SECTION 01000
DEFINITIONS, ABBREVIATIONS and REFERENCE STANDARDS
(REVISED 01-05-22)

PART 1 - DEFINITIONS

A. EASEMENT – An interest in land owned by another that entitles its holder to a specific use.

B. INVERT - The lowest point in the internal cross section of a pipe or other culvert.

C. RIGHT OF WAY - The area that encompasses public streets, sidewalks and utility strips.

D. SUBGRADE - That portion of the roadbed prepared as a foundation for the pavement structure.

PART 2 - ABBREVIATIONS

A. Following is a partial list of abbreviations that may appear in the specifications, and their definitions.

B. A.B.S. Acrylonitrile Butadiene Styrene

C. A.F.F. Above Finished Floor

D. AWG American Wire Gauge

E. BHP Brake Horsepower

F. °C Degrees Centigrade

G. cy or cu. yd. Cubic Yard

H. DIP Ductile Iron Pipe

I. °F Degrees Fahrenheit

J. ft. foot

K. gpd gallons per day

L. gpm gallons per minute

M. HP Horsepower

N. ID internal diameter

O. in. Inches

P. lbs. Pounds

Q. MSL mean sea level

R. O.C. on center

S. OD outside diameter

T. OSHA Occupational Safety and Health Act

U. oz. Ounce

V. P.C. point of curvature

W. P.E. Professional Engineer, registered in North Carolina

X. P.L.S. Professional Land Surveyor, registered in North Carolina

Y. ppm parts per million

Z. psi pounds per square inch

AA. P.T. point of tangency

BB. PVC polyvinyl chloride

CC. P.V.C. point of curvature on vertical curve

DD. P.V.T. point of tangency on vertical curve

EE. Qmax maximum discharge

FF.Qmin minimum discharge

GG. RH relative humidity

HH. sec. Second

II. sq. ft. square feet

JJ. sq. yd. square yard

KK. TDH Total Dynamic Head

LL. VAC volts (alternating current)

MM. VDC volts (direct current)

PART 3 – REFERENCE STANDARDS

A. All materials, products and procedures incorporated into the work shall be in strict accordance with the following codes, standards and specifications. Wherever reference is made to any published standard, code or standard specification, it shall mean the latest edition in effect at the invitation for bids.

B. American Association of State Highway and Transportation Officials (AASHTO)

C. American National Standards Institute (ANSI)

D. American Society of Testing and Materials (ASTM)

E. American Water Works Association (AWWA)

F. City of Raleigh (COR) Street Design Manual – is available on the City's website at the following path: http://www.raleighnc.gov/content/extra/Books/PlanDev/StreetDesignManual/ Where COR standard specifications exceed NCDOT standards, the COR standard specification shall apply.

G. City of Raleigh (COR) Standard Details - is available on the City's website at the following path: http://www.raleighnc.gov/business/content/PlanDev/Articles/DevServ/DrawingsStandardDetailsIndex.html. Where standard specifications between COR and NCDOT conflict, the more stringent standard specification shall apply.

H. Ductile Iron Pipe Research Association (DIPRA)

I. Manual on Uniform Traffic Control Devices for Streets and Highways, as prepared by the National Advisory Committee on Uniform Traffic Control Devices (MUTCD)

J. North Carolina Department of Transportation (NCDOT) Standard Drawings – may be obtained at the following link: https://connect.ncdot.gov/resources/Specifications/Pages/2018-Roadway-Standard-Drawings.aspx

K. North Carolina Department of Transportation (NCDOT) Standard Specifications – may be obtained at the following link: https://connect.ncdot.gov/resources/Specifications/StandSpecLibrary/2018%20Standard%20Specifications%20for%20Roads%20and%20Structures.pdf

L. North Carolina Department of Environment and Natural Resources (NCDENR)

M. National Electrical Code (NEC)

N. National Electrical Manufacturers Association (NEMA)

O. Natural Resources Conservation Service (NRCS)

P. Occupational Safety and Health Act (OSHA)

Q. Underwriters Laboratories, Inc. (UL)

END OF SECTION

SECTION 01500
PROJECT MANAGEMENT COMMUNICATIONS
(Revised 10-21-2024)

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Attention is directed to the CONTRACT, GENERAL AND SUPPLEMENTAL CONDITIONS, and all REQUIREMENTS, which are hereby made a part of the CONTRACT.
B. Refer to specification SECTION 02000 - SUBMITTALS for additional information.

1.02 SUMMARY
A. Project Management Communications: The CONTRACTOR shall use the internet-based project management software communications tool Trimble® Unity Construct and protocols included in that software during this project. The use of project management communications as herein described does not replace or change any contractual responsibilities of the participants.
   1. Project management communications is available through Trimble® Unity Construct ® in the form and manner required by the OWNER.
   2. User registration, licensing fees, computer equipment, software, internet connection and all else required to use the Trimble® Unity Construct application as required by the OWNER are the responsibility of the CONTRACTOR.
   3. The CONTRACTOR will obtain a minimum of one (1) dedicated user license for the duration of the contract including amendments and associated warranty period as applicable.
   4. Access to the OWNER's Trimble® Unity Construct project web site will be granted to individual licensed users. The sharing of user licenses is prohibited unless expressly authorized by the OWNER.
B. Purpose: The intent of using Trimble® Unity Construct is to improve project work efforts by promoting timely initial communications and responses. Secondly, to reduce the number of paper documents while providing improved record keeping by creation of electronic document files.
C. Minimum Equipment and Internet Connection: In addition to other requirements specified in this Section, The OWNER and his representatives, the CONTRACTOR and his sub-contractors and suppliers at every tier required to have a user license(s) shall be responsible for the following:

1. Providing suitable computer systems daily for each licensed user at the user's normal work location[1] with high-speed Internet access, i.e. DSL, local cable company's Internet connection, or portable Wi-Fi hotspot connection.
2. Each of the above referenced computer systems shall have the following minimum system[2] and software requirements:
    a. Desktop configuration (Laptop configurations are similar and should be equal to or exceed desktop system.)
        1) PC system Windows 7 or later or OSX v 10.8 or later
        2) 128 MB Ram
        3) Display capable of SVGA (1024 x 768 pixels) 256 colors display
        4) 101 key Keyboard
        5) Mouse or other pointing device
    b. Operating system and software shall be properly licensed.
        1) Microsoft Edge 91 or later, Google Chrome 99 or later, Mozilla Firefox 91 or later, Safari 14 or later, Safari for iOS mobile v 6.1 or later, Google Chrome for iOS, Google Chrome for Android, or other browser. This specification is not intended to restrict the host server or client computers if standard HTTP clients may access the published content.
        2) Adobe Acrobat Reader (current version is a free distribution for download).
        3) Or, users intending to scan and upload to the documents area of Trimble® Unity Construct should have Adobe Acrobat.
        4) Users should have the standard Microsoft Office Suite or the equivalent.

D. Training: Group training sessions are periodically scheduled by the OWNER. If a user training session(s) has been assigned to the CONTRACTOR, the CONTRACTOR is required to attend the scheduled training session(s) they are assigned to attend. Requests for specific scheduled training session(s) may be entertained, however, the OWNER is under no obligation to make space(s) available in requested alternative training session(s). CONTRACTOR may also obtain group training from Trimble® Unity Construct at their own expense. Please contact Trimble® for availability and cost.

E. Support: Trimble® Unity Construct and the OWNER has available support through on-line help files.

F. Project Archive: The project archive information will contain only documents that the authorized Trimble® Unity Construct user has security access to during construction.

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[1] The normal work location is the place where the user is assigned for more than one-half of his time working on this project.

[2] The minimum system herein will not be sufficient for many tasks and may not be able to process all documents and files stored in the Trimble® Unity Construct Documents area.

G. Copyrights and Ownership: Nothing in this specification or the subsequent communications supersedes the parties' obligations and rights for copyright or document ownership as established by the Contract Documents. The use of drawing files, processes, design, and construction information distributed in this system is intended only for the project specified herein and OWNER's ability to effectively manage the project upon its completion.

H. Authorized Users: Access to the OWNER's Trimble® Unity Construct project web site will be by individuals who are licensed users.
   1. The CONTRACTOR shall obtain a user license directly from the OWNER.
   2. Authorized users will be contacted directly by email once a license has been issued to the CONTRACTOR who will establish a user password.
   3. Individual users shall be responsible for the proper use of their passwords and access to data as agents of the company in which they are employed.
   4. The CONTRACTOR should contact the OWNER to confirm that they have successfully obtained and logged in using their user license.

I. Administrative Users: The OWNER has access and control of user licenses and all posted items. DO NOT POST PRIVATE OR YOUR COMPANY CONFIDENTIAL ITEMS IN THE PROJECT DATABASE. Improper or abusive language toward any party or repeated posting of items intended to deceive or disrupt the work of the project will not be tolerated and will result in revocation of user license at the sole discretion of the OWNER.

J. Communications: The use of fax, email and courier communication for this project is discouraged in favor of using Trimble® Unity Construct generated project email address, processes, and forms. Communication functions are as follows:
   1. Document Integrity and Revisions:
      a. Documents, comments, drawings and other records posted to e-Builder® shall remain for the project record. The authorship time and date shall be recorded for each document submitted to the system. Submitting a new document or record with a unique ID, authorship, and time stamp shall be the method used to make modifications or corrections.
      b. The system shall make it easy to identify revised or superseded documents and their predecessors.
      c. Server or software enhancements during the life of the project shall not alter or restrict the content of data published by the system. System upgrades shall not affect access to older documents or the software.
   2. Document Security:
      a. The system shall provide a method for communication of documents. Documents shall allow security group assignment to respect the contractual parties communication except for Administrative Users.

3. Document Integration:
    a. Documents of various types shall be logically related to one another and discoverable. For example, requests for information, daily field reports, supplemental sketches and photographs shall be capable of reference as related records.
4. Reporting:
    a. The system shall be capable of generating reports for work in progress, and logs for each document type. Summary reports generated by the system shall be available for licensed users.
5. Notifications and Distribution:
    a. Document distribution to project members shall be accomplished both within the extranet system and via email as appropriate. Project document distribution to parties outside of the project communication system shall be accomplished by secure email of outgoing documents and attachments, readable by a standard email client.
6. Required Document Types:
    a. RFI, Request for Information.
    b. Submittals, including record numbering by drawing and specification section.
    c. Transmittals, including record of documents and materials delivered in hard copy.
    d. Meeting Minutes.
    e. Application for Payments.
    f. Review Comments.
    g. Daily Field Reports.
    h. Construction Photographs.
    i. Surveys.
    j. Drawings.
    k. Supplemental Sketches.
    l. Schedules.
    m. Specifications.
    n. Field Orders.
    o. Work Change Directives.
    p. Punch List.
    q. Project Inspection Reports.
    r. Proposal Request and Proposed Changes.
    s. Additional forms may be necessary for project progress.

K. Record Keeping: Except for paper documents, which require original signatures, all 8½ x 11 inches documents (including scanned documents with signatures) or larger shall be submitted by transmission in electronic form to the Trimble® Unity Construct project web site by licensed users.
    a. The OWNER and his representatives, the CONTRACTOR and his sub-contractors and suppliers at every tier shall respond to documents received in electronic form within the Trimble® Unity Construct project web site and consider them as if received in paper document form.
    b. The OWNER and his representatives, the CONTRACTOR and his

sub-contractors and suppliers at every tier reserves the right to and shall reply or respond by transmissions in electronic form on the project web site to documents received in paper document form.

c. The OWNER and his representatives, the CONTRACTOR and his sub-contractors and suppliers at every tier reserves the right to and shall copy any paper document into electronic form and make same available on the project web site.

d. The following are some but not all of the paper documents which require original signature:
   1) Contract
   2) Change Orders
   3) Work Change Directives (CCD)
   4) Forms and reports
   5) Professionally sealed drawings and documents

PART 2 - PRODUCTS (Not Applicable.)

PART 3 – EXECUTION (Not Applicable.)

END OF SECTION

SECTION 02000
CONTRACTOR SUBMITTALS
(Revised 10-1-14)

PART 1 – SUBMITTALS

1.01 GENERAL

A. The Contractor shall transmit five (5) copies of submittals in sufficient time to allow thorough review by the Engineer. The Engineer will retain two (2) sets of submittals and return three (3) sets of submittals to the Contractor following review.

B. Submittals shall be accompanied by a letter of transmittal containing the date, project name, Contractor's name, supplier, manufacturer, number and title of submittal, notification of exceptions and/or deviations from the Contract requirements, and any other pertinent data to facilitate review.

C. The Contractor shall thoroughly check all submittals for accuracy and conformance to the intent of the Contract Documents, and make any necessary changes, prior to submitting them to the Engineer. All submittals shall bear the Contractor's certification stating that they have been so checked. **This certification shall include the following statement: "By this Submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers, and similar data and I have checked and coordinated each item with other applicable approved shop drawings and all contract requirements." SUBMITTALS WITHOUT THE CONTRACTOR'S CERTIFICATION WILL BE RETURNED TO THE CONTRACTOR WITHOUT REVIEW.**

D. No material shall be ordered, fabricated or shipped or any work performed until the Engineer returns the required submittal to the Contractor with satisfactory review indicated.

E. The Engineer's review of the Contractor's submittals shall in no way relieve the Contractor of any responsibility under the Contract. An acceptance of a submittal shall be interpreted to mean that the Engineer has no specific objections to the submitted material, subject to conformance with the Contract Documents.

1.02 SHOP DRAWINGS

A. The Contractor shall submit to the Engineer for review shop drawings for all fabricated work and for all manufactured items for which shop drawings are required elsewhere in the project manual. This shall include, but not be limited to, items related to paving materials, concrete, storm drainage,

water/reclaimed water distribution, sanitary sewer, traffic control, traffic signalization, structural (i.e. bridges, headwalls, retaining walls), engineering fabric/grids, pavement markings, and erosion control.

B. Where manufacturer's publications in the form of catalogs, brochures, illustrations or other data sheets are submitted, items for which approval is requested shall be shall be specifically indicated. Submittals showing only general information shall not be acceptable.

C. Within ten (10) days after notice to proceed, the contractor shall submit his preliminary schedule of shop drawing submittals to the Engineer for approval.

1.03 LAYOUT AND INSTALLATION DRAWINGS

A. The Contractor shall submit to the Engineer for review layout and installation drawings for all pipes, valves, fittings, sewers, manholes, electrical, conduits, etc. to be provided under this contract.

B. Within ten (10) days after notice to proceed, the contractor shall submit his preliminary schedule of layout and installation drawing submittals to the Engineer for approval.

PART 2 – OTHER REQUIREMENTS

2.01 PROGRESS SCHEDULE

A. The Contractor shall submit to the Engineer for review and approval the proposed progress schedule in accordance with Article 108-2 of the General Conditions.

B. The schedule shall be kept up to date and presented with each month's billing information and shall be made available at the bi-weekly progress meetings and at other times as may be deemed necessary by the Public Works Director or his representative. A blank form for the City of Raleigh Progress Chart is available for use by the Contractor.

C. Progress schedule shall be updated monthly and submitted to the Engineer with the application for payment. The Engineer may withhold progress payments until such time as the schedule or revised schedule is received.

D. Progress schedule shall be prepared in the form of a horizontal bar chart showing in detail the proposed sequence of work. Schedule shall be time scaled showing start and completion dates for each stage of the work. The schedule shall account for all subcontractors. The schedule shall provide for proper sequence of construction considering various crafts, purchasing time, submittal review, material delivery, equipment fabrication and similar time-consuming factors. The schedule shall show as a minimum, earliest starting

earliest completion, latest starting, latest completion, and total float for each task or item.

2.02 LIST OF SUBCONTRACTORS

A. The Contractor shall submit to the Engineer for review, prior to the preconstruction conference, a listing of all subcontractors. This submittal shall include a description of the work to be performed by each subcontractor, the estimated value of such work, and the subcontractor's experience performing similar work.

END OF SECTION

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SECTION 02315

TRENCHING FOR UTILITIES
(REVISED 01-05-22)

PART 1 GENERAL

1.01 SCOPE

A. Provide labor, equipment, and material to perform required excavating, backfilling, and compacting for utilities and related structures as specified herein and indicated on the Drawings. Work shall include, but not be limited to, the following:
   1. Survey staking as required for construction.
   2. Protection of existing improvements.
   3. Location of existing utilities.
   4. Use of explosives.
   5. Dewatering.
   6. Excavating, backfilling, and compacting for utilities.
   7. Installation of warning / identification tape and tracer wire.
   8. Borrow material.
   9. Disposal of surplus material.
   10. Demolition and removal of existing structures.
   11. Soil Testing.

1.02 RELATED SECTIONS

A. The following Sections have work that is directly related to this Section. This does not relieve the Contractor of his responsibility of proper coordination of all the work:
   1. Section 02230 Clearing and Grubbing
   2. Section 02370 Erosion Control
   3. Section 02510 Water Distribution System
   4. Section 02530 Sanitary Sewer System
   5. Section 02540 Reclaimed Water System
   6. Section 02920 Lawns and Grasses

B. The City of Raleigh Public Utilities Handbook, as it relates to this Section, shall be used in conjunction with this specification. All aspects of the project construction shall conform to this handbook unless specifically noted otherwise herein. It is the Contractors responsibility to obtain this document from the City's Public Utilities Department. It can be obtained by phone at 919-857-4540 or on the internet at http://www.raleigh-nc.org/ under departments and public utilities.

C. In the event of a discrepancy between this specification and the Handbook, the Contractor shall use the more stringent of the two documents. Notify the Owner immediately of the discrepancy.

1.03 REFERENCED STANDARDS

A. The latest revision, at the time of bidding, of the publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.
   1. N.C. Department of Transportation - Standard Specifications for Roads and Structures (NCDOT), latest edition.
   2. American Society of Testing Materials (ASTM)

a. D698 Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5-lb (2.49 Kg) Rammer and 12-inch Drop (Standard Proctor).
b. D1556 Density of Soil in Place by the Sand-Cone Method.
c. D1586 Penetration Test and Spilt-Barrel Sampling of Soils.
d. D2049 Test for Relative Density of Cohesionless Soils.
e. D2216 Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures.
f. D2487 Classification of Soils for Engineering Purposes.
g. D3839 Standard Guide for Underground Installation of “Fiberglass” (Glass-Fiber Reinforced Thermosetting-Resin) Pipe and Fittings.

3. American Water Works Association (AWWA)
   a. Fiberglass Pipe Design Manual of Water Supply Practices M45
   b. PVC Pipe Design and Installation Manual for Water Supply Practices M23
   c. Ductile Iron Pipe and Fittings Manual for Water Supply Practices M41
4. Uni-Bell PVC Pipe Association
   a. B-5-89 Recommended Practice for the Installation of Polyvinyl Chloride (PVC) Sewer Pipe.
5. Ductile Iron Pipe Research Association (DIPRA)
   a. 8-08/5M Design of Ductile Iron Pipe

1.04 DEFINITIONS

A. Backfill: A specified material used in filling the excavated trench and placed at a specified degree of compaction.
   1. Materials: Materials listed herein include processed materials plus the soil classifications listed under the Unified Soil Classification System, (USCS) (Method D2487 and Practice D2488). The soil materials are grouped into five broad categories according to their suitability for this application.
      a. Class I: Angular, 6 to 40-mm (1/4 to 1-1/2-in), graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shell.
      b. Class II: Coarse sands and gravels with maximum particle size of 40 mm (1-1/2 in.), including various graded sands and gravels containing small percentages of fines, generally granular and noncohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class.
      c. Class III: Fine sand and clayey gravels, including fine sands, sand-clay mixtures, and gravel-clay mixtures. Soil Types GM, GC, SM, and SC are included in this class.
      d. Class IV: Silt, silty clays, and clays, including inorganic clays and silts of medium to high plasticity and liquid limits. Soil Types MH, ML, CH and CL are included in this class. These materials shall not be used for bedding, haunching, or initial backfill.
      e. Class V: This class includes the organic soils OL, OH, and PT as well as soils containing frozen earth, debris, rock larger than 40 mm (1 1/2 in.) in diameter, and other foreign materials. These materials shall not be used for bedding, haunching, or initial backfill.
   2. Backfill Zones: Each backfill zone shall extend the full width of the trench bottom.
      a. Foundation: Extending down from the bottom of bedding zone as defined below.

b. Pipe Embedment
   1) Bedding: Extending from 4 inches below the pipe bottom to the pipe bottom for 30-inch diameter and smaller and 6 inches below the pipe bottom for pipes larger than 30 inches in diameter.
   2) Haunching: Extending from the bedding (bottom of the pipe) to the pipe spring line.
   3) Initial Backfill: Extending from the haunching (pipe spring line) to 1 foot above the top of the pipe.
c. Final Backfill: Extending from the initial backfill to the finish ground elevation.

B. Laying Conditions:
   1. Type 1: Flat bottom trench with loose backfill.
   2. Type 2: Flat bottom trench with backfill lightly consolidated to centerline of pipe.
   3. Type 3: Pipe bedded in 4 inches minimum of loose soil and backfill lightly consolidated to top of pipe.
   4. Type 4: Pipe bedded on Class I material to 1/8 pipe diameter (4 inch minimum) Backfill compacted to top of pipe a minimum of 80 percent of standard proctor.
   5. Type 5: Pipe bedded in compacted Class I material to pipe centerline with 4-inch minimum under pipe. Backfill to top of pipe with Class I, II, or III and compact to 90 percent of standard proctor.

C. Compaction: Process of mechanically stabilizing a material by increasing its density at a controlled moisture condition. "Degree of compaction" shall be expressed as a percentage of the maximum dry density obtained by the test procedure presented in ASTM D698 (Standard Proctor).
D. Excavation: The removal of soil or rock to obtain a specified depth or elevation.
E. Lift: Layer of soil placed on top of a previously prepared or placed soil.
F. Rock: Solid, homogeneous material which cannot be removed without the systematic drilling and blasting exceeding 1 cubic yard in volume. Material having a standard penetration rate less than 1-inch of penetration over 50 blows across continuous materials is defined as “rock.” Rock is further defined as materials and obstructions encountered that cannot be practically excavated with a large track mounted backhoe, such as a CAT-325 or larger, equipped with a 42-inch rock bucket and new rock teeth. Practical excavation is defined as the ability to remove at least 10 cubic yards during one (1) hour of continuous digging. Removal of "hard material" will not be considered rock excavation because of intermittent drilling and blasting that is performed merely to increase production.
G. Pipe Springline: A line running horizontally through the center of the pipe.
H. Topsoil: Natural, friable soil, representative of productive soils in the vicinity of the site. Topsoil shall be free from roots, stones larger than 1 inch, objectionable weed seeds, toxic substances, and materials that hinder grading, planting, and maintenance operations.

1.05 SUBMITTALS

A. Submit the following in accordance with Section 01330, Submittal Procedures:
   1. Catalog Data: Submit manufacturer's standard drawings or catalog cuts for the following. Clearly indicate equipment to be furnished for the Project including options to be provided.
      a. Warning / Identification tape.

b. Geofabric for trench stone wrap.

2. Test Reports: Submit for the following:
   a. Moisture-density relations of soils.
   b. Field moisture content.
   c. Soil classification.
   d. In-place field density.
   e. Geotechnical engineer's daily field reports.
   f. Third-party test reports for pre-construction condition assessments, crack monitoring and vibration monitoring per Section 02300, Earthwork.

PART 2 PRODUCTS

2.01 STONE

A. Class I material shall be #67 or #78M stone in accordance with NCDOT Standard Specifications for Roads and Structures, latest edition Section 1005, General Requirements for Aggregate.

B.

2.02 WARNING AND IDENTIFICATION TAPE

A. Tape shall be a minimum 3-inch wide polyethylene plastic tape manufactured specifically for identification of buried utilities with means of enabling detection by a metal detector to a minimum depth of 3 feet. Tape shall be color coded and continuously imprinted with warning and identification markings in bold black letters to read "CAUTION - BURIED (utility) LINE BELOW." Color and printing shall be permanent, unaffected by moisture or soil and shall be as follows:

	Utility	Color	Marking
1.	Reclaimed Water	Purple	Caution – Buried Reclaimed Water Line Below
2.	Sewer	Green	Caution - Buried Gravity Sewer Main Below Buried Pressure Sewer Line Below
3.	Water	Blue	Caution – Buried Water Line Below

B. Tape shall be by Blackburn Manufacturing, Joseph G. Pollard Co., or Reef Industries Inc or approved equal.

C. Warning tape shall only be installed for pressure mains constructed of PVC materials.

2.03 TRACER WIRE AND INDICATION POSTS

A. All non-ferrous pressure mains shall be provided tracing wire and test ports in such a manner as to be able to properly trace all mains without loss or deterioration of signal or without the transmitted signal migrating off the trace wire.

B. Tracer wire shall be #12 gauge solid (bare) copper and continuous to the greatest extent possible. The tracer wire shall be securely bonded together at all wire joints with an approved industrial crimp connector to provide electrical continuity. It shall be accessible at all tracer wire test ports.

C. Test ports with marker posts shall be located at bends and no further than 500 feet apart. The test port shall consist of a standard valve box (as specified in Section 02530), shall be H-20 traffic load rated flush with grade in non-paved areas and

flush with final asphalt or concrete pavement elevation and shall be located over the downstream or outgoing main. The valve box shall be equipped with a lid stamped “TS” and painted green for sewer mains, blue for water mains, and Pantone 522C for reuse mains. At each test port, a loop of wire shall be brought up and looped inside the box. The loop of wire inside the box shall be a minimum of three feet.

2.04 TRACER WIRE FOR NONMETALLIC WATER SERVICE PIPE

A. Where nonmetallic water service pipe is allowed, all new nonmetallic water service pipes shall be provided tracing wire in such a manner as to be able to properly trace all mains and service laterals without loss or deterioration of signal or without the transmitted signal migrating off the trace wire.
B. Tracing shall be #12 gauge solid (bare) copper and continuous to the greatest extent possible. The tracer wire shall be securely bonded together at all wire joints with an approved industrial crimp connector to provide electrical continuity.
C. The meter box at or near the right of way and or easement shall serve as the test port with the tracing wire brought up into the meter box with the service lateral and looped in the meter box. The loop wire inside the meter box shall be a minimum of three feet.
D. For new nonmetallic water service laterals where no tracer is installed on the main, provide an anode (1 pound minimum) for the tracing wire termination at the point of the new tap on the main.
E. For nonmetallic service lateral installations less than 8 feet, the tracing wire shall be attached to the pipe. For nonmetallic service lateral installations deeper than 8 feet, the tracing wire shall be installed at a depth of 7 to 8 feet. For nonmetallic service laterals that are installed in encasement pipe, the tracing wire shall be routed through the encasement pipe.
F. For nonmetallic service lateral that installed by directional drilling, the tracer wire shall be attached to and pulled through with the service pipe.
G. The wire shall be protected from damage during the execution of the work. No breaks or cuts in the tracer wire shall be permitted. Spliced connections shall only be allowed between the main liner tracer wire (if applicable) and the lateral tracer wire. Industrial crimps shall be used to provide electrical continuity and the crimps shall be similar metal to eliminate galvanic corrosion.
H. Contractor shall perform a continuity test on all tracer wire in the presence of the Owner or Owner's representative. If the tracer wire is found to be not continuous after testing, Contractor shall repair or replace the failed segment of wire at his own expense.
I. Copper clad steel tracer wire (#12) as manufactured by Copperhead Industries, or approved equal is an approved alternative to #12 bare solid copper tracer wire.

2.05 TRACER WIRE FOR GRAVITY SEWERS AND LATERALS AND MANHOLE MARKERS

A. In accordance with General Statute 87-121(g), gravity sewers and laterals installed after October 1, 2014 shall be electronically locatable.

B. All new gravity sewer main and sanitary sewer lateral shall be provided tracing wire in such a manner as to be able to properly trace all mains without loss or deterioration of signal or without the transmitted signal migrating off the trace wire.
C. Tracing shall be #12 gauge solid (bare) copper and continuous to the greatest extent possible. Copper clad steel tracer wire (#12) as manufactured by Copperhead Industries, or approved equal is an approved alternative to #12 bare solid copper tracer wire. The tracer wire shall be securely bonded together at all wire joints with an approved industrial crimp connector to provide electrical continuity. It shall be accessible at all tracer wire test ports.
D. For gravity mains, test ports shall be provided at frequency of 500 feet or at every manhole, whichever is the shorter of the distance. The test port shall consist of a standard valve box (as specified in Section 02530), shall be H-20 traffic load rated flush with grade in non-paved areas with concrete collar as shown on Detail W-17, and flush with final asphalt or concrete pavement elevation and shall be located over the downstream or outgoing main. The valve box shall be equipped with a lid stamped “TS” and painted green. At each test port, a loop of wire shall be brought up and looped inside the box. The loop of wire inside the box shall be a minimum of three feet. All tracing wire for branch mains and laterals that terminate into the manhole shall be routed around the circumference of the manhole and spliced to the main tracing line.
E. For sanitary sewer laterals, the cleanout at the right of way and or easement shall serve as the test port with the tracing wire brought up outside the cleanout assembly and wrapped around the assembly stack twice at a depth of approximately 12-inches below grade. Extend a loop of the wire to the top of cleanout.
F. For new sanitary sewer laterals where no tracer is installed on the main, provide an anode (1 pound minimum) for the tracing wire termination at the point of the new tap on the existing main.
G. For gravity main and or lateral installations less than 8 feet, the tracing wire shall be attached to the pipe. Tracer wire shall be laid flat and securely affixed to the pipe at 10 foot intervals. Where lateral taps are made by service saddles, the tracer wire shall not be allowed to be placed between the saddle and main. For gravity main and or lateral installation deeper than 8 feet, the tracing wire shall be installed at a depth of 7 to 8 feet. The wire shall be protected from damage during the execution of the work. No breaks or cuts in the tracer wire shall be permitted.
H. Spliced connections shall only be allowed between the main line tracer wire and branch main and lateral tracer wire. Industrial crimps shall be used to provide electrical continuity and the crimps shall be similar metal to eliminate galvanic corrosion.
I. Contractor shall perform a continuity test on all tracer wire in the presence of the Owner or Owner's representative. If the tracer wire is found to be not continuous after testing, Contractor shall repair or replace the failed segment of wire at his own expense.
J. Where existing branch mains are reconnected to a main line that is replaced or realigned, tracing wire is not required for the section of branch main that is reconnected unless it is replaced from manhole to manhole. All main lines that are replaced or realigned shall be provided tracing wire.

K. For gravity sewer mains and laterals that are installed in encasement pipe, the tracing wire shall be routed through the encasement pipe.
L. Manhole markers shall be placed adjacent to manholes at the discretion of Owner or Owner's representative.

2.06 TRACER WIRE FOR REUSE MAINS

A. Tracer wire to be installed on all PVC reuse pipe in such a manner as to be able to properly trace all mains without loss or deterioration of signal or without the transmitted signal migrating off the trace wire.
B. Tracer wire shall be #12 gauge solid (bare) copper and continuous to the greatest extent possible. Copper clad steel tracer wire (#12) as manufactured by Copperhead Industries, or approved equal is an approved alternative to #12 bare solid copper tracer wire. The tracer wire shall be securely bonded together at all wire joints with an approved industrial crimp connector to provide electrical continuity. It shall be accessible at all tracer wire test ports.
C. Test ports with marker posts shall be located at bends and no further than 300 feet apart. The test port shall consist of a standard valve box with a concrete collar, shall be H-20 traffic load rated flush with grade in non-paved areas with concrete collar as shown on detail W-17, and flush with final asphalt or concrete pavement elevation and shall be located over the downstream or outgoing main. The valve box shall be equipped with a lid stamped "TS" and painted Pantone 522C for reuse mains.
D. At each test port, a loop of wire shall be brought up and looped inside the box. The loop of wire inside the box shall be a minimum of three feet.
E. The wire shall be protected from damage during the execution of the work. No breaks or cuts in the tracer wire shall be permitted. Industrial crimps shall be used to provide electrical continuity and the crimps shall be similar metal to eliminate galvanic corrosion.
F. Contractor shall perform a continuity test on all tracer wire in the presence of the Owner or Owner's representative. If the tracer wire is found to be not continuous after testing, Contractor shall repair or replace the failed segment of wire at his own expense.
G. All main lines that are replaced or realigned shall be provided tracing wire.
H. For reuse mains that are installed in encasement pipe, the tracing wire shall be routed through the encasement pipe.

