from sewage spills shall be the sole responsibility of the Contractor.

1.6 QUALIFICATIONS

- A. The design, installation and operation of the temporary pumping system shall be the Contractor's responsibility. The Bypass Contractor (bypass pumping system contractor)

shall demonstrate to the Engineer that they specialize in the design and operation of temporary bypass pumping systems. The Bypass Contractor shall provide a minimum of five references of temporary bypass pumping projects of at least 30 million gallons per day (mgd) with at least one of the projects over 50 mgd, of a similar size and complexity as this project, performed by their firm within the past five years. The references shall include project scope of work and contact numbers and names for the Town of Smithfield and General Contractor if the work was performed as a subcontractor. Town of Smithfield reserves the right to approve or disapprove of a bypass pumping contractor based on experience or performance on other similar projects.

- B. The Bypass Contractor must have a physical location and service facility within 60 miles of the project site.
- C. All bypass pumping equipment shall be owned and maintained by the Bypass Contractor. No subleasing of bypass pumps or piping shall be allowed, approved or acceptable. Proof of ownership shall be submitted to the Engineer for review and verification. Town of Smithfield will not approve the Bypass Contractor if he/she does not own the bypass pumping equipment being furnished for this project.

In addition, all pump set up and tear down and piping installation and removal shall be performed by employees of the Bypass Contractor as documented by employee records. Subcontracting of the set up and tear down shall not be allowed.

Further, all pump and piping maintenance, repairs, pump watch (manning of pumps 24 hours per day), etc. shall be performed by employees of the Bypass Contractor as documented by employee records. Subcontracting of these duties (and any other duties related to the bypass pumping system) shall not be allowed.

1.7 SUBMITTALS

- A. The Contractor shall coordinate with the Engineer to determine the required Bypass System and the type and number of pumps to be used. For bypass pumping systems, Contractor shall submit, prior to installation, a detailed plan and description outlining all details and provisions of the temporary bypass pumping system. The plan shall be specific and complete, including such items as schedules, locations, elevations, type of plugs, plug restraints and blocking, temporary piping, capacities of equipment, instrumentation and controls, alarm systems, communication systems, soundproof enclosures, materials, precautions taken regarding handling the wastewater flow, and all other incidental items necessary and/or required to ensure proper operation of the bypass pumping system, including protection of the access and bypass pumping locations from damage due to the discharge flows, ability to pump dry weather and wet weather flows, and compliance with the requirements and permit conditions specified in these Contract Documents. No bypass pumping shall begin until all provisions and requirements have been reviewed and approved by Town of Smithfield.
- B. The design of the temporary bypass system shall be sealed by a North Carolina licensed Professional Engineer. The bypass pumping plan shall include, but not be limited to, the following:
 - 1. Overall sequence of construction for bypass pumping system;
 - 2. General layout for the bypass pumping system including locations and staging areas for pumps and piping locations/routes;

3. Modifications to existing sewer manholes and structures to perform the bypass pumping and restoration to such structures upon completion;
4. Modifications to existing sewer manholes and structures such that the manhole covers are elevated to the 100-year base flood elevation plus 1-foot.
5. Suction and Discharge Piping:
 - a. Drawings showing the alignment of the bypass pipes;
 - b. Flow stoppage system, including pipe and channel plugging method, types of plugs, plug materials, size of plugs, plug restraints and blocking, location and number of proposed tie-off and/or anchors used to prevent movement or blowouts for plugs;
 - c. Details of suction piping including number, size, materials, fittings including quick disconnects, connections to other piping, method of installation, and all other details related to the pump suction piping;
 - d. Details of discharge piping including number, size, materials, fittings including quick disconnects, connections to other piping, method of installation, details of the discharge location and piping arrangement at that location, and all other details related to the pump discharge piping;
 - e. Sections showing suction and discharge piping depth, embedment, select fill and special backfill;
 - f. Restraint systems for piping including thrust and restraint block sizes and locations and/or retraining systems on the piping;
 - g. Any temporary pipe supports and anchoring required;
 - h. Show force main pipe material and thickness can withstand all normal operating and surge pressures with a safety factor of 2.0;
 - i. Protection against main breaks and damage;
 - j. Method of protecting discharge manholes or structures from erosion and damage;
 - k. Schedule for installation of and maintenance of bypass pumping lines.
6. Bypass Pumps
 - a. Bypass pump sizes, capacity, number of each size to be on site, basis of selection (calculations), and power requirements;
 - b. Calculations of static lift, friction losses, and flow velocity (pump curves showing pump operating range shall be submitted) for each set up;
 - c. Size and location of standby power generators and diesel storage and access plan if engine driven equipment is to be provided, or plan for suitable connection to existing electrical gear, if electrical power is to be provided;
 - d. Elevation of bypass pumps, standby power generators and diesel storage base compared to the 100-year flood base elevation;
 - e. Design plans for access to bypass pumping locations;

- f. Method of noise control for each pump and/or generator including primary sound enclosures and sound blankets;
 - g. Fuel tank location, size, and containment systems;
 - h. Fuel consumption rate information (include for proposed pumps, at full capacity, include breakdown for one pump running, two pumps running, etc.);
 - i. Instrumentation and control system to determine flow levels and to eliminate the risk of spills due to improper installation and operations. The instrumentation and control system submitted by the Contractor for approval by Town of Smithfield shall include all equipment proposed (including redundant instrumentation and control equipment) and sequences of instrumentation activation as well as all alarms and fail-safe provisions.
- 7. Continuous on-site monitoring plan;
 - 8. Traffic control requirements and measures are to be employed throughout the project.
 - 9. General contact and emergency contact information for all personnel responsible for the operations and maintenance of the bypass pumping operations.

1.8 PLAN APPROVAL

- A. Completed Bypass Pumping Plans shall be submitted to Town of Smithfield for review and approval 30 days prior to any proposed bypass pumping operations.
- B. Contractor shall provide full list of employees on watch, schedule, and contact information for each. The list shall include a hierarchy of who is to be notified in the event of an emergency.

PART 2 - PRODUCTS

2.1 BYPASS PUMPING EQUIPMENT

- A. The pumps used must be manufactured by a company that is ISO 9001 registered with a RAB (registration accreditation board) accredited third party registrar. The pump manufacturer shall to also be ISO 9001 certified for Engineering Design Services and After Market Service. A copy of the ISO 9001 certificate shall be included with the bypass pump submittal to the Engineer.
- B. Pumps shall be dry self-priming type, in good working order, with a working pressure gauge on the discharge. All pumps used shall be fully automatic self-priming units that do not require the use of foot-valves or vacuum pumps in the priming system. All pumps used must be constructed to allow dry running for long periods of time to accommodate the cyclical nature of wastewater flows. The pumping equipment shall be sound attenuated as specified herein and be mounted on an environmental skid which has the capacity of containing any and all hazardous fluids utilized within the engine compartment. All diesel-driven engines must be Tier 3 or newer.
- C. Pumps may either be engine driven equipment or electrically driven equipment. Contractor shall be responsible for all power costs associated with provision and operation of engine driven equipment including but not limited to purchase and delivery of fuel. Contractor shall be responsible for providing all equipment and connections required to provide electrically driven equipment and for protecting the power feed. If diesel powered

pumps are provided, Contractor shall store sufficient fuel on site to allow for 72 hours of continuous operation without fuel delivery. 72 hours of continuous operation shall be based on 24 hours of operation at the system's firm capacity. The fuel shall be stored responsibly above the 100-year base flood elevation with self-containment and where possible shall not be located in a floodplain.

- D. Pumps shall meet the requirements of the governing municipality's noise ordinance. All pumps shall be Quiet Flow™, Critically Silenced™ or sound attenuated to 68 dBA at 23 feet. Pumps shall be provided with a pre-engineered sound attenuation enclosure. Sound blankets shall not be acceptable for primary noise attenuation, but sound blankets may also be required around the entire bypass pumping system if noise becomes an issue. If required, the sound blankets shall be free standing and 12-ft high minimum, shall have Class 1 flammability per ASTM E-84 and shall reduce sound by at least 10 dB at 125 Hz.
- E. Contractor shall provide the necessary stop/start controls for each pump. The stop/start control shall be an integral part of the engine control panel. For bypassing sewers greater than 24" and when using 6-inch pumps and larger, transducers are required to maintain the proper surcharge levels in the sewer line.
- F. Contractor shall provide level control device to allow pumps to ramp up and down in response to incoming sewage flow. Provide standby level control device to alarm high liquid level and to start pumps. The level control devices shall be designed to operate for a minimum of 24 hours on battery backup in the event of power failure.
- G. All pumps shall be manned 24 hours per day when operational. The Engineer will not consider allowing the use of auto dialers to report pumping system emergency conditions. Full time telemetry is required, and interface with Town of Smithfield may be required. All proposed auto-dialer information is to be submitted to Town of Smithfield for review and approval.
- H. Alarm systems shall be local (flashing light) and shall also activate the auto dialer. At a minimum, the following alarms shall be reported:
 - 1. High liquid level in the bypass pumping suction manhole with level control device.
 - 2. Engine failure
 - 3. Power failure
- I. Town of Smithfield shall be notified immediately if the bypass pumping system is unable to keep up with the incoming flow, regardless of the reason.
- J. The local alarm and level control devices shall be designed to operate for a minimum of 24 hours on battery backup in the event of power failure.

2.2 FORCE MAIN PIPING

- A. All discharge piping shall be rigid piping with positive, restrained joints. Allowable piping materials shall be fused, high-density polyethylene pipe (HDPE) as manufactured by Phillips Driscopipe, Inc. or equal, with a minimum wall thickness equaling SDR26 or PVC Pressure Pipe as manufactured by Certa-Lok or approved equal. Under no circumstances will aluminum "irrigation" type piping, glued PVC pipe or soft (lay-flat) hose be allowed.

All fused joints shall be performed by a certified operator (certified by a manufacturer of pipe fusion equipment). An appropriately sized fusion machine shall remain on site throughout the duration of the project to address any emergency pipe repair issues.

- B. The force main piping shall be designed and rated for at least 1.25 times the maximum system pressure. The maximum velocity in the suction and discharge piping shall be 10 feet per second. The Contractor shall be responsible for all design calculations and shall be responsible for securing and protecting all force main piping in any manner required by Town of Smithfield, Engineer or other controlling agency. The discharge piping shall be protected from pedestrian and vehicular traffic. Contractor shall add additional protection as deemed necessary to fully protect the piping at no additional cost to Town of Smithfield. Design of the force main piping in accordance with these specifications shall be documented, including calculations, and submitted to Town of Smithfield for approval.
- C. Contractor shall provide a temporary cast iron or steel cover over the bypass pumping suction manhole and discharge manhole to safeguard the manholes, to prevent inflow and to minimize odors. At the discharge manhole, the Contractor shall route the discharge piping down into the manhole and shall install 90-degree bends on the end of the piping to direct the flow out of the discharge manhole and heading downstream. The piping arrangement shall be such that the flow is not vertically directed. This piping arrangement will help to direct the flow and minimize turbulence (and odors) in the discharge manhole.
- D. A flow meter shall be installed on the discharge piping to continuously document the flow rate being pumped. The flow meter shall be continuously reviewed by the Contractor and compared to the pump curves submitted by the Contractor to confirm that the bypass pumping system is operating as designed and expected. If the bypass pumping system is not pumping as designed and submitted, the Contractor shall take immediate actions to modify and correct the situation in manner approved by the Engineer. If at any time the bypass pumps are not keeping up with the flow and the specified pumping rate is not being achieved and the situation cannot be immediately resolved, the Contractor shall cease all pumping operations, return the flow to gravity through the existing sewer, and re-design the pumping system.

PART 3 - EXECUTION

3.1 BYPASS SYSTEM

- A. Town of Smithfield shall have the authority to increase normal working hours of the Contractor during bypass pumping operations.
- B. Bypass System shall be comprised of a bypass pumping system combined with temporary piping to convey flow in the existing sewers.
- C. It is essential to the operation of the existing sewerage system that there is no interruption in the flow of sewage throughout the duration of the project. To this end, the Contractor shall provide, maintain and operate all temporary facilities such as dams, plugs, pumping equipment (both primary and back-up units as required), piping, all necessary power, and all other labor and equipment necessary to intercept the sewage flow before it reaches the point where it would interfere with the work, carry it past the work, and return it to the existing sewer downstream of the work.
- D. The Bypass Contractor shall provide all necessary means to safely convey the sewage past the work area. The Bypass Contractor will not be permitted to stop or impede the main flows under any circumstances. The Bypass Contractor shall maintain sewer flow around the work area in a manner that will protect public and private property from flooding and damage.

- E. The Bypass System shall be leak free and shall (at a minimum) maintain the required firm pumping capacity. The Bypass System shall provide reliable and trouble free pumping of the existing wastewater flow. All local alarms shall be readily visible to and accessible by Town of Smithfield.
- F. If, at any time during construction, effluent from the existing sewer is not fully contained by the bypass system and/or the bypass system is not keeping up with the flow, gravity service shall be restored immediately, and work shall be suspended until the problem is resolved to the satisfaction of the Engineer. Sewer system overflows will not be tolerated. All fines imposed on Town of Smithfield associated with overflows caused by the Contractor's work shall be paid by the Contractor.
- G. Odor Issues: If odor complaints occur at any time during the Contract, the Contractor shall take immediate measures to minimize the odor. It will be the Contractor's sole responsibility and cost to do all that is necessary to resolve the odor issues, including revising any bypass pumping layouts/configurations and adding odor control measures (such as chemical additions).

3.2 FIELD QUALITY CONTROL AND MAINTENANCE

- A. The Contractor shall provide at least one (1) trained employee to man the bypass pumping system continuously while the pumps are in use to monitor the system and check for alarms and leaks. At no time during the bypass pumping operations shall the system be unmanned.
- B. System Testing:
 - 1. The Bypass Contractor shall perform leakage and pressure tests of the bypass pumping discharge piping using clean water prior to actual operation. The Engineer shall be given 24 hours' notice prior to testing.
 - 2. Test pressure shall be 1.25 times the maximum system operating pressure. The test must hold pressure for a minimum of 1 hour.
 - 3. The bypass design operating pressure must not exceed 10 PSI below the max pressure rating of the HDPE.
- C. Contractor shall inspect the bypass discharge piping system a minimum of every two (2) hours to ensure no damage or leaks. All leaks must be addressed immediately. Flow shall be diverted off of the leaking piping immediately until repairs are made. The Contractor shall document each inspection and shall submit the inspection logs to the Engineer at the end of each week (or more frequently as required by the Engineer).
- D. Contractor shall inspect the pump operation a minimum of every two (2) hours to ensure trouble-free and leak free operation. A monitoring log shall be maintained by the Contractor and available for observation by the Engineer/Town of Smithfield upon request. All systems, piping, pumps, air vents, monitoring equipment, valves, plugs, security measures, level indicating devices and all related appurtenances associated with the bypass system shall be continuously and regularly monitored for proper and leak free operation.
- E. Contractor shall record the following information every ½ hour in the monitoring log:
 - 1. System Discharge Pressure
 - 2. Pump RPM
 - 3. Suction Manhole surcharge level

4. Plug Pressure
 5. Fuel levels
 6. Flow
- F. Any time the bypass pumping system is operating, the Contractor shall continuously perform the following maintenance services:
1. The Bypass Contractor shall insure that the temporary pumping system is properly maintained. At least one (1) trained pump watch employee (with a fully stocked service vehicle) shall be onsite 24/7 when pumps are operating.
 2. The trained employee shall be full time employees of the bypass contractor with at least one year experience with bypass pumping. No temporary employees are permitted to operate or watch the bypass.
- G. Spare Parts and Extra Materials:
1. Spare parts for each type of pump and piping shall be kept on site.
 2. HDPE repair bands for each size HDPE shall be kept on site.
 3. At least one (1) extra plug of each size utilized in the bypass pumping setup.
 4. At least one (1) fuel filter.
 5. At least one (1) pipe repair clamp shall be on site at all times.
- H. In the event of accidental spill or overflow, Contractor shall take all necessary actions immediately to stop the spill or overflow and take action to clean up, disinfect the spill and immediately notify Town of Smithfield. Disinfection shall include, but is not limited to, removal of all debris, pumping of any excess overflow back into the system, neutralization by raking and liming. Town of Smithfield will provide the Contractor with a call-down emergency list for contacts in the event of a spill or overflow. All bypass system abnormalities, operational changes, maintenance, and repairs shall be reported immediately to the Engineer and Town of Smithfield. All alarms shall be responded to in person by qualified Contractor's personnel immediately.