PART 3 EXECUTION

3.01 PROJECT SAFETY

A. Contractor is responsible for Project safety.

B. Perform work in conformance with applicable State and Federal safety regulations including, but not limited, to the following:
   1. North Carolina Safety and Health Standards for the Construction Industry (29CFR 1926 Subpart P and U).
   2. NC OSHA Industry Guide No. 14, Excavations.
   3. NC OSHA Industry Guide No. 20, Crane Safety.

C. Provide barriers, warning lights, and other protective devices at excavations as necessary for safety of workers and the public.

D. Provide sloping of bank, shoring, sheeting, or other means of maintaining the stability of the trench in accordance with the requirements of the Associated Contractor's Manual of Accident Prevention OSHA, Part 1926.P.
E. In trench depths of 22 feet or greater, provide certification sealed by Structural Engineer certifying that trench box, sheeting and shoring meets OSHA requirements.

3.02 VIDEO AND PHOTOGRAPHIC INSPECTIONS

A. Provide pre and post construction video inspections of the project area in accordance with Section 01320, Video and Photographic Documentation.
B. Submittal shall be in accordance with Section 01330, Submittal Procedures.

3.03 PROTECTION OF UNDERGROUND FACILITIES

A. Refer to paragraph 4.04 of the General Conditions and SC-4.04.A.2 of the Supplementary Conditions concerning the protection of Underground Facilities.
B. Prior to beginning any excavation work or boring, the Contractor shall, through field investigations, determine any conflicts or interferences between existing utilities and new utilities to be constructed under this project. This determination shall be based on the actual locations, elevations, slopes, etc., of existing utilities as determined in the field investigations, and locations, elevation, slope, etc. of new utilities as shown on the Drawings. If an interference exists, the Contractor shall bring it to the attention of the Engineer as soon as possible. If the Engineer agrees that an interference exists that was not apparent from the Contract Documents, or could not have been identified during a site visit during bidding, he shall modify the design as required. An interference shall be defined for these purposes as a conflict with an existing utility or structure that prevents the proposed utility from being installed where shown or specified after existing utilities and structures are adequately supported by the Contractor. In the event the Contractor fails to complete adequate field evaluations to identify conflicts, or bring a potential conflict or interference to the attention of the Engineer prior to beginning excavation work, any actual conflict or interference which does arise during the Project and could have been avoided with diligent utility location efforts shall be corrected by the Contractor, as directed by the Engineer, at no additional expense to the Owner.
C. Separation distances shall be in accordance with utilities requirements.

3.04 CONSTRUCTION STAKING

A. Provide construction staking as indicated in paragraph 4.05 of the General Conditions. Engineer will only provide electronic design files for Contractor’s surveyor and key reference points and benchmarks as shown on the Drawings.
B. Contractor shall report to Engineer whenever a reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations. Contractor shall be responsible for the accurate replacement or relocation of such reference points or property monuments by a registered professional surveyor in the State of North Carolina.

3.05 LOCATION OF INSTALLED UTILITIES

A. Contractor shall be responsible for locating contract installed utilities as requested by third parties proposing to dig in the contract area until the date that the entire contract is recommended for final payment by Engineer to Owner.

3.06 WATER CONTROL

A. Prevent surface water from entering the trench.
B. When trench bottom is below the existing ground water table, install a dewatering system to maintain water table a minimum of two (2) feet below trench bottom. Provide personnel experienced in dewatering work at the job site.
C. Maintain dewatering until backfilling has proceeded above the existing ground water level.
D. Dispose of water from dewatering operations in accordance with the North Carolina Sedimentation Pollution Control Act.
E. In no case shall trench water or groundwater be pumped into or allowed to enter the sanitary sewer system.

3.07 USE OF EXPLOSIVES

A. Blasting is allowable for the removal of rock, as defined herein, unless specifically prohibited by the Owner, Engineer or a Utility Owner with an existing utility within the proximity of the proposed blast site. The contractor shall review the drawings for specific areas where blasting is prohibited.
B. Obtain required permits for blasting (e.g., from City of Raleigh Fire Marshall's Office) prior to blasting, 24 hours minimum.
C. Store, handle, and use explosives in accordance with all applicable local, state, and federal regulations, and in accordance with the provisions of the "Manual of Accident Prevention and Construction" of the Associated General Contractors of America, Inc. Federal regulations include, but are not limited to, Title 27, Chapter 11, Part 555 of the Code of Federal Regulations (CFR) and OSHA Standards – Part 1926, Subpart U.
D. Provide seismographic monitoring during progress of blasting operations.
E. Take all necessary precautions to protect life and property, including the use of an approved blasting mat where there exists the danger of throwing rock or overburden. Keep the explosive materials that are on the job site in specially constructed boxes provided with locks. Failure to comply with this specification shall be grounds for suspension of blasting operations until full compliance is made. No blasting shall be allowed unless a galvanometer is employed to check cap circuits. Where blasting takes place within 500 feet of a utility, structure, or property which could be damaged by vibration, concussion or falling rock, keep a blasting log containing the following information for each and every shot. This log shall be kept in an orderly manner and made available to the Engineer and Owner upon request.
    1. Date of shot
    2. Time of shot
    3. Crew supervisor
    4. Number and depth of holes
    5. Approximate depth of overburden
    6. Amount and type of explosive used in each hole
    7. Type of caps used (instant or delay)
    8. The weather
    9. Seismograph instrument and readings
F. Use explosives in such a way to minimize vibration to existing utilities and structures.

G. Provide only experienced personnel for blasting in accordance with accepted practices.
H. Contractor is responsible for safety of life and damage to property resulting from the use of explosives. The Owner and Engineer shall be made aware of all blasting activities prior to their occurrence.
I. Provide services of a testing firm experienced in monitoring vibrations resulting from blasting operations as specified in Section 01450, Quality Control.
J. In addition to the above testing/monitoring requirements required, Contractor shall provide the services of a “third party” geotechnical testing firm experienced in monitoring vibrations resulting from blasting operation as specified in Section 01450, Quality Control. The firm selected shall be evaluated by the Engineer and Owner for approval as the official “third party”.
K. Third Party testing/monitoring as related to blasting operations shall include the following:
    1. Pre-Construction Condition Assessment
        a. Prior to beginning construction, the third party testing firm shall perform a pre-construction condition assessment to document the conditions of buildings and other sensitive structures within ***Distance for Blast Assesment*** feet of the proposed blasting area. The assessment shall be performed on all adjacent properties and any other properties as directed by the Engineer or Owner. The assessment should include video and photographic documentation of all exteriors including building foundations, and installation of crack monitors on cracks that might occur or expand due to construction vibrations. Provide all documentation described above to the Owner and Engineer prior to construction.
    2. Crack Monitoring During Construction:
        a. During construction, the third party testing firm shall perform periodic readings of the crack monitors installed prior to construction. Provide readings to the Engineer and Owner within 48 hours of taking the reading. If crack readings monitoring confirm that vibrations are not contributing to crack width, crack monitors may be read once per week. More frequent readings may be required by Owner or Engineer if construction activities could result in greater earthborne vibrations. Testing firm shall notify the Engineer and Owner immediately if monitoring indicates that construction operations have contributed to crack widening. Contractor shall submit a plan for review that proposes alternate construction methods to address the vibration problems and minimize further damage.
    3. Vibration Monitoring During Construction:
        a. The third party testing firm shall monitor vibrations at no less than four locations along the perimeter of the project during all blasting activities. The locations shall be based on the location of construction activities and their relative position to offsite structures. Prior to construction, a plan showing the proposed monitoring locations shall be submitted to the Engineer and Owner for approval. Adjustments may be made to the locations upon approval. The sensitivity range of the seismograph shall be selected such that the recording is initiated below the maximum allowable particle velocity of 1 in/sec and extends above the highest expected intensity. Specific activities of the vibration source (i.e., blasting) shall be indexed in time to allow correlation with the arrivals on the vibration.

b. The maximum allowable particle velocity is 1 in/sec. The contractor shall notify the Engineer and Owner immediately if monitors indicate that the vibrations are above the criteria established. Activities causing the vibrations shall be suspended until a revised construction plan has been developed by the testing firm to alleviate the problem.
c. The vibration monitors shall consist of digital seismographs that display the particle velocities and associated frequencies plotted against the criteria established for this project. Each seismograph shall contain geophones with response capability in three mutually perpendicular axes or components; one vertical and two horizontal (radial and transverse). The frequency response of the geophones shall be linear from at least 4 Hz to more than 200 Hz. The sensitivity shall range from less than 0.02 in/sec to more than 5.0 in/sec. The BlastMate III by Instantel is one type of seismograph that is suitable for this project.
d. Vibration monitors shall be field calibrated by the testing firm before each recording period. The transducer shall be positioned with the longitudinal axis toward the vibration source. Transducers must be adequately coupled with the ground. Operation and calibration of all equipment shall be per manufacturer's recommendations. Vibration records shall be collected in waveform plot or strip chart plot. The peak vector sum of the particle velocity in longitudinal, transverse, and vertical planes shall be shown along with the respective dominant or principle frequencies. The highest recorded particle velocity (i.e., the vector sum of the three orthogonal directions), when indexed to a particle vibration event, shall be reported as the peak particle velocity. The recorded peak particle velocity shall be compared to criteria appropriate for the subject of concern.
e. The Engineer and Owner shall be notified immediately of any complaint received by the Contractor. The Contractor shall immediately review those construction activities inducing the vibration and prepare a report documenting all relevant data such as the time and date of the complaint, a description of the construction activities, data from the monitoring instruments for the subject time/date, complaint information (including photographs, if possible) of the alleged damage. The Contractor shall submit for review a detailed plan for repair and revised construction plan to address the vibration problems to minimize further damage and complaints.
f. The testing firm shall provide monthly reports containing the results of the crack monitors and vibration monitors during those activities that generate earthborne vibrations, including but not limited blasting operations. The reports shall document that the firm is provided the work described herein.

L. Submit monitoring reports in accordance with Section 01450, Quality Control.
M. The Owner reserves the right to require the removal of rock by other means if blasting operations result in possible hazardous conditions.
N. The Contractor shall provide as contingency, on-site, by-pass pumping capability when blasting within 100 feet of existing sanitary sewer infrastructure or where required otherwise as noted on the Drawings or specified in other sections of the project manual.

3.08 EXCAVATING

A. Excavation shall be by open cut, unless otherwise indicated on the Drawings or specified herein. Other than where specifically indicated on the Drawings, short

sections of trench may be tunneled or direct bored with the approval of the Engineer.

B. Stockpile excavated material in such a manner that it will not obstruct the flow of runoff, streams, endanger Work, impair the use or appearance of existing facilities, or be detrimental to the completed Work.

C. Contractor shall segregate excavated material so as to maintain material suitable for backfill separate from material that is unsuitable.

D. Trench dimensions at the pipe embedment and foundation zone, shall be as detailed on the drawings.

E. Shape trench bedding to provide uniform bearing for the full pipe length. Bottom shall be free of protrusions that could cause point loading on pipe. Provide bell holes as required for properly making pipe joint.

F. Do not over excavate. Excavation below grade without approval of Engineer shall be backfilled with Class I.

G. Undercut soils that become unsatisfactory by construction activity or by being left exposed to the weather shall be replaced with Class I backfill material.

H. Remove shoring, bracing, and sheeting, unless otherwise noted, as the trench is backfilled. Engineer shall have the authority to require that the sheeting be left in place. Once the trench box has been removed to the top of the pipe (or initial backfill zone), the stone shall be replenished to have the required stone over the pipe for the entire width of the excavation. This includes area displaced by the trench boxes and any voids outside the box.

I. Excavation of trench shall not advance more than 100 feet ahead of the installation. In no case should the excavation extend beyond that which can be backfilled by the end of the workday.

J. Correct unstable soil conditions encountered at trench foundation by the following method:
   1. Excavate below grade as approved by Engineer and backfill with Class I material or approved substitute material.

K. Rock and Hard Material
   1. Excavate rock and hard material to a minimum depth of 6 inches below the pipe. Excavation shall be backfilled with Class I material.
   2. Mechanical removal of rock (i.e., no blasting) may be necessary along portions of the project, as noted on the Drawings or as required by the applicable regulatory agencies, where blasting could result in complications with surrounding infrastructure. This method of rock excavation will be used only when approved by the Owner, as the blasting method shall be the typical method.

L. Pressure Lines:
   1. Provide a minimum 3 feet of cover, unless indicated otherwise on the Drawings.
   2. Excavate trenches to provide vertical curve chords that will not exceed the pipe manufacturer’s recommended joint deflection.
   3. Provide concrete thrust blocks having a compressive strength of 3,000 psi at 28 days at change in horizontal and vertical direction and reduction in the pipe size, unless other restraint systems are indicated otherwise on the Drawings.

Cut trench sides vertical and square to receive concrete. Provide bearing area against trench wall as indicated on the Drawings.

M. Gravity Lines:
   1. Excavate trench to the alignment and grade indicated on the Drawings.

N. Utility Structures: Provide a minimum of 9 inches below subgrade and backfill with Class I compacted to 95 percent maximum density. If the soil conditions are found to be unsuitable for structural stability of the structure, Engineer may require additional depth of Class I material.

3.09 BACKFILLING

A. Weather Limitations: Proceed with backfill operations based on the following weather conditions:
   1. Temperature must be above freezing and rising.
   2. In windy, hot, or arid conditions with a high rate of evaporation add moisture to the material to maintain the optimum moisture content.
   3. Do not proceed in rain or on saturated subgrade.
   4. Do not place material on surfaces that are muddy, frozen, or contain frost.

B. General
   1. Maintain backfill operation within 100 feet from pipe laying operation.
   2. Backfill trench to existing ground surface with select excavated material at the specified compaction.
   3. If excavated material is unsuitable to obtain specified compaction, provide suitable off-site borrow material for backfill as approved by Engineer.
   4. Re-excavate trenches improperly compacted. Backfill and compact as specified.
   5. Provide appropriate tamping equipment, and water to obtain proper moisture content, to achieve specified compaction of backfill.
   6. Conduct operation of heavy equipment above pipe installation in such a manner as to prevent damage to pipe.
   7. Install warning / identification tape over utilities. Bury tape one foot below finished grade above the utility.
   8. Install tracer wire for non-metallic pressure pipe. Bury tracer wire one foot below finished grade over the pipe. Wire shall be looped into valve boxes and indication posts to allow access for direct contact location.

C. Backfill in pipe embedment zone (bedding, haunching, and initial backfill).
   1. General:
      a. Backfill with material as specified below. Material shall be free from objects larger than 2 inches.
      b. Where rock and hard material has been excavated below pipe bottom, backfill and compact bedding with Class I material. Class II or III material may be used for bedding with Engineer's approval unless specified otherwise below.
      c. Place backfill material to assure placement of material under pipe haunches.
      d. Take care during placement and compacting of material to avoid movement of pipe.
   2. Place backfill in bedding and haunching zones in 6 inch maximum lifts in traffic areas and 12 inch maximum lifts in non-traffic areas and compact to 90 percent density. Provide backfill material in pipe embedment zone as specified below.

a. Pressure Lines (Flexible and Rigid Pipe)
   1) Excavation in Class I, Class II, Class III, and stable Class IV soils suitable for bedding, the bedding surface shall provide a firm foundation of uniform density. Backfill with select excavated material.
   2) Excavation in Class V, unstable Class IV soils, running water, and other unstable soil conditions, excavate a minimum of 6 inches below pipe bottom and provide Class I material for bedding and haunch zone. Backfill with Class I, II, or III material in initial backfill.

b. Gravity Sewer Lines, Rigid pipe (ductile iron)
   1) Excavation in Class I, Class II, Class III, and stable Class IV soils suitable for bedding, the bedding surface shall provide a firm foundation of uniform density. Backfill with select excavated material.
   2) Excavation in Class V, unstable Class IV soils, running water, and other unstable soil conditions, excavate a minimum of 4 inches below pipe bottom and provide Class I material for bedding and haunch zone. Backfill with Class I, II, or III material in initial backfill.

c. Gravity Sewer Lines, Flexible (CCFRPM)
   1) Depth of cover 0 to 40 ft:
      i) Provide Class I material for bedding and through embedment zone to 12” above the top of pipe.

d. Gravity Sewer Lines, Flexible (PVC SDR 35)
   1) Depth 0 to 12 ft: Provide Class I material for bedding and haunching. Backfill with Class I, II, or III material in initial backfill.

e. Gravity Sewer Lines, C900/C905
   1) Refer to Drawings.

D. Final Backfill
   1. Backfill with materials free of stones and debris larger than 6 inches in dimension. Place backfill in lifts not exceeding the thickness and compacted to the minimum density specified below.
   2. Lifts and density:
      a. Undeveloped areas (i.e., forests, fields, and, croplands): Trench may be filled with bulldozer blade provided material fall will not damage pipe. Mound soil over the trench area sufficiently to settle level over time. Degree of compaction shall be 85 percent.
      b. Lawns: Backfill in 12-inch lifts and compact to 90 percent. Top 12 inches shall be free of material with a dimension over 2 inches.
      c. Roads (including Rights-of-way), drives, parking areas (including areas within 20 feet), and adjacent to existing utilities: Backfill in 6 inch lifts compact to 95 percent. Compact the final 8 inches below finished subgrades beneath pavements/sidewalks to at least 100% of the soil’s Standard Proctor maximum dry density within 2% of optimum moisture.
      d. Within 20 feet of foundations: Backfill in 6-inch lifts compacted to 95 percent.

E. Utility Structures: Bring backfill to grade in even lifts on all sides. Lift depths and compaction densities shall be as specified according to area of installation for pipe above. Backfill against cast-in-place concrete structure only after concrete has attained the specified 28-day compressive strength.

3.10 ANTI-SEEP COLLARS

A. Anti-seep Collars: Provide anti-seep collars to prevent groundwater flow along pipe in wetlands as indicated on the Drawings. Collars shall extend past trench walls

and bear against undisturbed soils. Dimension of collars shall be as indicated on the Drawings. Do not place stone in area of anti-seep collars.

B. Concrete Collar: Provide Class B concrete with minimum cement content of 5 sacks per cubic yard (5.5 sacks for angular course aggregate); 6.8 gallons of water per sack water-cement ratio; 2-4 inch slump range; and 28-day strength of 2,500 psi.
C. Clay Collar: Provide clay of medium to high plasticity with a soil classification of CL or CH and a permeability of 10-5 cm / second. Place clay in 6-inch lifts and compact by use of a mechanical hydraulic tamper to 95 percent.

3.11 SOIL TESTING

A. Provide services of a soil-testing firm as specified in Section 01450, Quality Control.
B. Testing laboratory soil specialist shall be at the project site, upon request of the Owner, to perform inspection and in-place density testing as specified in Section 02300 Earthwork.
C. Density tests shall be made in accordance with ASTM D-698, Standard Proctor Method.
D. Submit test reports and soil specialist daily logs in accordance with Section 01450, Quality Control.
E. For each test that fails the compaction requirements, the testing firm, at the direction of the Engineer, shall make two additional tests.
F. Based on test results, make corrections, adjustments, and modifications of methods, materials, and moisture content for proper trench compaction.

3.12 PAVEMENT REMOVAL AND PATCHING

A. Repair damaged pavement structure.
B. Cut existing pavement for utility installation in straight lines generally parallel to the utility. Properly dispose of removed pavement structure.
C. Extend pavement patch 1 foot beyond each side of trench on firm subgrade. Slope new surface to drain.
D. Asphalt Pavements: Replace asphalt pavement with a pavement structure equal to existing but no less than as detailed on the Drawings or as indicated in the Encroachment Agreement, whichever is more stringent.
E. Concrete Pavements: Replace concrete pavement with pavement structure equal to existing but no less than as detailed as Drawings. Concrete shall be minimum 3,000 psi. When existing concrete joint is within 5 feet of trench remove existing concrete to joint. Provide expansion joint at edge of existing concrete. Surface treatment shall match existing. For overlays, as indicated on Drawings, set new driveway elevation at overlay depth and transition to existing driveway elevation.
F. Curbs, Gutters, and Sidewalks: Replace curbs and gutters, and sidewalks removed or damaged with similar sections to match the existing. Remove to nearest existing joint.
G. Approval of Other Authorities: Pavements under the jurisdiction of the NC Division of Highways shall be subject to the approval of a representative of that Division.
H. For overlays, coordinate final limits with Owner, Engineer, and NC Division of Highways. Perform in accordance with NCDOT Encroachment Agreement.

I. For overlays, as indicated on Drawings, raise existing and new manholes and valve boxes to finished pavement grade. Excavate around top of existing manhole and valve box as necessary. Remove existing top ring, and install new grade ring(s) as necessary. Install existing cover. Raise existing valve box. Provide concrete collar around manhole ring and valve box per details on the Plans.
J. See Section 02700, Pavement and Appurtenances for additional requirements.

3.13 GRADING AND CLEAN-UP:

A. Provide for testing and clean up as soon as practicable, so these operations do not lag far behind the pipe installation. Perform preliminary clean up and grading as soon as backfill is complete.
B. Provide positive drainage of finished grade and drain away from structures. Finished grade shall be reasonably smooth, compacted, free from irregular surface changes and comparable to the adjacent existing ground surface.
C. Seed disturbed areas in accordance with Section 02920, Lawns and Grasses.
D. Upon completion of backfilling, remove and properly dispose of excess material and waste. Surplus materials shall be disposed in an Owner-approved facility. A list of approved facilities is available from City of Raleigh Public Utilities Department. The Contractor may submit an alternate facility for Owner approval, prior to utilization, in accordance with the Contract Documents.

END OF SECTION

SECTION 02940
TWO-YEAR LANDSCAPE MAINTENANCE SPECIFICATIONS (R)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Two-year landscape maintenance, including the following: at regular intervals pruning, mulching, weeding, watering, applying herbicides, and cleaning up planting beds.

1.3 GENERAL PROVISIONS

A. Pruning: all included trees, shrubs and hedging shall receive no less than the following:
   1. Shrubs and trees will be pruned once during the first year of warranty by the Contractor who installed them. The Landscape Contractor and Landscape Architect shall mutually decide when this shall occur.
   2. All pruning and tree maintenance shall adhere to the ANSI A300 standards for tree care.
   3. Pruning schedules shall be dictated by the plant's bloom time so as not to affect the flowering performance of the plant.
   4. Tree pruning shall include work that is necessary to maintain the tree's normal growth pattern, removal of dead or dying portions, removal of undesirable suckers or water sprouts and the removal of old flower parts to insure continuous flowering (crape myrtles).
   5. Shrub pruning (except in the case or formal hedges) shall include work that is necessary to maintain the shrub's natural shape.
   6. Hedges shall be maintained at the height decided upon by the Landscape Architect at the time of final acceptance.

B. Mulching.
   1. All mulched areas shall be checked periodically and are to be re-mulched so that they contain a depth of four inches (4") throughout the warranty period. Mulch used shall equal that which was supplied during installation of the plants.

C. Weeding.
   1. Weeding shall be scheduled throughout the maintenance period in order to keep the planting areas free of weeds. All the beds and mulched areas shall be maintained in a crisp, clean condition.

D. Applying Herbicide.
   1. Use of "Round-up" or other similar herbicides may be applied to beds to control weeds provided the Maintenance Contractor follows manufacturer's recommendations and no desired plant life is injured.
   2. The Maintenance Contractor guarantees that any of the herbicides used will not permanently damage or harm plant life of desired plants. If damage does occur, the Contractor will take full responsibility for the damage by replacing the affected plants.
   3. Application of all herbicides shall be by or under the supervision of a person licensed by the State of North Carolina to apply herbicides. The license of the Applicator shall be in good standing and valid. A copy of the Applicator's license or license number shall be provided to the Owner at the time the Contract is executed.

E. Pesticides.
1. All pesticide application must be made by a licensed applicator and recorded on the pesticide report.

F. Fertilizing
1. The Maintenance Contractor shall fertilize all plants in the month of February, using a granular surface application at a rate of three (3) lbs. nitrogen (N) per 1000 sf. The fertilizer shall be a complete formula with a ratio similar to 10-8-6.

G. Watering.
1. The Maintenance Contractor will be responsible for providing water to all plant material. It is the responsibility of the Maintenance Contractor to keep these areas moist enough to maintain healthy and attractive plant material. Refer to the watering schedule included herein.

H. Tree Straightening.
1. The Maintenance Contractor shall perform routine tree maintenance including straightening trees as required.

I. Clean-Up.
1. The Maintenance Contractor shall remove from the premises broken and damaged limbs which are on the ground.

1.4 PERFORMANCE REQUIREMENTS FOR WATERING TREES AND SHRUBS A.

Watering of Trees and Shrubs.

1. Shrubs and trees shall be watered for two years of warranty by the Landscape Contractor.
2. Water shall be free from oil, acid, alkali, salt and other substances harmful to the growth of plants.
3. Certain soil types and other factors (percolation, tree species, drought, etc.) may make it necessary to adjust the watering schedule. The soil around the installed plants should be probed regularly.

B. Watering Schedule.
1. Watering requirements during the initial shock period (installation period), which is the first thirty days after planting, will be as follows:
   a. Plants transplanted between October 15 and March 15:
      1) Every two days for four weeks, then
      2) Twice per week for four weeks.
2. Watering requirements during the establishment period (warranty period), which is after the first sixty days during temperate weather conditions (temperature under ninety degrees with occasional rain) shall be:
   a. May 15 through October 31: every two (2) weeks.
   b. November 1 through May 14: every three (3) weeks.
3. Watering requirements during the establishment period during periods of high temperature and drought conditions (temperature reaching or exceeding ninety degrees with no rain) shall be as needed. The following schedule shall serve as the minimum requirement:
   a. May 15 through October 31: once every seven (7) days.
   b. November 1 through May 14: everyone (1) to two (2) weeks.
4. Watering requirements for plants located on cut slopes and fill slopes may require more frequent watering. The soil around the installed plants should be probed regularly to determine the moisture content.

1.5 SUBMITTALS: MAINTENANCE REPORTS

A. The Maintenance Contractor shall submit to the City Engineering Services Director or his designee, a written report weekly during the maintenance period. This report is to be submitted within two business days of the actual maintenance work. This reporting is to include all services including frequency and proposed herbicides and scheduled waterings per the planting specification and be on a form provided by the City Urban Forester. Contractor should submit a maintenance plan including frequency and proposed herbicides for approval prior to starting work.

1.6 QUALITY ASSURANCE

PART 2 – PRODUCTS

2.1 Herbicides.

A. Apply "Round-Up" or approved equal.

2.2 Fertilizer.

A. Trees shall be fertilized in the month of February by granular surface application at a rate of three (3) lbs. nitrogen (N) per 1000 sf. The fertilizer shall be a complete formula with a ratio similar to 10-8-6.

2.3 Mulch.

A. Mulch shall not exceed 4 inches in depth and will remain a minimum of 3 inches away from the base of any given tree. Volcano mulching is an unacceptable practice that inhibits the health and vigor of tree. Mulch will be composted yard waste, provided at no cost to the contractor from the City of Raleigh Yard Waste Center, 900 New Hope Road, Raleigh (919) 250-2728. Hand-remove all litter and non-organic material. Only apply mulch that is no more than 10°F warmer than the air temperature.
B. Mulch shall be replenished to a depth of 4 inches at the end of the maintenance warrantee period.

2.4 Tree Gator Bags/Water Bags

A. Tree gator bags shall be those distributed by Bio-Plex, 2213 Huber Drive, Manheim, Pennsylvania 17545, (800) 441-3573, or approved equal.

PART 3 - EXECUTION

3.1 WATERING EXECUTION

A. Apply water only by open-end hose at a low pressure to avoid air pockets, erosion and injury to plant roots.
B. Sufficient watering is achieved by filling the water saucer twice per application per tree and per shrub.
C. Rain substitutes as a scheduled watering when at least two (2) inches of rainfall has been verified. It is the responsibility of the Landscape Contractor to keep these areas moist enough to establish healthy and attractive plant material.
D. Gator bags are an approved acceptable method for watering trees.

3.2 CLEANUP AND PROTECTION

A. During Landscape work, keep pavements clean and work area in an orderly condition.
B. Protect landscape work and materials from damage due to landscape operations and trespassers. Maintain protection during the maintenance period. Treat, repair, or replace damaged landscape work.
C. Upon completion of work each day, remove from the site all equipment and other articles used. All excess soil, stones, pruning clippings and debris shall be removed and legally disposed of. All work areas shall be left in a clean and neat condition, including pavement areas.
D. All damage to existing construction caused by maintenance operations shall be repaired to the satisfaction of the Owner, at the Maintenance Contractor's expense.

LANDSCAPING MAINTENANCE REPORT DURING WARRANTEE PERIOD

PROJECT: INSPECTOR:

DATE:

ITEM	YES	NO	N/A	COMMENT
Mowing				
Trash/Debris Collection				
Dead Plants if any				
Check Tree Stakes				
Apply Herbicide				
Apply Pesticide				
Apply Fertilizer				
Weed Plant Beds				
Observed Vandalism				
Aplied Mulch				
Watering				
Additional Comments/Observations:				

END OF SECTION 02940

SECTION 03000
CLEARING AND GRUBBING
(Revised 10-1-14)

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Except as otherwise designated in this section, clearing and grubbing shall be performed in accordance with Section 200 of the NCDOT Standard Specifications for Roads and Structures, latest edition.

B. The width of clearing for the project shall be limited to the right of way and temporary and permanent easements as noted on the drawings. The entire width of the permanent easement is to be cleared unless otherwise indicated by clearing limits noted on the drawings. Clearing and grubbing shall be conducted in a manner to prevent damage to vegetation that is intended to remain growing and also to prevent damage to adjacent property.

C. The Engineer will designate all areas of growth or individual trees inside the clearing limits, which are to be preserved due to their desirability. The trees to be preserved will be shown in the Contract Documents or designated by the Engineer.

1.02 RELATED SECTIONS

A. The following Sections have work that is directly related to this Section. This does not relieve the Contractor of his responsibility of proper coordination of all the work:
1. Section 16000 Sedimentation and Erosion Control
2. Section 17000 Temporary and Permanent Grasses.

1.03 WARRANTY AND FINES

B. Contractor is liable for damages to public and private property and fines as may be placed on the Project by the governing agencies due to failure to provide erosion control devices in accordance with the approved erosion control plan and as may become necessary due to actual site conditions.

PART 2 – PRODUCTS

Not used

PART 3 – EXECUTION

3.01 PROTECTION

A. Take reasonable care during construction to avoid damage to vegetation outside of the construction limits. Temporarily tie back ornamental shrubbery and tree branches, where appropriate, to minimize damage. Trees that receive damage to branches shall be trimmed of those branches to improve the appearance of the tree. Treat tree trunks damage by equipment with a tree dressing.

B. Locate and protect property corners and survey control monuments and stakes prior to start of clearing operations. Disturbed property corners or survey control monuments shall be surveyed and reset by a Professional Land Surveyor licensed in the State of North Carolina. The Contractor shall be responsible for the cost to survey and reset.

C. Mark clearing limits (e.g., flag right-of-way, easements, etc.).

D. Provide tree protection fencing at the outer edge of easements and rights-of-way as indicated on the plans or as directed by the Engineer/Owner. Tree protection fencing along easements and rights-of-way shall be placed around individual vegetation or groupings of vegetation (e.g., large tree, flower bushes, etc.), and along entire easement (both sides) where clearing through woods. Tree protection fencing shall also be provided where vegetation, within easement and rights-of-way, is indicated as not to be disturbed on Drawings. Where silt fence is provided, it may serve as tree protection fencing if indicated as combination fencing on the drawings. The fencing shall be as detailed on the drawings.

3.02 INSTALL EROSION CONTROL DEVICES

A. Clear areas required to install erosion control devices, which shall be in place and operational prior to other land disturbing activity. Install erosion control devices in accordance with Section 16000, Sedimentation and Erosion Control.

3.03 STAGING, BORROW, AND DISPOSAL AREAS

A. Obtain and pay for erosion control permit for staging, borrow, and disposal areas as required by Contractor and not already permitted by Owner.
B. Install and maintain erosion control devices in accordance with Contractor’s approved plan.

3.04 CLEARING AND GRUBBING

A. Clear and grub the total width of permanent easement and right-of-way unless indicated otherwise on the Drawings. Clear and grub within temporary construction easement

only as necessary for construction. Avoid disturbance to vegetation in temporary construction easements where possible, and as noted on the Drawings.

B. Clearing shall consist of cutting, grinding and removal of vegetation to the existing ground surface and removal of debris. Debris shall include, but not be limited to, fences, steps, walls, chimneys, footings, foundation slabs, basements, signs, junked vehicles, and other rubble.
C. Grubbing shall consist of the removal of roots over 3 inches in diameter, matted roots, stumps, and other vegetable matter to 12 inches below existing grade.
D. For areas outside of the right of way and outside of residential yards, grinding of stumps and roots in place is acceptable.
E. Fill holes and depressions and bring cleared and grubbed area to a uniform contour to match existing grade. Provide positive drainage.
F. Remove and properly dispose of cleared and grubbed material from the site. Make reasonable effort to channel timber resulting from clearing operations into a beneficial use.
G. Burning shall not be permitted at the site.
H. All material from clearing and grubbing shall be maintained within designated limits of disturbance/construction in accordance with the approved Erosion Control Plan until such material is removed and taken offsite for disposal or another use.

END OF SECTION

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SECTION 04000
EARTHWORK
(Revised 6-11-21)

PART 1 - GENERAL

1.01 Except as otherwise stipulated in this specification, all earthwork shall be performed in accordance with Section 225 of the NCDOT Standard Specifications for Roads and Structures, latest edition. The work covered by this section consists of the excavation, placement, and compaction or satisfactory disposal of all materials encountered within the limits of the work necessary for the construction of the project in conformity with the lines, grades, and cross sections shown on the plans or established by the Engineer.

1.02 The Contractor shall fill areas that settle unevenly during the course of construction.

PART 2 - UNCLASSIFIED EXCAVATION

2.01 GENERAL

A. All material excavated in order to achieve the site lines, grades, and cross sections shown on the plans shall be classified as Unclassified Excavation.

B. Should hard rock be encountered requiring blasting for removal, a PERMIT FOR BLASTING must be obtained, for a fee, from the City of Raleigh Fire Marshall's Office or the appropriate jurisdiction a MINIMUM of 24 hours before any explosive material or blasting agents are transported into the Corporate Limits of Raleigh.

C. Whenever encountered during work, remove any trash and non-natural debris. Remove all roots and pieces of wood or debris larger than three (3) inches in diameter.

D. All suitable material removed in the excavation shall be used as far as practicable in the formation of embankments, subgrades, and shoulders, and at such other places as may be indicated on the plans or directed by the Engineer. Unsuitable material and excess excavated material not required for construction of embankments shall be properly disposed of offsite.

E. The intersection of slopes with natural ground surfaces, including the beginning and ending of cut slopes, shall be uniformly rounded as shown on the plans or as may be directed by the Engineer. Concurrent with the excavation of cuts, the Contractor shall construct intercepting berm ditches or earth berms along and on top of the cut slopes at locations shown on the plans or designated by the Engineer. All slopes shall be finished to reasonably uniform surfaces acceptable for seeding and mulching operations. All protruding roots and other objectionable vegetation shall be removed from slopes.

F. The Contractor shall, as directed by the Engineer, cut off and plug all private utility lines, and remove all underground tanks encountered within the right of

way or construction limits during construction in accordance with State requirements.

G. As much as practicable, the Contractor shall perform the work covered by this subsection and the construction of embankments in such a manner that cut and fill slopes will be completed to final slopes and grade in a continuous operation. The operation of removing excavation material from any cut and the placement of embankment in any fill shall be a continuous operation to completion unless otherwise permitted by the Engineer.

H. If grading operations are suspended for any reason whatsoever, partially completed cut and fill slopes shall be brought to the required slope and the work of seeding and mulching or other required erosion control operations shall be performed.

PART 3 - BORROW EXCAVATION

3.01 GENERAL

A. Except as otherwise stipulated in this specification, all earthwork shall be performed in accordance with Section 230 of the NCDOT Standard Specifications for Roads and Structures, latest edition.

PART 4 - EMBANKMENT

4.01 GENERAL

A. Except as otherwise stipulated in this specification, all earthwork shall be performed in accordance with Section 235 of the NCDOT Standard Specifications for Roads and Structures, latest edition.

B. Before embankment construction is begun, all vegetation, debris, deleterious and unsuitable material shall be removed from the area within the limits of the embankment. Upon completion of clearing and stripping, the subgrade area to receive embankment shall be uniformly proofrolled under the observation of the Engineer. Proofrolling shall be accomplished using a loaded dump truck or similar pneumatic-tired equipment of a minimum ten (10) ton static weight making at least four (4) passes over each area. Any areas, which pump or deflect under proofrolling or are otherwise deemed unsuitable by the Engineer shall be stabilized or bridged as directed by the Engineer. Should such stabilization become necessary, the amount of compensation due the Contractor for such work shall be a fair market value for these services, which shall be mutually agreeable to the Contractor and Owner prior to the execution of such work.

C. Embankment material and backfill material shall consist of clean, readily compactible earthen material with a maximum particle size of two (2) inches. Embankment material shall be free from debris, organic matter, frozen or deleterious material, and shall be approved for use by the Owner.

D. The embankment material shall be deposited and spread in successive, uniform, approximately horizontal layers of not more than eight (8) inches in depth, loose measurement, for the full width of the cross section, and shall be kept approximately level by the use of effective spreading equipment. Each layer of the embankment shall be thoroughly compacted as hereinafter specified. Hauling shall be distributed over the full width of the embankment, and in no case will deep ruts be allowed to form during the construction of the embankment. The embankment shall be properly drained at all times.

E. Backfill materials placed around and over pipe culverts, box culverts, and arch culverts, and embankment materials placed around other structures, shall be clean select material. The material shall be placed and compacted in a manner, which will avoid unbalanced loading and will not produce undue stress on the structure. Such embankments shall be placed in loose layers not to exceed six (6) inches in depth and each layer shall be thoroughly compacted as hereinafter specified. All pipe culverts, box culverts, and arch culverts, after being backfilled as specified in this subsection, shall be protected by a three (3) foot cover of fill at any time that heavy hauling equipment is permitted to cross during construction of the roadway. Any damage or displacement to culverts or other structures due to the Contractor's operation shall be corrected or repaired by the Contractor prior to final acceptance.

F. During construction and until final acceptance, the Contractor shall construct temporary or permanent earth berms along the outer edges of the top surface of the embankment, construct temporary ditches, shape the embankment surface to provide for the drainage of surface runoff along and throughout the length of the embankments, and use any other methods necessary to maintain the work covered by this section so that the work will not contribute to excessive soil erosion.

G. The contractor shall replace, any portion of embankments, which have become displaced or damaged due to carelessness or neglect on the part of the Contractor.

H. All embankments shall be brought to the grade and cross section shown on the plans, or established by the Engineer, prior to final inspection and acceptance by the Engineer.

PART 5 - UNDERCUT EXCAVATION

5.01 Except as otherwise stipulated in this specification, all earthwork shall be performed in accordance with Section 225-4 of the NCDOT Standard Specifications for Roads and Structures, latest edition.

PART 6 – FINE GRADING

6.01 Performance of all work, related to any fine grading of subgrade in paved areas shall be in accordance with Section 500 of the NCDOT Standard Specifications for Roads and Structures, latest edition.

PART 7 - DITCH EXCAVATION

7.01 GENERAL

A. Except as otherwise stipulated in this specification, all ditch excavation shall be performed in accordance with Section 240 of the NCDOT Standard Specifications for Roads and Structures, latest edition.

PART 8 – BLASTING

8.01 GENERAL

A. Except as otherwise stipulated in this specification, all ditch excavation shall be performed in accordance with Section 220 of the NCDOT Standard Specifications for Roads and Structures, latest edition.

B. Blasting is allowable for the removal of rock, as defined herein unless specifically prohibited by the Owner, Engineer or a Utility Owner with an existing utility within the proximity of the proposed blast site. The contractor shall review the Drawings for specific areas where blasting is prohibited..

C. Obtain required permits for blasting (e.g., from City of Raleigh Fire Marshall's Office) prior to blasting, 24 hours minimum.

D. Store, handle, and use explosives in accordance with all applicable local, state, and federal regulations and in accordance with the provisions of the "Manual of Accident Prevention and Construction" of the Associated General Contractors of America, Inc. Federal regulations include, but are not limited to, Title 27, Chapter 11, Part 555 of the Code of Federal Regulations (CFR) and OSHA Standards – Part 1926, Subpart U.

E. Provide seismographic monitoring during progress of blasting operations.

F. Take all necessary precautions to protect life and property, including the use of an approved blasting mat where there exists the danger of throwing rock or overburden. Keep the explosive materials that are on the job site in specially constructed boxes provided with locks. Failure to comply with this specification shall be grounds for suspension of blasting operations until full compliance is made. No blasting shall be allowed unless a galvanometer is employed to check cap circuits. Where blasting takes place within 500 feet of a utility, structure, or property which could be damaged by vibration, concussion or falling rock, keep a blasting log containing the following information for each and every shot. This log shall be kept in an orderly manner and made available to the Engineer and Owner upon request.

1. Date of shot

2. Time of shot
3. Crew supervisor
4. Number and depth of holes
5. Approximate depth of overburden
6. Amount and type of explosive used in each hole
7. Type of caps used (instant or delay)
8. The weather
9. Seismograph instrument and readings

G. Use explosives in such a way to minimize vibration to existing utilities and structures.

H. Provide only experienced personnel for blasting in accordance with accepted practices.Contractor is responsible for safety of life and damage to property resulting from the use of explosives.

I. The Owner and Engineer shall be made aware of all blasting activities prior to their occurrence.

J. The Owner reserves the right to require the removal of rock by other means if blasting operations result in possible hazardous conditions.

PART 9 COMPREHENSIVE GRADING

9.01 GENERAL

A. Comprehensive grading may be utilized in lieu of the previous line items at the discretion of the Engineer. Comprehensive grading shall be in accordance with Section 226 of the NCDOT Standard Specifications for Roads and Structures, latest edition.

END OF SECTION

SECTION 05000
GEOTEXTILE FABRIC
(Revised 01-05-22)

PART 1 - GENERAL

A. Except as otherwise designated in this section, geotextile fabric shall be performed in accordance with Section 1056 of the NCDOT Standard Specifications for Roads and Structures, latest edition.

B. Geotextile Fabric shall be used for soil stabilization, foundation conditioning for storm drainage, subsurface drainage, erosion control, filtration, and other applications in accordance with the Contract.

C. Geotextile for pavement stabilization may be required to prevent pavement cracking and provide separation between the subgrade and pavement section at locations shown in the plans and as directed.

PART 2 - SUBMITTAL

D. The Contractor shall submit manufacturer's technical data and a sample of the fabric to be used for approval by the engineer prior to actual use. Submittals shall be in accordance with Section 02000 of the Contract Documents.

PART 3 - MATERIAL

A. The geotextile fabric shall be in accordance with Table 1056-1 of the NCDOT Standard Specifications for Roads and Structures, latest edition.

B. The Type used shall be based on the application as shown in Table 1056-1, with the exception of geotextile for pavement stabilization, which should be in accordance with the following criteria:

Provide Type 5 geotextile for geotextile for pavement stabilization that meets the following requirements:

GEOTEXTILE FOR PAVEMENT STABILIZATION REQUIREMENTS		
Property	**Requirement (MARV[A])**	**Test Method**
Wide Width Tensile Strength @ 5% Strain (MD & CD[A])	1,900 lb/ft	ASTM D4595
Wide Width Tensile Strength @ Ultimate (MD & CD[A])	4,800 lb/ft	ASTM D4595
Melting Point	300° F	ASTM D276

A. Define “minimum average roll value” (MARV), “machine direction” (MD) and “cross-machine direction” (CD) in accordance with ASTM D4439.

PART 4 - INSTALLATION

A. The fabric shall be free of defects or flaws, which may significantly affect its physical properties. The fabric shall be overlapped a minimum of 24 inches where necessary. Aggregate shall be back dumped and spread in a uniform lift maintaining the design aggregate thickness at all times. Construction vehicles will not be allowed to traffic directly on the fabric.

B. The soil shall not be overstressed. Equipment shall be utilized in spreading the dumping that exerts only moderate pressures on the soil. Severe rutting at the time of placement shall be corrected by increasing the aggregate depth. Any ruts shall be filled with additional aggregate rather than from aggregate bladed from surrounding areas.

C. Construct embankments to subgrade elevations in accordance with the contract. The Engineer and Geotechnical Engineer will determine if geotextile for pavement stabilization is required at locations shown in the plans and other locations as directed based on testing subgrade soils for quality. For subgrades without stabilization, allow 24 days to determine if geotextile for pavement stabilization is required. For stabilized subgrades with geotextile for pavement stabilization, stabilize subgrade soils to 12" beyond the base course as shown in the plans.

D. Place geotextile for pavement stabilization on subgrades immediately below pavement sections as shown in the plans and in slight tension free of kinks, folds, wrinkles or creases. Install geotextiles with the MD perpendicular to the roadway centerline. The MD is the direction of the length or long dimension of the geotextile roll. Do not splice or overlap geotextiles in the MD so splices or overlaps are parallel to the roadway centerline. Extend geotextile for pavement stabilization 12" beyond the base course as shown in the plans.

E. Completely cover subgrades with geotextile for pavement stabilization so geotextiles are adjacent to each other in the CD, i.e., perpendicular to the MD. The CD is the direction of the width or short dimension of the geotextile roll. Overlapping geotextiles in the CD is permitted but not required. Overlap geotextiles in the direction that base course will be placed to prevent lifting the edge of the top geotextile.

F. Do not damage geotextile for pavement stabilization when constructing base courses. Place and compact base course in accordance with the NCDOT Standard Specifications for Roads and Structures, latest edition. Do not operate heavy equipment on geotextiles any more than necessary to construct pavement sections. Replace any damaged geotextiles to the satisfaction of the Engineer.

END OF SECTION

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SECTION 06000
STORM DRAINAGE
(Revised 06-14-22)

PART 1 - GENERAL

A. Except as otherwise stipulated in this specification, all storm drainage shall be performed in accordance with Divisions 3 and 8 of the NCDOT Standard Specifications for Roads and Structures, latest edition. The work of furnishing and installing storm sewer shall consist of performing all work and services necessary to complete the construction of the storm sewer pipe, drainage structures, and outlet dissipation measures in accordance with the provisions of the Contract Documents.

B. Where proposed storm sewers are to be installed under existing roadways, the construction shall be performed in such a way that half of the roadway will be maintained and available to traffic in accordance with the plans, Contract Documents, the NCDOT “Roadway Standard Drawings,” and the MUTCD.

PART 2 - SUBMITTALS

A. The Contractor shall submit shop drawings to the Engineer for all storm drainage materials to be used on this project. Submittals shall be in accordance with Section 02000 of the Contract Documents.

PART 3 - QUALITY STANDARDS AND MATERIALS

A. Procedures for handling, laying, protection and use of pipe shall be in accordance with the pipe manufacturer's recommendations and these specifications. Procedures for construction of drainage structures shall be in accordance with these specifications.

B. Reinforced Concrete Pipes and Flared End Sections shall conform to Section 1032-6(B) of the NCDOT Standard Specifications for Roads and Structures, latest edition. Joints shall be sealed with a flexible plastic joint material meeting Federal specification SS-S-00210, such as Ram-Nek or a butyl rubber sealant.

C. Corrugated Steel Pipe shall conform to Section 1032-3 and 1032-4 of the NCDOT Standard Specifications for Roads and Structures, latest edition. Bands for connecting pipe shall be corrugated with a minimum of 2 corrugations for each pipe. The pipe shall be fully bituminous coated in accordance with the requirements of AASHTO M190. The pipe shall have an asphalt-paved invert.

D. Concrete Block or Brick shall conform to Section 1040-2 of the NCDOT Standard Specifications for Roads and Structures, latest edition. The block or brick shall be embedded in a mortar bed to form a one-half (1/2) inch mortar joint.

E. Mortar used in brick masonry and joints shall conform to Section 1040-9 of the NCDOT Standard Specifications for Roads and Structures, latest edition.

F. Precast Concrete Units shall conform to Section 1077 of the NCDOT Standard Specifications for Roads and Structures, latest edition. The standard joint shall be sealed with a flexible joint material meeting Federal specification SS-S-00210 such as Ram-Nek or a butyl rubber sealant.

G. Foundation Conditioning Material shall conform to Section 300-9 of the NCDOT Standard Specifications for Roads and Structures, latest edition.

H. Manhole Frames and Covers shall be in accordance with the NCDOT Standard Specifications for Roads and Structures, latest edition.

I. Manhole Steps shall be in accordance with the NCDOT Standard Specifications for Roads and Structures, latest edition.

J. Yard Inlets, Catch Basins, and Curb Inlets shall be in accordance with the latest edition of the NCDOT Standards and Specifications for Roads and Structures..
   i. Frame, Grates, & Hoods (NCDOT streets) shall be cast iron and conform to Section 1074-7 in the latest edition of the NCDOT "Standard Specifications for Roads and Structures" and the dimensional requirements set forth in the latest edition of the NCDOT "Roadway Standard Drawings." Grates shall be stamped with the appropriate NCDOT specification number as evidence of satisfying the above requirements. Hoods shall be stamped with "Drains to Neuse River" or other wording as confirmed by the Engineer. Lettering shall be ¾" height and shall be clean, crisp, and free of defects.

K. Endwalls and Reinforced Endwalls shall be installed in accordance with Section 83808 of the NCDOT Standard Specifications for Roads and Structures, latest edition.

PART 4 - CONSTRUCTION

A. All storm sewers shall be laid to provide a "true line" between manholes or structures, and they shall be installed at each deflection of line and/or grade.

B. The mortar for brick masonry shall conform to the requirements herein set forth. Excavation shall be made to the required depth and the foundation on which the brick masonry is to be laid shall be approved by the Inspector. The brick shall be laid so that they will be thoroughly bonded into the mortar joints by means of the "shove joint" method: (buttered or plastered joints will not be permitted). The headers and stretchers shall be so arranged as to thoroughly bond the mass. Brickwork shall be of alternate headers and stretchers with consecutive courses in thickness. The joints shall be completely filled with mortar. No spalls or bats shall be used except for shaping round irregular openings or when unavoidable to finish out a course. Competent bricklayers shall be employed on the work and all details of construction shall be in accordance with approved practice and to the satisfaction of the Engineer.

C. Manhole steps shall be set in the masonry as the work is built up, thoroughly bonded, and accurately spaced and aligned.

D. Inverts in storm drainage structures shall be shaped to form a smooth and regular surface free from sharp or jagged edges. They shall be sloped adequately to prevent sedimentation.

E. The castings shall be set in full mortar beds. All castings when set shall conform to the finished grade as established by the Engineer. Any castings not conforming shall be adjusted to the correct grade without extra compensation.

F. All pipes entering catch basins or junction boxes shall enter through a wall and not through a corner of the structure. The pipe shall not project into the drainage structure, but shall be finished flush with the inside of the structure.

G. When necessary, the contractor shall provide for the temporary diversion of water or dewatering in order to maintain the storm sewer foundations in a dry condition, and shall continue to maintain trenches in a dry condition until backfill and compaction activities are complete.

H. The Contractor shall maintain all storm sewers in a condition such that they will function properly from the time the storm sewers are installed until the City accepts the project. The Contractor shall thoroughly clean out all storm sewers at no expense to the owner throughout construction.

END OF SECTION

SECTION 07000
CAST IN PLACE CONCRETE
(Revised 01-05-22)

PART 1 – GENERAL

1.01 SCOPE

A. Except as otherwise stipulated in this section, all cast in place concrete shall be in accordance with section 1000 of the NCDOT Standard Specifications for Roads and Structures, latest edition.

B. Contractor shall provide all labor, equipment, and materials required for placement of cast in place concrete.

PART 2 - MATERIALS

2.01 Portland cement concrete for curb and gutter, driveways, driveway aprons, wheelchair ramps, sidewalks, traffic islands, paved ditches, or concrete transitional sections for drainage structures and other items as specified on the plans shall have a minimum 28 day compressive strength of 3,000 psi in accordance with Class A concrete as described in Section 1000 of the NCDOT Standard Specifications for Roads and Structures, latest edition, unless otherwise specified in the Contract Documents. Portland cement concrete for structures, culverts and other items as specified on the plans shall be Class A or Class AA in accordance with NCDOT Standard Specifications for Roads and Structures, latest edition. Dyed concrete is not allowed in construction of driveway aprons or public sidewalks unless otherwise specifically required in the Contract Documents.

2.02 Joint filler shall be a non-extruding joint material conforming to Section 1028-1 of the NCDOT Standard Specifications for Roads and Structures, latest edition."

2.03 Aggregate for portland cement concrete shall meet the requirements for fine and course aggregate of Section 1014 of the NCDOT Standard Specifications for Roads and Structures, latest edition.

2.04 Portland Cement and admixtures shall meet the requirements of Section 1000 of the NCDOT Standard Specifications for Roads and Structures, latest edition.

2.05 Water for mixing or curing the concrete shall be free from injurious amounts of oil, salt, acid, or other products injurious to the finished product.

2.06 Detectable warnings for proposed curb ramps shall consist of integrated raised truncated domes. The description, size and spacing shall conform to Section 848 of the NCDOT Standard Specifications for Roads and Structures, latest edition.

Use material for detectable warning systems as shown herein. Material and coating specifications must be stated in the Manufacturers Type 3 Certification and all Detectable Warning systems must be on the NCDOT Approved Products List.

Install detectable warnings created from one of the following materials: precast concrete blocks or bricks, clay paving brick, gray or ductile iron castings, mild steel, stainless steel, and engineered plastics, rubber or composite tile. Only one material type for detectable warning will be permitted per project, unless otherwise approved by the Engineer.

(A) Detectable Warnings shall consist of a base with integrated raised truncated domes, and when constructed of precast concrete they shall conform to the material requirements of Article 848-2 of the NCDOT Standard Specifications for Roads and Structures, latest edition.

(B) Detectable Warnings shall consist of a base with integrated raised truncated domes, and may be comprised of other materials including, but not limited, to clay paving brick, gray iron or ductile iron castings, mild steel, stainless steel, and engineered plastics, rubber or composite tile, which are cast into the concrete of the curb ramps. The material shall have an integral color throughout the thickness of the material. The detectable warning shall include fasteners or anchors for attachment in the concrete and shall be furnished as a system from the manufacturer.

Prior to installation, the Contractor shall submit to the Engineer assembling instructions from the manufacturer for each type of system used in accordance with Article 105-2 of the NCDOT Standard Specifications for Roads and Structures, latest edition. The system shall be furnished as a kit containing all consumable materials and consumable tools, required for the application. They shall be capable of being affixed to or anchored in the concrete curb ramp, including green concrete (concrete that has set but not appreciably hardened). The system shall be solvent free and contain no volatile organic compounds (VOC). The static coefficient of friction shall be 0.8 or greater when measured on top of the truncated domes and when measured between the domes in accordance with ASTM C1028 (dry and wet). The system shall be resistant to deterioration due to exposure to sunlight, water, salt or adverse weather conditions and impervious to degradation by motor fuels, lubricants and antifreeze.

(C) When steel or gray iron or ductile iron casting products are provided, only products that meet the requirements of Subarticle 106-1(B) of the NCDOT Standard Specifications for Roads and Structures, latest edition may be used. Submit to the Engineer a Type 6 Certification, catalog cuts and installation procedures at least 30 days prior to installation for all.

PART 3 - QUALITY ASSURANCE

3.01 Concrete shall be only plant-mixed, transit-mixed or ready-mixed concrete. **The time elapsing from mixing to placing the concrete shall not exceed ninety (90) minutes**. Concrete shall not be deposited on frozen subgrade and shall not be poured when the air temperature is falling and below 40° F, and the predicted low temperature for the succeeding 24 hour period is less than 32° F.

3.02 All concrete when placed in the forms shall have a temperature of between 50° F and 90° F and shall be maintained at a temperature of not less than 50° F for at least 72 hours for normal concrete and 24 hours for high early strength concrete, or for as much time as is necessary to secure proper rate of airing and designed compressive strength. The use of admixture, retarders, and accelerators shall be used as directed by the Engineer.

PART 4 - CONSTRUCTION METHODS

4.01 Proportioning of Concrete: The concrete shall be mixed in proportions discussed herein and approved by the Engineer.

4.02 Mixing Concrete: The concrete shall be mixed by machine on the job or at a central mixing plant. A batch mixer of any approved type may be used. The method of measuring the materials for the concrete, including water, shall be one which will insure separate and uniform proportions of each of the materials at all times. The mixing shall continue at least 1-1/2 minutes after all ingredients have been emptied before receiving material for the succeeding batch.

4.03 A central mixing plant shall not be used until approved by the Engineer and shall be certified by the NCDOT. The concrete from a central plant shall be delivered and deposited at the consistency specified without segregation. **The time elapsing from mixing to placing the concrete shall not exceed ninety (90) minutes.**

4.04 Concrete shall be mixed only in such quantities as are required for immediate use and all such material shall be used while fresh and before initial set has taken place. Any concrete in which set has begun shall not be used in the work. Retempering of concrete will not be allowed.

4.05 Subgrade: The subgrade shall be excavated to the required depth below the finished surface in accordance with the plans to the lines and grades established by the Engineer. All soft yielding material or other unsuitable material shall be removed and replaced with suitable material and the subgrade shall be compacted thoroughly and finished to a firm, smooth surface. **No curb and gutter, driveways, driveway aprons, wheelchair ramps, sidewalks, or traffic islands shall be poured until the subgrade is approved by the inspector.**

4.06 Forms: The forms shall be of metal and of the necessary dimensions to construct the combined curb and gutters specified in the plans. Wood forms may be used where conditions make the use of metal forms impractical. **The use of wood forms must be approved by the Engineer.** The forms shall be set true to the line and grade established by the Engineer and held rigidly in position, so as to prevent leakage of mortar and springing out of line when the concrete is placed in them. The forms shall be true in line, free from warping or bending. **No concrete shall be placed until the forms and subgrades have been approved by the Inspector.**

4.07 Placing of Concrete: The subgrade shall be moistened and the concrete shall be placed in the forms and tamped sufficiently to bring the mortar to the surface, after which it shall be finished smooth and even by means of a wooden float.

4.08 Curb and gutter shall be constructed in place in uniform sections ten (10) feet in length. The joints between sections shall be formed by steel templates one-sixth (1/6) inch in thickness and of the width and depth of the curb and gutter. The templates shall be left in place until the concrete has set sufficiently to hold its shape, but shall be removed while the forms are still in place.

4.09 Machine poured concrete curb and gutter will be scored at 15 feet intervals with expansion joints located at intervals no greater than 50 feet.

4.010 Expansion joints shall be one-half (1/2) inch in width and shall be placed between all rigid objects at a distance of no more than fifty (50) feet apart and shall extend the full depth of the concrete with the top of the filler one-half (1/2) inch below the finished surface.

4.011 Finishing: The edges of the curb and gutter shall be finished with an approved edging tool of one-half (1/2) inch radius. Joints shall be similarly finished immediately after the templates have been removed.

4.012 Curing: Contractor may select method of curing provided that the method is approved by the Engineer and that the means and methods of curing conform to standards specified by current AASHTO or ASTM specifications.

4.013 Removing Forms: Forms shall not be removed from freshly placed concrete until it has set for at least 12 hours. Forms shall be carefully removed in such a manner as to prevent damage to the edges of the concrete. Any honeycombed areas along the sides shall be filled promptly with mortar composed of one part cement and two parts of fine aggregate.

4.014 Cold Weather and Night Concreting: Concreting shall be done when weather conditions are favorable unless otherwise directed by the Engineer. Concrete operations shall be discontinued when a temperature of 40° F is reached on a falling thermometer and may be continued when temperature reaches 35° F on a

rising thermometer. No concreting shall be attempted when local weather bureau indicates temperature below freezing within the ensuing 24 hours unless proper precautions are made to protect the concrete by covering with thermal insulation satisfactory to the Engineer. The Contractor shall be responsible for the quality and strength of the concrete laid during cold weather and any concrete damaged by frost action or freezing shall be removed and replaced as directed by the Engineer at the Contractor's expense.

4.015 The Contractor may be permitted by the Engineer to proceed with concrete operations during cold weather in temperatures of not less than 25° F at placing time provided that the Contractor furnishes an approved admixture and uses an amount per batch not to exceed two percent (2%) by weight of the total amount of cement, and further provided that he takes other precautions deemed necessary by the Engineer to prevent concrete from freezing during curing period.

4.016 No more concrete shall be laid than can be properly finished and covered during daylight, unless adequate artificial light satisfactory to the Engineer is provided.

4.017 Protection of Concrete: Immediately after the forms have been removed and all honeycombed areas repaired, the back of the curb shall be backfilled to prevent underwash. Traffic shall be excluded from crossing the concrete for a period of approximately fourteen (14) days, by erection and maintenance of suitable barricades, unless otherwise specified in the Contract Documents or by the Engineer. Contractor shall be responsible for any damage resulting from traffic or vandalism until accepted by the Engineer, and he shall remove and replace any concrete damaged as directed by the Inspector.

PART 5 - CONSTRUCTION METHODS - CURB & GUTTER, DRIVEWAYS, DRIVEWAY APRONS, WHEELCHAIR RAMPS, SIDEWALKS, AND TRAFFIC ISLANDS

A. Areas of concrete to be removed shall be sawcut before removing. The sawcut shall provide a smooth, straight edge approximately two (2) inches deep before breaking away the adjacent concrete. There will be no direct payment for the work covered by this section.

B. Concrete shall be constructed in accordance with Section 825 of the NCDOT Standard Specifications for Roads and Structures, latest edition and shall be given a “sidewalk finish,” except as otherwise noted herein.

C. Brooming of the concrete surface shall be done transverse to the direction of traffic. Joint spacing shall not be less than 5 feet. Where existing sidewalks are being widened, transverse joints shall be located so as to line up with existing joints in the adjacent existing sidewalk. Grooved joints shall not be sealed.

D. No backfill shall be placed adjacent to the curb & gutter, driveways, driveway aprons, wheelchair ramps, or sidewalks until at least 3 curing days have elapsed,

as defined in Section 825-9 of the NCDOT Standard Specifications for Roads and Structures, latest edition. However, all backfill shall be placed within 4 calendar days after the completion of this 3 curing day time period. Backfill shall clean earthen material free of all debris and shall be compacted to a degree comparable to the adjacent undisturbed material or as directed by the inspector.

E. Prior to placing detectable warnings in proposed concrete curb ramps, adjust the existing subgrade to the proper grade and in accordance with Article 848-3 of the NCDOT Standard Specifications for Roads and Structures, latest edition. Prior to placing detectable warnings in existing concrete curb ramps, saw cut to the full depth of the concrete, for other material remove as necessary, and adjust the existing subgrade to the proper grade and in accordance with Article 848-3 of the NCDOT Standard Specifications for Roads and Structures, latest edition.

F. Install all detectable warning in proposed concrete curb ramps or to retrofit existing curb ramps in accordance with the manufacturer’s recommendations.

END OF SECTION

SECTION 08000
ASPHALT PAVEMENT
(REVISED 01-05-22)

PART 1 - GENERAL

A. Except as otherwise stipulated in this specification, all asphalt pavement production, installation, and compaction shall be performed in accordance with Division 5 & 6 of the NCDOT Standard Specifications for Roads and Structures, latest edition. The work covered by this section consists of the installation and/or removal of aggregate base course, asphalt concrete surface course, asphalt concrete intermediate course, asphalt concrete base course, asphalt tack coat, asphalt prime coat, Geotextile Interlayer, Asphalt Surface Treatments, and utility adjustments.

B. No base material shall be placed on a roadway until the storm sewer, subgrade, utilities and all appurtenances have been inspected and approved by the Inspector.

C. Before the asphalt surface course is placed on the road, the aggregate base course shall be inspected and approved by the Inspector.

PART 2 - MATERIALS

A. AGGREGATE BASE COURSE

1. The base course shall consist of an approved coarse aggregate produced in accordance with Section 520 in the NCDOT Standard Specifications for Roads and Structures, latest edition. All materials, construction requirements and other provisions in Section 520 shall apply. The subgrade for the coarse aggregate base course shall be constructed in accordance with the requirements of these Specifications.

2. The subgrade shall be thoroughly compacted and constructed to the line, grade, and cross section on the plans or as directed by the Engineer. Before placing the base course, the subgrade shall be inspected and approved by the Inspector, and backfilling behind the curb shall be complete.