3.3 INSTALLATION AND REMOVAL

- A. Contractor shall locate the bypass pipelines to minimize any disturbance to existing utilities and site areas (such as trees) and shall obtain approval of the pipeline locations from the Engineer.
- B. The Contractor shall remove manhole sections or make connections to the existing sewer and construct temporary bypass pumping structures only at access locations as approved by the Engineer and as may be required to provide adequate suction conduit.
- C. Plugging or blocking of sewage flows shall incorporate a primary and secondary plugging device. When plugging or blocking is no longer needed for performance and acceptance or work, it is to be removed in a manner that permits the sewage flow to slowly return to normal without surge, to prevent surcharging or causing other major disturbances downstream.
- D. During all bypass pumping operation, the Contractor shall protect existing structures, equipment and piping from damage inflicted by any equipment. The Contractor shall be

responsible for all physical damage to the existing structures, equipment and piping caused by human or mechanical failure.

- E. When working inside existing structures, the Contractor shall exercise caution and comply with all federal, state, and local occupational safety and health standards when working in the presence of gases, combustible or oxygen-deficient atmospheres, and confined spaces.
- F. The Contractor shall notify the Engineer at least 48 hours prior to initial startup and/or to any significant changes to the bypass system. This includes moving pumps and/or piping, installing or removing plugs, starting a new bypass location, ceasing an existing bypass location, reestablishing gravity flow, etc. The Engineer must inspect and approve the existing layout and all pumping equipment at each significant change to the bypass system. A bypass pumping checklist addressing all relevant features of the bypass system shall be generated by the Contractor and approved by the Engineer. The bypass pumping checklist shall be completed by both the Contractor and Engineer prior to the startup of any bypass pumping operations and/or to any significant changes to the bypass system.
- G. When the bypass piping crosses local streets and private driveways, the Contractor must bury the bypass pipelines in trenches, cover with flowable fill or ABC stone, and install asphalt patches per the Standard Specifications and Details. Steel road plates may be used for short periods of time until the asphalt can be installed. Bypass road ramps will only be allowed if specifically approved by the Engineer. Upon completion of the bypass pumping operations, and after the receipt of written approval of the Engineer, the Contractor shall remove all the piping, restore all property to pre-construction condition and restore all pavement in accordance with the standard specifications and details.
- H. When bypass pumping operations are complete, piping shall be drained and flushed into the sewer system prior to disassembly. The piping shall be flushed for a period long enough to ensure that all piping is clean and free from wastewater. All pumps, piping, fittings, thrust blocks, etc. shall be removed from the site upon project completion.

END OF SECTION

SECTION 400565 VALVES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Combination Air/Vacuum Release Valve
 - 2. Plug Valve

1.03 DEFINITIONS

- A. (ANSI) American National Standards Institute
- B. (ASTM) American Society for Testing and Materials
- C. (AWWA) American Water Works Association

1.04 SUBMITTALS

- A. Submit detailed product data and descriptive literature including dimensions, weights, headloss data, pressure rating and materials of construction.
- B. Provide shop drawings which clearly illustrate the general arrangement of the equipment and cross-sectional views of the components.

1.05 QUALITY ASSURANCE

- A. Supplier shall have been manufacturing valves of the type specified for a period of at least ten (10) years and shall, at the Engineer's request, provide a list of installations involving equipment of similar size and application.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 PRODUCTS

2.01 COMBINED AIR RELEASE AND VACUUM RELIEF VALVE

- A. Manufacturer
 - 1. Valves shall be as manufactured by Vent-O-Mat, International Valve, ARI, or approved equal.
- B. Valve body and all inner metal parts shall be 316 stainless steel.
- C. Valves shall be of the quick-opening, slow-closing type and may be standard height or short body design with a minimum 2-inch diameter screw-threaded inlet.
- D. Valve body shall have a removable bonnet secured with 316 stainless steel fasteners to facilitate maintenance of the internal working parts. Outlet is to be screw-threaded.
- E. Air and vacuum sewer valves shall be mounted to force main through the use of a bronze corporation stop and stainless steel tapping saddle followed by a stainless steel ball valve.

2.02 ECCENTRIC PLUG VALVE

- A. Manufacturer
 - 1. Plug valves shall be as manufactured by Dezurik only, due to standardization of spare parts.
- B. Plug valves shall be non-lubricated, with a plug facing of a material specifically recommended by the valve manufacturer for the indicated service and shall have stainless steel permanently lubricated upper and lower plug stem bearings. Valve seats shall be nickel. Valves shall be designed with adjustable seals that are replaceable without removing the bonnet. The bearing and seal area shall be protected with grit seals. Valves shall be factory coated with fusion-bonded epoxy. Area of port opening for all valves shall be no less than 100% of full pipe area. Valves shall have a direct pressure rating of 100 psi with a working pressure of 175 psi for 12-inch and smaller valves and 150 psi for 14-inch and larger valves. Bi-directional shutoff is required.
- C. All valve components/materials of construction to be Stainless Steel if optional materials are available.
- D. Valves with flange ends shall be provided where indicated. Flanges shall be in accordance with ANSI B16.1 except that the four holes straddling the principal axis of the valve may be tapped and connected to the adjacent piping with cap screws of adequate size as recommended by the valve manufacturer and approved by the Engineer.
- E. Plug valve operation shall be as indicated on the Plans and as follows:

1. All exposed valves in vaults shall have hand wheels and open to left.
 2. Buried valves shall have 2-inch square operating nuts.
 3. All valves require gearing in enclosed gear cases. Gearing shall be in accordance with the valve manufacturer's recommendations as required to permit easy operation of the valve by one man without excessively large hand wheel or cranks. Hand wheels shall not exceed 16 inches in diameter.
- F. Extension stems, stem guides, operating levers, and other miscellaneous items required for a complete installation shall be provided in accordance with the requirements and recommendations of the valve manufacturer. Operating nut shall be within 12" of grade.
- G. Discharge valves in vault shall be installed with adjustable aluminum pipe cradle and stainless steel standpipe. Buried valves shall be provided with a valve box. The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the operating nut, with the box cover flush with the surface of the pavement or other existing surface. Where the box is not set in pavement, the top section shall be anchored by a concrete pad, or an approved precast concrete pad, set flush with the existing terrain. The top section will be encased into the concrete pad.
- H. Valves shall be LEFT opening and RIGHT closing.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE INSTALLATION

- A. Valves shall be installed in accordance with the manufacturer's written Installation and Operation Manual and approved submittals.
- B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- C. Locate valves for easy access and provide separate support where necessary.

- D. Install valves in horizontal piping with stem at or above center of pipe.
- E. Install valves in position to allow full stem movement.

3.03 TESTING AND ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if leaking occurs.
- B. Witness Testing: All Plug Valves shall be witness tested with TOWN OF SMITHFIELD staff present. All costs associated with witness testing shall be borne by the bidding contractor. The results of all witness testing shall be maintained as part of the construction record documentation.

END OF SECTION

PERMITS

TOWN OF SMITHFIELD
PUMP STATION #1 FORCE MAIN IMPROVEMENTS
Town of Smithfield, North Carolina

NCDEQ Fast Track Sewer Extension

JOSH STEIN
Governor

D. REID WILSON
Secretary

RICHARD E. ROGERS, JR.
Director



February 12, 2025

Ted Credle, Director of Public Utilities
Town of Smithfield
230 Hospital Road
Smithfield, NC 27577

Subject: Permit No. WQ0046037
Town of Smithfield
Town of Smithfield Pump Station #1 and Force Main Improvements
Wastewater Collection System Extension Permit
Johnston County

Dear Permittee:

In accordance with your application received December 3, 2024, and additional information received on January 31, 2025, we are forwarding herewith Permit No. WQ0046037 dated February 12, 2025, to the Town of Smithfield (Permittee) for the construction and operation upon certification of the subject wastewater collection system extension. This permit shall be effective from the date of issuance until rescinded, and shall be subject to the conditions and limitations as specified therein. This cover letter shall be considered a part of this permit and is therefore incorporated therein by reference.

This permit replaces various known and unknown permitted infrastructure for the pump station and force main, and adds additional force main lengths totaling 10,000 linear feet. Once the new facility is built, the permittee will request to rescind WQ0017594 before operation.

Please pay particular attention to the special conditions and following standard conditions contained in this permit:

- Condition II.1: This permit shall not be automatically transferable; a request must be made and approved.
- Condition II.4: Requires that the wastewater collection facilities be properly operated and maintained in accordance with 15A NCAC 02T .0403 or any individual system-wide collection system permit issued to the Permittee.
- Condition II.7: Upon completion of construction and prior to operation of these permitted facilities, the completed Engineering Certification form with checklist attached to this permit shall be submitted with the required supporting documents to the address provided on the form. **Permit modifications are required for any changes resulting in non-compliance with this permit, regulations, or the Minimum Design Criteria.** [15A NCAC 02T.0116]



North Carolina Department of Environmental Quality | Division of Water Resources
Raleigh Regional Office | 3800 Barrett Drive | Raleigh, North Carolina 27609
919.791.4200

Town of Smithfield

Permit No. WQ0046037

It shall be the responsibility of the Permittee to ensure that the as-constructed project meets the appropriate design criteria and rules. Failure to comply may result in penalties in accordance with North Carolina General Statute §143-215.6A through §143-215.6C, construction of additional or replacement wastewater collection facilities, and/or referral of the North Carolina-licensed Professional Engineer to the licensing board.

If any parts, requirements, or limitations contained in this permit are unacceptable, you have the right to request an adjudicatory hearing upon written request within 30 days following receipt of this permit. This request must be in the form of a written petition, conforming to Chapter 150B of North Carolina General Statutes, and filed with the Office of Administrative Hearings, 6714 Mail Service Center, Raleigh, NC 27699-6714. Unless such demands are made, this permit shall be final and binding.

If you need additional information concerning this matter, please contact the Raleigh Regional Office via e-mail at DEQ.DWR.RRO.FastTracks@deg.nc.gov or 919-791-4200.

Sincerely,

Signed by:

372DCBCB61EE4A8...

Michael Hall, Regional Supervisor
Water Quality Regional Operations Section
Raleigh Regional Office
Division of Water Resources, NCDEQ

cc: Robert Bernard, PE; Stantec Consulting Services Inc
Johnston County
Johnston County Health Department
DWR Laserfiche



WASTEWATER COLLECTION SYSTEM EXTENSION PERMIT

In accordance with the provisions of Article 21 of Chapter 143, General Statutes of North Carolina as amended, and other applicable Laws, Rules, and Regulations, permission is hereby granted to the

Town of Smithfield
Johnston County

for the construction and operation of a 2,200–gallon per minute pump station with duplex pumps, on-site audible and visual high water alarms, telemetry, and a permanent generator with automatic transfer switch; as well as approximately 10,000 linear feet of 20-inch force main to serve residential homes, schools, day cares, food and drink facilities, businesses, offices, retail stores, factories, and church as part of the Town of Smithfield Pump Station #1 and Force Main Improvements project, and the discharge of zero “0” gallons per day (flow is permitted under upstream connections) of collected domestic and commercial wastewater into the Johnston County’s existing sewerage system, pursuant to the application received December 3, 2024, and additional information received on January 31, 2025 and in conformity with 15A NCAC 02T; the Division’s Gravity Sewer Minimum Design Criteria adopted February 12, 1996 and updated in March 2008, as applicable; the Division’s Minimum Design Criteria for the Fast-Track Permitting of Pump Stations and Force Mains adopted June 1, 2000 as applicable; and other supporting data subsequently filed and approved by the Department of Environmental Quality and considered a part of this permit.

This permit replaces the existing permit’s (WQ0017594) 600-GPM duplex pumps with 2,200-GPM duplex pumps, replaces force main from an unknown permit, and add new force main totaling 10,000 linear feet. Once the new facility is built, the permittee will request to rescind WQ0017594 prior to operation.

This permit shall be effective from the date of issuance until rescinded and shall be subject to the specified conditions and limitations contained therein.

Signed by:

372DCBCB61EE4A8...

Michael Hall, Regional Supervisor
Water Quality Regional Operations Section
Raleigh Regional Office
Division of Water Resources, NCDEQ

Permit Number: WQ0046037
Permit Issued: February 12, 2025

SUPPLEMENT TO PERMIT COVER SHEET

Town of Smithfield is hereby authorized to:

Construct, and then operate upon certification the aforementioned wastewater collection extension. The sewage and wastewater collected by this system shall be treated in the Johnston County's Central Johnston County Outfall 1 Wastewater Treatment Facility in accordance with Permit Number NC0030716.

Permitting of this project does not constitute an acceptance of any part of the project that does not meet 15A NCAC 02T; the Division's Gravity Sewer Minimum Design Criteria adopted February 12, 1996 as applicable; and the Division's Minimum Design Criteria for the Fast-Track Permitting of Pump Stations and Force Mains adopted June 1, 2000 as applicable, unless specifically mentioned herein. Division approval is based on acceptance of the certification provided by a North Carolina-licensed Professional Engineer in the application. It shall be the Permittee's responsibility to ensure that the as-constructed project meets the appropriate design criteria and rules.

Construction and operation is contingent upon compliance with the Standard Conditions and any Special Conditions identified below.

I. SPECIAL CONDITIONS

1. This permit shall become voidable unless the agreement between Town of Smithfield and Johnston County for the collection and final treatment of wastewater is in full force and effect. [15A NCAC 02T.0304(g)]
2. No flow in excess of the quantity permitted herein, zero additional GPD, shall be made tributary to the subject sewer system until an application for permit modification for an increase in flow or a new upstream application with flow has been submitted to and approved by the Division. [15A NCAC 02T.0304(b)]
3. Each pump station shall be clearly and conspicuously posted using a weatherproof sign with a pump station identifying name/number, 24-Hour Emergency telephone number, and name of the owner/operator of the sewer system/pump station and instructions to call the number in the event of alarm activation or other emergency. Simplex pump stations or vacuum sewer pits serving a single-family residence may have a placard or sticker on the control panel in lieu of a sign. [15A NCAC 02T .0305(h)(2)]
4. The abandonment of any existing wastewater facilities including septic systems being replaced by new sewer infrastructure shall be done in accordance with the applicable agency having compliance oversight on such facilities.

II. STANDARD CONDITIONS

1. This permit shall not be transferable. In the event there is a desire for the wastewater collection facilities to change ownership, or there is a name change of the Permittee, a formal permit request shall be submitted to the Division accompanied by documentation from the parties involved, and other supporting materials as may be appropriate. The approval of this request shall be considered on its merits and may or may not be approved. [15A NCAC 02T.0116; G.S 143-215.1(d3)]

2. This permit shall become voidable unless the wastewater collection facilities are constructed in accordance with the conditions of this permit; 15A NCAC 02T; the Division's Gravity Sewer Minimum Design Criteria adopted February 12, 1996 as applicable; the Division's Minimum Design Criteria for the Fast-Track Permitting of Pump Stations and Force Mains adopted June 1, 2000 as applicable; and other supporting materials unless specifically mentioned herein. [15A NCAC 02T.0110]
3. This permit shall be effective only with respect to the nature and volume of wastes described in the application and other supporting data. [15A NCAC 02T .0110]
4. The wastewater collection facilities shall be properly maintained and operated at all times. The Permittee shall maintain compliance with an individual system-wide collection system permit for the operation and maintenance of these facilities as required by 15A NCAC 02T .0403. If an individual permit is not required, the following performance criteria shall be met:
 - a. The sewer system shall be effectively maintained and operated at all times to prevent discharge to land or surface waters, and to prevent any contravention of groundwater standards or surface water standards.
 - b. A map of the sewer system shall be developed and shall be actively maintained.
 - c. An operation and maintenance plan including pump station inspection frequency, preventative maintenance schedule, spare parts inventory and overflow response has been developed and implemented.
 - d. Pump stations that are not connected to a telemetry system shall be inspected every day (i.e. 365 days per year). Pump stations that are connected to a telemetry system shall be inspected at least once per week.
 - e. High-priority sewer lines shall be inspected at least once per every six-months and inspections are documented.
 - f. A general observation of the entire sewer system shall be conducted at least once per year.
 - g. Overflows and bypasses shall be reported to the appropriate Division regional office in accordance with 15A NCAC 2B .0506(a), and public notice shall be provided as required by North Carolina General Statute §143-215.1C.
 - h. A Grease Control Program is in place as follows:
 1. For public owned collection systems, the Grease Control Program shall include at least biannual distribution of educational materials for both commercial and residential users and the legal means to require grease interceptors at existing establishments. The plan shall also include legal means for inspections of the grease interceptors, enforcement for violators and the legal means to control grease entering the system from other public and private satellite sewer systems.
 2. For privately owned collection systems, the Grease Control Program shall include at least bi-annual distribution of grease education materials to users of the collection system by the permittee or its representative.
 3. Grease education materials shall be distributed more often than required in Parts (1) and (2) of this Subparagraph if necessary to prevent grease-related sanitary sewer overflows.
 - i. Right-of-ways and easements shall be maintained in the full easement width for personnel and equipment accessibility.