3. The base course material shall be placed in lifts **not to exceed eight (8) inches**. Each layer shall be graded to the required section and compacted to at least one hundred percent (100%) of the density as determined by AASHTO T180. The base material shall be compacted at a moisture content which is approximately that required to produce the maximum density.

4. After final shaping and compacting, the Inspector will check the surface of the base for conformance to grade and typical section. The thickness of the base shall be within a tolerance of plus or minus 1/2 inch of the base thickness required by the plans.

B. SUPERPAVE - ASPHALT CONCRETE SURFACE COURSE: TYPE SF 9.5 A, S 9.5 B, S 9.5 C, S 12.5 B, S 12.5 C, & S 12.5 D:

1. The Superpave surface course shall be Asphalt Concrete Surface Course, Type SF 9.5 A, S 9.5 B, S 9.5 C, S 12.5 B, S 12.5 C, or S 12.5 D shall be produced, delivered, placed, tested, compacted, and accepted in accordance with Sections 609 and 610 of the NCDOT Standard Specifications for Roads and Structures, latest edition.

2. Sections of the newly finished pavement shall be protected from traffic until they have become properly hardened. Finished surfaces of the base shall be checked with a 10-foot straightedge, applied parallel to the center of the pavement, and any places that vary more than one-eighth (1/8) of an inch as measured from the bottom of the straightedge to the finished course shall be corrected.

C. SUPERPAVE - ASPHALT CONCRETE INTERMEDIATE COURSE: TYPE I 19.0 B, I 19.0 C, & I 19.0 D:

1. The Superpave intermediate course shall be Asphalt Concrete Intermediate Course, Type I 19.0 B, I 19.0 C, or I 19.0 D shall be produced, delivered, placed, tested, compacted, and accepted in accordance with Sections 609 and 610 of the NCDOT Standard Specifications for Roads and Structures, latest edition.

D. SUPERPAVE - ASPHALT CONCRETE BASE COURSE: TYPE B 25.0 B, B 25.0 C, & B 37.5C:

1. The Superpave base course shall be Asphalt Concrete Base Course, Type B 25.0 B, B 25.0 C, or B 37.5C shall be produced, delivered, placed, tested, compacted, and accepted in accordance with Sections 609 and 610 of the NCDOT Standard Specifications for Roads and Structures, latest edition.

E. PAVEMENT REPAIR PATCH

1. Where it is necessary to open cut along or across streets with asphalt surfaces, the pavement shall be replaced in accordance with the City's Asphalt Pavement Patch Detail (T-10.05) or the NCDOT encroachment agreement, whichever is more strict. The replacement surface and/or base shall extend a minimum of 1 foot on each side of the excavated opening. The thickness of the replacement material shall be sufficient to provide a base and surface of equivalent strength to the undisturbed base and surface. The replaced pavement shall meet all applicable material and installation specifications outlined elsewhere in the Contract Documents.

F. ASPHALT TACK COAT

1. The tack coat shall be asphalt or asphalt cement and shall meet the general, material, and construction specifications as specified in Section 605 of the NCDOT Standard Specifications for Roads and Structures, latest edition.

G. ASPHALT PRIME COAT

1. Asphalt Prime Coat is not required unless otherwise directed by the plans or Engineer.

H. ASPHALT PLANT MIX

1. The production, delivery, and placement of all types of asphalt plant mixed bases, intermediate, and surface courses shall conform to Sections 609 and 610 of the NCDOT Standard Specifications for Roads and Structures, latest edition.

PART 4 - CONSTRUCTION METHODS

A. SUBGRADE

1. This subgrade shall be prepared and compacted in accordance with Section 500 in the NCDOT Standard Specifications for Roads and Structures, latest edition.

B. PROOFROLLING

1. Equipment: The equipment shall consist of a loaded tandem-axle dump truck or similar pneumatic-tired equipment of a minimum ten (10) ton static weight. The Contractor is responsible for providing the equipment necessary in order to perform proofrolling.
2.
3. Method: After the roadbed has been completed within five hundredths (0.05) feet of final grade, the roadbed shall then be compacted and tested with two (2) or more coverages unless otherwise directed by the Owner, using a heavy pneumatic-tired roller meeting the requirements listed above. A coverage is considered that stage in the rolling procedure when the entire width of the area being proofrolled has been in contact with the pneumatic tires of the roller. The roller shall be operated in a systematic manner so that the number of coverages over all areas to be proofrolled can be readily determined and recorded.

    a) The equipment shall be operated at a speed between two and one-half (2-1/2) and three and one-half (3-1/2) miles per hour. All proofrolling procedures shall be followed to the satisfaction of the Inspector on site during the proofrolling.

4. Corrective Action: If it becomes necessary to take corrective action, such as, but not limited to, underdrain installation, undercut and backfill of unsuitable materials, and aeration of excessively wet material in areas that have been proofrolled, these areas shall be proofrolled again following the completion of the necessary corrections. If the corrections are necessary due to the negligence of the Contractor or weather, the corrective work and additional proofrolling shall be performed by the Contractor.

C. WEATHER, TEMPERATURE, AND SEASONAL LIMITATIONS FOR PRODUCING AND PLACING ASPHALT

1. All weather and seasonal limitations shall be in accordance with Sections 610-4 of the NCDOT Standard Specifications for Roads and Structures, latest edition.

2. Should rain begin during paving operations, the Owner assumes no responsibility for asphalt left on the trucks at the time that the paving operation is halted.

D. PROTECTION OF MATERIAL

1. The Contractor shall provide and have ready for use at all times enough tarpaulins or covers for use in case of rain, chilly wind, or other delay, for the purpose of covering or protecting any material dumped but not spread.

E. COMPACTING ASPHALT CONCRETE MIXTURE

1. After placing, the mixture shall be thoroughly and uniformly compacted with tandem rollers of eight (8) or ten (10) ton model weighing not less than 250 pounds per inch width of roller tread. The number and weight of rollers shall be sufficient to compact the mixture to the required density while it is still in a workable condition.

2. Each roller shall be operated by a competent, experienced operator and must be kept in continuous operation as nearly as practicable. Rolling shall start longitudinally at the outer edges and proceed toward the center of the pavement, overlapping on successive trips by at least one half (1/2) the width of the roller.

3. The speed of the roller shall be at all times slow enough to avoid displacement of the hot mixture as a result of reversing. Any displacement shall be immediately corrected. Rolling shall proceed at a rate not in excess of 500 square yards per hour per roller and shall continue until no further visible compaction is obtainable and all roller marks have been eliminated.

4. Rolling shall be started as soon as the mixture will bear the roller without undue misplacement or hairline cracking. Delays in rolling hand raked mixture will not be tolerated.

5. To prevent adhesion of the mixture to the roller, the wheels shall be kept moistened with water. Places not accessible to the roller shall be thoroughly compacted with hot tamps.

F. COMPACTED DENSITIES

1. Unless otherwise noted compaction and density control of Asphalt Pavements shall be in accordance with the requirements of Sections 609 and 610 of the NCDOT Standard Specifications for Roads and Structures, latest edition.

2. The Contractor shall allow time for the inspections and testing of areas, as needed, by the City of Raleigh or their qualified testing firm, as directed by the Engineer.

G. PLANT TICKETS

1. The number of batches and total weight of all loads of mixture shall be recorded in duplicate upon plant ticket forms. With each load delivered to the work, the truck driver shall present one copy of the plant ticket to the Inspector. The driver shall retain one copy for the Contractor. Should the Engineer decide to provide a plant inspector, he/she shall keep the stub copy. The weights to be included in the estimate shall be the total of the tickets delivered by the truck driver to the Inspector at the work site. At any time, for the purpose of checking the weighing equipment at the plant, the Owner may direct the

Contractor to weigh or cause to be weighed on tested and approved platform scales at the Contractor's expense the contents of any truckload that is to be delivered to the work site.

H. PROTECTION OF PAVEMENT

1. When edges are not protected, planks of the same thickness shall be placed adjacent to longitudinal or transverse joints until the surface course is completed. Sections of newly finished pavements shall be protected from traffic until they have become properly hardened by temperature cooling.

PART 5 - REMOVAL OF EXISTING PAVEMENT

A. Milling asphalt pavement shall be in accordance with Section 607 of the latest version of the NCDOT Standard Specifications for Roads and Structures, latest edition.

B. All materials, which cannot be used in the work, shall be disposed of off site of the right of way in waste areas provided by the Contractor.

PART 6 - ASPHALT RESURFACING

A. GENERAL

1. Asphalt Resurfacing shall meet all applicable material and installation specifications outlined elsewhere in the Contract Documents.

2. Should construction take place near signalized intersections of a state maintained roadway, the Contractor shall contact the NCDOT Division Traffic Engineer to schedule the field location of any traffic signal conflicts. The Contractor shall notify the Engineer of any potential conflict prior to construction. The Contractor shall be responsible for coordinating the conflict relocation with NCDOT during construction.

3. The Contractor shall prepare a weekly schedule detailing the construction activities planned for the following week. This schedule shall be presented to the Inspector before Friday, 12:00 noon of the week preceding the effective date of the schedule. Weekly meetings may be required to review construction activities as directed by the Engineer.

4. In the event that all vehicles are not removed from the construction area despite timely delivery of the construction notice letter, the Contractor shall attempt to contact vehicle owners by other means in an effort to find the vehicle’s owner to have the vehicles relocated. If the Contractor is unsuccessful they shall contact the Engineer and provide the make, model, and license plate number of the vehicle as well as the vehicle location. The Engineer shall try contacting the vehicle owner and if unsuccessful shall contact a designated towing company to move the vehicle out of the construction area, to a neighboring street as directed by the Engineer, at the City of Raleigh’s expense. The towing company shall attach a standard letter to the vehicle upon towing. The Engineer will provide the standard letter.

5. Construction traffic control shall be provided on each street by the Contractor in strict conformance with NCDOT “North Carolina Supplement to the MUTCD,” the MUTCD, the Contract Documents, or as directed by the Engineer. No work shall begin on any street without the proper traffic control measures in place.

6. Construction traffic control shall be installed and practiced as a means to inform drivers that asphalt tack coat is being placed on the road surface.

7. The Contractor shall be responsible for spraying or burning all weeds growing on and in the streets. The Contractor shall be responsible for removing and properly disposing of the dead weeds and carefully cleaning each street before beginning asphalt concrete construction operations.

8. Asphalt resurfacing projects shall have a maximum acceptable elevation difference, between the top of the resurfacing layer and the gutter, of 1.5 inch. The Owner shall not accept any newly resurfaced streets exceeding this maximum elevation difference. Should it be determined that the resurfacing layer is more than 1.5 inch higher than the gutter elevation the resurfacing shall be removed and replaced or remedied as directed by the Engineer at the Contractor's expense.

9. The Contractor shall allow time for the inspection of areas, as needed, by a qualified testing firm as directed by the Engineer.

10. The Contractor shall construct all improvements so as to create and/or maintain positive drainage.

B. MATERIALS

1. GEOTEXTILE INTERLAYER INSTALLATION

a) The geotextile interlayer shall be a needlepunched, nonwoven engineering fabric made of polypropylene and staple fiber; calendared on one side. It shall be resistant to ultraviolet degradation and have the following properties:

	Typical	**Test**
Grab Tensile Strength (lbs)	101	ASTM D 4632
Grab Elongation (%)	50	ASTM D 4632
Puncture Strength (lbs)	65	ASTM D 4833
Mullen Burst (psi)	220	ASTM D 3786
Trapezoidal Tear (lbs)	45	ASTM D 4533
Mass Per Unit Area (oz/sq yd)	4.1	ASTM D 5261
Thickness (mils)	35	ASTM D 5199
Melting Point (°F)	Greater than 150	ASTM D 276
UV Resistance (%)	70 at 500 hrs	ASTM D 4355

b) For the tack coat, uncut asphalt cements are preferred, however, cationic or anionic emulsions may be used. For asphalt cements the minimum temperature shall be 150° C, but to avoid damage to the fabric the distributor tank temperatures shall not exceed 160° C. When asphalt emulsions are used, the emulsion shall be cured prior to placing the fabric.

c) The engineering fabric shall be placed onto the asphalt sealant, calendared side up, prior to the time the asphalt has cooled and lost tackiness. Wrinkles or folds in excess of 1 inch shall be slit and laid flat. In order to maximize fabric contact with the pavement surface, blooming or pneumatic rolling will be required. The fabric joints shall be overlapped sufficiently to ensure full closure of the joint, but should not exceed 6 inches. To prevent edge pickup by the paver, transverse joints shall be lapped in the direction of paving. A second application of sealant to the fabric overlaps will be required as directed by the Engineer.

d) Quickly following the fabric installation, the hot-mix overlay should be placed evenly. Should the asphalt bleed through the fabric causing construction problems prior to overlay placement, the affected areas shall be blotted by spreading sand. Turning the paver and other vehicles shall be gradual and kept to a minimum to avoid movement of, or damage to the sealant saturated fabric.

2. ASPHALT SURFACE TREATMENT:

a) Chip seal shall be “straight seal” with 78M stone in accordance with Section 660 of the NCDOT Standard Specifications for Roads and Structures, latest edition. Careful attention shall be given to surface preparation (as specified in Section 660) under chip sealing.

b) Cleanup: Excess aggregate resulting from straight seal shall be collected and removed from the construction site either before resurfacing occurs or one (1) week after the straight seal is applied, whichever occurs first.

3. LEVELING COURSE

a) In asphalt resurfacing projects a leveling course of Superpave - Asphalt Concrete Surface Course (Type SF 9.5 A, S 9.5 B, S 9.5 C, S 12.5 B, S 12.5 C, & S 12.5 D), as directed by the Engineer, shall be hand-placed in areas where the pavement is depressed, sunken or uneven, and its surface grade varies from surrounding elevation by one (1) inch or greater. Leveling asphalt shall be placed prior to chip seal applications or as designated by the Engineer.

PART 7 - SPEED HUMPS AND RAISED CROSSWALKS

A. GENERAL

1. Speed hump and raised crosswalk construction shall meet all applicable material and installation specifications outlined elsewhere in the Contract Documents.

2. In the event that all vehicles are not removed from the construction area despite timely delivery of the construction notice letter, the Contractor shall attempt to contact vehicle owners by other means in an effort to find the vehicle’s owner to have the vehicles relocated. If the Contractor is unsuccessful they shall contact the Engineer and provide the make, model, and license plate number of the vehicle as well as the vehicle location.

The Engineer shall try contacting the vehicle owner and if unsuccessful shall contact a designated towing company to move the vehicle out of the construction area, to a neighboring street as directed by the Engineer, at the City of Raleigh's expense. The towing company shall attach a standard letter to the vehicle upon towing. The Engineer will provide the standard letter.

3. Construction traffic control shall be provided on each street by the Contractor in strict conformance with NCDOT "North Carolina Supplement to the MUTCD," the MUTCD, the Contract Documents, or as directed by the Engineer. No work shall begin on any street without the proper traffic control measures in place.

4. The maximum acceptable height of speed humps and/or raised crosswalks shall be as indicated in the Contract Documents or as designated by the Engineer. The Owner shall not accept any newly constructed speed humps and/or crosswalks exceeding the maximum specified elevation. Should it be determined that the height exceeds the maximum elevation, the speed humps and/or raised crosswalks shall be removed and replaced or remedied as directed by the Engineer at the Contractor's expense.

5. The Contractor shall construct all improvements so as to create and/or maintain positive drainage.

PART 8 – UTILITY ADJUSTMENTS

A. GENERAL

1. No manholes or water valve boxes shall be raised and left for a period of time greater than fourteen (14) days before the street is resurfaced. Should this period of time be exceeded, all work shall be stopped until the resurfacing of such streets has been completed. Immediately after utility adjustments take place the sides of the utility shall be painted bright orange for visibility and if directed by the Engineer 36" (minimum) reflective orange traffic cones or other devices shall also be added for visibility.

2. Cast iron risers will not be allowed for adjustment of manholes and water valve boxes.

3. If any existing broken manholes or water valve boxes are discovered, the Owner shall furnish new manhole rings and covers or new water valve boxes for replacement of the broken ones by the Contractor. Replacements will be the same as stocked by the City of Raleigh or approved as acceptable alternate by the Engineer.

4. Adjustment of water meters, valve boxes, cleanouts, and/or fire hydrants shall include vertical adjustments only to leave the appurtenances positioned in the same horizontal location in accordance with the plans and standard City of Raleigh Public Utilities Details.

5. Relocation of water meters, cleanouts, and/or fire hydrants shall include both horizontal and vertical adjustments necessary to relocate the appurtenances to a different horizontal and vertical location in accordance with the plans and standard City of Raleigh Public Utilities Details.

6. Existing water service pipes, connections, and materials for relocations may be utilized off the water main if material is in acceptable condition as determined by the City of Raleigh. If material is not found to be in acceptable condition, contractor shall provide new water service pipe, connections, and materials (including curb stops) as required per COR details.

END OF SECTION

SECTION 09000
UTILITY WORK ALONG ROADWAYS
(Revised 10-1-14)

PART 1 - GENERAL

1.01 The Contractor shall provide all labor, materials, tools, and equipment to perform all work and services necessary for, or incidental to, the furnishing, complete installation, and testing of all work along roadways in accordance with the Construction Drawings, Contract Documents, and the City of Raleigh Streets Design Manual.

1.02 Although such work is not specifically shown or specified, all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a secure, complete, and compatible installation shall be furnished and installed as part of this section.

1.03 All work within the North Carolina Department of Transportation (NCDOT) right of way is done under permit. The Contractor shall secure the necessary permits, notify NCDOT of proposed construction, and be responsible for any damage due to construction. In addition, the Contractor shall obey all traffic laws and comply with all NCDOT and local requirements, rules, and regulations.

1.04 The Contractor shall provide adequate warning signs, lights, barriers, railing, flaggers, etc., and shall conduct all work in accordance with the latest versions of the NCDOT “Standard Specifications for Roads and Structures,” NCDOT “Roadway Standard Drawings Manual,” Manual on Uniform Traffic Control Devices (MUTCD), and the NCDOT Supplement to the MUTCD (NCSMUTCD). The Contractor shall possess one copy of each of the above referenced publications. Any conflicts found between the NCSMUTCD and the MUTCD shall be resolved in favor of the MUTCD.

1.05 The Contractor shall conduct operations so as to maintain and protect access for vehicular and pedestrian traffic, to and from all properties affected by operations.

1.06 Unless otherwise stated in the Encroachment Agreement, construction within 10-ft from the edge of pavement on a NCDOT maintained roadway shall be limited to the hours of 9:00 a.m. to 4:00 p.m.

1.07 The Contractor shall schedule “on the site” inspection prior to beginning work at highway bridges and/or box culverts by contacting the NCDOT Head of Bridge Maintenance.

1.08 Lines installed under major roadways shall be constructed by boring or tunneling as may be required by the NCDOT, the Contract Documents, and the Standard Specifications.

1.09 Any unpaved road, side road, dwelling entrance road, commercial entrance, road shoulder, or other area stabilized by rock material shall be protected from erosion during construction and shall be stabilized by the use of crusher run stone after backfilling. This stone stabilization shall be approximately 4-inches thick unless otherwise directed by the Engineer.

PART 2 - OPEN CUTTING OF ROADWAYS

2.01 GENERAL

A. Open cuts within the roadway shall have vertical faces where soil and depth conditions permit and shall be shored where necessary. All excess excavated material shall be removed and disposed of at a location provided by the Contractor outside the limits of the right of way unless otherwise approved by the NCDOT Division.

B. A trench made in the travel portion of the roadway shall not be left open overnight except in an emergency and only then when adequate barricades, signs, and torches or lights are prominently displayed to protect the traveling public.

C. The Contractor shall backfill and replace all pavement cuts. The Contractor shall also maintain ditches cut along and across roadways in accordance with the permits received from the NCDOT and as required by the Contract Documents and the Standard Specifications. Shoulders, side ditches and cut or fill slopes shall be repaired to the satisfaction of the Engineer.

D. Trench installations that may be vulnerable to damage due to precipitation, or which may be hazardous to traffic shall be closed without delay. A trench shall not remain open longer than 24 hours except with the approval of the NCDOT Division Engineer.

E. Where utility lines pass under culverts on the NCDOT right of way, the Contractor shall fill the void from the bottom of the utility line to the spring line of the culvert with #57 stone. Where the distance between the bottom of the culvert and the top of the utility line exceeds the radius of the culvert, the Contractor shall compact soil around and above the utility line to at least 95% of maximum dry density as measured by AASHTO Method T99 and place #57 stone from the spring line of the culvert to a depth below the bottom of the culvert at least equal to the culvert radius.

F. Excavation material shall not be stored on the pavement if it can reasonably be handled otherwise. In cases where storing of excavated material on pavement is absolutely necessary, it shall be moved as quickly as practical, and the pavement shall be thoroughly cleaned. Sand or screenings shall be placed on the pavement before the excavated material to allow for better clean up.

G. Excavation in the immediate vicinity of drainage structures shall be made with special care so as not to damage or interfere with the use of the existing drainage facilities. Drainage facilities that are damaged by the Contractor shall be repaired immediately at no additional expense to the Owner.

2.02 PERPENDICULAR TRENCHING

A. Where a trench is cut perpendicular to the road, only one-half of the road width shall be obstructed at one time in order to maintain traffic. Before the other half is cut, the initial trench shall be made usable, safe, and maintained for traffic.

2.03 PARALLEL TRENCHING

A. Where a trench is cut parallel to the road, adequate barricades and warning signs shall be placed and, if necessary, flaggers shall be employed to control traffic. If trenches are left open overnight, a sufficient number of barricades, signs and torches or lights shall be prominently displayed so that the traveling public will be adequately protected.

B. Where space permits, the trench bottom shall not be nearer the edge of the pavement (measured in a horizontal plane) than the depth of the excavation so that the theoretical slope from the edge of the pavement to the bottom of the ditch is no steeper than a one-to-one slope. On paved sections under 24-ft in width, consideration shall be given for future widening and paving of shoulders. Where, in the opinion of the Engineer, soil conditions are such that sheet pilings or other shorings are necessary, they shall be placed by the Contractor. The trench shall not be closer than 3-ft to the edge of the pavement unless approved by the Engineer.

2.04 COMPACTION

A. The backfill around and under pipes or other utility installations on all open-cut sections across or parallel to roadways shall consist of approved material free from rocks compacted in 6-inch lifts to at least 95% maximum dry density as measured by AASHTO Method T99. Trench backfill above the pipe shall be placed in lifts of 8-inches or less of uncompacted soil. Each lift shall be thoroughly tamped by a mechanical tamp before the next lift is placed. A pneumatic tamp, a gasoline ram type tamp, or a vibrating tamp will be required to meet the specifications of a “mechanical tamp.”

END OF SECTION

SECTION 10000
UTILITY TRENCHES

PART 1 - GENERAL

A. The Contractor shall provide all labor, materials, tools, and equipment to perform all work and services necessary for, or incidental to, the excavation, shaping, and backfill of utility trenches in accordance with the Construction Drawings, Contract Documents, and the latest editions of the City of Raleigh Public Utilities Handbook

B. Existing Utilities: The Contractor shall be completely and solely responsible for locating all existing buried utilities and preventing damage to those utilities.

C. Pavement Removal: Where trenches are excavated in paved areas, the pavement shall be saw-cut prior to removal. All pavement cuts shall be repaired within a maximum of three (3) calendar days from the date the cut is made. If conditions do not permit a permanent repair within the given time limit, permission to make a temporary repair must be obtained from the Engineer.

D. Trench Excavation: Trenches for all buried utility installations, such as water distribution lines, sanitary sewer lines, force mains, and storm sewer lines shall be excavated to the required depth to permit installation of the pipe along the lines and grades as specified by the Contract Documents and the City of Raleigh Public Utilities Handbook. Trenches shall be prepared in accordance with the City of Raleigh Public Utilities Handbook. Where excavation is in rock, the rock shall be removed to a depth of at least 6-inches below grade and the void shall be backfilled with #67 stone and thoroughly compacted to the sub-grade level. Wet or unstable trenches shall be stabilized with #67 stone.

E. Dewatering: The Contractor shall dewater the trench throughout construction by pumping in a manner that all pipe jointing may be made under dry conditions. Water shall be disposed of in a manner not detrimental to the public health or to public or private property.

F. Rock Blasting and Excavation: Blasting procedures shall conform to all applicable local, state, and federal laws and ordinances. A blasting permit shall be obtained by the City of Raleigh Frie Marshall's Office, prior to any blasting. The application shall be obtained 24-hours before any blasting takes place, and the Fire Marshall may specify the hours of blasting. The contractor shall take all necessary precautions to protect life and property, including use of an approved blasting mat where there exists the danger of throwing rock or over-burden. The contractor shall keep the explosive materials that are on the job site in specially ocnstructeed boxes provided with locks. Failure to comply with this specification shall be grounds for suspension of blasting operations until full compliance is made. No blasting shall be allowed unless a galvanometer is employed to check cap circuits. Where blasting takes place within five hundred feet of a utility, structure, or property which could be damaged by vibration, concussion, or falling rock, the contractor shall be required to

take seismograph readings and to keep a blasting log containing the following information for each and every shot.

1) Date of shot
2) Time of shot
3) Crew Supervisor
4) Number and depth of holes
5) Approximate depth of overburden
6) Amount and type of explosive used in each hole
7) Type of caps used (instant or delay)
8) The weather
9) Seismograph instrument and readings

This blasting log shall be made available to the Engineer upon request and shall be kept in an orderly manner. It shall be the Contractor's responsibility to have adequate insurance to cover any damages resulting from blasting so to save the City of Raleigh harmless from any claims.

G. Pipe Laying: All pipe shall be laid in accordance with its manufacturer's recommendations and the Contract Documents and Standard Specifications. The subgrade at the bottom of the trench shall be shaped to secure uniform support throughout the length of the pipe. A space shall be excavated under the bell of each pipe to provide space to relieve bearing pressure on the bell and to provide room to adequately make the joint. Open ends of pipe shall be plugged with a standard plug or capped at all times when pipe laying is not in progress. Trench water shall not enter the pipe.

H. Trench Backfill: **All trenches shall be properly backfilled at the end of each working day.** Backfill material shall be free of construction debris, frozen material, organic material, or unstable material. The upper 2-ft of backfill material shall be free from stones greater than 4-inches in diameter. In the event that unsuitable backfill is discovered as determined by the Engineer, the Engineer may direct the Contractor to replace all or portions of the unsuitable backfill with suitable backfill materials approved by the Engineer. The Contractor shall be prepared to remove unsuitable material from the site at no additional expense to the Owner.

I. Compaction: Backfill shall be compacted to a density of no less than 95% maximum dry density as measured by AASHTO method T99. Backfill shall be placed in lifts of 8-inches or less of the uncompacted soil. When compacting in layers, each layer must be thoroughly tamped by a mechanical tamp, such as "Rammax Sheepsfoot" or equivalent, before the next layer is placed.

J. Clean-up: The Contractor shall remove all excess excavation materials, earth, debris, etc. and shall clean up and leave all affected property, streets, roads and highways in a neat, clean and orderly condition as required throughout construction and upon completion of the work specified under this section. Unless directed by the Engineer, all affected areas shall be returned to the contour that existed prior to construction – mounding of the easement or right-of-way shall not be allowed. If so

directed by the Engineer, the Contractor shall deposit all or a part of the excess earth at such point or points as may be designated. Excess earth from trenches along state controlled highways or roads shall be disposed of in a manner satisfactory to the State Department of Transportation. All temporary pipes and ditching used during construction to carry surface water shall be removed.

END OF SECTION

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SECTION 11000
WATER DISTRIBUTION SYSTEM
(REVISED 01-05-22)

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Except as otherwise stipulated in this section, all work shall conform to Division 15 of the NCDOT Standard Specifications for Roads and Structures, latest edition.

B. Work under this section includes, but is not limited to, piping, valves, fire hydrants, water service line, and appurtenances for a complete potable water distribution system.

1.02 REFERENCES

A. Publications are referred to in the text by basic designation only.
   1. American Society of Sanitary Engineering (ASSE) Standards
      a. 1013 Reduced Pressure Principle Backflow Preventers
      b. 1015 Double Check Backflow Prevention Assembly
      c. 1069 Outdoor Enclosures for Backflow Prevention Assemblies
   2. American Society for Testing and Materials (ASTM)
      a. C443 Flexible Watertight Joints for Precast Manhole Sections
      b. C478 Precast Reinforced Concrete Manhole Sections
      c. C890 Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures
      d. C923 Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.
   3. American Water Works Association (AWWA)
      a. B300 Hypochlorites
      b. B301 Liquid Chlorine
      c. C104 Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
      d. C105 Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids
      e. C110 Ductile-Iron and Gray-Iron Fittings, 3 inch through 48 inch, for Water and Other Liquids
      f. C115 Flanged Ductile-Iron Pipe with Ductile Iron or Gray Iron Threaded Flanges
      g. C150 Thickness Design of Ductile Iron Pipe
      h. C151 Ductile-Iron Pipe, Centrifugally Cast, for Water
      i. C153 Ductile-Iron Compact Fittings, 3 inch through 24 inch and 54 inch through 64 inch, for Water Service
      j. C502 Dry-Barrel Fire Hydrants
      k. C504 Rubber-Seated Butterfly Valves
      l. C508 Swing-Check Valves for Waterworks Service, 2 inch Through 24 inch NPS
      m. C509 Resilient Seated Gate Valves for Water and Sewerage Systems
      n. C510 Double Check Valve Backflow-Prevention Assembly
      o. C511 Reduced-Pressure Principle Backflow-Prevention Assembly
      p. C512 Air-Release, Air / Vacuum, and Combination Air Valves for Waterworks Service
      q. C550 Protective Epoxy Interior Coatings for Valves and Hydrants
      r. C600 Standard for Installation of Ductile Iron Water Mains and Their Appurtenances
      s. C651 Disinfecting Water Mains

t. C800 Underground Service Line Valves and Fittings
u. C909

4. National Sanitation Foundation (NSF) Standards
   a. 14 Plastic Piping Components and Related Materials
   b. 60 Drinking Water Treatment Chemicals – Health Effects
   c. 61 Drinking Water System Components - Health Effects

1.03 SUBMITTALS

A. Submit the following in accordance with Section 02000 - Contractor Submittal Procedures:

1. Affidavit of Compliance: Affidavit shall attest that supplied products conform to the referenced standard and this specification and that all tests set forth in each applicable referenced publication have been performed and that all test requirements have been met. Submit for each of the following materials:

   a. Pipe and Fittings
      1) Ductile iron
      2) Copper pipe and tubing
      3) Mechanical Joint Wedge Action Restraint, i.e. “Megalug”

   b. Valves
      1) Gate
         i) Resilient-Seated
         ii) Tapping
      2) Butterfly
      3) Check
      4) Air release

   c. Fire hydrants

   d. Pre-cast concrete manholes

   e. Service valves and fittings
      1) Corporation valves
      2) Meter setter with meter valve and check valve

   f. Backflow prevention assembly

2. Catalog Data: Submit manufacturer's standard drawings or catalog cuts for the following. Clearly indicate equipment to be furnished for the Project including options to be provided.

   a. Pipe and Fittings
      1) Ductile iron
      2) Copper pipe and tubing
      3) Mechanical Joint Wedge Action Restraint, i.e. “Megalug”

   b. Valves
      1) Gate
         i) Resilient-Seated
         ii) Tapping
      2) Butterfly

3) Check
4) Air release

c. Pre-cast Concrete Manholes and appurtenances
1) Manhole steps
2) Pipe connectors
3) Joint material

d. Castings
e. Tapping sleeves
f. Valve boxes
g. Fire hydrants
h. Service valves and fittings
1) Service saddles
2) Corporation valves
3) Meter setter with meter valve and check valve
4) Meter box
i. Backflow prevention assembly and enclosure
j. Blowoff assembly

3. Reports:
a. Field test report for each section of pipe for the following:
1) Measured chlorine residual
2) Bacteriological test
3) Pressure test

b. Field test report for each backflow prevention device.

4. Operation and Maintenance Instructions: Submit complete operation and maintenance manual for the following:
a. Valves
b. Fire hydrants
c. Backflow prevention assembly

1.04 DELIVERY, STORAGE, AND HANDLING

A. Provide a suitable pipe hook or rope sling when handling the pipe. Lifting of the pipe shall be done in a vertical plane. Under no conditions shall the sling be allowed to pass through the pipe unless adequate measures are taken to prevent damage to both the bell and spigot ends.

B. Deliver pipe in the field as near as practicable to the place where it is to be installed. In road right-of-way, distribute pipe daily along the side of the trench opposite to the spoil bank. Stringing pipe in road right-of-way except on a daily basis is not allowed. In easements, distribute pipe along the side of the trench opposite to the spoil bank. Stringing pipe in easements is allowed. Where necessary to move the pipe longitudinally along the trench, it shall be done in such a manner as not to injure the pipe or coating.

C. Shield PVC pipe and fittings stored on site from the sun's ultraviolet rays by suitable cover, or indoor storage.

PART 2 PRODUCTS

2.01 GENERAL

A. Products with surfaces intended to be in contact with the drinking water shall be certified and listed in accordance with NSF 61 for potable drinking water.

2.02 DUCTILE IRON PIPE

A. Pipe and fittings 3-inch to 64-inch shall conform to AWWA C150 and C151 and the following requirements:

1. Size shall be as indicated on the Drawings.
2. Minimum pipe pressure class shall be 350 for pipes 6-inch to 12-inch diameter, and pressure class 250 for pipes 16-inch and larger.
3. Suitable for a system working pressure of 250 psi and surge pressure of 300 psi at the depth indicated on the Drawings with a laying condition as indicated in Section 10000, Utility Trenches.
4. Interior lining to be used in a drinking water system shall be certified and listed in accordance with NSF 61.
5. Interior shall be lined with cement-mortar with seal coat in accordance with AWWA C104.

B. Ductile-iron pipe for below ground service shall have push-on or mechanical joints, unless noted otherwise on the Drawings, conforming to AWWA C150 and C151, and to the following requirements:

1. Provide mechanical joint fittings for push-on or mechanical joint pipe, unless noted otherwise on the Drawings.

C. Ductile-iron pipe for above ground service shall have flanged joints, unless noted otherwise on the Drawings, conforming to AWWA C115.

1. Pipes to be painted shall have only a shop primer on the outside by the manufacturer. Verify that proposed manufacturer's primer is compatible with the proposed paint system.

D. Fittings for ductile-iron pipe shall conform to AWWA C110, or C153 and to the following requirements:

1. Joint type shall be as specified above for the supplied ductile-iron pipe.
2. Fittings shall be made of ductile-iron.

E. Ductile iron pipe on piers shall have Mech-Lok™ rigid restrained joint by Griffin Pipe Products Co. or approved substitute.

1. Restrained
   a. Provide restrained joint pipe where called for on the drawings. Length of restrained pipe shall be as indicated on the Drawings. Restrained joints shall be Snap-Lok (Griffin Pipe), Flex Ring and Lok-Ring (American), TR Flex (U.S. Pipe) or approved equal.
   b. Restrained joint pipe and fittings shall meet all AWWA standards and other requirements as specified above for standard ductile iron pipe and fittings unless addressed herein.
   c. Field made joints are allowable but should be avoided where possible. Careful planning to locate field cuts in standard pipe sections is preferred. For field made

joints in restrained piping, use field weldments or an insert equal to TR Flex Gripper Rings or approved equal. Gasket type field made joints will not be allowed.

d. Restrained joint fittings shall be provided by the restrained joint pipe manufacturer where located within restrained joint pipe sections. Fittings shall be of the same model and type as the pipe supplied from the pipe manufacturer.
e. Restrained joint fittings may be push-on joint type.
f. Megalugs, Series 1100, as manufactured by EBAA Iron Sales shall be allowable for restraint where fittings or valves are not available with restrained joints.
g. Where additional fittings/valves are required for pipes not shown on Drawings, consult with Engineer for length of restrained joint pipe necessary each side of fittings/valve prior to installation of pipe/fitting.
h. Tees for hydrants do not have to be restrained along the main line except where they are within required restrained length of nearby fittings or valves.
i. Contractor shall develop a field layout schedule and drawing for restrained joint pipe installations.
j.

2.03 COPPER PIPE AND TUBING

A. Copper pipe and tubing shall conform to ASTM B-88 Type K and Type L standard specification for seamless copper water tube with copper or brass fittings. Type K to be used underground. Type L to be used above ground.

B. Soldered joint fittings shall conform to NSI B-16.22. Fittings to be of same manufacturer as pipe.

C. Screw joint fittings to be provided where required and indicated.

D. Screw joint unions shall be provided at each in-line valve, pressure regulator, pressure reducer and/or where indicated.

2.04 TAPPING SLEEVE

A. Tapping Sleeve: Sleeves shall be flanged for the tapping valve and manufactured for a working pressure of 150 psi. Sleeve shall have a full body 360-degree gasket. Sleeve shall have a 3/4-inch test plug. Bolts and nuts shall be stainless steel. Tapping Sleeve shall be Mueller mechanical joint, Mueller Outlet Seal, American Uniseal, Kennedy Square Seal, or Clow F5205 or F5207. 100% stainless steel sleeves may be used, as manufactured by Rockwell, Romac, Ford, or JCM, provided that all metallic parts of the sleeves shall be 100% stainless steel including bolts. Ductile iron flanges may be included on sleeves or saddles.

B. Tapping saddles may be used on mains 16-inches and larger. In 16 and 24 inch saddles as manufactured by Mueller, American, Kennedy and Clow tapping saddles shall be manufactured of ductile iron providing a factor of safety of 2.5 at a working pressure of 250 psi. In main sizes of 30-inch and larger, ductile iron tapping saddles as manufactured by American Pipe Company or U.S. Pipe Company shall be utilized. Saddles shall be equipped with a standard AWWA C-110-98 flange connection. Sealing gaskets shall be “O” ring type, high quality molded rubber having an approximate seventy durometer hardness, placed into a groove on the curved surface of the tapping saddle. Straps shall be of alloy steel. Saddles may be used for taps one-half the size of the main or less (i.e. 8-inch tapping saddle for use on a 16-inch main).

2.05 VALVES

A. General: Valves shall meet the following requirements:

1. Size shall be as required for the pipe size and material as indicated on the Drawings and specified.
2. Open by counterclockwise rotation.
3. Provide an interior protective epoxy coating in accordance with AWWA C550 on ferrous surfaces in contact with the liquid.
4. Components in contact with the liquid shall be in compliance with NSF 61.
5. Standard system working pressure is 175 psi.
6. Equip valves with a suitable means of operation.
7. Ends shall be mechanical joint for underground location and flanged joint for above ground location/underground utility vaults.
8. For buried valves over 5 feet deep, provide extension stems of cold rolled steel to bring the operating nut to within 2 feet of the ground surface. Extension stems shall also be provided as required for floor stands and to floor valve box.
9. Provide valve accessories as required for proper valve operation for valve locations as indicated on the Drawings and as recommended by valve manufacturer.
10. Similar valve types shall be of one manufacturer. Valves shall be manufactured by Mueller, Kennedy, Pratt, or American.

B. Gate Valves, Resilient-Seated: Gate valves 3-inch to 20-inch shall conform to AWWA C509 for and to the following requirements:

1. O-ring stem seal on non-rising (NRS) stem valves.
2. Shall be cast iron or ductile iron.
3. Valves shall be non-rising stem (NRS) with wrench nut for underground locations and Outside Screw and Yoke (OS&Y) with handwheel for above ground locations unless noted otherwise on the Drawings.
4. Valves shall be as manufactured by American, Mueller, Kennedy, AVK, Clow, M&H, or Waterous.
5. Valves 16-inch and larger shall be equipped with gearing to facilitate opening. Gear cases shall be enclosed type. Geared valves shall be equipped with indicators to show the position of the gate in relation to the water.
6. Valves 20-inch and larger shall be equipped with a by-pass.

C. Tapping Valves: Tapping valves shall conform to the specifications for the gate valves as indicated in this Section and the following:

1. Valve shall be specifically modified for the passage and clearance of the tapping machine cutter.
2. The mating end to the tapping sleeve shall be raised male surface to provide true alignment to the sleeve and tapping machine. The valve shall be compatible with the tapping sleeve.

D. Butterfly Valves: Butterfly valves 3-inch through 72-inch shall conform to AWWA C504 for potable water and to the following requirements:

1. Valve body shall be ductile iron and mechanical joint for below ground locations and flanged short body in underground vaults and above ground locations. End mechanical joints shall conform to ANSI/AWWA C110/A21.10 and ANSI/AWWA C111/A21.11. End flanges shall conform to ANSI B16.1, class 125 and ANSI/AWWA C110/21.10.

2. Valves shall be class 150B.
3. Rubber seats shall mate with stainless steel, bronze mating or resilient material surfaces.
4. Valve shafts shall consist of one-piece unit extending completely through the valve disc for valves under 12-inches. Above this size, shaft shall be one piece or the stub-shaft type. Shafts shall be type 304 stainless steel.
5. Valve discs shall be cast iron, ductile iron, or stainless steel.
6. Valve Actuator
   a. Manual Actuator: Manual actuator shall be of the traveling nut type. Valves for buried service shall have a standard AWWA nut. Valves for above ground shall have a handwheel, or chain wheel as indicated on the Drawings.
   b. Shall be as manufactured by Philadelphia Gear Works or EPI.
7. Valve shall be manufactured by Mueller, Kennedy, Pratt, or American.

E. Swing-Check Valves: Swing-check valves 2 to 24-inch shall conform to AWWA C508 and to the following requirements:

1. Provide lever and weight for swing check control.
2. Metal to Metal seat construction.
3. Ends shall be flanged.

2.06 AIR VALVES

A. Provide air valves in conformance with AWWA C512 and the following:

1. Valve type shall be an Air Release valve.
   a. Inlet size: 2 inch
   b. Small orifice minimum: 1/8 inch
2. Valve shall be designed for the following automatic operation:
   a. Release accumulated air while the main is in operation and under pressure.
3. Valve shall be designed for a system pressure 150 psi.
4. Provide threaded inlet.
5. Provide stainless steal ball float and internal trim.
6. Provide isolating bronze ball valve for connection to main line.
7. Valve shall be Crispin Pressure Air Valve, Model PL 20, or two-inch Val-Matic Model VM-45 with a vacuum check unit or equal as approved by Public Utilities Director.

2.07 MANHOLES

A. Provide manholes made of precast concrete sections in conformance with ASTM C478, NC Department of Transportation, and the following requirements:

1. General
   a. Provide manholes to the depth as indicated on the Drawings. Manhole inside diameter shall be 4 feet unless noted otherwise on the Drawings.
   b. Precast concrete manholes shall be as manufactured by Adams Concrete, Hanson Pipe and Precast, Inc., D & M Concrete Specialties, Inc., N. C. Products Corp., Stay Right Tank, Tindall Concrete Products, Inc. or approved substitute.

2. Precast Concrete Sections

a. Minimum wall thickness shall be 5-inches.
b. Base: Cast monolithically without construction joints or with an approved PVC waterstop in the cold joint between the base slab and the walls. The width of the base extensions on Extended Base Manholes shall be no less than the base slab thickness.
c. Riser: Minimum lay length of 16 inches.
d. Eccentric Cone: Top inside diameter shall be 24 inches. Width of the top ledge shall be no less than the wall thickness required for the cone section.
e. Precast or core holes for pipe connections. Diameter of hole shall not exceed outside diameter of pipe by more than 3-inches.
f. Grade Rings: May be used to adjust ring and covers to finished grade. No more than 12 vertical inches of grade rings will be allowed per manhole. Grade Rings shall be no less than 4 inches in height.
g. Lifting Devices: Devices for handling precast components shall be provided by the precast manufacturer and comply with OSHA Standard 1926.704.

3. Joints
   a. Manufacturer in accordance with tolerance requirements of ASTM C 990 for butyl type joints.
   b. Minimize number of joints. Do not use riser section for manholes up to 6 feet tall and no more than one riser for each additional 4 feet in height.
   c. Flexible Joint Sealants: Provide preformed butyl rubber based sealant material conforming to Federal Specification SS-S-210A, Type B - Butyl Rubber or O-ring rubber gasket conforming to ASTM C443.

4. Flexible Pipe Connectors: Provide flexible connectors for pipe to manhole that conform to ASTM C923. Location of connectors shall vary from Project Drawings no more than 1/2-inch vertically and 5 degrees horizontally.

5. Manhole Steps:
   a. Steps shall be made of 1/2-inch grade 60 steel encapsulated by co-polymer polypropylene and have serrated tread and tall end lugs.
   b. Secure steps to the wall with compression fit in tapered holes or cast-in-place. Align steps along a vertical wall and shall not be located over a pipe opening. First step shall be a maximum of 26 inches from the bottom.
   c. Steps shall be by American Step Co., Inc., Bowco Industries, Inc., M. A. Industries, Inc. or approved substitute.

2.08 CASTINGS

A. General

1. Made of gray iron, ASTM A-48 - class 30, or ductile iron, ASTM A536, grade 65-45-12.
2. Castings shall be free from imperfections not true to pattern. Casting tolerances shall be plus or minus 1/16 inch per foot of dimension. Top shall set neatly in frame, with edges machined for even bearing and proper fit to prevent rattling and flush with the edge of frame.
3. Castings shall be as manufactured by Neenah Foundry Co., U.S. Foundry & Manufacturing Corp., Vulcan Foundry, or approved equal.

B. Manhole Ring and Cover:

1. Minimum clear opening shall be 22 inches.
2. Minimum weight for frame and cover shall be 300 pounds and suitable for Heavy Duty Highway Traffic Loads of H-20.
3. Frame shall have four 3/8-inch anchor bolt holes equally spaced.
4. "Water" shall be cast on the cover as appropriate. Casting shall bear the name of the manufacturer and the part number.
5. Provide cover with two 1-inch perforated holes unless noted as watertight on the Drawings.
6. Provide the following where indicated on the Drawings:
   a. Ring and cover shall be watertight.
   b. Bolt down cover. Bolt down covers shall be provided with four (4) 3/8-inch stainless steel hex head bolts at 90 degrees.

2.09 VALVE ACCESSORIES

A. Valve Box, Below Ground: Boxes shall be high strength cast iron, class 35, of the screw or telescopic type. Box shall consist of a flare base section, center extension as required, and a top section with the word “WATER” cast in the cover. Length of box shall be such that full extension of box is not required at the depth of water main cover.

B. Extension Stem (if necessary): Stem shall be sized so as to transmit full torque from the operating mechanism to the valve stem without binding, twisting, or bending. Stem shall be made from extra heavy steel pipe. Stem shall be complete with couplings for connection to valve and floor stand where required. When valve extension kits are used they must be as recommended by the valve manufacturer.

2.10 SERVICE VALVES AND FITTINGS

A. Water service valves and fittings shall conform NSF 61 and AWWA C800 for normal pressure and the following requirements:

1. Service saddle: Provide service saddle for service pipe connection to main pipe material. Saddles shall meet the following requirements:
   a. Bronze body to conform to the outside dimension of the main.
   b. O-ring, Buna N rubber gasket to provide watertight connection.
   c. Hinged, double bottom strap design.
   d. Threaded outlet to match threads on corporation valve.

2. Corporation valve
   a. Stop size shall be the same as service line.
   b. Inlet thread shall be as per AWWA C800.
   c. Outlet thread shall be as required for the pipe material specified.

3. Curb Stop
   a. Installed in approved valve box
   b. Bronze ball valve material
   c.

4. Pressure reducing valve
   a. Shall meet ASSE 1003.
   b. Bronze body, renewable stainless steel seat.
   c. Suitable for reducing from an inlet pressure range of 100 – 150 psi to an outlet pressure of 40 psi.

5. Meter boxes
   a. Boxes and cover shall be cast iron, precast concrete, concrete block, high density polyethylene or cast in place concrete as shown on standard details.
   b. Minimum 18 inches deep.
   c. Sized for required water meter.

6. Meter setter
   a. Setter shall be made of copper.
   b. Shall be 5/8” and 12” in height.
   c. Setter shall have a meter valve on the public side of the meter. Valve shall be O-ring sealed and capable of being locked in the closed position. Setter shall have an ASSE approved dual check valve on the private side of the meter.

2.11 FIRE HYDRANTS

A. Fire hydrants shall conform to AWWA C502 and to the following requirements:

1. Nozzles: Two (2) 2-1/2-inch hose and One (1) 5-inch Storz pumper connections.
2. Storz connector shall have following characteristics:
   a. brass hydrant nozzle connection
   b. hard anodized aluminum Storz ramps and lugs (hydrant and cap side)
   c. require high-torque Storz spanner wrench in order for cap to be removed.
3. Nozzle threads: NST
4. All nozzles require cap and
5. Main valve diameter: 5-1/4.
6. Minimum depth of bury: 42-inches.
7. Inlet connection: 6-inch mechanical joint.
8. Open counterclockwise.
9. Close with water pressure.
10. O-ring seals
11. All hydrants to include cast or ductile epoxy lined shoe, rubber drain seals, and positive, protective valve stop device.
12. Traffic model with frangible sections near the ground line designed to break on impact.
13. Provide extension for hydrant standpipe as required to set centerline of hydrant nozzle a minimum of 15-inches and a maximum of 24-inches.
14. Exterior color above ground line shall match Owners.
15. Fire Hydrant shall be as manufactured by Kennedy, Mueller, Clow, American Darling, M&H, AVK, East Jordan Iron Works, U.S. Pipe, or Waterous.
16. All hydrants of one manufacturer.

2.12 BACKFLOW PREVENTION ASSEMBLY

A. A list of approved assemblies for backflow preventers (BFP) is included in the Public Utilities Handbook and the list is updated on a regular basis.

2.13 BACKFLOW PREVENTER ENCLOSURES

A. A list of approved enclosures for backflow preventers (BFP) is included in the Public Utilities Handbook and the list is updated on a regular basis.

2.14 METERS

A. All meters shall be provided and installed by the City of Raleigh Public Utilities Department.

2.15 THRUST BLOCKING

A. Provide concrete thrust blocking in accordance with the detail on the Drawings.

B. Thrust blocking is not required where restrained joint fittings and equivalent length of restrained joint pipe are used unless shown otherwise on the Drawings.

2.16 DISINFECTANT

A. The following products may be used as the disinfectant:
   1. Chlorine, liquid: AWWA B301.
   2. Hypochlorite, calcium and sodium: AWWA B300.

PART 3 EXECUTION

3.01 GENERAL

A. Pipe installation shall meet the following general guidelines:

   1. Lay pipe in the presence of Engineer, unless specifically approved otherwise.
   2. Handle pipe and accessories in accordance with manufacturer's recommendations. Take particular care not to damage pipe coatings.
   3. Carefully inspect pipe immediately prior to laying. Do not use defective pipe. Replace pipe damaged during construction.
   4. Lay pipe to grade and alignment indicated on the Drawings.
   5. Provide proper equipment for lowering pipe into trench.
   6. Do not lay pipe in water or when the trench or weather conditions are unsuitable for the work.
   7. Provide tight closure pipe ends when work is not in progress.
   8. Keep pipe interior free of foreign materials.
   9. Clean bell and spigots before joining. Make joints and lubricate gasket in accordance with pipe manufacturer recommendation.
   10. Disinfection of pipe during installation:
      a. Soak gaskets for minimum of one hour in a 50 - 100 ppm hypochlorite solution prior to installation.
      b. Mop bells and spigots of pipe, fittings and valves with a 50 - 100 ppm hypochlorite solution immediately prior to making joints.
   11. Block fittings with concrete or restrain as indicated on the Drawings.

3.02 RELATION OF WATER MAINS TO SEWERS

A. Lateral Separation: Lay water mains at least 10 feet laterally from existing and proposed sewers. Where existing conditions prevent a 10-foot lateral separation, the following shall be followed with approval of the Engineer:

   1. Lay water main in a separate trench, with the elevation of the bottom of the water main at least 18 inches above the top of the sewer.

2. Lay water main in the same trench as the sewer with the water main located at one side on a bench of undisturbed earth, and with the elevation of the bottom of the water main at least 18 inches above the top of the sewer.

B. Crossing Separation: Lay bottom of water main at least 18-inches above the top of the sewer. Where existing conditions prevent an 18-inch vertical separation, construct both the water main and sewer of ferrous materials and with joints that are equivalent to water main standards for a distance of 10 feet on each side of the point of crossing.

C. Crossing a Water Main Under a Sewer: When it is necessary for a water main to cross under a sewer, construct both the water main and the sewer of ferrous materials and with joints equivalent to water main standards for a distance of 10 feet on each side of the point of crossing. A section of water main pipe shall be centered at the point of crossing.

3.03 WATER SERVICE

A. Water service lines shall extend from the main distribution line to a meter box located at the right-of-way or to a point approximately 5 feet outside the building face, whichever is appropriate..

B. 3/4-inch water service lines may be direct tapped to ductile iron pipe. Water service taps larger than 3/4-inch shall be made using a service saddle.

C. Taps shall be located at 10 or 2 o'clock on the circumference of the pipe.

D. Service taps shall be staggered, alternating from one side of the water main to the other and at least 12 inches apart.

E. Taps on the same side of the main shall be a minimum of 24 inches apart.

F. Install meter boxes and water service components so top of meter will be within 6 inches of the surface.

G. Owner will provide and install water meter.

3.04 DUCTILE IRON PIPE

A. Install pipe in conformance with AWWA C600 and the following:

1. For laying pipe in a vertical or horizontal curve, each full length pipe may be deflected by the following offset distance unless the pipe manufacturer's recommended distances are less:

   a. Push-on joint
      1) 3 to 12-inch pipe: 14-inch offset
      2) 14 to 36-inch pipe: 8-inch offset
   b. Mechanical joint
      1) 3 to 6-inch pipe: 20-inch offset
      2) 8 to 12-inch pipe: 15-inch offset
      3) 14 to 20-inch pipe: 8-inch offset
      4) 24 to 36-inch pipe: 6-inch offset

2. For laying restrained joint pipe in a vertical or horizontal curve, except for horizontal directional drills (HDD), each full length pipe may be deflected by the following offset distance:

   a. 6 to 12-inch pipe: 11-inch offset
   b. 16 to 20-inch pipe: 7-inch offset

c. 24 to 30-inch pipe: 5-inch offset
d. 36-inch pipe: 4-inch offset
e. 42 to 48-inch pipe: 1 ¼ -inch offset

3. The Contractor shall verify the offset distances specified are acceptable with the pipe manufacturer prior to installation.

3.05 VALVES AND FITTINGS

A. Install buried valves on top of an 18-inch square, 3-inch thick, solid concrete pad (minimum dimensions). The concrete pad may be provided by a pre-cast manufacturer or cast-in-place in the field above grade. Concrete used for the pads shall be a minimum 3,000 psi mix. The pads may not be cast-in-place in the pipe trench. Connection to pipe shall be such that there shall be no stress at the joint caused by misalignment or inadequate support of pipe or valve.

B. Valve Box: Set a valve box over each buried valve. Support box so that no stress shall be transmitted to the valve or pipe line. Install box plumb and set top flush with finished grade. Operating nut shall be centered in box. Provide a 24-inch x 24-inch wide by 6-inch thick concrete pad at top of valve boxes outside paved areas. In paved areas, the top of the valve boxes shall be set in the finished paved surfaces matching the paved surface elevation.

C. Valve operation nut shall be within 30 inches of the top of box. Provide stem extension if necessary to bring operating nut to within 30 inches of the top of box.

D. Install fittings as recommended by the manufacturer. Fittings shall be blocked or otherwise restrained from movement.

E. Install valves, gates, and accessories indicated on the Drawings and in complete accordance with the manufacturer's recommendations.

F. Install air / vacuum valve inside a manhole.

3.06 MANHOLES

A. Provide 12 inches of No. 67 stone base to extend a minimum of 6 inches beyond the manhole base.

B. Set base plumb and level. Align manhole invert with pipe invert.

C. Secure pipe connectors to pipe in accordance with manufacturer's recommendation.

D. Clean bells and spigots of foreign material that may prevent sealing. Unroll the butyl sealant rope directly against base of spigot. Do not stretch. Follow manufacturer's instructions when using O-ring seals.

E. Set precast components so that steps align.

F. Plug lift holes using a non-shrink grout. Cover with a butyl sealant sheet on the outside and seal on the inside with an application of an epoxy gel 1/8-inch thick extending 2 inches beyond the opening.

G. Set manhole frames to grade with grade rings. Seal joints between cone, adjusting rings, and manhole frame with butyl sealant rope and sheet.

H. Encase manhole rings in a concrete collar 18-inches wide by 6-inches thick of 3,000 psi concrete beneath paved surfaces.

I. Finish the interior by filling fractures greater than 1/2 inch in length, width or depth with a sand cement mortar. Do not fill the joints between the precast components.

J. Clean the interior of the manhole of foreign matter.

3.07 METERS

A. Install meter boxes and water service components so top of meter will be within 6 inches of the surface.

B. The Owner will install water meter.

3.08 HYDRANT

A. Set hydrant in accordance with detail on Drawings.

3.09 PAINTING

A. Equipment shall receive the manufacturer's standard coating for the intended application. Coatings shall be suitable for the intended application.

B. Repaint damaged paint services.

C. Above ground piping and piping within vaults shall be painted in accordance with Section, Painting.

3.10 PIGGING

A. All new mains, unless otherwise noted in the Contract Documents, shall be pigged with a polyethylene “pig”, 5#/cubic foot density a the conclusion on installation.

B. Pigs shall be blown at the end of the main by either fire hydrant or blow-off assembly.

3.11 BACKFLOW PREVENTION TESTING

A. Install and test Backflow prevention devices in accordance with the requirements of the City.

3.12 PRESSURE TESTING

A. Pressure test in accordance with AWWA C600 for ductile iron pipe and AWWA C605 and M23 for PVC pipe and as specified herein

B. General:
   1. The Engineer shall approve the source, quality, and method of disposal of water to be used in test procedures.
   2. Obtain Owner's permission 48 hours prior to filling or flushing of pipe system with water from Owner's water system. Owner shall operate valves connected to the existing water system. Where large quantities of water may be required for flushing, Owner reserves the right to require that flushing be done at periods of low demand.
   3. Clean and flush pipe system of foreign matter prior to testing.
   4. Provide air vents at the high points in the line section to be tested for releasing of air during filling. Service corporation stops may be used for air vent when located at a high point. Leave corporation stops in place after testing and note locations on As-Built Drawings.
   5. Allow concrete blocking to reach design strength prior to pressure testing.
   6. Test main prior to installation of service taps.
   7. Repair defects in the pipe system. Make repairs to the same standard as specified for the pipe system.
   8. Retest repaired sections until acceptance.
   9. Repair visible leaks regardless of the test results.
   10. Pipe sections shall not be accepted and placed into service until specified test limits have been met.

C. Testing
   1. Notify Owner and Engineer a minimum of 48 hours prior to testing.

2. Perform tests in the presence of Engineer.
3. Make pressure tests between valves. Furnish suitable test plugs where line ends in "free flow."
4. Upon completing a section of pipe between valves, test pipe by maintaining for a two hour period a hydrostatic pressure of 150 psig.
5. Test pressure shall not vary by more than +/- 5 psi for the duration of the test.
6. No length of line shall be accepted if the leakage is greater than that determined by the following formula based on the appropriate test pressure:
   L = Allowable leakage per 1,000 feet of pipe in gallons per hour.
   D = Nominal diameter of the pipe in inches.
   100 psi: L = D x 0.07
   150 psi: L = D x 0.08
   200 psi: L = D x 0.09
   250 psi: L = D x 0.10

3.13 DISINFECTION

A. After satisfactory completion of the pressure test, disinfect new potable water mains and existing mains that have required repair in accordance with AWWA C651 and as specified herein. Disinfect water mains in a maximum length per day of 2,000 feet.

B. General:
   1. Provide a superintendent experienced in the required procedures for disinfecting with chlorine.
   2. Obtain Owner's permission 48 hours prior to filling, flushing, and chlorinating of the water mains. Owner shall operate valves connected to the existing water system.
   3. Do not allow highly chlorinated water into the existing distribution system.
   4. A reducing agent shall be applied to the water to neutralize the residual chlorine. Federal, state, or local environmental regulations may require special provisions or permits prior to disposal of highly chlorinated water.
   5. Perform disinfection and testing in presence of Engineer.

C. Connection to Existing System: Notify Owner 48 hours prior to making connections to the existing system. Thoroughly clean the existing water main exterior prior to the installation of tapping sleeves and corporation stops. Lightly dust with calcium hypochlorite powder the water main exterior and the interior surface of the tapping sleeve, and corporation stops.

D. After satisfactory flushing of the main, disinfect by the injection of a chlorine solution. Induce chlorine in sufficient quantity to maintain a chlorine residual of at least 50 ppm throughout the system to be tested. Maintain the chlorine solution in the system for at least 24 hours.

E. Valves and Fire Hydrants: Open and close valves on the mains being disinfected a minimum of three times during the chlorine contact period and a minimum of three times during flushing. Fire hydrants and other appurtenances should receive special attention to insure proper disinfection.

F. For Cut-In Construction: Use the following procedures for disinfecting of the new installation and the existing main at the cut-in point in accordance with AWWA C651, Section 9:

   1. Apply liberal quantities of hypochlorite, in the form of tablets, to the open trench.
   2. Interior of new pipe and fittings and the ends of the existing mains shall be swabbed or sprayed with a one percent hypochlorite solution before installation.
   3. Install a 2-inch tap downstream of the work area. Tap shall be used for blowing off the main, or use the next fire hydrant downstream of the work area for blowing off the main.
   4. Install a 2-inch tap just upstream of the new installation. Control Water from the existing system so as to flow slowly into the work area during the application of chlorine. After

the line is thoroughly flushed, add chlorine solution at a concentration of 100 ppm by the continuous feed method and hold in the main for one (1) hour.

G. Prior to flushing, the free chlorine residual shall be a minimum of 10 ppm. Flushing of the lines shall not proceed until the lines contain the normal chlorine residual of the system.
   1. Dechlorination: No discharge or heavily chlorinated water into a storm sewer or stream will be permitted unless the discharge is first treated by a neutralizing chemical applied to the water to be wasted to neutralize thoroughly the residual chlorine. A declorinating device is required. Disposal of chlorinated water shall meet the applicable sections of AWWA C651, and the NC NPDES General Permit NCG03000 or more current general permit if effective at the time of construction.

H. Test in the field for free chlorine residual:
   1. Sample location shall be the same as required for the bacteriological test samples.
   2. Immediately after injection of the chlorine solution. Sample shall have a chlorine residual as specified.
   3. Prior to flushing of the highly chlorinated water from the potable water system and a minimum of 24-hours after the initial injection of the chlorine. Sample shall have a minimum chlorine residual as specified.

3.14 BACTERIOLOGICAL TESTING

A. Coordinate sampling and testing with the Owner. Follow procedure as outlined in the Public Utilities Handbook and below.

B. Required location for obtaining water samples:
   1. Between Main Line valves
   2. End of each main.
   3. A minimum of one from each branch.
   4. Mains at cut-in locations: Each side of work area. Time between samples to be determined by Engineer in field.

C. Notify the City of Raleigh Public Utilities Department when the system is ready to sample. The Public Utilities Department will take water samples at each specified location for the bacteriological and turbidity testing.

D. Recommended additional samples. During the required sampling of water from the new system, it is recommended that samples be taken from the existing potable water source to determine if coliforms are present.

E. Care in sampling. No hose or fire hydrant shall be used for the collection of samples. Take samples from an approved sample tap consisting of a corporation stop installed in the main with a copper tube gooseneck assembly. Operation shall be such as to ensure that the sample collected is actually from water that has been in the new system. Copper tube gooseneck assembly shall be removed and sample tap corporation stop shut off upon completion of testing bacteriological testing is requirements.

F. Samples will be tested by the Owner for turbidity in accordance with the Public Utilities Handbook. If it passes then the bacteriological test will be performed by Public Utilities.

G. Test samples for the presence of coliform organisms in accordance with the latest edition of Standard Methods for the Examination of Water and Wastewater. Testing method used shall be the multiple-tube fermentation technique, the membrane-filter technique, or presence/absence.

H. Test for odor. The water in the new system should also be tested to assure that no offensive odor exists due to chlorine reactions or excess chlorine residual.

I. If samples show the presence of coliform, procedure 1 or 2 described below shall be followed, with the approval of the Owner, before placing the unit or facility in service.
   1. Take repeat samples at least 24 hours apart until consecutive samples do not show the presence of coliform.
   2. Again subject the system to chlorination and sampling as described in this section.

J. If samples are free of coliform, and with the approval of the Owner, the potable water system may be placed in service.