- j. Documentation shall be kept for Subparagraphs (a) through (i) of this Rule for a minimum of three years with exception of the map, which shall be maintained for the life of the system.
5. The Permittee shall report by telephone to a water resources staff member at the [Raleigh](#) Regional Office, telephone number (919) 791-4200, as soon as possible, but in no case more than 24 hours, following the occurrence or first knowledge of the occurrence of either of the following:
- a. Any process unit failure, due to known or unknown reasons, that renders the facility incapable of adequate wastewater transport, such as mechanical or electrical failures of pumps, line blockage or breakage, etc.; or
 - b. Any SSO and/or spill over 1,000 gallons; or
 - c. Any SSO and/or spill, regardless of volume, that reaches surface water

Voice mail messages or faxed information is permissible, but this shall not be considered as the initial verbal report. Overflows and spills occurring outside normal business hours may also be reported to the Division of Emergency Management at telephone number (800) 858-0368 or (919) 733-3300. Persons reporting any of the above occurrences shall file a spill report by completing and submitting Part I of Form CS-SSO (or the most current Division approved form) within five days following first knowledge of the occurrence. This report must outline the actions taken or proposed to be taken to ensure that the problem does not recur. Part II of Form CS-SSO (or the most current Division approved form) can also be completed to show that the SSO was beyond control. [G.S. 143-215.1C(a1)]

- 6. Construction of the gravity sewers, pump stations, and force mains shall be scheduled so as not to interrupt service by the existing utilities nor result in an overflow or bypass discharge of wastewater to the surface waters of the State. [15A NCAC 02T.0108(b)]
- 7. Upon completion of construction and prior to operation of these permitted facilities, the completed Engineering Certification form with checklist attached to this permit shall be submitted with the required supporting documents to the address provided on the form. A complete certification is one where the form is fully executed and the supporting documents are provided as applicable. Any wastewater flow made tributary to the wastewater collection system extension prior to completion of this Engineer's Certification shall be considered a violation of the permit and shall subject the Permittee to appropriate enforcement actions.

If the permit is issued to a private entity with an Operational Agreement, then a copy of the Articles of Incorporation, Declarations/Covenants/Restrictions, and Bylaws that have been appropriately filed with the applicable County's Register of Deeds office shall be submitted with the certification.

A complete certification is one where the form is fully executed and the supporting documents are provided as applicable. Supporting documentation shall include the following:

- a. One copy of the project construction record drawings (plan & profile views of sewer lines & force mains) of the wastewater collection system extension. Final record drawings should be clear on the plans or on digital media (CD or DVD disk) and are defined as the design drawings that are marked up or annotated with after construction information and show required buffers, separation distances, material changes, etc.
- b. One copy of the supporting applicable design calculations including pipe and pump sizing, velocity, pump cycle times, and level control settings, pump station buoyancy, wet well storage,

surge protection, detention time in the wet well, and force main, ability to flush low points in force mains with a pump cycle, and downstream sewer capacity analysis. If a portable power source or pump is dedicated to multiple stations, an evaluation of all the pump stations' storage capacities and the rotation schedule of the portable power source or pump, include travel timeframes, shall be provided.

- c. Changes to the project that do not result in non-compliance with this permit, regulations, or the Minimum Design Criteria should be clearly identified on the record drawings, on the certification in the space provided, or in written summary form.

Prior to Certification (Final or Partial): Permit modifications are required for any changes resulting in non-compliance with this permit (including but not limited to pipe length changes of 10% or greater, increased flow, pump station design capacity design increases of 5% or greater, and increases in the number/type of connections), regulations, or the Minimum Design Criteria.

Requested modifications or variances to the Minimum Design Criteria will be reviewed on a case-by-case basis and each on its own merit. Please note that variances to the Minimum Design Criteria should be requested and approved during the permitting process prior to construction. After-construction requests are discouraged by the Division and may not be approved, thus requiring replacement or repair prior to certification & activation. [15A NCAC 02T .0116]

8. Gravity sewers installed greater than ten percent below the minimum required slope per the Division's Gravity Sewer Minimum Design Criteria shall not be acceptable and shall not be certified until corrected. If there is an unforeseen obstacle in the field where all viable solutions have been examined, a slope variance can be requested from the Division with firm supporting documentation. This shall be done through a permit modification with fee. Such variance requests will be evaluated on a case-by-case basis. Resolution of such request shall be evident prior to completing and submitting the construction certification. [15A NCAC 02T.0105(n)]
9. A copy of the individual permit and construction record drawings shall be maintained on file by the Permittee for the life of the wastewater collection facilities. [15A NCAC 02T .0116]
10. Failure to abide by the conditions and limitations contained in this permit; 15A NCAC 02T; the Division's Gravity Sewer Design Criteria adopted February 12, 1996 as applicable; the Division's Minimum Design Criteria for the Fast-Track Permitting of Pump Station and Force Mains adopted June 1, 2000 as applicable; and other supporting materials may subject the Permittee to an enforcement action by the Division, in accordance with North Carolina General Statutes §143-215.6A through §143-215.6C, construction of additional or replacement wastewater collection facilities, and/or referral of the North Carolina-licensed Professional Engineer to the licensing board. [15A NCAC 02T .0108(b-c)]
11. In the event that the wastewater collection facilities fail to perform satisfactorily, including the creation of nuisance conditions, the Permittee shall take immediate corrective action, including those as may be required by this Division, such as the construction of additional or replacement facilities. [15A NCAC 02T .0110; 15A NCAC 02T .0108(b)]
12. The issuance of this permit shall not exempt the Permittee from complying with any and all statutes, rules, regulations, or ordinances that may be imposed by the Division any other Federal, State, or Local government agencies which have jurisdiction or obtaining other permits which may be required by the Division or any other Federal, State, of Local government agencies. [G.S. 143-215.1(b)]

CERTIFICATION CHECKLIST

To be completed by the certifying engineer prior to operation of the permitted sewers, per 15A NCAC 02T.0116.

Certifying Engineer: _____

Certification Review Date: _____

Project Name: _____

WQ00 _____ **Project County:** _____

- 1) Has permittee information changed since the permit was issued (or last modified): change of mailing address, change of ownership, transfer from developer to HOA/POA, etc. ☐ Yes ☐ No
 - If yes, please provide either a change of ownership form or new contact information. Note that transfer of permits from the developer to the HOA/POA must occur with the first certification.
 - 2) Have the as-built drawings have been signed, sealed, and dated by an N.C. PE? ☐ Yes ☐ No
 - 3) Final Engineering certification? ☐ Yes ☐ No
 - **If Partial Engineering certification, provide detailed narrative including what is being certified in the current phase, what was previously certified (if applicable), and what is left to be certified.**
 - 4) Adequate information related to sewer lines: ☐ Yes ☐ No ☐ N/A
 - Three feet minimum cover has been provided for all sewers unless ferrous pipe was installed.
 - Minimum diameters for gravity sewers are 8-inches for public lines and 6-inches for private lines.
 - Manholes have been installed: At the end of each line, at all changes in grade, size, or alignment, at all intersections, and at distances not greater than 425 feet; minimum diameter shall be 4 feet (48-inches).
 - 5) Adequate information related to pump stations: ☐ Yes ☐ No ☐ N/A
 - Ensure power reliability option was selected per [15A NCAC 02T.0305\(h\)](#).
 - 6) Was project construction completed in accordance with all of the following: ☐ Yes ☐ No ☐ N/A
 - [15A NCAC 02T, Minimum Design Criteria \(MDC\) for the permitting of Gravity Sewers](#) (latest version), and [MDC for the Permitting of Pump Stations and Force Mains](#) (latest version)?
- If not, a variance approval is required in accordance with [15A NCAC 02T.0105\(b\)](#), **prior to certification and operation.**
- Contact the Central Office to discuss the variance to determine a course of action.
 - Applicant must submit two copies of the variance request form, plans, specifications, calculations, and any other pertinent information to the Central Office (one hard copy, one digital copy).
 - The central office will review the variance request, and if approvable, specific language regarding the variance will be incorporated into the permit, either via a special condition or a supplementary letter. A copy of the reissued permit with variance language or the variance letter must be maintained with the original documents.
- 7) Does the project contains high priority lines ([15A NCAC 02T .0402\(2\)](#))? ☐ Yes ☐ No
 - If yes, ensure that the permit already contains the necessary condition related to high priority lines 15A NCAC 02T.0403 (a)(5). If the permit does not include this language, the Fast Track reviewer will reissue the permit with the appropriate language.
 - 8) Are Permit modifications are required for any changes resulting in non-compliance with this permit (including but not limited to pipe length changes of 10% or greater, change in flow, pump station design capacity design change of 5% or greater, and/or change in the number/type of connections)? ☐ Yes ☐ No
 - If yes, a permit modification request must be submitted to the appropriate Regional Office, and **a modified permit with revised certification must be issued prior to certification and operation.**

FAST TRACK SEWER ENGINEERING CERTIFICATION

PERMITTEE: Town of Smithfield
PERMIT #: WQ0046037
PROJECT: Town of Smithfield Pump Station #1 and Force Main Improvements
ISSUE DATE: February 12, 2025

This project shall not be considered complete nor allowed to operate in accordance with Condition 7 of this permit until the Division has received this Certification and all required supporting documentation. It should be submitted in a manner that documents the Division's receipt. Send the required documentation to the Regional Supervisor, Water Quality Regional Operations Section at the address at the bottom.

Any wastewater flow made tributary to the wastewater collection system extension prior to completion of this Certification shall be considered a violation of the permit and shall subject the Permittee to appropriate enforcement actions. The Permittee is responsible for tracking all partial certifications up until a final certification is received. A Final Certification shall be a complete set of record drawings and design calculations regardless of whether partials have been submitted.

PERMITTEE'S CERTIFICATION

I, the undersigned agent for the Permittee, hereby state that this project has been constructed pursuant to the applicable standards & requirements, the Professional Engineer below has provided applicable design/construction information to the Permittee, and the Permittee is prepared to operate & maintain the wastewater collection system permitted herein or portions thereof.

 Printed Name, Title

 Signature

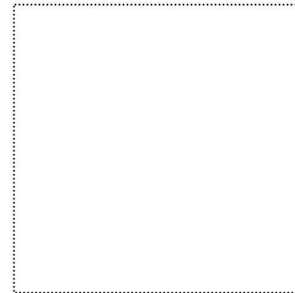
 Date

ENGINEER'S CERTIFICATION

I, _____, as a duly registered Professional Engineer in the State of North Carolina, having been authorized to observe (☐ periodically, ☐ weekly, ☐ full time) the construction of the project name and location as referenced above for the above Permittee hereby state that, to the best of my abilities, due care and diligence was used in the observation of the following construction: **2,200-gallon per minute pump station with duplex pumps, on-site audible and visual high water alarms, telemetry, and a permanent generator with automatic transfer switch; as well as approximately 10,000 linear feet of 20-inch force main**; such that the construction was observed to be built within substantial compliance of this permit; 15A NCAC 02T; the Division of Water Resources' (Division) Gravity Sewer Minimum Design Criteria adopted February 12, 1996 as applicable; the Division's Minimum Design Criteria for the Fast-Track Permitting of Pump Stations and Force Mains adopted June 1, 2000 as applicable; and other supporting materials.

North Carolina Professional Engineer's Seal w/signature & date:

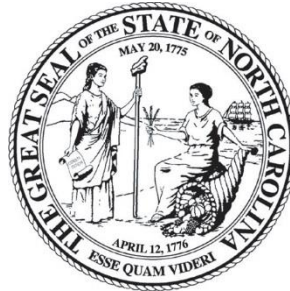
☐ **Final** ☐ **Partial (include description)**



Certification Comments/Qualifiers (attach if necessary):

Erosion & Sedimentation Control

CERTIFICATE OF PLAN APPROVAL



The posting of this certificate certifies that an erosion and sedimentation control plan has been approved for this project by the North Carolina Department of Environmental Quality in accordance with North Carolina General Statute 113A – 57 (4) and 113A – 54 (d) (4) and North Carolina Administrative Code, Title 15A, Chapter 4B.0107 (c). This certificate must be posted at the primary entrance of the job site before construction begins and until establishment of permanent groundcover as required by North Carolina Administrative Code, Title 15A, Chapter 4B.0127 (b).

JOHNS-2025-0174: Town of Smithfield Pump Station 1 and Force Main Improvements

4/24/2025

Date of Plan Approval



William H. Denton IV, PE

Regional Engineer

Certificate of Coverage Number: _____

JOSH STEIN
Governor

D. REID WILSON
Secretary

WILLIAM E. TOBY VINSON, JR
Director



04-24-2025

LETTER OF APPROVAL WITH MODIFICATIONS

Town of Smithfield
305 E Market St
Smithfield, NC 27577

RE: Project Name: Town of Smithfield Pump Station 1 and Force Main Improvements
Permit Number: JOHNS-2025-0174
Acres Approved: 9.5
County: Johnston
City: Smithfield
Address: Huntley Street
River Basin: Neuse
Stream Classification: C: Aquatic Life, Secondary Contact Recreation, Fresh water
Plan Type: New Plan

Dear Town of Smithfield,

This office has reviewed the subject erosion and sedimentation control plan. We hereby issue this Letter of Approval. Any modifications required for approval are listed in the body of the email that accompanied this attached letter. The enclosed Certificate of Approval must be posted at the job site. This plan approval shall expire three (3) years following the date of approval, if no land-disturbing activity has been undertaken, as is required by Title 15A NCAC 4B .0129.

As of April 1, 2019, all new construction activities not explicitly exempt are required to complete and submit an electronic Notice of Intent (eNOI) form requesting a Certificate of Coverage (COC) under the NCG010000 Construction General Permit. After the form is reviewed and found to be complete, you will receive a link with payment instructions for the annual permit fee. After the fee is processed, you will receive the COC. As the Financially Responsible Party shown on the FRO form submitted for this project, you MUST obtain the COC prior to commencement of any land disturbing activity. The eNOI form may be accessed at deq.nc.gov/NCG01.



North Carolina Department of Environmental Quality | Division of Energy, Mineral and Land Resources
512 North Salisbury Street | 1612 Mail Service Center | Raleigh, North Carolina 27699-1612
919.707.9200

Please direct questions about the eNOI form to the [Stormwater Program staff](#) in the Raleigh central office. If the owner/operator of this project changes in the future, the new responsible party must obtain a new COC.

Title 15A NCAC 4B .0118(a) and the NCG01 permit require that the following documentation be kept on file at the job site:

1. The approved E&SC plan as well as any approved deviation.
2. The NCG01 permit and the COC, once it is received.
3. Records of inspections made during the previous 12 months.

Also, this letter gives the notice required by G.S. 113A-61.1(a) of our right of periodic inspection to ensure compliance with the approved plan.

North Carolina's Sedimentation Pollution Control Act is performance-oriented, requiring protection of existing natural resources and adjoining properties. If, following the commencement of this project, the erosion and sedimentation control plan is inadequate to meet the requirements of the Sedimentation Pollution Control Act of 1973 (North Carolina General Statute 113A-51 through 66), this office may require revisions to the plan and implementation of the revisions to ensure compliance with the Act.

Acceptance and approval of this plan is conditioned upon your compliance with Federal and State water quality laws, regulations, and rules. In addition, local city or county ordinances or rules may also apply to this land-disturbing activity. This approval does not supersede any other permit or approval.

Please note that this approval is based in part on the accuracy of the information provided in the Financial Responsibility Form and on the plan, which you provided. You are requested to file an amended form if there is any change in the information included on the form.

Modifications Required for Approval:

1.Approval of this erosion and sedimentation control (E&SC) plan does not authorize impacts to wetlands, coastal marsh, streams or other waters of the State or United States or supersede any other permitting requirement of any Federal, State or Local agency. Please provide a copy of the USACE 404 permit and DWR 401 certifications when available for the office file. Submit documentation with maps showing location and extent of impacts to streams and wetlands with any special conditions pertaining to E&SC and restoration of affected areas. Identify the streams, wetlands, and buffers on the plan sheets. Include any additional measures, construction specifications, maintenance requirements and construction sequencing as required by the 404/401 on the plan sheets.

PLEASE NOTE: If the approval of these other permits results in any changes to the E&SC plan then a revised E&SC application reflecting those changes must be submitted to our office for review and approval. (GS 113A-54.1(c), 15A NCAC 04B .0106(1))

2.Provide the location of the site, to scale as near as possible and enlarged sufficient to adequately view details, on the most recent paper-bound (historical) version of the Natural Resources Conservation Service (NRCS) soil survey map. Do **not** use the new color versions of the soils maps available on the NRCS website. Use the scanned copies of the historical black and white maps, which are more accurate. The historical soils maps can be found on the NRCS website here: <https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soil/soil-surveys-by-state>. Alternatively, the historical maps may also be found on the Division of Water Resources Riparian Buffer Protection Program website here: <https://experience.arcgis.com/experience/a16078049de54d42a2bc384b9ceda91f/page/Page-1/?views=Layers>. (GS 113A-57.4(c), 15A NCAC 04B .0105, 15A NCAC 04B .0106(a)(1) and (a)(3), NCG01 Section II.A. (4))

3.Provide a detailed explanation in the construction sequence regarding how streams will be crossed. Submit any applicable constructions details and the associated E&SC measures. (i.e., coffer dam, mats, silt bag, etc.). (GS 113A-57(3), 15A NCAC 04B .0105, 15A NCAC 04B .0113)

Your cooperation is appreciated.