K. Contamination: If, in the opinion of the Engineer, possible contaminants have entered the existing water system, or water samples show the water in the existing system to be unsafe on completion of the work, the existing water system shall be disinfected as specified herein and shall include all contaminated components. Disinfection of the existing system shall be coordinated with the Owner.

3.14 VALVE OPERATION

A. Prior to final acceptance provide competent personnel to operate each valve in presence of Owner and Engineer. Verify that valves are left in the open position.

END OF SECTION

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SECTION 11500
RECLAIMED WATER DISTRIBUTION
(REVISED 10-1-14)

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Work under this section includes, but is not limited to, piping, valves, and appurtenances for a complete reuse water system.

1.02 RELATED SECTIONS

A. The following Sections have work that is directly related to this Section. This does not relieve the Contractor of his responsibility of proper coordination of all the work:
   1. Section 10000 Utility Trenching
   2. Section 13000 Tunneling, Boring, and Jacking

1.03 REFERENCES

A. Publications are referred to in the text by basic designation only.
   1. American Society for Testing and Materials (ASTM)

      a. A126 Gray iron Castings and Valves, Flanges and Pipe Fittings.
      b. C443 Flexible Watertight Joints for Precast Manhole Sections
      c. C478 Precast Reinforced Concrete Manhole Sections
      d. C890 Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures
      e. C923 Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
      f. C2794 Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
      g. D638 Tensile Properties of Plastics
      h. D714 Evaluating Degree of Blistering of Paints
      i. D1244 Test Method for Concrete Sewer Manholes by the Negative Air Pressure
      j. D1248 Polyethylene Plastics Molding and Extrusion Materials
      k. D1784 Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
      l. D2241 Poly(Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR Series)
      m. D2321 Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe
      n. D2412 Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
      o. D3034 Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
      p. D3139 Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
      q. D3262 “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe.
      r. D3350 Polyethylene Plastics Pipe and Fittings Materials
      s. D4060 Abrasion Resistance of Organic Coatings by the Taber Abraser
      t. E96 Water Vapor Transmission of Materials

u. F477 Elastomeric Seals (Gaskets) for Joining Plastic Pipe
v. F1417 Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air
w. G95 Cathodic Disbondment Test of Pipeline Coatings

2. American Water Works Association (AWWA)
   a. C104 Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
   b. C110 Ductile-Iron and Gray-Iron Fittings, 3 inch through 48 inch, for Water and Other Liquids
   c. C151 Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
   d. C153 Ductile-Iron Compact Fittings, 3 inch through 16 inch, for Water and Other Liquids
   e. C504 Rubber-Seated Butterfly Valves
   f. C508 Swing-Check Valves for Waterworks Service, 2 inch Through 24 inch NPS
   g. C512 Air-Release, Air / Vacuum, and Combination Air Valves for Waterworks Service
   h. C550 Protective Epoxy Interior Coatings for Valves and Hydrants
   i. C600 Standard for Installation of Ductile Iron Water Mains and Their Appurtenances
   j. C900 Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 inch through 12 inch, for Water Distribution
   k. C905 Polyvinyl Chloride (PVC) Water Transmission Pipe, 14 inch through 36 inch, for Water Distribution
   l. C909
   m. M23 PVC Pipe - Design Installation
3. National Sanitation Foundation (NSF) Standards
   a. 14 Plastic Piping Components and Related Materials
4. UNI-BELL Plastic Pipe Association (UNI)
   a. B-5 Recommended Practice for the Installation of Polyvinyl Chloride (PVC) Sewer Pipe
   b. B-6 Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe

1.04 SUBMITTALS

A. Submit the following in accordance with Section, Submittal Procedures:
   1. Affidavit of Compliance: Affidavit shall attest that supplied products conform to the referenced standard and this specification and that tests set forth in each applicable referenced publication have been performed and that test requirements have been met. Submit for each of the following materials:
      a. Pipe
         1) Ductile iron
         2) PVC Pressure Pipe
            i) C900
            ii) C905
      b. Pre-cast concrete manholes
      c. Valves
         1) Plug

2) Check
3) Air Release

d. Ground Hydrants

2. Catalog Data: Submit manufacturer's standard drawings or catalog cuts for the following. Clearly indicate equipment to be furnished for the Project including options to be provided.
   a. Pipe
      1) Ductile iron
      2) Ductile Iron with restrained joints
      3) PVC Pressure Pipe
         i) C900
         ii) C905
   b. Polyethylene Wrap
   c. Pre-cast Concrete Manholes and the following appurtenances:
      1) Manhole steps
      2) Pipe connectors
      3) Joint material
      4) Castings
   d. Service saddles
   e. Valves
      1) Resilient-seated gate
      2) Plug
      3) Check
      4) Air Release
   f. Ground Hydrants
3. Reports:
   a. Field test report for each section of pipe for the following:
      1) Pressure test for force mains.
4. Operation and Maintenance Instructions: Submit complete operation and maintenance manual for the following:
   a. Valves.
   b. Ground Hydrants

1.05 DELIVERY, STORAGE, AND HANDLING

A. Provide a suitable pipe hook or rope sling when handling the pipe with a crane. Lifting of the pipe shall be done in a vertical plane. Under no conditions shall the sling be allowed to pass through the pipe unless adequate measures are taken to prevent damage to both tongue and groove ends.
B. Deliver pipe in the field as near as practicable to the place where it is to be installed. In road right of way, distribute pipe daily along the side of the trench opposite to the spoil bank. Stringing pipe in road right of way except on a daily basis is not allowed. In easements, distribute pipe along the side of the trench opposite to the spoil bank. Create fifth sentence Stringing pipe in easements is allowed. Where necessary to move the pipe longitudinally along the trench, it shall be done in such a manner as not to injure the pipe or coating.
C. Shield PVC pipe and fittings stored on site from the sun's ultraviolet rays by suitable cover, or indoor storage.

PART 2 PRODUCTS

2.01 DUCTILE-IRON PIPE

A. Pipe and fittings shall conform to the following requirements:
   1. Size shall be as indicated on the Drawings.
   2. Minimum pipe pressure class shall be 350 for pipes 4-inch to 12-inch diameter, and pressure class 250 for pipes 16-inch and larger.
   3. Suitable for a system working pressure of 150 psi for pipes up to 16". For pipes larger than 24", pipe shall be suitable for system working pressure of 250 psi.
   4. Pipe shall be supplied in nominal lengths of 18 or 20 feet.
   5. Cement-mortar lined with seal coat in accordance with AWWA C104.

B. Ductile-iron pipe for below ground service shall have push-on or mechanical joints, unless noted otherwise on the Drawings, conform to AWWA C151, and to the following requirements:
   1. Suitable for a system working pressure of 150 psi at the depth indicated on the Drawings with a laying condition as indicated in Section 02315, Trenching for Utilities.
   2. Provide mechanical joint fittings, unless noted otherwise on the Drawings.
   3. Encase pipe in polyethylene conforming to AWWA C105.

C. Ductile-iron pipe for above ground service shall have flanged joints, unless noted otherwise on the Drawings, and conform to AWWA C115.
   1. Pipes to be painted shall have only a shop primer on the outside by the manufacturer. Verify that proposed manufacturer's primer is compatible with the proposed paint system.

D. Fittings for ductile-iron pipe shall conform to AWWA C110, or C153 and to the following requirements:
   1. Joint type shall be as specified above for the supplied ductile-iron pipe.
   2. Fittings shall be made of gray-iron or ductile-iron.

E. Ductile iron pipe on piers shall have TR Flex or Lok Tyte™ rigid restrained joint by U.S. Pipe, Lok-Fast or Lok-Ring as manufactured by American Pipe, Super-Lock as manufactured by Clow, Bolt-lok or Rigid-lok as manufactured by Griffin or approved equal.

F. Special Pipe Joints
   1. River Crossing (Ball Joint)
      a. Boltless
      b. Bolted
   2. Restrained
      a. Provide restrained joint pipe at fittings and valves where indicated on the Drawings. Length of restrained pipe shall be as shown. Restrained joints shall be Snap-Lok (Griffin Pipe), Flex Ring and Lok-Ring (American), TR Flex (U.S. Pipe) or approved equal.
      b. Restrained joint pipe and fittings shall meet all AWWA standards and other requirements as specified above for standard ductile iron pipe and fittings unless addressed herein.
      c. Field made joints are allowable but should be avoided where possible. Careful planning to locate field cuts in standard pipe sections is preferred.

For field made joints in restrained piping, use field weldments or an insert equal to TR Flex Gripper Rings or approved equal. Gasket type field made joints will not be allowed.

d. Restrained joint fittings shall be provided by the restrained joint pipe supplier for where located within restrained joint pipe sections. Fittings shall be of the same model as the pipe supplied from the pipe manufacturer.
e. Restrained joint fittings may be push-on joint type.
f. Megalugs, Series 1100, as manufactured by EBAA Iron Sales shall be allowable for restraint where fittings or valves are not available with restrained joints.
g. Where additional fittings/valves are required and not shown on Drawings, consult with Engineer for length of restrained joint pipe necessary each side of fittings/valve prior to installation of pipe/fitting.
h. Contractor shall develop a field layout schedule and drawing for restrained joint pipe installations.

2.02 POLYVINYL CHLORIDE (PVC) PRESSURE PIPE

A. General
1. Pipe and fitting size shall be as indicated on the Drawings.
2. PVC materials shall comply with ASTM D1784 with a cell classification of 12454-B.
3. Pipe used for potable water systems shall comply with NSF 61.
4. Pipe used for reclaimed water system shall be covered in polyethylene wrap, either sheet or tube type and conform to ANSI/AWWA C105/A21.5 Joint tape shall be self-sticking, PVC, or polyethylene, 10 mils thick; such as Chase “Chasekote 750”, Kendall “Polyken 900” or 3M “Scotchrap 50”.

B. AWWA C900: C900 PVC pipe 4-inch to 12-inch shall conform to AWWA C900 and the following requirements:
1. Outside diameter shall conform to ductile-iron pipe.
2. For pipes 12” and under shall be DR 18 (unless shown different on the Drawings) in accordance with ANSI/AWWA C900.
3. Pipe shall have plain end and elastomeric-gasket bell ends.
4. Fittings shall conform to AWWA C110 or C153 and have mechanical joints. Fittings shall be made of gray-iron or ductile-iron. Interior of fittings shall be cement-mortar lined with seal coat in accordance with AWWA C104.

C. AWWA C905: C905 PVC pipe 14-inch to 36-inch shall conform to AWWA C905 and the following requirements:
1. Outside diameter shall conform to ductile-iron pipe.
2. For pipes 14” and larger, wall thickness shall be DR 18 in accordance with ANSI/AWWA C905. Pipe shall have plain end and elastomeric-gasket bell ends.
3. Fittings shall conform to AWWA C110 or C153 and have mechanical joints. Fittings shall be made of gray-iron or ductile-iron. Interior of fittings shall be cement-mortar lined with seal coat in accordance with AWWA C104.

2.03 MANHOLES

A. Provide manholes made of precast concrete sections in conformance with ASTM C478, the City of Raleigh Public Utilities Handbook, NC Department of Transportation, and the following requirements:
   1. General
      a. Provide manholes to the depth as indicated on the Drawings. Manhole inside diameter shall be 4 feet unless noted otherwise on the Drawings.
      b. Precast concrete manholes shall be as manufactured by Adams Concrete, Carolina Precast Concrete, Inc., D & M Concrete Specialties, Inc., N. C. Products Corp., Stay Right Tank, Tindall Concrete Products, Inc. or approved substitute.
   2. Precast Concrete Sections
      a. Minimum wall thickness shall be 5-inches.
      b. Base: Cast monolithically without construction joints or with an approved PVC waterstop in the cold joint between the base slab and the walls. Minimum thickness of base shall be 6-inches.
      c. The width of the base extensions on Extended Base Manholes shall be no less than the base slab thickness. Extended bases shall comply with detail on Drawings.
      d. Riser: Minimum lay length of 16 inches.
      e. Eccentric Cone: Top inside diameter shall be 24 inches. Width of the top ledge shall be no less than the wall thickness required for the cone section.
      f. Precast or core holes for pipe connections. Diameter of hole shall not exceed outside diameter of pipe by more than 3-inches.
      g. Lifting Devices: Devices for handling precast components shall be provided by the precast manufacturer and comply with OSHA Standard 1926.704.
   3. Joints
      a. Manufacturer in accordance with tolerance requirements of ASTM C 990 for butyl type joints.
      b. Minimize number of joints. Do not use riser section for manholes up to 6 feet tall and no more than one riser for each additional 4 feet in height.
      c. Flexible Joint Sealants: Flexible Joint Sealants: Preformed butyl rubber based sealant material conforming to Federal Specification SS-S-210A, Type B and ASTM C990.
      d. External Seal: Polyethylene backed flat butyl rubber sheet no less than 1/16-inch thick and 8-inches wide.
   4. Inverts
      a. Brick and mortar or precast concrete invert constructed to the width of the effluent pipe.
      b. Form and finish invert channel to provide a consistent slope from inlet(s) to outlet up to 6-inches.
      c. Channel walls shall be formed to the springline of the outlet pipe diameter.
      d. Finish benches at 60 degrees to manhole walls. Provide a 1/4-inch radius at the edge of bench and trough.
   5. Flexible Pipe Connectors: Provide flexible connectors for pipe to manhole that conform to ASTM C923. Location of connectors shall vary from Project Drawings no more than 1/2-inch vertically and 5 degrees horizontally. Boot

sleeves shall have stainless steel expansion bands and pipe clamps that meet or exceed ASTM C923 and A167.

6. Manhole Steps:
   a. Steps shall be made of 1/2-inch grade 60 steel encapsulated by co-polymer polypropylene and have serrated tread and tall end lugs.
   b. Secure steps to the wall with compression fit in tapered holes or cast-in-place. Align steps along a vertical wall and shall not be located over a pipe opening. First step shall be a maximum of 26 inches from the bottom.
   c. Steps shall be provided inside manholes and shall be provided on the outside when the top of manhole elevation is greater than three (3) feet above the existing ground elevation.
   d. Steps shall be as shown on the Drawings.
   e. Steps shall be by American Step Co., Inc., Bowco Industries, Inc., M. A. Industries, Inc. or approved substitute.

2.04 CASTINGS

A. General
   1. Made of gray iron, ASTM A-48 - class 30.
   2. Castings shall be free from imperfections not true to pattern. Casting tolerances shall be plus or minus 1/16-inch per foot of dimension. Top shall set neatly in frame, with edges machined for even bearing and proper fit to prevent rattling and flush with the edge of frame.
   3. Castings shall be as manufactured by Neenah Foundry Co., U.S. Foundry & Manufacturing Corp., or Vulcan Foundry

B. Manhole Frame and Cover:
   1. Minimum clear opening shall be 22 inches.
   2. Minimum weight for frame and cover shall be 300 pounds and suitable for Heavy Duty Highway Traffic Loads of H-20.
   3. Frame shall have four 3/8-inch anchor bolt holes equally spaced.
   4. Cast “DANGER PERMIT REQUIRED – CONFINED SPACE DO NOT ENTER” on the cover. Casting shall bear the name of the manufacturer and the part number.
   5. Provide camlocks on all manholes located in reuse water easement.
   6. Provide cover with two 1-inch perforated holes unless noted as watertight on the Drawings.
   7. Provide the following where indicated on the Drawings:
      a. Ring and cover shall be watertight.
      b. Bolt down cover. Bolt down covers shall be provided with four (4) 3/8-inch stainless steel hex head bolts at 90 degrees.

2.05 TAPPING SLEEVE

A. Tapping Sleeve: Sleeves shall be flanged for the tapping valve and manufactured for a working pressure of 150 psi. Sleeve shall have a full body 360-degree gasket. Sleeve shall have a 3/4-inch test plug. Bolts and nuts shall be stainless steel. Tapping Sleeve shall be Mueller mechanical joint, Mueller Outlet Seal, American Uniseal, Kennedy Square Seal, or Clow F5205 or F5207. 100% stainless steel sleeves may be used, as manufactured by Rockwell, Romac, Ford, or JCM,

provided that all metallic parts of the sleeves shall be 100% stainless steel including bolts. Ductile iron flanges may be included on sleeves or saddles.

B. Tapping saddles may be used on mains 16-inches and larger. In 16 and 24 inch saddles as manufactured by Mueller, American, Kennedy and Clow tapping saddles shall be manufactured of ductile iron providing a factor of safety of 2.5 at a working pressure of 250 psi. In main sizes of 30-inch and larger, ductile iron tapping saddles as manufactured by American Pipe Company or U.S. Pipe Company shall be utilized. Saddles shall be equipped with a standard AWWA C-110-98 flange connection. Sealing gaskets shall be "O" ring type, high quality molded rubber having an approximate seventy durometer hardness, placed into a groove on the curved surface of the tapping saddle. Straps shall be of alloy steel. Saddles may be used for taps one-half the size of the main or less (i.e. 8-inch tapping saddle for use on a 16-inch main).

2.06 VALVES

A. General: Valves shall meet the following requirements:
   1. Size shall be as required for the pipe size and material as indicated on the Drawings and specified.
   2. Open by counterclockwise rotation.
   3. Standard system working pressure is 175 psi.
   4. Equip valves with a suitable means of operation.
   5. For buried valves over 5 feet deep, provide extension stems of cold rolled steel to bring the operating nut to within 2 feet of the ground surface.
   6. Provide valve accessories as required for proper valve operation for valve locations as indicated on the Drawings and as recommended by valve manufacturer.
   7. Valve accessories shall be compatible to proper valve operation.
   8. Similar valve types shall be of one manufacturer.

B. Gate Valves, Resilient-Seated: Gate valves 3-inch to 20-inch shall conform to AWWA C509 for and to the following requirements:
   1. O-ring stem seal on non-rising (NRS) stem valves.
   2. Ends shall be mechanical joint for underground locations and flanged joint for above ground locations.
   3. Valves shall be non-rising stem (NRS) with wrench nut for underground locations and Outside Screw and Yoke (OS&Y) with handwheel for above ground locations unless noted otherwise on the Drawings.
   4. Be of one manufacturer.
   5. Valves 16-inch and larger shall be equipped with cast iron gearing to facilitated opening. Gear cases shall be extended or totally enclosed type. Geared valves shall be equipped with indicators to show the position of the gate in relation to the water.
   6. Valves 16-inch and larger shall be equipped with a bypass.

C. Butterfly Valves: Butterfly valves 3-inch through 72-inch shall conform to AWWA C504 for potable water and to the following requirements:
   1. Valve body shall be ductile iron and mechanical joint for below ground locations and flanged short body in underground vaults and above ground locations. End mechanical joints shall conform to ANSI/AWWA C110/A21.10 and ANSI/AWWA

C111/A21.11. End flanges shall conform to ANSI B16.1, class 125 and ANSI/AWWA C110/21.10.
2. Valves shall be class 150B.
3. Rubber seats shall mate with stainless steel, bronze mating or resilient material surfaces.
4. Valve shafts shall consist of one-piece unit extending completely through the valve disc for valves under 12-inches. Above this size, shaft shall be one piece or the stub-shaft type. Shafts shall be type 304 stainless steel.
5. Valve discs shall be cast iron, ductile iron, or stainless steel.
6. Valve Actuator
   a. Manual Actuator: Manual actuator shall be of the traveling nut type. Valves for buried service shall have a standard AWWA nut. Valves for above ground shall have a handwheel, or chain wheel as indicated on the Drawings.
   b. Shall be as manufactured by Philadelphia Gear Works or EPI.
7. Valve shall be manufactured by Mueller, Kennedy, Pratt, or American.

2.07 AIR VALVES

A. Provide air valves in conformance with AWWA C512 and the following:
   1. Valve type shall be a Crispin Pressure Air Valve Model P 20 with a vacuum check unit, or two-inch Val-Matic Model VM-45 with vacuum check unit or equal as approved by the Public Utilities Director. Valve shall be located in City of Raleigh approved eccentric manhole. Engineer shall stake location of air release.

2.08 VALVE BOX

A. Valve Box, Below Ground: Boxes shall be class 35 cast iron of the screw or telescopic type. Box shall consist of a base section, center extension as required, and a top section with cover marked “REUSE”, “REUSE WATER” or “RECLAIMED WATER”.

2.09 SERVICE VALVES AND FITTINGS

A. Water service valves and fittings shall conform NSF 61 and AWWA C800 for normal pressure and the following requirements:
   1. Service saddle: Provide service saddle for service pipe connection to main pipe material. Saddles shall meet the following requirements:
      a. Bronze body to conform to the outside dimension of the main.
      b. O-ring, Buna N rubber gasket to provide watertight connection.
      c. Hinged, double bottom strap design.
      d. Threaded outlet to match threads on corporation valve.
   2. Corporation valve
      a. Stop size shall be the same as service line.
      b. Inlet thread shall be as per AWWA C800.
      c. Outlet thread shall be as required for the pipe material specified.
   3. Pressure reducing valve
      a. Shall meet ASSE 1003.

b. Bronze body, renewable stainless steel seat.
c. Suitable for reducing from an inlet pressure range of 100 – 150 psi to an outlet pressure of 40 psi.

4. Meter boxes
   a. Boxes and cover shall be cast iron, precast concrete, concrete block, high density polyethylene or cast in place concrete as shown on standard details.
   b. Minimum 18 inches deep.
   c. Sized for required water meter.
5. Meter setter
   a. Setter shall be made of copper.
   b. Shall be 5/8” and 12” in height.

2.10 GROUND HYDRANTS

A. Hose bibs for private reuse systems shall be non-freeze ground hydrants that are lockable or designed to be operated with the use of a special tool. Ground hydrants shall be Watts HY-500, Woodford Y95, Zurn Z-1360, or approved equal.

2.11 THRUST BLOCKING

A. Provide concrete thrust blocking for pressure lines in accordance with the detail on the Drawings.
B. Thrust blocking is not required where restrained joint fittings and equivalent length of restrained joint pipe are used unless shown otherwise on the Drawings.

2.12 TEMPORARY BLOW-OFF ASSEMBLY

A. Blow-offs shall conform to Plan details and shall be of the type shown. The valve shall meet the requirements for other gate valves and shall be suitable for the anticipated pressure. Blow-offs shall be furnished with concrete valve markers. All above grade pipe and appurtenances shall be painted purple, Pantone 522.

2.13 VALVE MARKERS

A. Valve markers shall be as shown on the plans and of concrete, reinforced as shown. Concrete shall be of a mix designed to produce a 3000 psi compressive strength at 28 days. They shall be marked with recessed letters, either MV, AV, or BO as appropriate and installed facing item to be located. Valve markers shall be painted purple, Pantone 522.

PART 3 EXECUTION

3.01 GENERAL

A. Pipe installation shall meet the following general guidelines:
   1. Lay pipe in the presence of the Owner’s designated resident project representative, unless specifically approved otherwise.
   2. Handle pipe and accessories in accordance with manufacturer’s recommendations. Take particular care not to damage pipe coatings.
   3. Carefully inspect pipe immediately prior to laying. Do not use defective pipe. Replace pipe damaged during construction.
   4. Lay pipe to grade and alignment indicated on the Drawings.
   5. Provide proper equipment for lowering pipe into trench.

6. Provide tight closure pipe ends when work is not in progress.
7. Keep pipe interior free of foreign materials.
8. Do not lay pipe in water or when the trench or weather conditions are unsuitable for the work.
9. Clean bell and spigots before joining. Make joints and lubricate gasket in accordance with pipe manufacturer recommendation.
10. Block fittings with concrete, or restrained as indicated on the Drawings or as required to prevent movement.
11. Reuse water lines installed within casing by bore and jack shall be done in accordance with Section 02445, Bore and Jack of Conduits.

3.02 SEPARATION OF WATER MAINS, WATER RECLAMATION MAINS, AND SEWERS:

No water reclamation main line shall pass within fifty (50) feet of a drinking water supply well, source or structure unless special construction and pipe materials are used to obtain adequate protection. Under any circumstances, all reclaimed water piping with 100' of a well must be ductile iron.

A. Parallel Installation

1. Normal Conditions

Water mains shall be at least 10 feet horizontally from any water reclamation main, sanitary sewer, or sewer manhole; the distance shall be measured on edge.

2. Unusual Conditions

When local conditions prevent a horizontal separation of 10 feet, a water main may be closer to a water reclamation main, manhole or sanitary sewer provided that:

a. The bottom (invert) of the water main is at least 18 inches above the top (crown) of the water reclamation main or sewer.

B. Crossing

1. Normal Conditions

Water lines crossing water reclamation mains or sewers shall be laid to provide a separation of at least 18 inches between the bottom of the water line and the top of the water reclamation mains or sewer.

2. Unusual Conditions

a. When local conditions prevent a vertical separation as described above, the following construction shall be used:

b. Water reclamation mains or sanitary sewers passing over or under water mains with less than 18 inches of vertical separation should be constructed of AWWA approved ductile iron water pipe and pressure tested in place to water main standards without leakage prior to backfilling.

c. Water mains passing under water reclamation mains or sanitary sewers shall, in addition, be protected by providing:

(1) Adequate structural support for the water reclamation main or sewer to prevent excessive deflection of joints and settling on and breaking of the water line.

(2) The length of water pipe will be centered at the point of crossing so that the joints will be equidistant and as far as possible from the water reclamation main or sewer.

d. Reclaimed water mains shall maintain a vertical separation of at least 18 inches between the bottom of the water reclamation main and the top of the sewer pipe or 2' of horizontal separation between pipes.

C. Under no condition shall water pipes pass through or come in contact with any part of a sewer manhole

3.03 SERVICE

A. Reuse service lines shall extend from the main distribution line [to a meter box located at the right-of-way] or [to a point approximately 5 feet outside the building face].
B. 3/4-inch water service lines may be direct tapped to ductile iron pipe. Water service taps larger than 3/4-inch shall be made using a service saddle.
C. Taps shall be located at 10 or 2 o'clock on the circumference of the pipe.
D. Service taps shall be staggered, alternating from one side of the water main to the other and at least 12 inches apart.
E. Taps on the same side of the main shall be a minimum of 24 inches apart.
F. Install meter boxes and water service components so top of meter will be within 6 inches of the surface.
G. Owner will provide and install water meter.

3.04 DUCTILE IRON PIPE

A. Install pipe in conformance with AWWA C600 and the following:
1. For laying pipe in a vertical or horizontal curve, each full length pipe may be deflected by the following offset distance:
a. Push-on joint
1) 3 to 12-inch pipe: 14-inch offset
2) 14 to 36-inch pipe: 8-inch offset
b. Mechanical joint
1) 3 to 6-inch pipe: 20-inch offset
2) 8 to 12-inch pipe: 15-inch offset
3) 14 to 20-inch pipe: 8-inch offset
4) 24 to 36-inch pipe: 6-inch offset
2. For laying restrained joint pipe in a vertical or horizontal curve, except for horizontal directional drills (HDD), each full length pipe may be deflected by the following offset distance:
a. 6 to 12-inch pipe: 11-inch offset
b. 16 to 20-inch pipe: 7-inch offset
c. 24 to 30-inch pipe: 5-inch offset
d. 36-inch pipe: 4-inch offset
e. 42 to 48-inch pipe: 1 ¼ -inch offset

3.05 PVC PRESSURE PIPE

A. Install PVC C900/C905 pipe in conformance with AWWA C605.
B. Solvent Weld: Where indicated in these specifications or on the plans, solvent weld type joints shall be used. Field cut ends shall be sanded to roughing the surface. Joints shall be cleaned of foreign material. Solvent shall be applied to the joint and joint made as recommended by the manufacturer. Excess solvent shall be wiped off. The joint should not be moved until sufficiently set up.
C. Bell and Spigot Joints: Clean bell and spigot ends prior to jointing. Ends of field cut pipe shall be beveled with file. Gasket shall be clean and lightly lubricated. Joint shall be made as recommended by the manufacturer.

3.06 VALVES AND FITTINGS

A. Install buried valves on top of an 18-inch square, 3-inch thick, solid concrete pad (minimum dimensions). The concrete pad may be provided by a pre-cast manufacturer or cast-in-place in the field above grade. Concrete used for the pads shall be a minimum 3,000 psi mix. The pads may not be cast-in-place in the pipe trench. Connection to pipe shall be such that there shall be no stress at the joint caused by misalignment or inadequate support of pipe or valve.
B. Install fittings as recommended by the manufacturer. Fittings shall be blocked or otherwise restrained from movement.
C. Valve Boxes: Set valve boxes flush with finished grade. Box shall be supported so that no stress shall be transmitted to the valve. Operating nut shall be centered in box.
D. Install valves, gates, and accessories indicated on the Drawings and in complete accordance with the manufacturer’s recommendations.
E. Valve boxes shall be set straight with the operating nut centered and supported on (2) 4” concrete blocks, to prevent load transfer onto valve body or pipe line. Set top of box at finished grade. Provide a 24-inch x 24-inch wide by 6-inch thick concrete pad at top of valve boxes outside paved areas.

3.07 AIR VALVES

A. Main shall be drilled for a two inch connection.
B. Valve shall be installed on the main line with a service saddle.
C. Install air valve in a flat top manhole.

3.08 MANHOLES

A. Set base plumb and level. Align manhole invert with pipe invert.
B. Secure pipe connectors to pipe in accordance with manufacturer’s recommendation.
C. Clean bells and spigots of foreign material that may prevent sealing. Unroll the butyl sealant rope directly against base of spigot. Do not stretch. Follow manufacturer’s instructions when using O-ring seals.
D. Set precast components so that steps align.

E. Plug lift holes using a non-shrink grout. Cover with a butyl sealant sheet on the outside and seal on the inside with an application of an epoxy gel 1/8-inch thick extending 2 inches beyond the opening.
F. Set manhole frames to grade with grade rings. Seal joints between cone, adjusting rings, and manhole frame with butyl sealant rope and sheet.
G. Apply external seal to the outside of joint.
H. Finish the interior by filling fractures greater than 1/2-inch in length, width or depth with a sand cement mortar.
I. Clean the interior of the manhole of foreign matter.

3.09 PAINTING

A. Equipment shall receive the manufacturer's standard coating for the intended application. Coatings shall be suitable for the intended application.
B. Repaint damaged paint services.
C. Above ground piping and piping within vaults shall be painted in accordance with Section 09900, Painting.

3.10 TESTING

A. General
1. Clean and flush pipe system of foreign matter prior to testing.
2. Notify Owner and Engineer a minimum of 48 hours prior to testing.
3. Perform tests in the presence of Engineer.
4. Length of line to be tested at one time shall be subject to approval of Engineer.
5. Pipe sections shall not be accepted and placed into service until specified test limits have been met.
6. Repair defects in the pipe system. Make repairs to the same standard as specified for the pipe system.
7. Retest repaired sections until acceptance.
8. Repair visible leaks regardless of the test results.

B. Pressure Mains
1. The Engineer shall approve the source, quality, and method of disposal of water to be used in test procedures.
2. Obtain Owner’s permission 48 hours prior to filling or flushing of pipe system with water from Owner’s water system. Owner shall operate valves connected to the existing water system. Keep pipe interior clean during construction to minimize the amount of water required for flushing. Where large quantities of water may be required for flushing, Engineer reserves the right to require that flushing be done at periods of low demand.
3. Pressure test in accordance with AWWA C600 for ductile iron pipe and AWWA C605 and M23 for PVC pipe and the following.
4. Make pressure tests between valves. Furnish suitable test plugs where line ends in “free flow.”
5. Provide air vents at the high points in the line section to be tested for releasing of air during filling. Service corporation stops may be used for air vent when

located at a high point. Leave corporation stops in place after testing and note locations on As-Built Drawings.

6. Allow concrete blocking to reach design strength prior to pressure testing.
7. Reuse main shall be completely filled with water, all air expelled from the pipe, and the discharge end of the pipeline shall be plugged and adequately blocked before hydrostatic test begins.
8. Upon completing a section of pipe between valves, test pipe by maintaining for a two hour period the following hydrostatic pressure for each main:
   a. Reuse main: 150 psig
9. Test pressure shall not vary by more than +/- 5 psi for the duration of the test.

END OF SECTION

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SECTION 12000
SANITARY SEWER SYSTEM
(REVISED 10-1-14)

PART 1 GENERAL

SECTION INCLUDES

A. Except as otherwise stipulated in this section, all work shall conform to Division 15 of the NCDOT Standard Specifications for Roads and Structures, latest edition.
B. Work under this section includes, but is not limited to, piping, manholes, diversion structures, valves, and appurtenances for a complete sanitary sewer collection system.

RELATED SECTIONS

C. The following Sections have work that is directly related to this Section. This does not relieve the Contractor of his responsibility of proper coordination of all the work:
   1. Section 10000 Utility Trenches
   2. Section 13000 Tunneling, Boring, and Jacking

REFERENCES

D. Publications are referred to in the text by basic designation only.
   1. American Society for Testing and Materials (ASTM)

      a. A126 Gray Iron Castings and Valves, Flanges and Pipe Fittings.
      b. B117 Operating Salt Spray (Fog) Apparatus
      c. C33 Concrete Aggregates
      d. C76 Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
      e. C150 Portland Cement
      f. C361 Reinforced Concrete Low-Head Pressure Pipe.
      g. C443 Flexible Watertight Joints for Precast Manhole Sections
      h. C478 Precast Reinforced Concrete Manhole Sections
      i. C497 Standard Methods Testing Concrete Pipe, Manhole Sections or Tile
      j. C618 Coal Fly Ash and Raw or Calcined natural Possolan for Use as a Mineral Admixture in Portland Cement Concrete
      k. C655 Reinforced Concret D-Load Culvert, Storm Drain and Sewer Pipe
      l. C822 Definition of Terms Related to Concrete Pipe and Related Products
      m. C890 Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures
      n. C923 Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
      o. C1103 Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
      p. C1131 Least Cost (Life Cycle) Analysis of Concrete Culvert, Storm Sewer, and Sanitary Sewer Systems
      q. C1619 Elastomeric Seals for Joining Concrete Structures
      r. C2794 Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
      s. D638 Tensile Properties of Plastics
      t. D714 Evaluating Degree of Blistering of Paints
      u. D1244 Test Method for Concrete Sewer Manholes by the Negative Air Pressure

v. D1248 Polyethylene Plastics Molding and Extrusion Materials
w. D1784 Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
x. D2241 Poly(Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR Series)
y. D2310 Machine Made Fiberglass (Glass Fiber Reinforced Thermosetting Resin) Pipe
z. D 2321 Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe
aa. D2412 Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
bb. D2924 Standard Test Method for External Pressure Resistance of Fiberglass (Glass Fiber Reinforced Thermosetting Resin) Pipe
cc. D2996 Filament Wound Fiberglass (Glass Fiber Reinforced Thermosetting Resin) Pipe
dd. D2997 Centrifugally Cast Fiberglass (Glass Fiber Reinforced Thermosetting Resin) Pipe
ee. D3034 Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ff. D3139 Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
gg. D3262 “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe.
hh. D3350 Polyethylene Plastics Pipe and Fittings Materials
ii. D3567 Determining Dimensions of Fiberglass (Glass Reinforced Thermosetting Resin) Pipe and Fittings
jj. D3681 Chemical Resistance of “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe in a Deflected Condition
kk. D3839 Underground Installation of “Fiberglass” (Glass Fiber Reinforced Thermosetting Resin) Pipe
ll. D4060 Abrasion Resistance of Organic Coatings by the Taber Abraser
mm. D4161 “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals
nn. D4541 Pull-Off Strength of Coatings Using Portable Adhesion Testers
oo. D4258 Surface Cleaning Concrete for Coating
pp. D4259 Abrading Concrete
qq. E96 Water Vapor Transmission of Materials
rr. F477 Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ss. F1417 Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air
tt. G95 Cathodic Disbondment Test of Pipeline Coatings

2. American Water Works Association (AWWA)
   a. C104 Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
   b. C110 Ductile-Iron and Gray-Iron Fittings, 3 inch through 48 inch, for Water and Other Liquids
   c. C151 Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
   d. C153 Ductile-Iron Compact Fittings, 3 inch through 16 inch, for Water and Other Liquids
   e. C504 Rubber-Seated Butterfly Valves
   f. C508 Swing-Check Valves for Waterworks Service, 2 inch Through 24 inch NPS
   g. C512 Air-Release, Air / Vacuum, and Combination Air Valves for Waterworks Service
   h. C550 Protective Epoxy Interior Coatings for Valves and Hydrants

i. C600 Standard for Installation of Ductile Iron Water Mains and Their Appurtenances
j. C900 Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 inch through 12 inch, for Water Distribution
k. C905 Polyvinyl Chloride (PVC) Water Transmission Pipe, 14 inch through 36 inch, for Water Distribution
l. C950 Standard for Fiberglass Pipe
m. M23 PVC Pipe - Design Installation
n. M41 Ductile Iron Pipe and Fittings
o. M45 Fiberglass Pipe Design

3. National Sanitation Foundation (NSF) Standards
   a. 14 Plastic Piping Components and Related Materials

4. UNI-BELL Plastic Pipe Association (UNI)
   a. B-5 Recommended Practice for the Installation of Polyvinyl Chloride (PVC) Sewer Pipe
   b. B-6 Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe

5. Ductile Iron Pipe Research Association (DIPRA)
   a. 8-08/5M Design of Ductile Iron Pipe

6. Reinforced Concrete Pipe
   a. American Concrete Pipe Association (ACPA) Design Data 9 Standard Installations and Bedding Factors for the Indirect Design Method.

SUBMITTALS

E. Submit the following in accordance with Section, Submittal Procedures:
   1. Affidavit of Compliance: Affidavit shall attest that supplied products conform to the referenced standard and this specification and that tests set forth in each applicable referenced publication have been performed and that test requirements have been met. Submit for each of the following materials:

      a. Pipe
         1) Ductile iron
         2) PVC Pressure Pipe
            i) C900
            ii) C905
         3) Polyvinyl Chloride (PVC) gravity sewer pipe
            i) SDR 35
            ii) Schedule 40, drain, waste, and vent (DWV) pipe
         4) Centrifugally Cast Fiberglass Reinforced Polymer Mortar (CCFRPM) Pipe
         5) Filament Wound Fiberglass Reinforced Polymer Mortar Pipe
         6) Reinforced Concrete HDPE Lined Pipe

      b. Pre-cast concrete manholes
         1) For T-base manholes the precast manufacturer shall provide detailed design calculations for each configuration, which shall include calculations for wall stresses, flotation, depth, reinforcement, and all other criteria necessary for a complete design.

c. Valves
   1) Plug
   2) Check
   3) Air Release
   4) Resilient-seated gate

d. Protecto 401 Ductile Iron Pipe Liner

2. Catalog Data and Calculations: Submit manufacturer's standard drawings or catalog cuts and calculations for pipe pressure/thickness class, concrete reinforcement and stiffness class for the appropriate type pipe based on the Drawings and Specifications for the following. Clearly indicate material to be furnished for the Project including options to be provided and indicate if a greater pipe pressure/thickness class, concrete reinforcment or pipe stiffness class will be necessary based on the manufacturer's calculations.

   a. Pipe
      1) Ductile iron
      2) Ductile Iron with restrained joints
      3) PVC Pressure Pipe
         i) C900
         ii) C905

      4) Polyvinyl Chloride (PVC) gravity sewer pipe
         i) SDR 35
         ii) Schedule 40, drain, waste, and vent (DWV) pipe
         iii) Composite (Truss)
         iv) Ribbed

      5) Centrifugally Cast Fiberglass Reinforced Polymer Mortar (CCFRPM) Pipe
      6) Filament Wound Fiberglass Reinforced Polymer Mortar Pipe
      7) Reinforced Concrete HDPE Lined Pipe

   b. Pre-cast Concrete Manholes and the following appurtenances:
      1) Manhole steps
      2) Pipe connectors
      3) Joint material
      4) Castings
      5) Interior Coating System

   c. Service saddles

   d. Valves
      1) Resilient-seated gate
      2) Plug
      3) Check
      4) Air Release

   e. Protecto 401 Ductile Iron Pipe Liner

3. Reports:

    a. Field test report for each section of pipe for the following:
        1) Pressure test for force mains.
        2) Low-pressure air test for gravity mains.
        3) Vacuum test for manholes.
        4) Deflection test for gravity mains.

4. Operation and Maintenance Instructions: Submit complete operation and maintenance manual for the following:

    a. Valves.

DELIVERY, STORAGE, AND HANDLING

F. Provide a rope sling when handling the pipe. Lifting of the pipe shall be done in a vertical plane. Under no conditions shall the sling be allowed to pass through the pipe unless adequate measures are taken to prevent damage to both tongue and groove ends.
G. Deliver pipe in the field as near as practicable to the place where it is to be installed. Distribute pipe along the side of the trench opposite to the spoil bank. Where necessary to move the pipe longitudinally along the trench, it shall be done in such a manner as not to injure the pipe or coating.
H. Shield PVC pipe and fittings stored on site from the sun's ultraviolet rays by suitable cover, or indoor storage.

PART 2 PRODUCTS

DUCTILE-IRON PIPE

A. Pipe and fittings shall conform to the following requirements:
    1. Size shall be as indicated on the Drawings.
    2. Minimum pipe pressure class shall be 350 for pipes 6-inch to 12-inch diameter, and a minimum pressure class 250 for pipes 16-inch and larger.
    3. Suitable for a system working pressure of 250 psi minimum for gravity sewer, 150 psi for force mains.
    4. Pipe shall be supplied in nominal lengths of 18 or 20 feet.
    5. Cement-mortar lined with seal coat in accordance with AWWA C104 for pipes smaller than 12-inches.
    6. Interior of pipes and fittings for pipes 12-inches and larger shall be lined with PROTECTO 401 ceramic epoxy as described in paragraph in this section.
    7. Pipe pressure/thickness class shall be suitable for the type laying condition as provided in Section 02315, Trenching for Utilities, and at the depth indicated on the Drawings. The proper pressure/thickness class shall be at a minimum as shown on the Contract Drawings. Pipe manufacturer to verify pipe selection, and document to Engineer, prior to ordering and manufacture of pipe.

        Note: The pipe pressure classes shown on the Contract Drawings were determined with the use of the pipe liner as specified above. If this specified pipe liner is modified or changed for any reason, then the Engineer and Pipe Manufacturer, prior to the Contractor ordering the pipe, shall reevaluate the pressure class.

8. Provide mechanical joint fittings, unless noted otherwise on the Drawings.
9. Pipe class shall not transition between manholes and shall be the highest pressure/thickness class required for that reach with exception to sections between manholes including jacking pipe as indicated on the Drawings.
10. Ductile Iron may be used for gravity sewers and force mains.

B. Ductile-iron pipe for below ground service shall have push-on or mechanical joints, unless noted otherwise on the Drawings, conforming to AWWA C150 and C151, and to the following requirements:

1. Provide mechanical joint fittings for push-on or mechanical joint pipe, unless noted otherwise on the Drawings.

C. Ductile-iron pipe for above ground service shall have flanged joints, unless noted otherwise on the Drawings, and conform to AWWA C115.

1. Pipes to be painted shall have only a shop primer on the outside by the manufacturer. Verify that proposed manufacturer's primer is compatible with the proposed paint system.

D. Fittings for ductile-iron pipe shall conform to AWWA C110, or C153 and to the following requirements:

1. Joint type shall be as specified above for the supplied ductile-iron pipe.
2. Fittings shall be made of ductile-iron.
3.

E. Ductile iron pipe on piers shall have Mech-Lok™ rigid restrained joint by Griffin Pipe Products Co. or approved equal.

F. Special Pipe Joints

1. River Crossing (Ball Joint)
   a. Boltless
   b. Bolted

2. Restrained
   a. Provide restrained joint pipe at fittings and valves where indicated on the Drawings. Length of restrained pipe shall be as shown. Restrained joints shall be Snap-Lok (Griffin Pipe), Flex Ring and Lok-Ring (American), TR Flex (U.S. Pipe) or approved equal.
   b. Restrained joint pipe and fittings shall meet all AWWA standards and other requirements as specified above for standard ductile iron pipe and fittings unless addressed herein.
   c. Field made joints are allowable but should be avoided where possible. Careful planning to locate field cuts in standard pipe sections is preferred. For field made joints in restrained piping, use field weldments or an insert equal to TR Flex Gripper Rings or approved equal. Gasket type field made joints will not be allowed.

d. Restrained joint fittings shall be provided by the restrained joint pipe manufacturer where located within restrained joint pipe sections. Fittings shall be of the same model and type as the pipe supplied from the pipe manufacturer.
e. Restrained joint fittings may be push-on joint type.
f. Megalugs, Series 1100, as manufactured by EBAA Iron Sales or approved equal shall be allowable for restraint where fittings or valves are not available with restrained joints.
g. Where additional fittings/valves are required and not shown on Drawings, consult with Engineer for length of restrained joint pipe necessary each side of fittings/valve prior to installation of pipe/fitting.
h. Tees for hydrants do not have to be restrained along the main line except where they are within required restrained length of nearby fittings or valves.
i. Contractor shall develop a field layout schedule and drawing(s) for restrained joint pipe installations that are to be submitted for approval as outlined in Section 01330, Submittal Procedures.

PROTECTO 401 DUCTILE IRON PIPE LINER

G. General

1. The interior wall of ductile iron sewer pipe 12” and larger in diameter shall be protected by the Protecto 401 Ceramic Epoxy liner.
2. The lining shall meet the manufacturer’s recommendations and the following requirements as a minimum.
3. The liner manufacturer shall have a minimum of ten (10) years of successful experience and be able to demonstrate successful performance on comparable projects.

H. Lining Material

1. The material shall be an amine cured novalac epoxy containing at least 20% by volume of ceramic quartz pigment.
2. Permeability rating of 0.00 when tested according to Method A of ASTM E-96-66, Procedure A with a test duration of 30 days.
3. The following tests must be run on coupons from factory lined ductile iron pipe:
   a. ASTM B-117 Salt Spray (scribed panel) – Results to equal 0.0 undercutting after two years.
   b. ASTM G-95 Cathodic Disbondment 1.5 volts @ 77°F. Results to equal no more than 0.5mm undercutting after 30 days.
   c. Immersion testing rated on using ASTM D-714-87.
      1) 20% Sulfuric Acid – No effect after two years.
      2) 140°F 25% Sodium Hydroxide – No affect after two years.
      3) 160°F Distilled Water – No effect after two years.
      4) 120°F Tap Water (scribed panel) – 0.0 undercutting after two years with no effect.
   d. An abrasion resistance of no more than 3 mils (0.075mm) loss after one million cycles using European Standard EN 598: 1994 section 7.8 Abrasion resistance.

POLYVINYL CHLORIDE (PVC) PRESSURE PIPE

I. General

1. Pipe and fitting size shall be as indicated on the Drawings.
2. PVC materials shall comply with ASTM D1784 with a cell classification of 12454-B.
3. Pipe used for potable water systems shall comply with NSF 61.
4. PVC pipe is allowable only for gravity sewers.

J. AWWA C900: C900 PVC pipe 4-inch to 12-inch shall conform to AWWA C900 and the following requirements:

1. Outside diameter shall conform to ductile-iron pipe.
2. Pipe shall be pressure class **160** with a standard dimension ratio of DR **18**.
3. Pipe shall have plain end and elastomeric-gasket bell ends.
4. Fittings shall conform to AWWA C110 or C153 and have mechanical joints. Fittings shall be made of gray-iron or ductile-iron. Interior of fittings shall be cement-mortar lined with seal coat in accordance with AWWA C104.

K. AWWA C905: C905 PVC pipe 14-inch to 48-inch shall conform to AWWA C905 and the following requirements:

1. Outside diameter shall conform to ductile-iron pipe.
2. Pipe shall have a pressure rating of **160** with a standard dimension ratio of DR **18**.
3. Pipe shall have plain end and elastomeric-gasket bell ends.
4. Fittings shall conform to AWWA C110 or C153 and have mechanical joints. Fittings shall be made of gray-iron or ductile-iron. Interior of fittings shall be cement-mortar lined with seal coat in accordance with AWWA C104.

L. Schedule 40 & 80: Schedule 40 & 80 PVC pipe ½-inch to 12-inch shall conform to ASTM D1785 and the following requirements:

1. Outside diameter shall conform to iron pipe.
2. Pipe shall be schedule 40 or 80.
3. Pipe shall have an integral elastomeric-gasket bell end or solvent weld joints.
4. Fittings for the pipe shall conform to ASTM D2466 or D2467 as appropriate for the pipe schedule.

CENTRIFUGALLY CAST FIBERGLASS REINFORCED POLYMER MORTAR (CCFRPM) PIPE

M. Pipe and fittings shall conform to the following requirements:

1. Size stiffness class (SN) shall be as indicated on the Drawings.
2. Pipe shall be supplied in 20-foot nominal lengths.
3. Each length of pipe, fittings, couplings, specials to be used shall be plainly and permanently marked with the following: pipe class or strength designation, manufacturer's name or trademark, date of manufacture, and the nominal pipe size.
4. CCFRPM Pipe is allowable only for gravity sewers.

N. Centrifugally Cast Fiberglass Reinforced Polymer Mortar Pipe shall conform to ASTM D3262, for CCFRPM pipe manufactured of “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) materials, and to the following requirements:

1. CCFRPM pipe shall be as manufactured by HOBAS Pipe.
2. The pipe shall be manufactured in accordance with ASTM D3262 with a minimum nominal pipe stiffness of (SN) as shown on the Drawings. The pipe shall meet the following cell limits: Type 1, Liner 2, Grade 3, as described by Section 4.2 and Table 1 of ASTM D3262. The stiffness is to be measured in accordance with ASTM D2412. The corrosion liner shall not be considered as contributing to the structural strength of the pipe.
3. The pipe shall be manufactured by the centrifugal casting process resulting in a dense, nonporous, corrosion-resistant, consistent, composite structure to meet the operating conditions as shown on the Drawings.
4. Pipe shall conform to ASTM D2412 for minimum stiffness and external loading characteristics.
5. Couplings, fittings and push-on joints shall be manufactured with flexible, elastomeric seals conforming to the requirements of ASTM D4161 and ASTM F477 and shall meet or exceed the pipe class at the location of its installation.
6. Pipe joint shall be push-on type couplings unless specified otherwise.
7. Pipe shall meet the minimum requirements of ASTM D3681 and ASTM D3262. Manufacturer shall provide complete 10,000-hour test results on pipe produced at the proposed location of manufacture. Results shall reflect that the pipe has a minimum allowable strain of no less than 0.9% at fifty years when tested in accordance with ASTM D3681 and D3262.
8. Normal production pipe for this project shall not incorporate raw materials that are not in compliance with ASTM D3681 and ASTM 3262.
9. Interior of pipe shall be manufactured using a nonstructural resin with a minimum allowable elongation of 50% when measured in accordance with ASTM D638. The liner nominal thickness shall be 40-mils.
10. Exterior pipe surfaces shall be comprised of a layer of sand and resin to provide UV protection to the exterior.

4.02 POLYVINYL CHLORIDE (PVC) GRAVITY SEWER PIPE

A. General

1. Shall only be used for 15-inch diameter and smaller gravity sewers.
2. Pipe and fitting size shall be as indicated on the Drawings.
3. PVC materials shall comply with ASTM D1784 with a cell classification of 12454-B.
4. Pipe shall have an integral elastomeric-gasket bell end. Gaskets shall be in conformance with ASTM F477.
5. See Section, Trenching for Utilities, for trench bedding and haunching requirements.

B. SDR 35: PVC SDR 35 gravity sewer pipe 4-inch to 15-inch and related fittings shall conform to ASTM D-3034 and the following requirements:

1. Pipe shall have standard dimension ratio of SDR 35.
2. Nominal pipe length shall be a minimum of 13 feet.

4.07 FILAMENT-WOUND FIBERGLASS REINFORCED POLYMER MORTAR PIPE

A. Pipe and fittings shall conform to the following requirements:

1. Size and stiffness class (SN) shall be as indicated on the Drawings.
2. Pipe shall be supplied in 20-foot or 40-foot nominal lengths.
3. Each length of pipe, fittings, couplings, specials to be used shall be plainly and permanently marked with the following: pipe class or strength designation, manufacturer's name or trademark, date of manufacture, and the nominal pipe size.
4. Filament-Wound Fiberglass reinforced Polymer Mortar Pipe is allowable only for gravity sewers.
5. Wall Thickness: The average wall thickness of the pipe shall not be less than the nominal wall thickness published in the manufacturer's literature, and the minimum wall thickness at any point shall not be less than 87.5% of the nominal wall thickness.
6. End Squareness: All points around each end of a pipe unit shall fall within +/-1/4 inch or +/-0.5% of the nominal diameter of the pipe, whichever is greater, to a plane perpendicular to the longitudinal axis of the pipe.
7. Stiffness: Each pipe shall have sufficient strength to exhibit the minimum pipe stiffness at 5% deflection as required by the Engineer. Stiffness shall be tested in accordance with the test method of ASTM D2412. A minimum of one pipe shall be tested every 100 lengths of each type, grade, and size pipe produced.

B. Filament-Wound Fiberglass Reinforced Polymer Mortar Pipe shall conform to ASTM D3262, for fiberglass reinforced polymer mortar pipe manufactured of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) materials, and to the following requirements:

1. The pipe shall be as manufactured by Flowtite Pipe and supplied by U.S. Composite Pipe South (USCPS), Inc.
2. The pipe shall be manufactured in accordance with ASTM D3262 with a minimum nominal pipe stiffness of (SN) as shown on the Drawings. The pipe shall meet the following cell limits: Type 1, Liner 2, Grade 3, as described by Section 4.2 and Table 1 of ASTM D3262. The stiffness is to be measured in accordance with ASTM D2412. The corrosion liner shall not be considered as contributing to the structural strength of the pipe.
3. The pipe shall be manufactured by the continuous advancing mandrel (filament wound) process resulting in a dense, nonporous, corrosion-resistant, consistent, composite structure to meet the operating conditions as shown on the Drawings.
4. Pipe shall conform to ASTM D2412 for minimum stiffness and external loading characteristics.
5. Couplings, fittings and push-on joints shall be manufactured with flexible, elastomeric seals conforming to the requirements of ASTM D4161 and ASTM F477 and shall meet or exceed the pipe class at the location of its installation.
6. Pipe joint shall be push-on type couplings unless specified otherwise.
7. Pipe shall meet the minimum requirements of ASTM D3681 and ASTM D3262. Manufacturer shall provide complete 10,000-hour test results on pipe produced at the proposed locaton of manufacture. Results shall reflect that the pipe has a minimum allowable strain of no less than 0.65% at fifty years when tested in accordance with ASTM D3681 and D3262.
8. Normal production pipe for this project shall not incorporate raw materials that are not in compliance with ASTM D3681 and ASTM 3262.

9. Interior of pipe shall be manufactured using a nonstructural resin with a minimum allowable elongation of 50% when measured in accordance with ASTM D638. The liner nominal thickness shall be 40-mils.
10. Exterior pipe surfaces shall be comprised of a layer of sand and resin to provide UV protection to the exterior.

C. Resin Systems: The manufacturer shall use only approved polyester resin systems with a proven history of performance of in this particular application.
D. Glass Reinforcements: The reinforcing glass fibers to be used to manufacture the components shall be of the highest quality commercial grade of glass filaments suitably treated with binder and sizing compatible with impregnating resins.
E. The internal liner shall be suitable for service in a sewer pipe, and shall be highly resistant to exposure to sulfuric acid as produced by biological activity from hydrogen sulfide gases. Pipe shall meet or exceed requirements off ASTM D3681.
F. Silica Sand: Sand shall be minimum 98% silica with a maximum moisture content of 0.2%
G. Additives: Resin additives, such as curing agents, pigments, dyes, fillers, thixotrophic agents, etc., when used, shall not detrimentally effect the performance of the product.
H. Elastomeric Gaskets: Gaskets shall be supplied by qualified gasket manufacturers and be suitable for the service intended.

REINFORCED CONCRETE HDPE LINED GRAVITY SEWER PIPE

I. All Pipe Reinforced Concrete HDPE Lined Sewer shall conform to the applicable ASTM Standard. The Class or D-Load strength of the pipe shall be as specified on the Drawings or Bid Form.

1. All pipe shall be manufactured using the Dri-cast or Wet Cast Method of manufacture. The manufacturing method shall be at the option of the pipe manufacturer but once a method is selected, it shall not be changed without the approval of the Engineer. Joint lengths shall be a minimum of 8’ except where shorter lengths are needed for closures and connections.
2. All joints shall meet the requirements of ASTM C 361 Section 8. All gaskets shall meet the requirements of ASTM C361 Section 6.9 and ASTM C1619.
3. Non-air-entraining Portland cement conforming to ASTM C 150 Type II or Type V shall be used. Flyash conforming to ASTM C 618 Class F or Class C may be used. Total flyash content shall not exceed 25% by weight of total cementitious material.
4. The use of any admixture must be approved by the Engineer.
5. All coarse and fine aggregates shall meet the requirements of ASTM C 33 except for gradation.
6. The application of HDPE liner to forms and other surfaces is considered to be specialized work. Personnel performing such work shall be adequately trained in the methods of liner installation prior to commencing work.
7. To ensure adequate liner/pipe wall bond, all HDPE lined pipe shall pre-set for a minimum of two hours with the forming core left in the pipe. All pipe shall be cured in a fully enclosed curing chamber or have individual curing covers placed over each pipe.
8. Each pipe shall be clearly marked with the strength, date of manufacture, the name or trade mark of the manufacturer and the manufacturer’s Quality Assurance stamp of approval.

J. HDPE Liner

1. Liner shall demonstrate minimum pull-out strength of 14,000 psf.
2. Embedded liner shall demonstrate its ability to withstand back pressure hydrostatic forces of 50 feet of hydrostatic head (20 psi). Test procedure shall be submitted to the engineer for approval.
3. Liner sheets shall be produced in rolls that are 8.0 ft (2.4 m) in width and a thickness of 80 mils (2.0 mm).
4. The locking studs shall be an integral part of the liner sheet. Stud spacing shall be on approximately 1.25 in (30 mm) centers, such that there are approximately 110 studs per square foot (1200 per square meter).
5. The liner and welding cap strips shall be made from 97-98% virgin high high density polyethylene and 1.5-3% carbon black or pigmentation for the purpose of an otherwise specified color.
6. Cap strips shall be approximately 4 inches wide but not greater than 6" and shall be equivalent to that of the liner.
7. Liner sheets shall have the physical properties as stated and when tested in accordance with Table 1.
8. Raw resin shall have the properties as tested and when tested in accordance with Table 2.
9. Liner sheets shall be supplied in pre-fabricated tubes and shall be manufactured by GSE Lining Technology, Inc. or approved equal.

Table 1: Liner Properties

TESTED PROPERTY NOMINAL VALUE	TEST METHOD	FREQUENCY				
Thickness, m(mil) Density, g/cm^3	ASTM D 5199 ASTM D 1505	Every 5th roll 1/100,000	2.00 (80) 0.94	3.00 (120) 0.94	4.00 (160) 0.94	5.00 (200) 0.94
Tensile Properties (each direction) Strength at	ASTM D 6693, Type IV Dumbell G.L. = 2.0	1/100,000 ft^2	2,200 (15.2) 500	2,200 (15.2) 500	2,200 (15.2) 500	2,200 (15.2) 500
Stud Pull-Out Strength[1], lb/ft^2		1/product	>14,000 (669.89)	>14,000 (669.89)	>14,000 (669.89)	>14,000 (669.89)
Carbon Black Content/Pigment Content, % Black (carbon)	ASTM D 1603*/421 8 ASTM D 5630	1/100,000 ft^2	2-3 1.5-2.5	2-3 1.5-2.5	2-3 1.5-2.5	2-3 1.5-2.5
Carbon Black	ASTM D	1/100,000 ft^2	Note 2	Note 2	Note 2	Note 2
Notched Constant Tensile Load, hours	ASTM D 5397	1/formulation	1,000	1,000	1,000	1,000
Coefficient of Linear Thermal Expansion,	ASTM D 696	1/product	1 .20E-04	1 .20E-04	1 .20E-04	1 .20E-04
Low Temperature Brittleness, ˚C	ASTM D 746	1/product	-77	-77	-77	-77
Dimensional Stability, % (each direction)	ASTM D 1204	1/product	±1.0	±1.0	±1.0	±1.0
Water Absorption, %	ASTM D 570	1/product	0.1	0.1	0.1	0.1
Water Vapor Transmission,	ASTM E 96	1/product	<0.01	<0.01	<0.01	<0.01
Roll Width, ft (m)			8 (2.44)	8 (2.44)	8 (2.44)	8 (2.44)
Roll Length, ft (m)			246 (74.97)	213 (64.91)	196 (	196 (59.73)

Roll Area, ft^2 (m^2)			1,968 (182.83)	1,704 (158.30)	1,568 (145.67)	1,568 (145.67)

Table 2: Raw Material Properties

Property	Test Method	Value	Testing Frequency
Density, g/cm3	ASTM D 1505	0.932	1/ resin lot
Melt Flow, g/10 min	ASTM D 1238 (190/2.16)	≤ 1.0	1/ resin lot
OIT, minutes	ASTM D 3895 (1atm/200°C)	100	1/ formulation

10. Welding procedure shall be submitted and approved as required in 5.01.B.2.
11. Joints shall be welded by the electrofusion process or a process approved by the Engineer.
12. Welding procedure shall include the following:
    a. Prior to the start of each days joint welding or if welding is stopped for more than 3 hours, sample cap strips will be welded and coupons cut and pull tested to verify the strength of the weld.
    b. Each weld shall be visibly inspected. In addition, all joint welds shall be probed with a trowel, putty knife, or similar tool approved by the Engineer.
    c. Each joint weld shall be fully vacuum tested immediately following the completion of the welding process.
    d. At the completion of each run of joint welds, a computer print-out of each weld shall be provided to the Engineer. Print-out shall include welder identification, weld/joint identification, weld time, cool time & power supply conditions, as a minimum.

MANHOLES

K. Provide manholes made of precast concrete sections in conformance with ASTM C478, the Drawings, the City of Raleigh Public Utilities Handbook, NC Department of Transportation, and the following requirements:

1. General

    a. Provide manholes to the depth as indicated on the Drawings. Manhole style, type, and inside diameter shall be as noted on the Drawings.
    b. Manholes on lines 12” and larger in diameter, as well as manholes that directly receive a force main discharge, shall be internally coated with a polyurea coating. Coating shall be Duramer 1030 as manufactured by SewerKote or approved equal. Coatings may be applied by brush, spray, or roller. Coating shall be provide in three separate parts; primer, intermediate coat, and top coat
        1) Primer coat shall be a 20% solids, deeply penetrating, dual-component polyurea primer applied to 0.5 – 1.0 mils dry film thickness (150 ft^2/gal).
        2) Intermediate coat shall be a dual component polyurea applied at 50 – 100 mils dry film thickness (50 ft^2/gal).
        3) Top coat shall be a 65% solids, two-part polyurea applied at 7.5 – 10 mils dry film thickness (125 ft^2/gal).

c. Precast concrete manholes shall be as manufactured by Tindall Concrete Products, Inc., Adams Concrete, Hanson Pipe and Precast, D & M Concrete Specialties, Inc., N. C. Products Corp., Stay Right Tank, or approved substitute.
d. T-series manholes as manufactured by Tindall Concrete Products or approved equal shall be an acceptable substitute to round manholes as specified herein. The T-series shall be the same size manhole as shown on the Drawings for round manholes (e.g., 6' ID manhole, etc.) and shall meet all applicable requirements of the specifications. No reduction in size of the riser sections and top slab shall be allowable.

2. Precast Concrete Sections

a. Minimum wall thickness shall be 5-inches.
b. Base: Cast monolithically without construction joints or with an approved PVC waterstop in the cold joint between the base slab and the walls. Minimum thickness of base shall be 6-inches.
c. The width of the base extensions on Extended Base Manholes shall be no less than the base slab thickness. Extended bases shall comply with the details on Drawings.
d. Riser: Minimum lay length of 16 inches.
e. Cone: Eccentric or concentric cones may be used on 8 through 12-inch mains. Concentric cones shall be used on all 15-inch and larger mains.
f. Transition Slab: Provide a flat transition from 60-inch and larger manholes to 48-inch diameter risers, cones, and flat slab top sections. The maximum height of manhole over the transition top section shall be 12 feet. Transition sections shall not be used in areas subject to vehicle traffic.
g. Flat Slab Top: Designed for HS-20 traffic loadings as defined in ASTM C890. Items to be cast into Special Flat Slab Tops (i.e. ring, cover, vent base) shall be sized to fit within the manhole ID and the top and bottom surfaces. Provide a float finish for exterior slab surface.
h. Precast or core holes for pipe connections. Diameter of hole shall not exceed outside diameter of pipe by more than 3-inches.
i. Lifting Devices: Devices for handling precast components shall be provided by the precast manufacturer and comply with OSHA Standard 1926.704.