Sincerely,

Jacari Daye

Land Quality Section

NCDOT Encroachment



Stantec Consulting Services Inc.
4969 Centre Pointe Drive, Suite 200
North Charleston SC 29418-6952

November 8, 2024

Project/File: Town of Smithfield Pump Station #1 and Force Main Improvements

State of North Carolina Department of Transportation

1501 Mail Service Center
Raleigh, NC 27699-1501

Reference: Town of Smithfield Pump Station 1 and Force Main Improvements

Project Description

The proposed project includes demolition of the Town of Smithfield's existing Pump Station #1, installation of a new pump station in the same location, and the installation of approximately 10,000 linear feet of new 20-inch diameter force main, connecting to the Johnston County Regional Wastewater Treatment Plant. The service area served by the existing and proposed pump station will remain the same and generally includes a combination of residential and commercial land uses.

This encroachment request is for the cased crossing of Hwy 70 (West Market Street) associated with the force main improvements.

Force Main Improvements

The proposed force main will consist of approximately 10,000 linear feet of new 20-inch diameter ductile iron pipe. The new force main will extend from the existing pump station, located west of the Neuse River on West Market Street, to the Johnston County Regional Wastewater Treatment Plant. Alignment of the proposed force main will be easterly on West Market Street, across the Neuse River, and then will generally parallel existing Town of Smithfield gravity sewer lines along the east and south side of the Neuse River to an existing manhole at the Johnston County Regional WWTP. The crossing of the Neuse River will utilize an existing 12-inch diameter pipe currently installed. There is no new crossing of the Neuse River as part of the proposed work. The work also includes a jack and bore underneath West Market Street.

Schedule

Work is anticipated to begin summer 2025. Project duration is approximately 12 months.

Included with this submittal are the following:

- Cover Letter

Reference: Town of Smithfield Pump Station #1 and Force Main Improvements

- Encroachment Agreement
- Plan and Profile for proposed cased crossing

Respectfully,

STANTEC CONSULTING SERVICES INC.

Robert Bernard

Robert Bernard, PE

Principal

Phone: 704-491-0297

Robert.Bernard@stantec.com

Cc: Michael Scott, Town Manager, Town of Smithfield
Ted Credle, Director of Public Utilities, Town of Smithfield

DEPARTMENT OF TRANSPORTATION

RIGHT OF WAY ENCROACHMENT AGREEMENT

-AND-

PRIMARY AND SECONDARY HIGHWAYS

Town of Smithfield

350 E Market Street

Smithfield, NC 27577

THIS AGREEMENT, made and entered into this the ____ day of _____ 20 24 by and between the Department of Transportation, party of the first part; and Town of Smithfield

party of the second part,

WITNESSETH

THAT WHEREAS, the party of the second part desires to encroach on the right of way of the public road designated as Route(s) US-Highway 70 (West Market Street), located approximately 910' West of the intersection of Front Street In the Town of Smithfield, North Carolina.

with the construction and/or erection of: Approximately 115 linear feet of new 20" diameter ductile iron sanitary sewer force main pipe encased in 32" diameter steel casing pipe. This section of force main will go under US-Highway 70 via bore & Jack (trenchless) installation as part of Pump Station No. 1.

WHEREAS, it is to the material advantage of the party of the second part to effect this encroachment, and the party of the first part in the exercise of authority conferred upon it by statute, is willing to permit the encroachment within the limits of the right of way as indicated, subject to the conditions of this agreement;

NOW, THEREFORE, IT IS AGREED that the party of the first part hereby grants to the party of the second part the right and privilege to make this encroachment as shown on attached plan sheet(s), specifications and special provisions which are made a part hereof upon the following conditions, to wit:

That the installation, operation, and maintenance of the above described facility will be accomplished in accordance with the party of the first part's latest UTILITIES ACCOMMODATIONS MANUAL, and such revisions and amendments thereto as may be in effect at the date of this agreement. Information as to these policies and procedures may be obtained from the Division Engineer or State Utilities Manager of the party of the first part.

That the said party of the second part binds and obligates himself to install and maintain the encroaching facility in such safe and proper condition that it will not interfere with or endanger travel upon said highway, nor obstruct nor interfere with the proper maintenance thereof, to reimburse the party of the first part for the cost incurred for any repairs or maintenance to its roadways and structures necessary due to the installation and existence of the facilities of the party of the second part, and if at any time the party of the first part shall require the removal of or changes in the location of the said facilities, that the said party of the second part binds himself, his successors and assigns, to promptly remove or alter the said facilities, in order to conform to the said requirement, without any cost to the party of the first part.

That the party of the second part agrees to provide during construction and any subsequent maintenance proper signs, signal lights, flagmen and other warning devices for the protection of traffic in conformance with the latest Manual on Uniform Traffic Control Devices for Streets and Highways and Amendments or Supplements thereto. Information as to the above rules and regulations may be obtained from the Division Engineer of the party of the first part.

That the party of the second part hereby agrees to indemnify and save harmless the party of the first part from all damages and claims for damage that may arise by reason of the installation and maintenance of this encroachment.

That the party of the second part agrees to restore all areas disturbed during installation and maintenance to the satisfaction of the Division Engineer of the party of the first part. The party of the second part agrees to exercise every reasonable precaution during construction and maintenance to prevent eroding of soil; silting or pollution of rivers, streams, lakes, reservoirs, other water impoundments, ground surfaces or other property; or pollution of the air. There shall be compliance with applicable rules and regulations of the North Carolina Division of Environmental Management, North Carolina Sedimentation Control Commission, and with ordinances and regulations of various counties, municipalities and other official agencies relating to pollution prevention and control. When any installation or maintenance operation disturbs the ground surface and existing ground cover, the party of the second part agrees to remove and replace the sod or otherwise reestablish the grass cover to meet the satisfaction of the Division Engineer of the party of the first part.

That the party of the second part agrees to assume the actual cost of any inspection of the work considered to be necessary by the Division Engineer of the party of the first part.

That the party of the second part agrees to have available at the construction site, at all times during construction, a copy of this agreement showing evidence of approval by the party of the first part. The party of the first part reserves the right to stop all work unless evidence of approval can be shown.

Provided the work contained in this agreement is being performed on a completed highway open to traffic; the party of the second part agrees to give written notice to the Division Engineer of the party of the first part when all work contained herein has been completed. Unless specifically requested by the party of the first part, written notice of completion of work on highway projects under construction will not be required.

That in the case of noncompliance with the terms of this agreement by the party of the second part, the party of the first part reserves the right to stop all work until the facility has been brought into compliance or removed from the right of way at no cost to the party of the first part.

That it is agreed by both parties that this agreement shall become void if actual construction of the work contemplated herein is not begun within one (1) year from the date of authorization by the party of the first part unless written waiver is secured by the party of the second part from the party of the first part.

During the performance of this contract, the second party, for itself, its assignees and successors in interest (hereinafter referred to as the "contractor"), agrees as follows:

- Compliance with Regulations: The contractor shall comply with the Regulations relative to nondiscrimination in Federally-assisted programs of the U. S. Department of Transportation, Title 49, Code of Federal Regulations, Part 21, as they may be amended from time to time, (hereinafter referred to as the Regulations), which are herein incorporated by reference and made a part of this contract.
- Nondiscrimination: The contractor, with regard to the work performed by it during the contract, shall not discriminate on the grounds of race, color, or national origin in the selection and retention of subcontractors, including procurements of materials

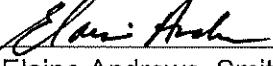
and leases of equipment. The contractor shall not participate either directly or indirectly in the discrimination prohibited by Section 21.5 of the Regulations, including employment practices when the contract covers a program set forth in Appendix B of the Regulations.

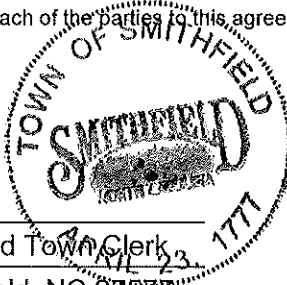
- c. **Solicitations for Subcontracts, including Procurements of Materials and Equipment:** In all solicitations either by competitive bidding or negotiation made by the contractor for work to be performed under a subcontract, including procurements of materials or leases of equipment, each potential subcontractor or supplier shall be notified by the contractor of the contractor's obligations under this contract and the Regulations relative to nondiscrimination on the grounds of race, color, or national origin.
- d. **Information and Reports:** The contractor shall provide all information and reports required by the Regulations, or directives issued pursuant thereto, and shall permit access to its books, records, accounts, other sources of information, and its facilities as may be determined by the Department of Transportation or the Federal Highway Administration to be pertinent to ascertain compliance with such Regulations or directives. Where any information required of a contractor is in the exclusive possession of another who fails or refuses to furnish this information, the contractor shall so certify to the Department of Transportation, or the Federal Highway Administration as appropriate, and shall set forth what efforts it has made to obtain the information.
- e. **Sanctions for Noncompliance:** In the event of the contractor's noncompliance with the nondiscrimination provisions of this contract, the Department of Transportation shall impose such contract sanctions as it or the Federal Highway Administration may determine to be appropriate, including, but not limited to,
 - (1) withholding of payments to the contractor under the contract until the contractor complies, and/or
 - (2) cancellation, termination or suspension of the contract, in whole or in part.
- f. **Incorporation of Provisions:** The contractor shall include the provisions of paragraphs "a" through "f" in every subcontract, including procurements of materials and leases of equipment, unless exempt by the Regulations, or directives issued pursuant thereto. The contractor shall take such action with respect to any subcontract or procurement as the Department of Transportation or the Federal Highway Administration may direct as a means of enforcing such provisions including sanctions for noncompliance. Provided, however, that, in the event a contractor becomes involved in, or is threatened with, litigation with a subcontractor or supplier as a result of such direction, the contractor may request the Department of Transportation to enter into such litigation to protect the interests of the State, and, in addition, the contractor may request the United States to enter into such litigation to protect the interests of the United States.

R/W (161) : Party of the Second Part certifies that this agreement is true and accurate copy of the form R/W (161) incorporating all revisions to date.

IN WITNESS WHEREOF, each of the parties to this agreement has caused the same to be executed the day and year first above written.

ATTEST OR WITNESS:

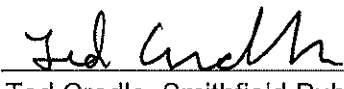

Elaine Andrews, Smithfield Town Clerk
350 E Market St., Smithfield, NC 27577



DEPARTMENT OF TRANSPORTATION

BY:

DIVISION ENGINEER


Ted Credle, Smithfield Pub. Utilities Dir.
350 E Market St., Smithfield, NC 27577
Second Party

INSTRUCTIONS

When the applicant is a corporation or a municipality, this agreement must have the corporate seal and be attested by the corporation secretary or by the empowered city official, unless a waiver of corporate seal and attestation by the secretary or by the empowered city official is on file in the Raleigh office of the State Utilities Manager. In the space provided in this agreement for execution, the name of the corporation or municipality shall be typed above the name, and title of all persons signing the agreement should be typed directly below their signature.

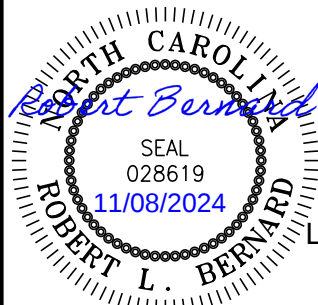
When the applicant is not a corporation, then his signature must be witnessed by one person. The address should be included in this agreement and the names of all persons signing the agreement should be typed directly below their signature.

This agreement must be accompanied, in the form of an attachment, by plans or drawings showing the following applicable information:

1. All roadways and ramps.
2. Right of way lines and where applicable, the control of access lines.
3. Location of the existing and/or proposed encroachment.
4. Length, size and type of encroachment.
5. Method of installation.
6. Dimensions showing the distance from the encroachment to edge of pavement, shoulders, etc.
7. Location by highway survey station number. If station number cannot be obtained, location should be shown by distance from some identifiable point, such as a bridge, road, intersection, etc. (To assist in preparation of the encroachment plan, the Department's roadway plans may be seen at the various Highway Division Offices, or at the Raleigh office.)
8. Drainage structures or bridges if affected by encroachment (show vertical and horizontal dimensions from encroachment to nearest part of structure).
9. Method of attachment to drainage structures or bridges.
10. Manhole design.
11. On underground utilities, the depth of bury under all traveled lanes, shoulders, ditches, sidewalks, etc.
12. Length, size and type of encasement where required.
13. On underground crossings, notation as to method of crossing - boring and jacking, open cut, etc.
14. Location of vents.

GENERAL REQUIREMENTS

1. Any attachment to a bridge or other drainage structure must be approved by the State Utilities Manager in Raleigh prior to submission of encroachment agreement to the Division Engineer.
2. All crossings should be as near as possible normal to the centerline of the highway.
3. Minimum vertical clearances of overhead wires and cables above all roadways must conform to clearances set out in the National Electric Safety Code.
4. Encasements shall extend from ditch line to ditch line in cut sections and 5' beyond toe of slopes in fill sections.
5. All vents should be extended to the right of way line or as otherwise required by the Department.
6. All pipe encasements as to material and strength shall meet the standards and specifications of the Department.
7. Any special provisions or specifications as to the performance of the work or the method of construction that may be required by the Department must be shown on a separate sheet attached to encroachment agreement provided that such information cannot be shown on plans or drawings.
8. The Department's Division Engineer should be given notice by the applicant prior to actual starting of installation included in this agreement.



PROPOSED GEOTECHNICAL
BORING # X
W78°21'05" N35°30'50"

20' X 30' BORE
LAUNCHING PIT

PUMP STATION 1

LIMITS OF
DISTURBANCE, TYP.

115 LF 32" DIA 0.50" THICK STEEL
ENCASEMENT PIPE BY TRENCHLESS
INSTALLATION

ROW

EXIST 16" V
PER RECORD

EXIST 16" WM
PER RECORD

CONTRACTOR TO FIELD LOCATE
EXISTING FORCE MAIN, MAINTAIN 10
FT HORIZONTAL SEPARATION AND 1.5
FT VERTICAL SEPARATION DURING
CONSTRUCTION.

10' X 10' BORE
RECEIVING PIT

SILT
FENCE,
TYP.

EDGE OF
PAVEMENT

INTERSECTION OF
NORTH FRONT ST (~910)

BUS - 70 (WEST MARKET ST.)
150' ROW

STA. 11+52

45° BEND 20" DI RJ

STA. 11+55

45° BEND 20" DI RJ

TREES TO BE
REMOVED (TYP.)

ROW



Stantec
801 Jones Franklin Road, Suite 300
Raleigh, North Carolina 27606-3563
Tel: (919) 851-6866
www.stantec.com

Notes

OWNER: TOWN OF SMITHFIELD

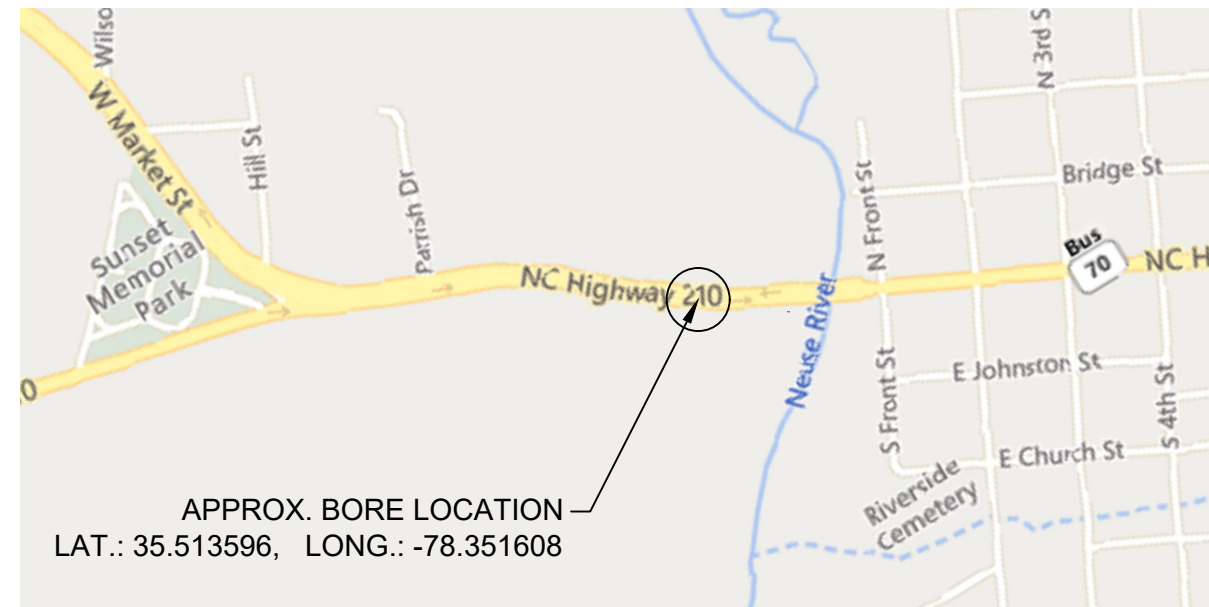
LOCATION: JOHNSTON COUNTY, NORTH CAROLINA

NOTES:

1. MAXIMUM BORE DIAMETER = 34"
2. NO EXCAVATION WITHIN THE CLEAR RECOVERY ZONE SHALL BE LEFT OPEN OVERNIGHT.
3. INSTALL CONCRETE BARRIERS AROUND BORE AND RECEIVING PITS AS REQUIRED.
4. DO NOT STOCKPILE EXCAVATED MATERIAL IN ROAD RIGHT-OF-WAY.
5. WORK IN NCDOT R.O.W. SHALL BE DONE IN ACCORDANCE WITH NCDOT STANDARDS.
6. EXCAVATIONS TO BE PROTECTED WITH TRENCH BOXES.
7. ALL EXCAVATION MATERIAL TO BE HAULED OFF SITE.
8. IF ROCK EXCAVATION IS REQUIRED, JACK AND TUNNEL METHOD TO BE UTILIZED WITH SMALL CONTROLLED BLASTING.
9. ENCASEMENT ENDS TO BE SEALED WITH BRICK AND CEMENT.

CONTACT

NAME	ROLE	NUMBER
ROBERT BERNARD	ENGINEER	704 - 491 - 0297
JOE RODRIGUEZ	ENGINEER IN TRAINING	980 - 296 - 9346
TED CREDLE	TOWN OF SMITHFIELD DIRECTOR OF PUBLIC UTILITIES	919 - 934 - 2116 x-1162



APPROX. BORE LOCATION
LAT.: 35.513596, LONG.: -78.351608

VICINITY MAP
N.T.S.

Client/Project

TOWN OF SMITHFIELD

PUMP STATION 1 AND
FORCE MAIN
IMPROVEMENTS

Project No.

175568555

Title

NCDOT ENCROACHMENT
PLAN

Revision

1

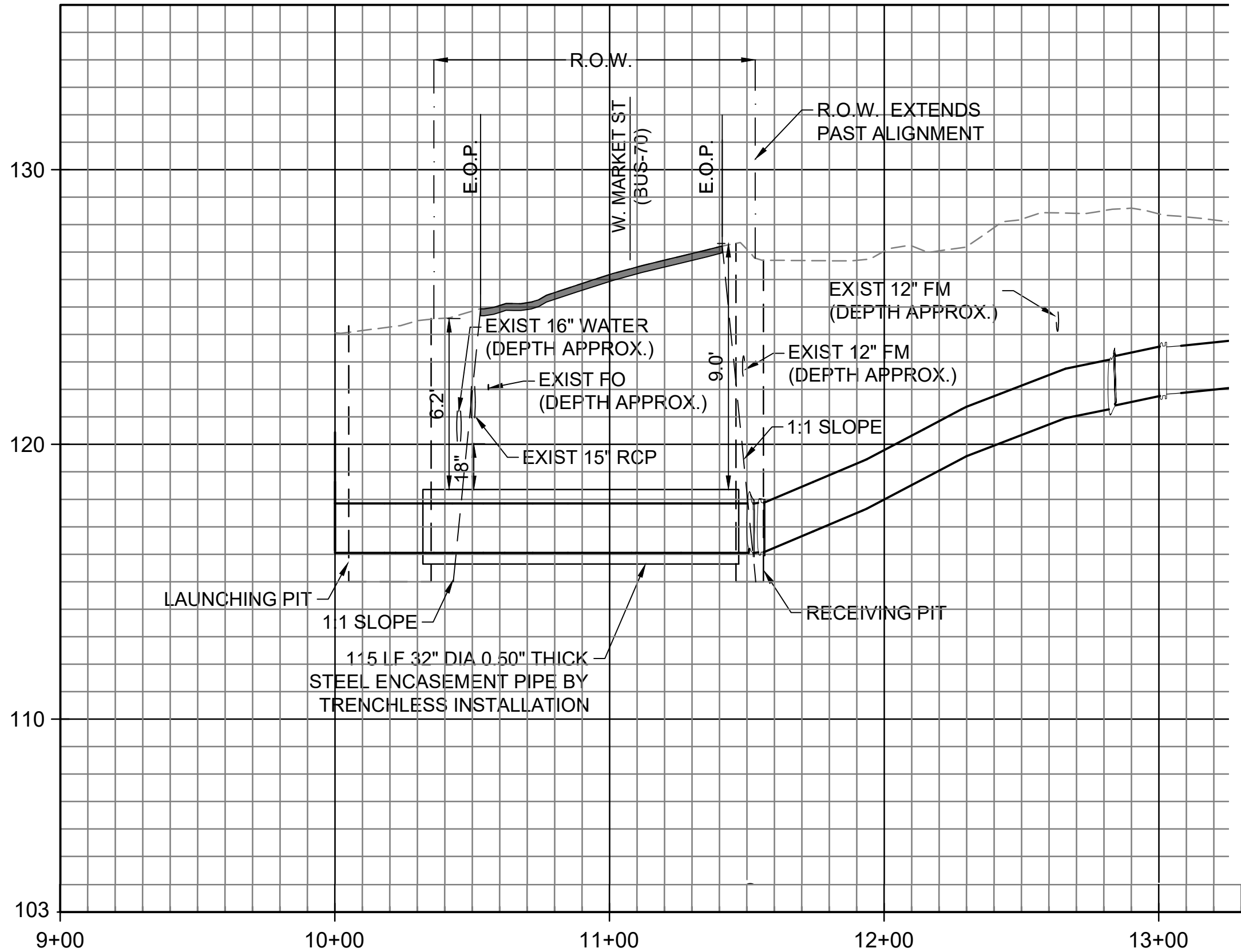
Reference Sheet

Date

2024.11.08

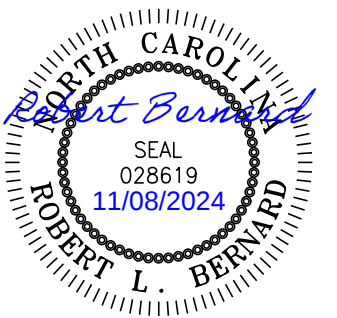
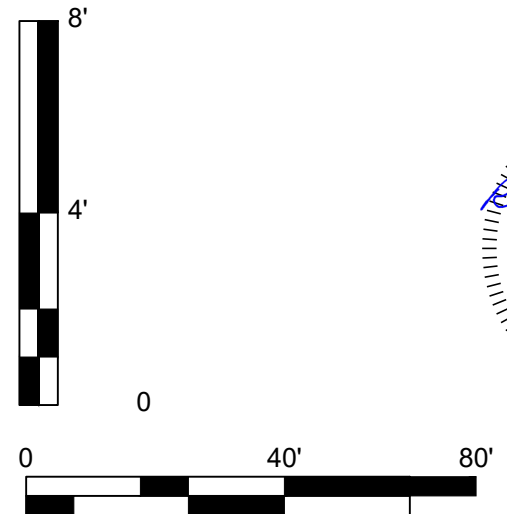
Figure No.

PlotDate: 2024/11/05 10:23 AM Login: Rodriguez, Joe
u:\175568555\technical_production\drawing\sheet_files\68555_c100-c113_fm.dwg



NOTES:

1. MAXIMUM BORE DIAMETER = 34"
2. TRAFFIC WILL BE EXCLUDED FROM THE 1:1 SLOPE AREA UNTIL BACKFILL IS COMPLETE.
3. IF THE 1:1 SLOPE CANNOT BE PROTECTED THEN ACTIVE SHORING (SHEET PILING, SOLDIER PILES, AND LAGGING, ETC.) SHALL BE NECESSARY TO PROTECT THE ROADWAY IF DEEMED BY A NCDOT ENGINEER.
4. SHORING WILL BE IN ACCORDANCE WITH OSHA TRENCHING STANDARD 1926 SUBPART P, OR AS AMENDED.
5. ACTUAL TRENCH WIDTH MAY VARY BASED ON CONSTRUCTION METHODS OF INDIVIDUAL CONTRACTOR OR SOIL CONDITIONS.
6. LANE CLOSURE FLAGGING AND TRAFFIC CONTROL SHALL BE IN ACCORDANCE WITH NCDOT STANDARDS AND SPECIFICATIONS.



Stantec
801 Jones Franklin Road, Suite 300
Raleigh, North Carolina 27606-3563
Tel: (919) 851-6866
www.stantec.com

Notes

OWNER: TOWN OF SMITHFIELD

LOCATION: JOHNSTON COUNTY, NORTH CAROLINA

Client/Project

TOWN OF SMITHFIELD

PUMP STATION 1 AND
FORCE MAIN
IMPROVEMENTS

Project No.

175568555

Title

NCDOT ENCROACHMENT
PLAN

Revision

1

Reference Sheet

Date

2024.11.08

Figure No.



STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

ROY COOPER
GOVERNOR

J.R. "JOEY" HOPKINS
SECRETARY

Town of Smithfield
350 E Market Street
Smithfield, NC 27577

Subject: Encroachment Pre-Approval Letter
Town of Smithfield Pump Station 1
Route(s): US70BUS
Encroachment Number: E043-051-24-00645
Johnston County

Town of Smithfield –

This letter is to certify that the Town of Smithfield, upon selecting a contractor to perform the subject encroachment work, will ensure that said contractor will secure and provide the original copy of the required \$10,000 performance bond to the District 3 Office at 67 JR Rd Suite 700 Selma, NC 27576 **prior** to beginning any work within NCDOT ROW.

Failure to provide this bond before beginning work shall result in a suspension of any work within the NCDOT ROW and any damages sustained within the NCDOT ROW caused by said encroachment work shall have its cost covered by the Town of Smithfield.

Town of Smithfield Representative: 

NCDOT District 3 Representative: _____

Please provide signature and Town Seal on this letter

NC DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
DIVISION 4 DISTRICT 3
67 JR ROAD, SUITE 700
SELMA, NC 27576

Telephone: (919) 739-5300

From: [Service - DOT_encr](#)
To: [Hughes, Logan](#); [Bernard, Robert](#)
Cc: [Campbell, Chase](#)
Subject: E043-051-24-00645 Applicant response needed for Town of Smithfield in Johnston County
Date: Thursday, February 13, 2025 3:03:36 PM

Workflow Notification

Hello Robert Bernard,

Encroachment ID [E043-051-24-00645](#) has been reviewed by the NCDOT and is considered incomplete for the following reasons:

- Other: Received. Awaiting bond for final signature. Thanks.

Click [here](#) to upload the required documents for this encroachment. Please click the blue **SEND BACK TO DOT** button, after your update is complete, to have NCDOT review the encroachment.

Important: A new encroachment is not required to submit the requested documents. Uploading the documents in the existing encroachment and clicking the **SEND BACK TO DOT** button will return the encroachment to NCDOT for review.

If you have any questions or need further assistance, please contact Dalton J. Langston (djlangston@ncdot.gov) in the Division 04 - District 3 office at 919-739-5300.

Sincerely,
NCDOT Permits Portal

Caution: This email originated from outside of Stantec. Please take extra precaution.

Attention: Ce courriel provient de l'extérieur de Stantec. Veuillez prendre des précautions supplémentaires.

Atención: Este correo electrónico proviene de fuera de Stantec. Por favor, tome precauciones adicionales.

GEOTECHNICAL INVESTIGATIONS

**TOWN OF SMITHFIELD
PUMP STATION #1 FORCE MAIN IMPROVEMENTS
Town of Smithfield, North Carolina**

Pump Station 1 Force Main Improvements

Geotechnical Engineering Report

March 1, 2024 | Terracon Project No. 70235284

Prepared for:

Stantec, Inc.
801 Jones Franklin Road, Suite 300
Raleigh, North Carolina 27606



Nationwide
Terracon.com

- Facilities
- Environmental
- Geotechnical
- Materials



2401 Brentwood Road, Suite 107
Raleigh, NC 27604
P (919) 873-2211
North Carolina Registered Firm: F-0869

Terracon.com

March 1, 2024

Stantec, Inc.
801 Jones Franklin Road, Suite 300
Raleigh, North Carolina 27606

Attn: Mr. Robert Bernard, PE - Principal
P: (980) 297-7653
E: Robert.Bernard@stantec.com

Re: Geotechnical Engineering Report
Pump Station 1 Force Main Improvements
Smithfield, North Carolina
Terracon Project No. 70235284

Dear Mr. Bernard:

We have completed the scope of Geotechnical Engineering services for the above-referenced project in general accordance with Terracon Proposal No. P70235284-R1 dated January 10, 2024. This report presents the findings of the subsurface exploration and provides geotechnical recommendations for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,

Terracon

Gunnar H. Goslin
Project Manager



Tom Schipporeit, PE, BC.GE
Senior Geotechnical Engineer

Table of Contents

Introduction..... 1
Project Description..... 1
Site Conditions 2
Geotechnical Characterization 3
Conclusions and Recommendations..... 4
General Comments 7

Figures

GeoModel

Attachments

- Exploration and Testing Procedures
- Photography Log
- Site Location and Exploration Plans
- Exploration and Laboratory Results
- Supporting Information

Note: This report was originally delivered in a web-based format. **Blue Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the  logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

Refer to each individual Attachment for a listing of contents.

Introduction

This report presents the results of our subsurface exploration and Geotechnical Engineering services performed for the proposed force main improvements located in Smithfield, North Carolina. The purpose of these services was to provide information and geotechnical engineering recommendations relative to the sections of the force main to be installed using trenchless methods (horizontal directional drill and jack-and-bore).

The geotechnical engineering Scope of Services for this project included the advancement of SPT borings, laboratory testing, engineering analysis, and preparation of this report.

Drawings showing the site and SPT boring locations are shown on the **Site Location** and **Exploration Plans**, respectively. The results of the laboratory testing performed on soil samples obtained from the site during our field exploration are included in the **Exploration Results** section.

Project Description

Our initial understanding of the project was provided in our proposal and was discussed during project planning. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

Item	Description
Information Provided	This report is based on the following sources of information: ■ Preliminary drawings dated February 17, 2023, with requested geotechnical boring locations. ■ A full set of project drawings dated February 17, 2023.
Project Description	The project includes approximately 0.8-miles of new wastewater force main. The force main pipe will be 20-inch-diameter ductile iron pipe (DIP). It will connect with an existing 12-inch-diameter forced main under the Neuse River.

Item	Description
Proposed Crossings	Three proposed crossings are associated with this project and they include West Market Street and two unnamed stream crossings along the southern bank of the Neuse River. The crossing under West Market Street will be installed using jack-and-bore of a 32-inch-diameter encasement pipe approximately 10 to 12 feet below the existing ground surface. The stream crossings will be installed using either jack-and-bore or horizontal directional drilling (HDD) trenchless techniques approximately 15 to 20 feet below the existing ground surface. Temporary launching and receiving pits up to approximately 15 feet deep will be constructed at the jack-and-bore locations.

Terracon should be notified if any of the above information is inconsistent with the planned construction, as modifications to our recommendations may be necessary.

Site Conditions

The following description of site conditions is derived from our site visit in association with the field exploration.

Item	Description
Site Location Information	The project is generally located along Market Street (US Highway Business 70/NC Highway 210) and the Neuse River in Smithfield, North Carolina. See Site Location
Existing Improvements (Along Right-of-Way)	The project alignment crosses Market Street, follows a gravel paved roadway, crosses the Neuse River, follows an improved greenway trail along the southern bank of the Neuse River, and is in a wooded area west of the South 2 nd Street Greenway Trail connector.
Current Ground Cover at Crossings	Gravel parking lot at the requested location along Market Street and woods at the two stream crossings.
Existing Topography	According to preliminary construction plans provided by Stantec dated February 7, 2023, existing ground surface elevations along the alignment range between 106 and 129 feet.

We also collected photographs at the time of our field exploration program. Representative photos are provided in our **Photography Log**.

Geotechnical Characterization

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface explorations, laboratory data, geologic setting and our understanding of the project. This characterization, termed GeoModel, forms the basis of our geotechnical calculations and evaluation of the site. Conditions observed at each exploration point are indicated on the individual logs. The individual logs can be found in the **Exploration Results** and the GeoModel can be found in the **Figures** attachment of this report.

As part of our analyses, we identified the following model layers within the subsurface profile. For a more detailed view of the model layer depths at each boring location, refer to the GeoModel.

Model Layer	Layer Name	General Description
1	Surficial materials	Gravel (8 in.) and Topsoil (3 to 4 in.)
2	Fill	Clayey sand with gravel
3	Clayey Sand and Sandy Clay	Very Loose Clayey Sand (SC) and Soft to Medium Stiff Sandy Clay (CL)
4	Clay	Stiff to Very Stiff Clay (CL)
5	Sand	Loose Sand with Silt (SP-SM)
6	Gravel	Dense Clayey Gravel with Sand (GC)

The site is located at the boundary of the Coastal Plain and the Piedmont physiographic provinces. The Coastal Plain is typically characterized by marine, alluvial, and aeolian sediments that were deposited during periods of fluctuating sea levels and moving shorelines. The Piedmont is characterized by residual overburden soils weathered in place from the underlying igneous and metamorphic rock.

The site is located near the Neuse River and is underlain by Coastal Plain deposits consisting of alluvium overlying marine soils to the maximum boring depth of 20 feet. The Coastal Plain deposits are underlain by bedrock consisting of phyllite and schist, the depth of which appears to be greater than 20 feet based on our borings.

Groundwater depths were measured at depths ranging between 2.9 to 4.7 feet. Groundwater conditions may be different at the time of construction. Groundwater conditions may change because of seasonal variations in rainfall, runoff, and other conditions not apparent at the time of drilling. Long-term groundwater monitoring was outside the scope of services for this project.

Conclusions and Recommendations

Potential Geologic Installation Difficulties for Trenchless Construction

Horizontal Directional Drilling (HDD)

Based on our experience with HDD and the area geology, we have the following professional opinions relative to typical geologic installation difficulties associated with HDD drilling at the project site:

HDD Potential Geologic Installation Difficulties

Typical Geologic Installation Difficulties	Comments
Cohesionless sand, gravel, cobbles, or boulders with little to no fines	Cohesionless sands with less than 5 to 10% fines can occur in site geology. Cohesionless sands with little to no fines were encountered in Boring B-2 between depths of 12 and 17 feet.
Horizontal zones of gravel, cobbles, or boulders in soil matrix	Horizontal zones of gravel can occur in site geology. Clayey gravel was encountered in Boring B-2 between depths of 17 and 20 feet.
Near vertical zones of gravel, cobbles, or boulders in soil matrix	Not consistent with site geology.
Voids or preferential seepage paths potentially resulting in loss of drilling fluid return	There is a potential for loss of drilling fluid in gravel, as encountered in Boring B-2 between depths of 17 and 20 feet.
Very loose sand or very soft to soft silt/clay	Routinely encountered in site geology. Very loose clayey sand was encountered in Boring B-1 between depths of 3 and 8 feet. Very soft to soft sandy silty clay was encountered in Boring B-3 between depths of 3 and 8 feet.
Peat, organic soil	Can occur in site geology Peat or organic soil was not encountered by the borings.
Material with sufficient potential swell upon exposure to water to reduce borehole diameter	High plasticity clays occasionally present in geologic setting. High plasticity clays were not encountered in our borings.
Continuous strata of hard material requiring rock drilling techniques to penetrate	Not encountered in our borings. However, rock could be present at this site at depths greater than 20 feet based on our borings and the site's geology.
Artesian groundwater conditions	Not common in this geologic setting. Artesian groundwater conditions were not encountered during our exploration.

Jack-and-Bore

Based on our experience with jack-and-bore pipe installation and the area geology, we have the following professional opinions relative to typical geologic installation difficulties associated with jack-and-bore pipe installation at the project site:

Jack-and-Bore Installation Difficulties¹

Subsurface Condition	Generally Suitable ³	Difficulties May Occur ⁴	Substantial Problems ⁵	Consistent with Geology	Encountered by Borings	Comments
Groundwater ²			X	Yes	B-1, B-2, B-3	Groundwater encountered at depths of approx. 3 to 5 feet. Depth will vary seasonally.
Soft to very soft clays, silts, and organic deposits		X		Yes	B-1, B-2, B-3	
Medium stiff to very stiff clays and silts	X			Yes	B-1, B-2, B-3	
Hard clays and highly weathered shales	X			Yes	No	
Very loose to loose sands		X		Yes	B-1, B-2	
Medium dense to dense sands	X			Yes	No	
Weathered rock, marls, chalk, and firmly cemented sand	X			Yes	No	
Slightly weathered to un-weathered rock		X		Yes	No	
Soil with significant gravel, cobbles, and boulders			X	Yes	B-2	Clayey gravel encountered in B-2 at depths between 17 and 20 feet
Mixed-face (soil and rock in same section or alternating along alignment)			X	Yes	No	
Rock fill or soil fill containing rock			X	No	No	

1. Manmade conditions such as foundations, utilities, environmental contamination, excavation slopes, etc. are not addressed.
2. Jack-and-Bore installation method is generally not suitable for use below the groundwater level. Dewatering will be required if used below groundwater level. Substantial problems could be encountered depending on soil conditions, tooling, and contractor means and methods.
3. "Generally Suitable" presumes a knowledgeable experienced contractor using appropriate tooling and equipment.
4. "Difficulties May Occur" that can be addressed by tooling, equipment, and contractor means and methods.
5. "Substantial Problems" up to and including conditions that may be unsuitable for the use of jack-and-bore construction method.

Temporary Boring/Receiving Pits

Excavatability: We anticipate that excavations for the proposed pits can be accomplished with conventional earthmoving equipment. The bottom of excavations should be thoroughly cleaned of loose soils and disturbed materials prior to backfill placement and/or construction.

Temporary Slopes/Shoring: Temporary construction slopes and excavation shoring should comply with local, state, and federal governing regulations, including OSHA (29 CFR Part 1926) excavation safety standards. Temporary excavations should be cut to a stable slope or the excavations should be temporarily braced, depending upon the excavation depth, nearby site features, and encountered subsurface conditions. The Contractor's Competent Person will need to determine the soil type(s) encountered in excavations and the appropriate excavation slope or bracing. The NCDOT requires shoring where the bottom of the excavation is within a 1H:1V slope down from the edge of pavement.

Temporary slopes may need to be designed using analytical methods, as the standard OSHA temporary slope angles for different types of soils may not be applicable for this site. For example, temporary excavations sloped at 1.5H:1V for Type C soils will typically not be stable if groundwater inflow is not adequately controlled and/or removed, or if layers of very soft to soft clay or peat are prevalent in the excavation sideslopes.

Stockpiles should be placed well away from the top edge of the excavations, and their heights should be controlled so they do not surcharge the sides of the excavations. We recommend that stockpiles be set back a minimum horizontal distance from the top edge of the excavation equal to the maximum depth of the excavation.

The responsibility for excavation safety, stability of temporary construction excavations, and deflections/settlement of existing site features lie solely with the contractor. This information is provided only as a service and under no circumstance should Terracon be assumed to be responsible for construction site safety, stability of temporary excavations, or the effectiveness of the contractor's excavation support system.

Dewatering: Based on the borings the temporary pit excavations are likely to encounter groundwater. Potential groundwater control methods for the temporary construction excavations for this project include open pumping, predrainage, dewatering, and cutoff/exclusion. Open pumping utilizes submersible sump pumps in pits or trenches dug below the bottom of the excavation and backfilled with No. 57 stone wrapped in non-woven geotextile. Pumping can be performed on an intermittent basis to remove water from the construction excavations but should be continuous (24 hours a day) to maintain excavation bottom stability. Predrainage dewatering requires the installation of temporary wells and/or wellpoints within or around the excavations, with

continuous (24 hours a day) pumping both before excavation and while the excavations are in use to lower the groundwater adequately beneath the entire excavation areas. Cutoff or exclusion involves the installation of sheetpiling completely around the excavations and open pumping from inside the sheeting during excavation. Predrainage dewatering outside the sheeting can be implemented to reduce groundwater pressure on the sheetpiling and potential leakage of the sheeting at joints.

The responsibility for dewatering of construction excavations and preventing excessive settlement of existing structures and other site features due to dewatering should lie solely with the contractor. This information is provided only as a service and under no circumstance should Terracon be assumed to be responsible for the effectiveness of the construction dewatering method(s) selected by the contractor.

To obtain additional information which may aid the contractor or dewatering consultant design a dewatering system for this site, field pump tests may be beneficial.

General Comments

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client and is not intended for third parties. Any use or reliance of the provided information by third

parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly affect excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety and cost estimating including excavation support and dewatering requirements/design are the responsibility of others. Construction and site development have the potential to affect adjacent properties. Such impacts can include damages due to vibration, modification of groundwater/surface water flow during construction, foundation movement due to undermining or subsidence from excavation, as well as noise or air quality concerns. Evaluation of these items on nearby properties are commonly associated with contractor means and methods and are not addressed in this report. The owner and contractor should consider a preconstruction/precondition survey of surrounding development. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

Geotechnical Engineering Report

Pump Station 1 Force Main Improvements | Smithfield, North Carolina

March 1, 2024 | Terracon Project No. 70235284

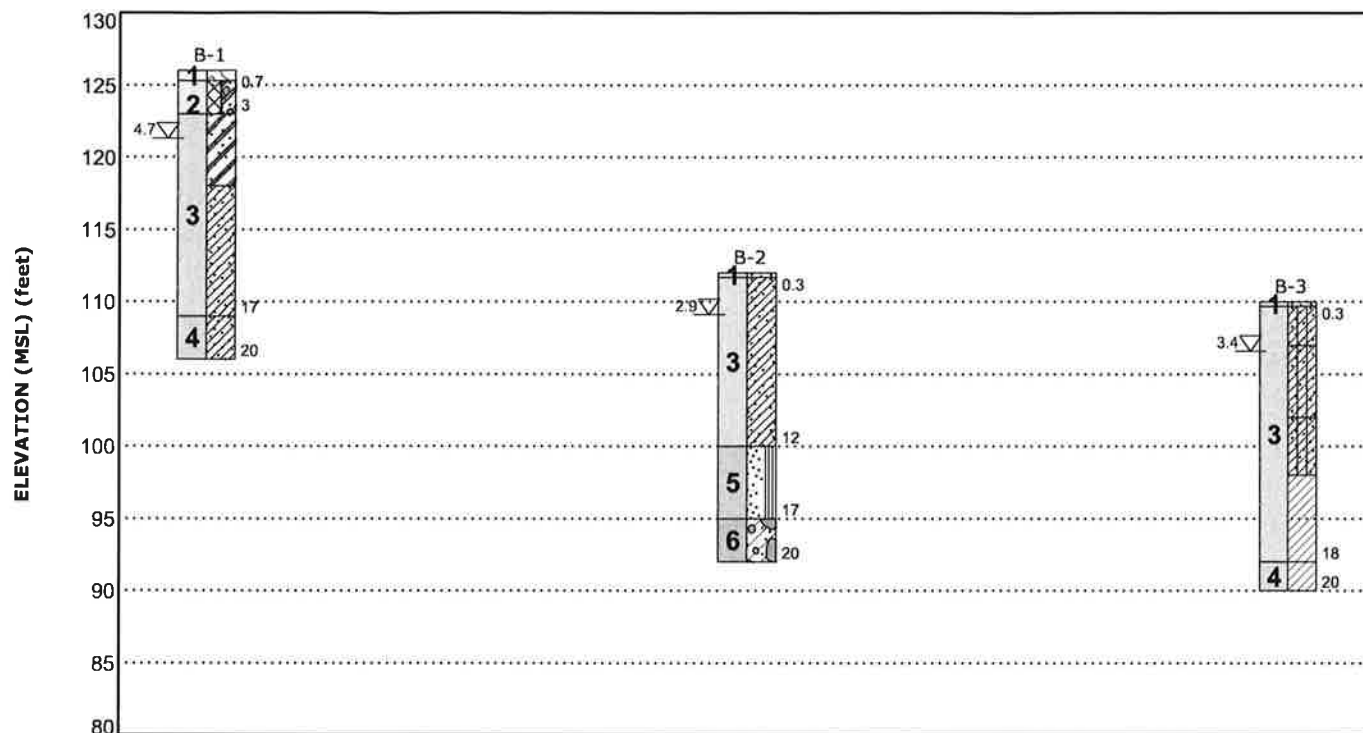


Figures

Contents:

GeoModel

GeoModel



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description	Legend	
1	Surficial materials	Gravel (8 in.) and Topsoil (3 to 4 in.)	Aggregate Base Course	Clayey Sand with Gravel
2	Fill	Clayey sand with gravel	Clayey Sand	Sandy Lean Clay
3	Clayey Sand and Sandy Clay	Very Loose Clayey Sand (SC) and Soft to Medium Stiff Sandy Clay (CL)	Topsoil	Poorly-graded Sand with Silt
4	Clay	Stiff to Very Stiff Clay (CL)	Clayey Gravel with Sand	Sandy Silty Clay
5	Sand	Loose Sand with Silt (SP-SM)	Lean Clay	
6	Gravel	Dense Clayey Gravel with Sand (GC)		

NOTES:

Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project.

First Water Observation

Groundwater levels are temporal. The levels shown are representative of the date and time of our exploration. Significant changes are possible over time.

Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

Geotechnical Engineering Report

Pump Station 1 Force Main Improvements | Smithfield, North Carolina

March 1, 2024 | Terracon Project No. 70235284



Attachments

Exploration and Testing Procedures

Field Exploration

Number of Borings	Approximate Boring Depth (feet)	Location
1	20	Market Street Crossing
1	20	Neuse River Crossing 1
1	20	Neuse River Crossing 2

Boring Layout and Elevations: Terracon personnel provided the boring layout using handheld GPS equipment (estimated horizontal accuracy of about ± 10 feet) and referencing existing site features. Approximate ground surface elevations were interpolated from information obtained from the Johnston County GIS website.

Subsurface Exploration Procedures: We advanced the borings with a track-mounted drill rig using mud rotary drilling techniques. Four samples were obtained in the upper 10 feet of each boring and at intervals of 5 feet thereafter. In the split-barrel sampling procedure, a standard 2-inch outer diameter split-barrel sampling spoon was driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths.

After completing drilling operations, we flushed the boreholes of drilling mud with water, installed temporary piezometers, and observed the boreholes for the presence of groundwater after a period of about 4-hours. The recorded groundwater levels are shown on the attached boring logs. After removal of temporary piezometers, all borings were backfilled with a cement-grout slurry mix using tremie methods.

The sampling depths, penetration distances, and other sampling information were recorded on the field boring logs. The samples were placed in appropriate containers and taken to our soil laboratory for testing and classification by geotechnical staff. Our exploration team prepared field boring logs as part of the drilling operations. These field logs included visual classifications of the materials observed during drilling and our interpretation of the subsurface conditions between samples. Final boring logs were prepared from the field logs. The final boring logs represent our interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

Geotechnical Engineering Report

Pump Station 1 Force Main Improvements | Smithfield, North Carolina

March 1, 2024 | Terracon Project No. 70235284



Laboratory Testing

Geotechnical staff reviewed the field data and assigned laboratory tests. The laboratory testing program included the following types of tests:

- Moisture Content
- Atterberg Limits
- Grain Size Analysis

The laboratory testing program included examination of soil samples by geotechnical staff. Based on the results of our field and laboratory programs, we described and classified the soil samples in accordance with the Unified Soil Classification System.

Photography Log



Near location B-1 looking north on January 4, 2024



Near location B-2 looking southeast on January 4, 2024

Geotechnical Engineering Report

Pump Station 1 Force Main Improvements | Smithfield, North Carolina

March 1, 2024 | Terracon Project No. 70235284



Boring B-3 looking southeast on January 4, 2024

Site Location and Exploration Plans

Contents:

Site Location Plan

Exploration Plan (3 pages)

Note: All attachments are one page unless noted above.

Geotechnical Engineering Report

Pump Station 1 Force Main Improvements | Smithfield, North Carolina

March 1, 2024 | Terracon Project No. 70235284



Site Location

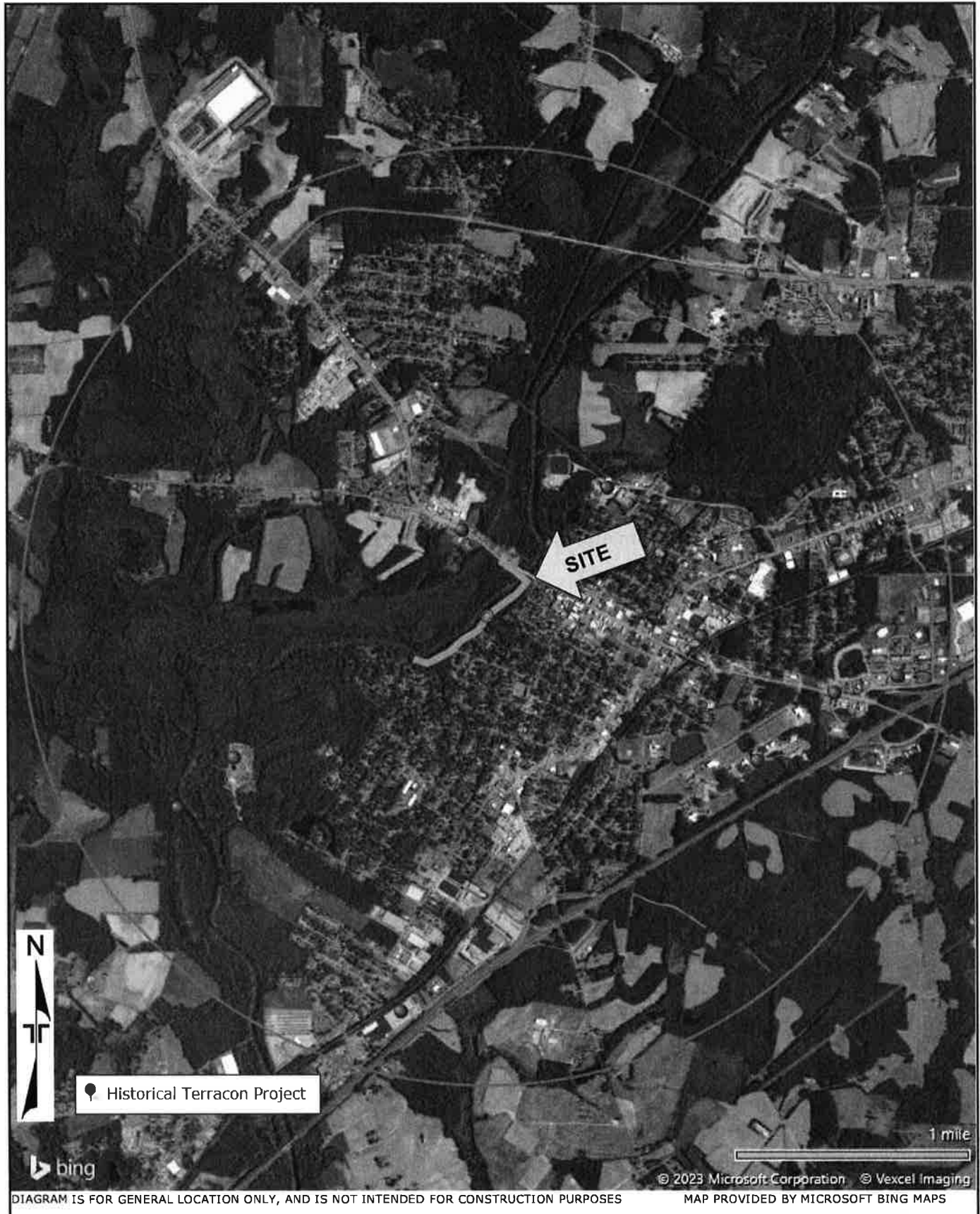
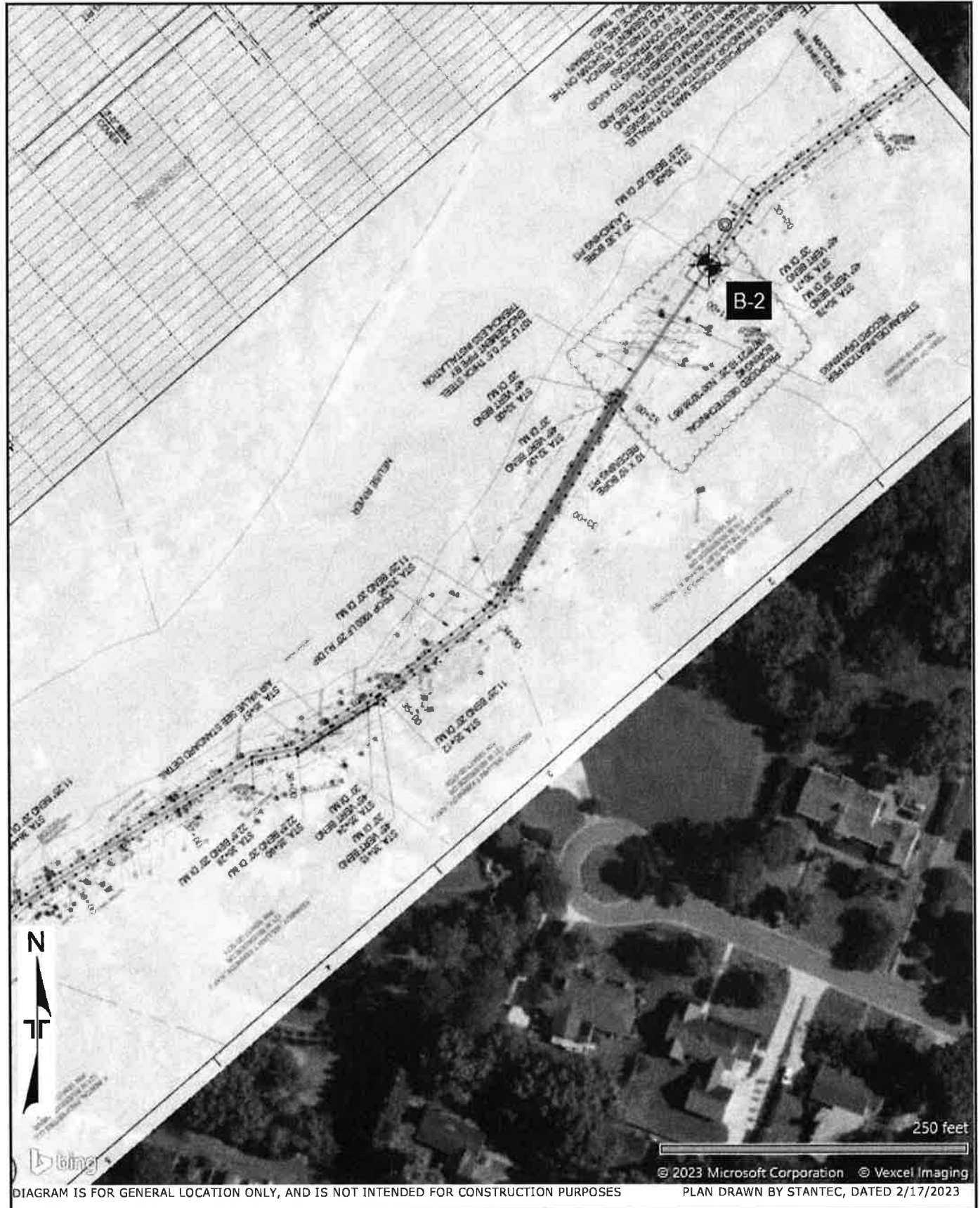


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Exploration Plan (2 of 3)



Exploration Plan (3 of 3)



Exploration and Laboratory Results

Contents:

Boring Logs (3 pages)

Atterberg Limits

Grain Size Distribution (4 pages)

Note: All attachments are one page unless noted above.

Boring Log No. B-1

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 35.5138° Longitude: -78.3514° Depth (Ft.)	Elevation: 126 (Ft.) +/-	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Atterberg Limits	Percent Fines
									LL-PL-PI	
1		GRAVEL , 8 inches	125.3	0.7						
2		FILL - CLAYEY SAND WITH GRAVEL (SC) , fine to coarse grained, gray and tan	123	3.0			8-9-8 N=17	8.5	33-14-19	28
3		CLAYEY SAND (SC) , fine to coarse grained, brown and gray, very loose	118	5			1-1-1 N=2	17.7	41-14-27	32
							WOH-WOH-WOH	30.3	40-14-26	25
							2-1-2 N=3			
							1-2-2 N=4	29.7	36-17-19	51
4		SANDY LEAN CLAY (CL) , greenish gray, soft	109	10						
							2-3-7 N=10			
		Boring Terminated at 20 Feet	106	20						

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (if any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevations were interpolated from Johnston Co. GIS website.

Samples obtained using a 2" O.D. split spoon sampler

Notes

Water Level Observations

About 4 hours after drilling

Drill Rig

CME 45 - track

Hammer Type

Automatic

Driller

M. Radford - Bridger

Logged by

G. Goslin

Boring Started

02-01-2024

Boring Completed

02-01-2024

Advancement Method

Mud rotary

Abandonment Method

Boring backfilled with bentonite grout using tremie method upon completion

Boring Log No. B-2

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 35.5101° Longitude: -78.3529° Depth (Ft.)	Elevation: 112 (Ft.) +/-	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Atterberg Limits	Percent Fines
									LL-PL-PI	
1		0.3		111.7						
		TOPSOIL , 3 inches								
		SANDY LEAN CLAY (CL) , trace fine gravel, trace silt, red and brown, soft to medium stiff								
		greenish tan								
3				5			2-3-3 N=6			
							1-2-1 N=3			
							1-2-2 N=4	30.8	42-24-18	63
				10			2-1-1 N=2			
		12.0		100						
		POORLY GRADED SAND WITH SILT (SP-SM) , fine to medium grained, gray, loose								
5				15			2-3-5 N=8	30.4	NP	6
		17.0		95						
		CLAYEY GRAVEL WITH SAND (GC) , few cemented sands, fine to coarse grained, greenish gray, dense								
6				20			7-15-24 N=39	13.3	38-20-18	16
		20.0		92						
		Boring Terminated at 20 Feet								

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (if any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevations were interpolated from Johnston Co. GIS website.

Samples obtained using a 2" O.D. split spoon sampler

Notes

Water Level Observations

▽ About 4 hours after drilling

Drill Rig

CME 45 - track

Hammer Type

Automatic

Driller

M. Radford - Bridger

Logged by

G. Goslin

Boring Started

02-01-2024

Boring Completed

02-01-2024

Advancement Method

Mud rotary

Abandonment Method

Boring backfilled with bentonite grout using tremie method upon completion

Boring Log No. B-3

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 35.5075° Longitude: -78.3567° Depth (Ft.)	Elevation: 110 (Ft.) +/-	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Atterberg Limits	Percent Fines
									LL-PL-P _I	
1		0.3	109.7							
		TOPSOIL , 4 inches								
		SANDY SILTY CLAY (CL-ML) , reddish brown, medium stiff								
		3.0	107				4-3-2 N=5	25.7	28-21-7	66
		SANDY SILTY CLAY (CL-ML) , reddish brown, very soft to soft								
		8.0	102				WOH-1-WOH	30.8	28-22-6	65
		SANDY SILTY CLAY (CL-ML) , reddish brown, medium stiff								
		12.0	98				2-2-2 N=4			
		LEAN CLAY (CL) , trace sand, brown, medium stiff								
		18.0	92				3-4-4 N=8			
		LEAN CLAY (CL) , trace sand, greenish gray, very stiff								
		20.0	90				2-3-5 N=8	26.7	45-22-23	97
		LEAN CLAY (CL) , trace sand, greenish gray, very stiff								
		20.0	90				6-11-14 N=25			
		Boring Terminated at 20 Feet								

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevations were interpolated from Johnston Co. GIS website.

Samples obtained using a 2" O.D. split spoon sampler

Notes

Water Level Observations

▽ About 4 hours after drilling

Drill Rig

CME 45 - track

Hammer Type

Automatic

Driller

M. Radford - Bridger

Logged by

G. Goslin

Boring Started

02-01-2024

Boring Completed

02-01-2024

Advancement Method

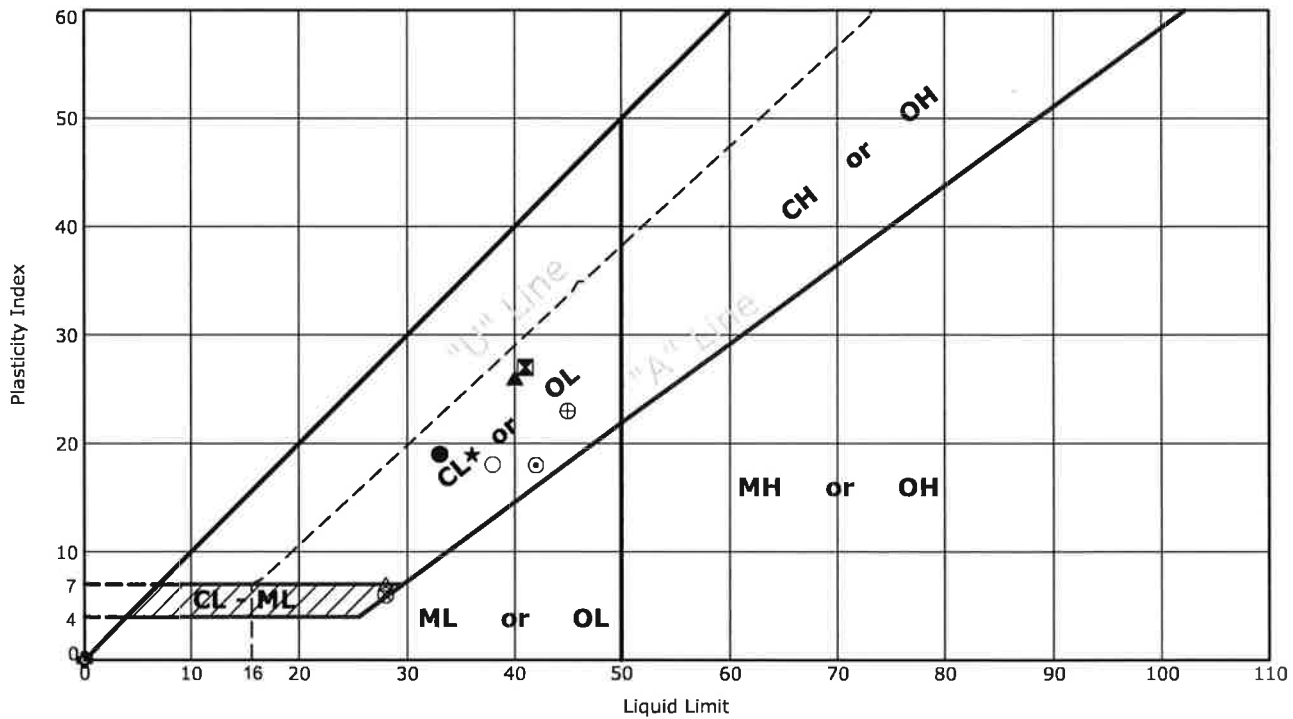
Mud rotary

Abandonment Method

Boring backfilled with bentonite grout using tremie method upon completion

Atterberg Limit Results

ASTM D4318



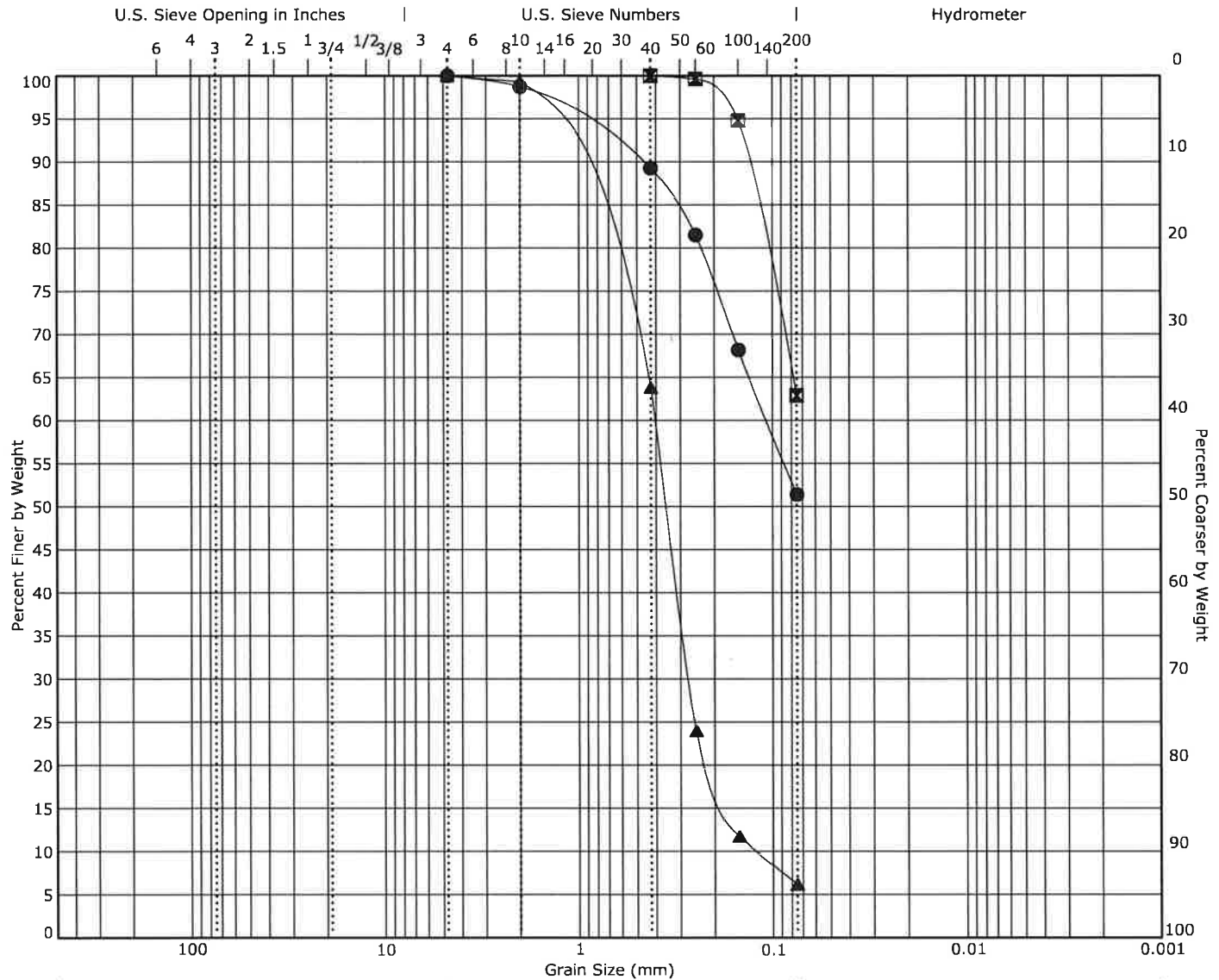
	Boring ID	Depth (Ft)	LL	PL	PI	Fines	USCS	Description
●	B-1	1 - 2.5	33	14	19	27.6	SC	CLAYEY SAND with GRAVEL
⊠	B-1	3.5 - 5	41	14	27	31.7	SC	CLAYEY SAND
▲	B-1	6 - 7.5	40	14	26	25.1	SC	CLAYEY SAND
★	B-1	13.5 - 15	36	17	19	51.4	CL	SANDY LEAN CLAY
⊙	B-2	6 - 7.5	42	24	18	62.9	CL	SANDY LEAN CLAY
⊕	B-2	13.5 - 15	NP	NP	NP	6.2	SP-SM	POORLY GRADED SAND with SILT
○	B-2	18.5 - 20	38	20	18	16.4	GC	CLAYEY GRAVEL with SAND
△	B-3	1 - 2.5	28	21	7	66.1	CL-ML	SANDY SILTY CLAY
⊗	B-3	3.5 - 5	28	22	6	64.9	CL-ML	SANDY SILTY CLAY
⊕	B-3	13.5 - 15	45	22	23	96.9	CL	LEAN CLAY

ASTM D422 / ASTM C136[illegible]

C_u

Grain Size Distribution

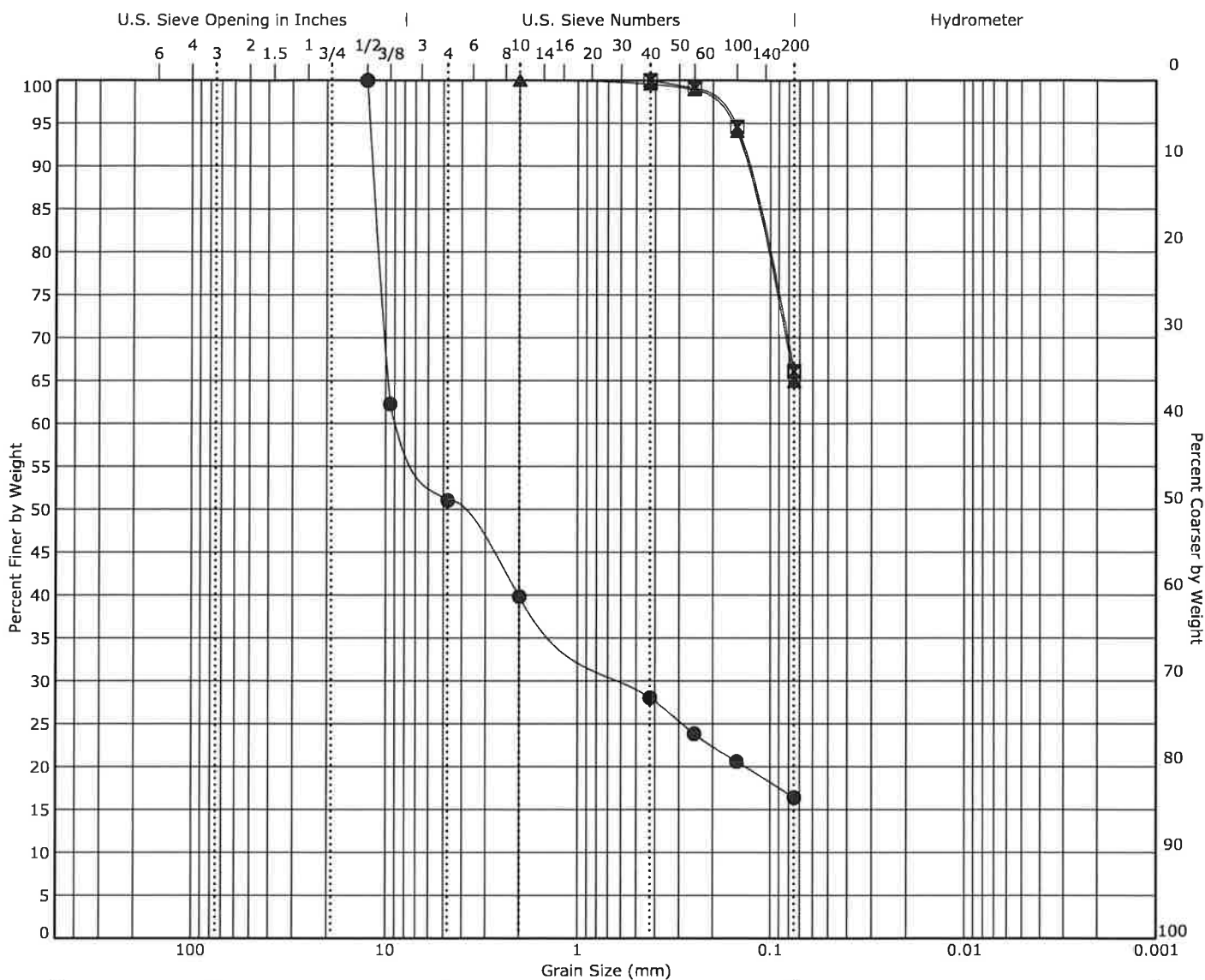
ASTM D422 / ASTM C136



		Gravel		Sand			Silt or Clay		USCS
Cobbles		coarse	fine	coarse	medium	fine	% Silt	% Clay	
Boring ID	Depth	% Cobbles	% Gravel	% Sand	% Fines				
● B-1	13.5 - 15	0.0	0.0	48.6	51.4				CL
☒ B-2	6 - 7.5	0.0	0.0	37.1	62.9				CL
▲ B-2	13.5 - 15	0.0	0.0	93.8	6.2				SP-SM
Description				●	☒	▲	Grain Size		
●	SANDY LEAN CLAY			Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
☒	SANDY LEAN CLAY			#4	100.0	#40	100.0	#4	100.0
▲	POORLY GRADED SAND with SILT			#10	98.76	#60	99.63	#10	99.33
				#40	89.29	#100	94.78	#40	63.8
				#60	81.52	#200	62.87	#60	23.96
				#100	68.17			#100	11.71
				#200	51.4			#200	6.19
Remarks								Coefficients	
●								●	☒
☒								▲	
▲								C _c	1.50
								C _u	3.34

Grain Size Distribution

ASTM D422 / ASTM C136



	Boring ID	Depth	Gravel		Sand			Silt or Clay		USCS
			coarse	fine	coarse	medium	fine	% Silt	% Clay	
●	B-2	18.5 - 20	0.0	48.9	34.6		16.4			GC
☒	B-3	1 - 2.5	0.0	0.0	33.9		66.1			CL-ML
▲	B-3	3.5 - 5	0.0	0.0	35.1		64.9			CL-ML

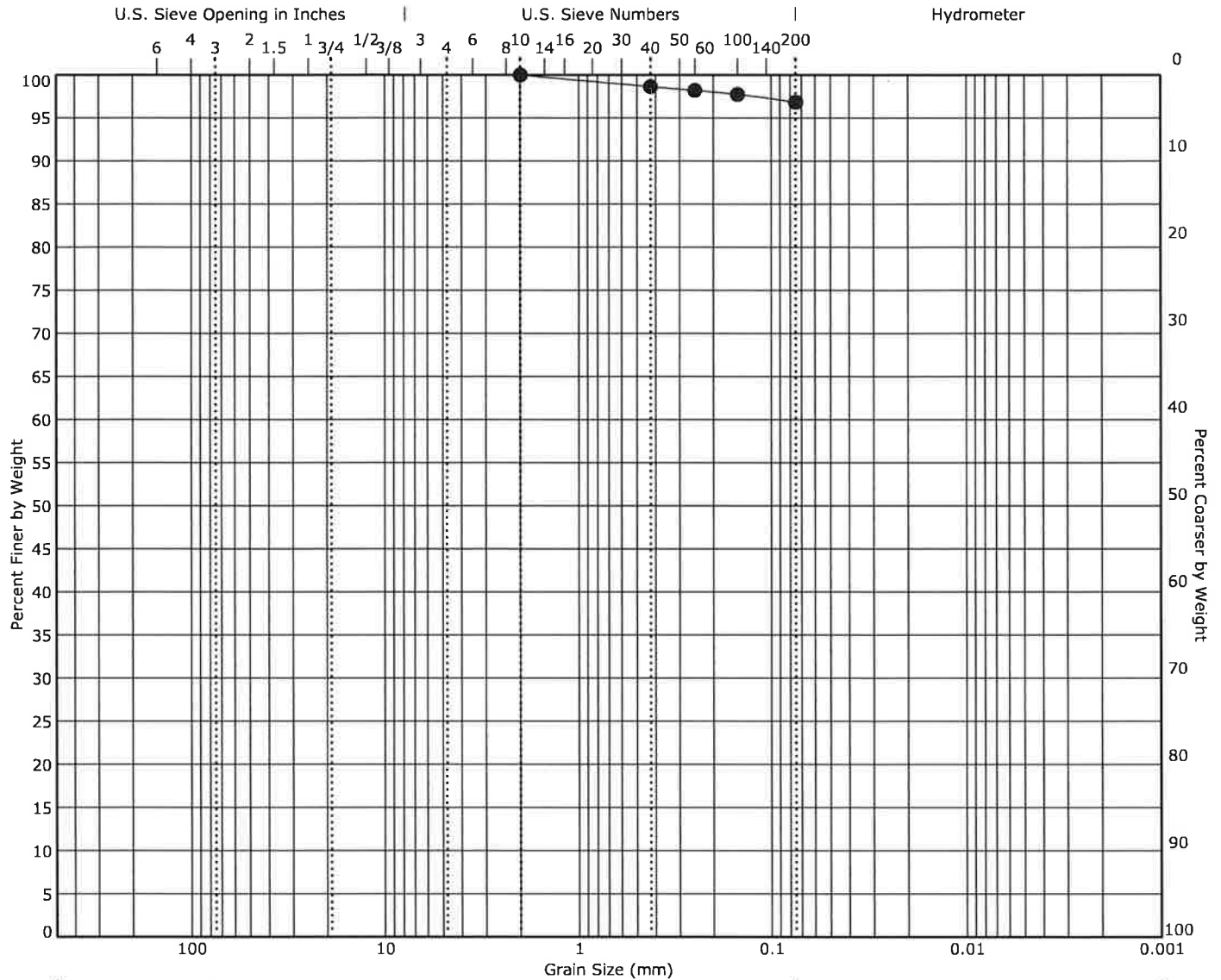
Description	●	☒	▲	Grain Size		
● CLAYEY GRAVEL with SAND	Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
☒ SANDY SILTY CLAY	1/2"	100.0	#40	100.0	#10	100.0
▲ SANDY SILTY CLAY	3/8"	62.27	#60	99.07	#40	99.59
	#4	51.05	#100	94.58	#60	98.86
	#10	39.83	#200	66.1	#100	94.01
	#40	28.05			#200	64.91
	#60	23.84				
	#100	20.62				
	#200	16.41				
Remarks	Coefficients					
●						
☒						
▲						

C_c

C_u

Grain Size Distribution

ASTM D422 / ASTM C136



Geotechnical Engineering Report

Pump Station 1 Force Main Improvements | Smithfield, North Carolina

March 1, 2024 | Terracon Project No. 70235284



Supporting Information

Contents:

General Notes

Unified Soil Classification System

General Notes

Sampling	Water Level	Field Tests
 Standard Penetration Test	 Water Initially Encountered  Water Level After a Specified Period of Time  Water Level After a Specified Period of Time  Cave In Encountered	N Standard Penetration Test Resistance (Blows/Ft.) (HP) Hand Penetrometer (T) Torvane (DCP) Dynamic Cone Penetrometer UC Unconfined Compressive Strength (PID) Photo-Ionization Detector (OVA) Organic Vapor Analyzer
Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.		

Descriptive Soil Classification

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

Location And Elevation Notes

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See Exploration and Testing Procedures in the report for the methods used to locate the exploration points for this project. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

Strength Terms

Relative Density of Coarse-Grained Soils (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		Consistency of Fine-Grained Soils (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
Relative Density	Standard Penetration or N-Value (Blows/Ft.)	Consistency	Unconfined Compressive Strength Qu (tsf)	Standard Penetration or N-Value (Blows/Ft.)
Very Loose	0 - 3	Very Soft	less than 0.25	0 - 1
Loose	4 - 9	Soft	0.25 to 0.50	2 - 4
Medium Dense	10 - 29	Medium Stiff	0.50 to 1.00	4 - 8
Dense	30 - 50	Stiff	1.00 to 2.00	8 - 15
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 - 30
		Hard	> 4.00	> 30

Relevance of Exploration and Laboratory Test Results

Exploration/field results and/or laboratory test data contained within this document are intended for application to the project as described in this document. Use of such exploration/field results and/or laboratory test data should not be used independently of this document.

Unified Soil Classification System

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests ^A

			Soil Classification	
			Group Symbol	Group Name ^B
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	Gravels: More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels: Less than 5% fines ^C	$Cu \geq 4$ and $1 \leq Cc \leq 3$ ^E	GW Well-graded gravel ^F
			$Cu < 4$ and/or $[Cc < 1 \text{ or } Cc > 3.0]$ ^E	GP Poorly graded gravel ^F
		Gravels with Fines: More than 12% fines ^C	Fines classify as ML or MH	GM Silty gravel ^{F, G, H}
			Fines classify as CL or CH	GC Clayey gravel ^{F, G, H}
	Sands: 50% or more of coarse fraction passes No. 4 sieve	Clean Sands: Less than 5% fines ^D	$Cu \geq 6$ and $1 \leq Cc \leq 3$ ^E	SW Well-graded sand ^I
			$Cu < 6$ and/or $[Cc < 1 \text{ or } Cc > 3.0]$ ^E	SP Poorly graded sand ^I
Fine-Grained Soils: 50% or more passes the No. 200 sieve		Sands with Fines: More than 12% fines ^D	Fines classify as ML or MH	SM Silty sand ^{G, H, I}
			Fines classify as CL or CH	SC Clayey sand ^{G, H, I}
	Silts and Clays: Liquid limit less than 50	Inorganic:	$PI > 7$ and plots above "A" line ^J	CL Lean clay ^{K, L, M}
			$PI < 4$ or plots below "A" line ^J	ML Silt ^{K, L, M}
		Organic:	$\frac{LL_{oven\ dried}}{LL_{not\ dried}} < 0.75$	OL Organic clay ^{K, L, M, N}
				Organic silt ^{K, L, M, O}
Highly organic soils: Primarily organic matter, dark in color, and organic odor		Inorganic:	PI plots on or above "A" line	CH Fat clay ^{K, L, M}
			PI plots below "A" line	MH Elastic silt ^{K, L, M}
		Organic:	$\frac{LL_{oven\ dried}}{LL_{not\ dried}} < 0.75$	OH Organic clay ^{K, L, M, P}
				Organic silt ^{K, L, M, Q}
			PT	Peat

^A Based on the material passing the 3-inch (75-mm) sieve.

^B If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

^C Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

^D Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

$$Cu = D_{60}/D_{10} \quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$$

^F If soil contains $\geq 15\%$ sand, add "with sand" to group name.

^G If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

^H If fines are organic, add "with organic fines" to group name.

^I If soil contains $\geq 15\%$ gravel, add "with gravel" to group name.

^J If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

^K If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

^L If soil contains $\geq 30\%$ plus No. 200 predominantly sand, add "sandy" to group name.

^M If soil contains $\geq 30\%$ plus No. 200, predominantly gravel, add "gravelly" to group name.

^N $PI \geq 4$ and plots on or above "A" line.

^O $PI < 4$ or plots below "A" line.

^P PI plots on or above "A" line.

^Q PI plots below "A" line.