3. Joints
a. Manufacturer in accordance with tolerance requirements of ASTM C 990 for butyl type joints.
b. Minimize number of joints. Do not use riser section for manholes up to 6 feet tall and no more than one riser for each additional 4 feet in height.
c. Flexible Joint Sealants: Flexible Joint Sealants: Preformed butyl rubber based sealant material conforming to Federal Specification SS-S-210A, Type B and ASTM C990.
d. External Seal: Polyethylene backed flat butyl rubber sheet no less than 1/16-inch thick and 8-inches wide.

4. Inverts
a. Brick and mortar or precast concrete invert constructed to the width of the effluent pipe.
b. Form and finish invert channel to provide a consistent slope from inlet(s) to outlet up to 6-inches.
c. Channel walls shall be formed to the springline of the outlet pipe diameter.

d. Finish benches at 60 degrees to manhole walls. Provide a 1/4-inch radius at the edge of bench and trough.

5. Flexible Pipe Connectors: Provide flexible connectors for pipe to manhole that conform to ASTM C923. Location of connectors shall vary from Drawings no more than 1/2-inch vertically and 5 degrees horizontally. Boot sleeves shall have stainless steel expansion bands and pipe clamps that meet or exceed ASTM C923 and A167.
6. Manhole Steps:
   a. Steps shall be made of 1/2-inch grade 60 steel encapsulated by co-polymer polypropylene and have serrated tread and tall end lugs.
   b. Secure steps to the wall with compression fit in tapered holes or cast-in-place. Align steps along a vertical wall and shall not be located over a pipe opening. First step shall be a maximum of 26 inches from the bottom.
   c. Steps shall be provided inside manholes and shall be provided on the outside when the top of manhole elevation is greater than three (3) feet above the existing ground elevation.
   d. Steps shall be as shown on the Drawings.
   e. Steps shall be by American Step Co., Inc., Bowco Industries, Inc., M. A. Industries, Inc. or approved substitute.

CASTINGS

L. General

1. Made of gray iron, ASTM A-48 - class 30.
2. Castings shall be free from imperfections not true to pattern. Casting tolerances shall be plus or minus 1/16-inch per foot of dimension. Top shall set neatly in frame, with edges machined for even bearing and proper fit to prevent rattling and flush with the edge of frame.
3. Castings shall be as manufactured by Neenah Foundry Co., U.S. Foundry & Manufacturing Corp., or Vulcan Foundry

M. Manhole Frame and Cover:

1. Minimum clear opening shall be 22 inches.
2. Minimum weight for frame and cover shall be 300 pounds and suitable for Heavy Duty Highway Traffic Loads of H-20.
3. Frame shall have four 3/8-inch anchor bolt holes equally spaced.
4. Cast “DANGER PERMIT REQUIRED – CONFINED SPACE DO NOT ENTER” on the cover. Casting shall bear the name of the manufacturer and the part number.
5. Provide camlocks on all manholes located in sanitary sewer easement.
6. Provide cover with one 1-inch perforated holes unless noted as watertight on the Drawings.
7. Provide the following where indicated on the Drawings:
   a. Ring and cover shall be watertight.
   b. Bolt down cover. Bolt down covers shall be provided with four (4) 3/8-inch stainless steel hex head bolts at 90 degrees.

SEWER SERVICE

N. Provide PVC wye sewer saddles for services on PVC mains. Saddles shall be solvent welded and fastened with double stainless steel bands.

O. Provide a cast or ductile iron wye sewer saddle for services on ductile iron main. Saddles shall be “Geneco E40” sewer saddles or approved equal consisting of a virgin SBR gasket compounded for sewer service, a ductile iron saddle casting, a 304 stainless steel adjustable strap for fastening the gasket and the saddle casting to the sewer main, and a 304 stainless steel adjustable circle clamp for securing the service line into the SBR gasket.

VALVES

P. General: Valves shall meet the following requirements:

1. Size shall be as required for the pipe size and material as indicated on the Drawings and specified.
2. Open by counterclockwise rotation.
3. Standard system working pressure is pressure 175 psi.
4. Equip valves with a suitable means of operation.
5. For buried valves over 5 feet deep, provide extension stems of cold rolled steel to bring the operating nut to within 2 feet of the ground surface.
6. Provide valve accessories as required for proper valve operation for valve locations as indicated on the Drawings and as recommended by valve manufacturer.
7. Valve accessories shall be compatible to proper valve operation.
8. Similar valve types shall be of one manufacturer.

Q. Gate Valves, Resilient-Seated: Gate valves 3-inch to 20-inch shall conform to AWWA C509 for and to the following requirements:

1. O-ring stem seal on non-rising (NRS) stem valves.
2. Ends shall be mechanical joint for underground locations and flanged joint for above ground locations.
3. Valves shall be non-rising stem (NRS) with wrench nut for underground locations and Outside Screw and Yoke (OS&Y) with handwheel for above ground locations unless noted otherwise on the Drawings.
4. Be of one manufacturer.
5. Valves 16-inch and larger shall be equipped with cast iron gearing to facilitated opening. Gear cases shall be extended or totally enclosed type. Geared valves shall be equipped with indicators to show the position of the gate in relation to the water.
6. Valves 16-inch and larger shall be equipped with a bypass.
7. Special material for bolts and nuts.

R. Plug Valves: Plug valves shall conform to the following requirements:

1. Plug valves shall be of the non-lubricated, eccentric type designed for a working pressure of 175 psi for valves 12 inch and smaller, 150 psi for vales 14 inch and larger.
2. Valves shall provide tight shut-off at rated pressure.
3. The plug valve body shall be cast iron ASTM A126 Class B with a welded-in overlay of not less than 90% nickel alloy content on all the surfaces contacting the face of the plug.
4. The valve plug shall be constructed of cast iron conforming to ASTM A126 Class B, with Buna N resilient seating surface to mate with the body seat.
5. Valve flanges shall be in accordance with ANSI B16.1 Class 125.

6. Shaft bearings shall be sleeve-type, sintered, oil impregnated, and permanently lubricated stainless steel.
7. Plug valve shaft seals shall be of the multiple V-ring type and shall be adjustable. Sealing system shall conform to AWWA C504 and C507 standards. All packing shall be replaceable without removing the bonnet or actuator and while valve is in service.
8. Valves 6” and larger shall be provided with gear actuators.
9. Provide levers or hand wheels to operate the valve as recommended by the manufacturer.

S. Swing Check Valves: Swing check valves from 2 to 24 inch shall conform to AWWA C508 and to the following requirements:

1. Provide lever and weight for swing check control.
2. Resilient material to Metal seat construction.
3. Ends shall be flanged.

AIR VALVES

T. Provide air valves in conformance with AWWA C512 and the following:

1. Valve type shall be a combination valve.
   a. Inlet size: 2 inch
   b. Large orifice minimum: 1 inch
   c. Small orifice minimum: 1/8 inch
2. Valve shall be designed for the following automatic operation:
   a. Release of large quantities of air during the filling of the main.
   b. Permit air to enter the main when it is being emptied.
   c. Release accumulated air while the main is in operation and under pressure.
3. Valve shall be designed for a system pressure 150 psi. Valve shall also operate at a minimum system pressure of 20 psi.
4. Provide threaded inlet.
5. Provide stainless steel ball float and internal trim.
6. Provide isolating bronze ball valve for connection to main line.
7. For sewage force mains provide tall body to minimize possibility of sewage plugging orifice or linkage.
8. Sewage force main valve shall include backwash accessories. They shall include bronze flushing ball valves and 5 feet of rubber hose with quick-connect coupling on each end.

VALVE BOX

U. Valve Box, Below Ground: Boxes shall be high strength cast iron of the screw or telescopic type. Box shall consist of a base section, center extension as required, and a top section with cover marked “SEWER.”

THRUST BLOCKING

V. Provide concrete thrust blocking for pressure lines in accordance with the detail on the Drawings.
W. Thrust blocking is not required where restrained joint fittings and equivalent length of restrained joint pipe are used unless shown otherwise on the Drawings.

PART 3 EXECUTION

GENERAL

A. Pipe installation shall meet the following general guidelines:
   1. Lay pipe in the presence of Engineer, unless specifically approved otherwise.
   2. Handle pipe and accessories in accordance with manufacturer's recommendations. Take particular care not to damage pipe coatings.
   3. Carefully inspect pipe immediately prior to laying. Do not use defective pipe. Replace pipe damaged during construction.
   4. Lay pipe to grade and alignment indicated on the Drawings.
   5. Provide proper equipment for lowering pipe into trench.
   6. Provide tight closure pipe ends when work is not in progress.
   7. Keep pipe interior free of foreign materials.
   8. Do not lay pipe in water or when the trench or weather conditions are unsuitable for the work.
   9. Clean bell and spigots before joining. Make joints and lubricate gasket in accordance with pipe manufacturer recommendation.
   10. Block fittings with concrete, or restrained as indicated on the Drawings or as required to prevent movement.

B. Gravity Pipe: Gravity pipe installation shall meet the following general guidelines:
   1. Lay pipe upgrade from the lower end and at the grades and alignment indicated on the Drawings.

RELATION OF WATER MAINS TO SEWERS

C. Lateral Separation: Lay water mains at least 10 feet laterally from existing and proposed sewers. Where existing conditions prevent a 10-foot lateral separation, the following shall be followed with approval of the Engineer:
   1. Lay water main in a separate trench, with the elevation of the bottom of the water main at least 18 inches above the top of the sewer.
   2. Lay water main in the same trench as the sewer with the water main located at one side on a bench of undisturbed earth, and with the elevation of the bottom of the water main at least 18 inches above the top of the sewer.

D. Crossing Separation: Lay bottom of water main at least 18 inches above the top of the sewer. Where existing conditions prevent an 18-inch vertical separation, construct both the water main and sewer of ferrous materials and with joints that are equivalent to water main standards for a distance of 10 feet on each side of the point of crossing.

E. Crossing a Water Main Under a Sewer: When it is necessary for a water main to cross under a sewer, construct both the water main and the sewer of ferrous materials and with joints equivalent to water main standards for a distance of 10 feet on each side of the point of crossing. A section of water main pipe shall be centered at the point of crossing.

SEWER PIPE

F. Lay sewer pipe to true lines and grades by using laser beam equipment or other acceptable means.

G. Minimum Separation Distances:
   1. In general, 100-foot horizontal separation from wells or other water supplies. If sewer pipe is installed within 50 foot of a public well or water supply or 25 foot of a private well or water supply, ferrous pipe must be used. Manholes shall not be located within 50-foot of a public well or water supply or 25 foot from a private well or water supply.
   2. 24-inch vertical separation from storm sewers or ferrous pipe shall be used.
   3. For separation from water mains see paragraph 3.02 above.

DUCTILE IRON PIPE

H. Install pipe in conformance with AWWA C600 and the following:

   1. For laying pipe in a vertical or horizontal curve, each full length pipe may be deflected by the following offset distance unless the pipe manufacturer's recommended distances are less:

      a. Push-on joint
         1) 3 to 12-inch pipe: 14-inch offset
         2) 14 to 36-inch pipe: 8-inch offset

      b. Mechanical joint
         1) 3 to 6-inch pipe: 20-inch offset
         2) 8 to 12-inch pipe: 15-inch offset
         3) 14 to 20-inch pipe: 8-inch offset
         4) 24 to 36-inch pipe: 6-inch offset

   2. For laying restrained joint pipe in a vertical or horizontal curve, except for horizontal directional drills (HDD), each full length pipe may be deflected by the following offset distance:

      a. 6 to 12-inch pipe: 11-inch offset
      b. 16 to 20-inch pipe: 7-inch offset
      c. 24 to 30-inch pipe: 5-inch offset
      d. 36-inch pipe: 4-inch offset
      e. 42 to 48-inch pipe: 1 ¼ -inch offset

   3. For laying restrained joint pipe in a vertical or horizontal curve, except for horizontal directional drills (HDD), each full length pipe may be deflected by the following offset distance:

      a. 6 to 12-inch pipe: 11-inch offset
      b. 16 to 20-inch pipe: 7-inch offset
      c. 24 to 30-inch pipe: 5-inch offset
      d. 36-inch pipe: 4-inch offset
      e. 42 to 48-inch pipe: 1 ¼ -inch offset

   4. The Contractor shall verify the offset distances specified are acceptable with the pipe manufacturer prior to installation.

   5. Carrier pipe of any joint type may not be deflected.

PROTECTO 401 DUCTILE IRON PIPE LINER

I. Application

1. The entire surface shall be inspected prior to receiving protective compound to ensure that no oil, grease, etc. exists on the surface. If any surface contains any of these items shall be solvent cleaned to remove said substances.
2. Once free of any oil, grease, etc., all surfaces shall be abrasive blasted using sand or grit abrasive media. No rust shall be present on surface at the time of application.
3. After surface preparation, the pipe interior shall receive 40 mils nominal dry film thickness of Protecto 401.
4. No lining shall take place when the substrate or ambient temperature is below 40°F.
5. The surface must be dry and dust free during application.
6. Bell Sockets and Spigot Ends shall be coated with 6 mils nominal, 10 mils maximum with Protecto Joint Compound 6 inches back from the end of the spigot end.
7. The joint compound shall be applied by brush to ensure full coverage.
8. No excessive buildup shall be present in the gasket seat or on the spigot ends.
9. Coating of the gasket seat and spigot ends shall be done after the application of the lining to the interior of the pipe.
10. The number of coats shall be as recommended by the lining manufacturer.
11. No material shall be used for lining which is not indefinitely recoatable with itself without roughening of the surface.
12. Provide touch up, as necessary, using Protecto Joint Compound per manufacturer's recommendations.

J. Inspection and Certification

1. A magnetic film thickness gauge shall be used to confirm the thickness on all ductile iron pipe and fittings. Thickness testing shall be done in accordance with SSPC-PA-2 Film Thickness Rating.
2. The interior lining shall be tested using a non-destructive 2,500 volt test to check for pinholes. Repair defects prior to shipment.
3. Each pipe joint and fitting shall be marked with the date of application of the lining system along with its numerical sequence of application on that date and records maintained by the applicator of his work. These records shall be made available to the Engineer upon request.
4. The pipe/fitting manufacturer shall provide a certificate attesting that the applicator meets the requirements of this specification, and that the material used was as specified and applied as specified.

PVC PRESSURE PIPE

K. Install PVC C900/C905 pipe in conformance with AWWA C605.

L. Solvent Weld: Where indicated in these specifications or on the plans, solvent weld type joints shall be used. Field cut ends shall be sanded to roughing the surface. Joints shall be cleaned of foreign material. Solvent shall be applied to the joint and joint made as recommended by the manufacturer. Excess solvent shall be wiped off. The joint should not be moved until sufficiently set up.

M. Bell and Spigot Joints: Clean bell and spigot ends prior to jointing. Ends of field cut pipe shall be beveled with file. Gasket shall be clean and lightly lubricated. Joint shall be made as recommended by the manufacturer.

FIBERGLASS REINFORCED PIPE – CENTRIFUGALLY CAST AND FILAMENT WOUND

N. Install pipe in accordance with manufacturer's recommendations and the following requirements:
   1. The bedding and burial of pipe and fittings shall be in accordance with the Drawings and Specifications and the Manufacturer's requirements.
   2. Do not exceed forces recommended by the manufactuer when joining pipe.
   3. Gasket shall be wiped clean prior to joining. Damaged, defective, or bulging gaskets shall be replaced with a new coupling.
   4. Wipe the plain end of pipe clean prior to insertion in the coupling. The coupling components shall also be wiped clean prior to connection.
   5. Apply joint lubricant, as approved by pipe manufacturer, to pipe end and elastomeric gaskets.
   6. For handling pipe, use textile slings or other suitable materials or a forklift. Use of cables or chains is not permitted. Damaged pipe will be rejected.
   7. Pipe shall be free of nicks, scratches and gouges at the time of installation. Visible gouges shall be cause for rejection of pipe.
   8. Join pipe in straight alignment then deflect slightly if required. Do not allow the deflection angle to exceed the deflection permitted by the manufacturer.
   9. No blocking under the pipe will be permitted.
   10. Storage of pipe on the job site shall be done in accordance with the pipe manufacturer's recommendation and with approval of the Engineer.
   11. Under no circumstances shall pipe or fittings be dropped either into the trench or during unloading. The interior of the pipe shall be kept clean of oil, dirt, and foreign matter; and the machined ends and couplings shall be wiped clean immediately prior to jointing.
   12. Use a pipe cutter where necessary to cut and machine all pipe in the field. A "full insertion mark" shall be provided on each field-cut pipe end. Field-cut pipe shall be beveled with a beveling tool in accordance with the manufacturer's recommendations. Bevels shall be in accordance with the manufacturer's requirements.
   13. If not integral to the bell or coupling, rubber gaskets shall be marked with manufacturer's identification sizes and proper insertion direction.
   14. Before use, all pipe and specials shall be thoroughly examined for defects; and no piece shall be installed which is known to be defective. If any defective piece should be discovered after having been installed, it shall be removed and replaced with a sound on in a satisfactory manner.
   15. For open-trench construction, the laying of the pipe in finished trenches shall begin at the lowest point with the coupling/bell ends pointing opposite to the direction of flow. The interior of the pipe and the jointing seal shall be free from sand, dirt, and trash before installing in the line. Extreme care must be taken to keep the couplings of the pipe free from dirt and rocks so joints may be properly assembled without overstressing the coupling. The jointing of the pipe shall be done in strict accordance with the pipe manufacturer's instructions and shall be done entirely in the trench.

REINFORCED CONCRETE HDPE LINED SEWER PIPE

A. Care shall be taken in loading, transporting, and unloading to prevent damage to the pipe. All pipe shall be examined and approved by the Engineer or his appointed representative before laying and no piece shall be installed which is found to be defective.
B. Preparation of bedding and backfill shall be as specified on the Drawings and per the requirements of the American Concrete Pipe Association's Design Data 9. Pipe shall be laid with uniform bearing under the full barrel of the pipe.
C. Pipe shall be protected from lateral displacement by pipe embedment material installed as provided in the Drawings. Under no circumstances shall concrete pipe be laid in water and no pipe shall be laid in unsuitable weather or trench conditions. Pipe shall be laid with bell ends facing the direction of laying except when making closures.
D. Rubber gaskets shall be installed in strict conformance with the pipe manufacturer's recommendations.
E. Pipe shall be laid to line and grade as shown on the plans. Curves may be formed using fittings, specials, or unsymmetrical joint closure of straight pipe as required.
F. As the pipe line is being laid, and prior to welding of the HDPE liner, each joint shall be tested with a Go/No-Go joint air test to verify joint integrity. The test shall be conducted on the mated joint after two subsequent joints have been laid to confirm that the joint and gasket are assembled properly, i.e. no pinched or rolled gaskets or cracked bells. The test shall consist of using a Cherne Joint Tester (or approved equal) employing a modified test procedure. The modified test shall consist of pressurizing the sealing bladders to 80 psi and then pressurizing the joint to 5 psi. The pressure can not drop more than 1 psi in 5 seconds for the joint to be considered acceptable. Any problems with the joint (bell, spigot, or gasket) will be identified by the inability to pressurize the joint. If the joint fails this test, the joint shall be removed and replaced using new gaskets then re-tested. All joint tests shall be witnessed and approved by the Engineer or the designated representative.

VALVES AND FITTINGS

O. Install buried valves on top of an 18-inch square, 3-inch thick, solid concrete pad (minimum dimensions). The concrete pad may be provided by a pre-cast manufacturer or cast-in-place in the field above grade. Concrete used for the pads shall be a minimum 3,000 psi mix. The pads may not be cast-in-place in the pipe trench. Connection to pipe shall be such that there shall be no stress at the joint caused by misalignment or inadequate support of pipe or valve.
P. Install fittings as recommended by the manufacturer. Fittings shall be blocked or otherwise restrained from movement.
Q. Valve Boxes: Set valve boxes flush with finished grade. Box shall be supported so that no stress shall be transmitted to the valve. Operating nut shall be centered in box.
R. Install valves, gates, and accessories indicated on the Drawings and in complete accordance with the manufacturer's recommendations.
S. Valve boxes shall be set straight with the operating nut centered and supported on (2) 4" concrete blocks, to prevent load transfer onto valve body or pipe line. Set top of box at finished grade. Provide a 24-inch x 24-inch wide by 6-inch thick concrete pad at top of valve boxes outside paved areas.

AIR VALVES

T. Main shall be drilled for a two inch connection.
U. Valve shall be installed on the main line with a service saddle.
V. Install air valve in a flat top manhole.

MANHOLES

W. Set base plumb and level. If using precast inverts, then align manhole invert with pipe invert.
X. Secure pipe connectors to pipe in accordance with manufacturer's recommendation.
Y. Clean bells and spigots of foreign material that may prevent sealing. Unroll the butyl sealant rope directly against base of spigot. Do not stretch. Follow manufacturer's instructions when using O-ring seals.
Z. Set precast components so that steps align.
AA. Plug lift holes using a non-shrink grout. Cover with a butyl sealant sheet on the outside and seal on the inside with an application of an epoxy gel 1/8-inch thick extending 2 inches beyond the opening.
BB. Set manhole frames to grade with grade rings in paved areas. Grade rings are not allowable for manholes located in easements. Seal joints between cone, adjusting rings, and manhole frame with butyl sealant rope and sheet. Concrete collar as shown in detail on the drawings shall be installed for manholes located in pavement.
CC. Apply external seal to the outside of joint.
DD. Finish the interior by filling fractures greater than 1/2-inch in length, width or depth with a sand cement mortar.
EE. Clean the interior of the manhole of foreign matter.

SEWER CLEANOUTS

FF. Sewer cleanouts connected to ductile iron pipe shall also be ductile iron sewer pipe conforming to these specifications.
GG. Sewer cleanouts connected to PVC pipe shall also be PVC sewer pipe schedule 40 conforming to ASTM-D-3034 latest revision. Use elastomeric gaskets for pipe joints.
HH. PVC wye sewer saddles shall be used on new PVC pipe. Saddles shall be used on existing PVC, solvent welded to the main and fastened with double stainless steel bands.
II. Cleanouts shall be a minimum of 4-inch diameter unless noted otherwise on the Drawings. Provide sewer cleanouts with screw-in watertight cap. Installation shall be in accordance with the details as shown on the Drawings.

SERVICE CONNECTIONS

JJ. Make service connections in accordance with the standard detail(s) on the Drawings.
KK. Service connections to the main lines shall be perpendicular to the main line to the edge of the right-of-way or easement line.

LL. Four-inch lines shall have a minimum slope of 1.0 % and have cleanouts every 75 feet at a minimum in addition to a cleanout at the right-of-way line or at the edge of the easement.
MM. Six-inch lines shall have a minimum slope of 0.60 % and have cleanouts every 100 feet at a minimum in addition to a cleanout at the right-of-way line or at the edge of the easement.
NN. 6-inch service lines shall tie directly into a manhole.
OO. Wye sewer saddles shall be made only when the sewer main is 8-, 10-, or 12-inch diameter concrete, ductile iron, or PVC sewer pipe. This type connection cannot be used on truss sewer pipe. The opening in the sewer main for the saddle shall be cut with a hydraulically driven or pneumatically driven circular tapping saw of the same nominal diameter as the sewer service line.

PAINTING

PP. Equipment shall receive the manufacturer's standard coating for the intended application. Coatings shall be suitable for the intended application.
QQ. Repaint damaged paint services.
RR. Above ground piping and piping within vaults shall be painted in accordance with the specification section for each item.

TESTING

SS. General
1. Clean and flush pipe system of foreign matter prior to testing.
2. Notify Owner and Engineer a minimum of 48 hours prior to testing.
3. Perform tests in the presence of Engineer.
4. Length of line to be tested at one time shall be subject to approval of Engineer.
5. Pipe sections shall not be accepted and placed into service until specified test have been performed and approved.
6. Repair defects in the pipe system. Make repairs to the same standard as specified for the pipe system.
7. Retest repaired sections until acceptance.
8. Repair visible leaks regardless of the test results.

TT. Pressure Mains
1. The Engineer shall approve the source, quality, and method of disposal of water to be used in test procedures.
2. Obtain Owner’s permission 48 hours prior to filling or flushing of pipe system with water from Owner’s water system. Owner shall operate valves connected to the existing water system. Keep pipe interior clean during construction to minimize the amount of water required for flushing. Where large quantities of water may be required for flushing, Engineer reserves the right to require that flushing be done at periods of low demand.
3. Pressure test in accordance with AWWA C600 for ductile iron pipe and AWWA C605 and M23 for PVC pipe and the following.
4. Make pressure tests between valves. Furnish suitable test plugs where line ends in “free flow.”
5. Provide air vents at the high points in the line section to be tested for releasing of air during filling. Service corporation stops may be used for air vent when located at a high point. Leave corporation stops in place after testing and note locations on As-Built Drawings.

6. Allow concrete blocking to reach design strength prior to pressure testing.
7. Force main shall be completely filled with water, all air expelled from the pipe, and the discharge end of the pipeline shall be plugged and adequately blocked before hydrostatic test begins.
8. Upon completing a section of pipe between valves, test pipe by maintaining for a two hour period the following hydrostatic pressure for each main:
   a. Force main: **150** psig
9. Test pressure shall not vary by more than +/- 5 psi for the duration of the test.

10. No length of line shall be accepted if the leakage is greater than that determined by the following formula based on the appropriate test pressure:
    L = Allowable leakage per 1,000 feet of pipe in gallons per hour.
    D = Nominal diameter of the pipe in inches.
    100 psi: L = D x 0.07
    150 psi: L = D x 0.08
    200 psi: L = D x 0.09
    250 psi: L = D x 0.10

UU. Gravity Sewer Mains

1. Test gravity lines between manholes.

2. Light Testing: Engineer will check for displacement of pipe as follows:

   a. A light will be flashed between the ends of the pipe section being tested.
   b. If the illuminated interior shows misalignment, or other defects as designated by Engineer, defects shall be repaired.

3. General

   a. Infiltration shall not exceed 100 gallons per inch of diameter, per mile of pipe, per 24 hours. Engineer may require flow measurement for verification of infiltration.
   b. Verify that maximum infiltration rate shall not be surpassed by air testing as follows.

4. Low Pressure Air Test:

   a. Air testing of sewer mains shall conform to UNI-B-6 and the following requirements:
   b. Perform initial air test when each section of main is complete including services to right of way. Test as construction proceeds.
   c. Wet interior surfaces of porous pipe material prior to testing.
   d. Safety
      1) Provide a superintendent who has experience in low pressure air testing of gravity sewer mains.
      2) Follow safety recommendations of air testing equipment manufacturer.
      3) Properly brace sewer plugs during testing. Test plugs prior to use in air testing.
      4) No one shall be allowed in manhole or trench when pipe is under pressure.

5) Pressurizing equipment shall include a regulator and a pressure relief valve, which are set no higher than 9 psig. Monitor gauges continuously to assure that the pressure does not exceed 9 psig.

e. Equipment
   1) Sewer plugs shall be specifically designed for low pressure air testing.
   2) Use two separate air hoses.
      i) One to connect the control panel to the sealed line for introducing the air.
      ii) One from the sealed line to the control panel to provide constant monitoring of the air pressure in the line.
      iii) If Pneumatic plugs are used a separate line shall be used to inflate the plugs.

   3) As a minimum the above ground air testing equipment shall include a shutoff valve, pressure regulating valve, pressure relief valve, input pressure gauge, and a continuous monitoring pressure gauge having a pressure range from 0 to at least 10 psig.

   4) Continuous monitoring pressure gauge shall be at least 4 inches in diameter with minimum divisions of 0.10 psi and an accuracy of +/- 0.04 psi.

   5) Monitoring gauges shall be subject to calibration as deemed necessary.
   6) Air used for testing shall pass through a single above ground control panel.

f. Testing

   1) Groundwater Determination: Immediately prior to each air test, determine groundwater level by a method acceptable to the Engineer. Adjust pressure used in air test in accordance with groundwater level.
   2) Apply air slowly to the test section until the pressure reached is 4.0 psi plus an adjustment of 0.433 psi for each foot of ground water above the crown of the pipe. Internal air pressure, including adjustment for ground water, should never exceed 9.0 psi for ductile iron and concrete pipe and 5.0 psi for Fiberglass pipes. The Contractor may have to dewater trench to maintain ground water at or below crown of fiberglass pipe when testing.
   3) When the above required pressure is reached, throttle air supply to maintain internal pressure for at least two minutes to permit stabilization.
   4) When pressure has stabilized at required pressure, shut off air supply.
   5) While observing the continuous monitoring pressure gauge, decrease pressure approximately 0.5 psi from required pressure.
   6) At this reading timing shall commence with a stop watch and allowed to run until pressure has dropped 1.0 psi or allowable time has lapsed. Line shall be “Acceptable” if the pressure drop does not exceed 1 psig in the time prescribed for the test in Table 1, Low Pressure Air Testing for Gravity Sewer Mains, at the end of this section.

5. Deflection Test for SDR 35 and Ribbed (ASTM F 949) PVC pipe.

   a. Measure for deflection of pipe no sooner than thirty days after installation and backfill.

b. Deflection shall not exceed 5 percent of pipe diameter. Maximum allowable long term deflection shall be 5 percent.
c. Measure deflection with an approved “GO-NO-GO GAUGE” method or by an approved recording deflectometer. Verify gauge on site prior to testing.

6. Deflection Test for Fiberglass Pipe.

a. Measure for deflection of pipe within 48 hours (initial test) after installation and backfill and again (final test) within thirty days.
b. Deflection shall not exceed 3 percent of pipe diameter for the initial test and 4 percent of pipe diameter for the final test. Maximum allowable long term deflection shall be 5 percent.
c. Measure deflection with an approved “GO-NO-GO GAUGE” method or by an approved recording deflectometer. Verify gauge on site prior to testing.

VV. Vacuum test each manhole in accordance with ASTM C1244 and the following:

1. No personnel shall be allowed in manhole during testing.
2. Test manhole after assembly and prior to backfilling.
3. Plug pipes with suitably sized and rated pneumatic or mechanical pipeline plugs. Brace plugs to prevent displacement.
4. Position vacuum test head assembly to seal against interior surface of the top of cone section in accordance with manufacturer’s recommendation.
5. Draw vacuum of 10 inches of mercury on manhole. Shut off the vacuum pump and close valve on vacuum line.
6. Measure time for vacuum to drop to 9 inches of mercury. Manhole shall pass if time meets or exceeds the following:

Manhole I.D. (inches)	48	60	72	84	96	120	T-series
Seconds	60	75	90	105	120	150	105

7. If manhole fails test, remove head assembly, coat interior with a soap and water solution, and repeat vacuum test for approximately 30 seconds. Leaking areas will have soapy bubbles. Make necessary repairs to the satisfaction of Engineer and repeat test until manhole passes.

CLEANING

WW. Upon completion of other testing, clean all newly installed sewer mains. This shall include all sewer main and lateral connections. This cleaning shall meet the following requirements:

1. The Engineer and Owner shall be present throughout the cleaning operations.
2. The sewer mains shall be cleaned with a high-velocity water jet. No debris of any kind shall be released into the sewer system.

XX. Upon completion of cleaning operations, within 2 hours, Owner shall televise all newly installed sewer mains.

1. Contractor shall coordinate cleaning and televising operations with Owner to ensure time schedules can be achieved.
2. If televising is not properly coordinated, Owner may request Contractor to clean sewer mains again.

END OF SECTION

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SECTION 13000
BORING, JACKING AND TUNNELING
(REVISED 10-1-14)

PART 1 - GENERAL

1.01 The Contractor shall provide all labor, materials, tools, and equipment to perform all work and services necessary for, or incidental to, the furnishing and complete installation of carrier pipe, encasement pipe and tunnel liner plates by means of boring and jacking, tunneling, or tunneling and jacking in accordance with the Construction Drawings, Contract Documents, and the latest edition of the City of Raleigh Public Utilities Handbook and City of Raleigh Standard Drawings.

1.02 Although such work is not specifically shown or specified, all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a secure, complete and compatible installation shall be furnished and installed as part of this section.

1.03 The Contractor shall submit to the Engineer shop drawings for all products and materials specified under this section for the construction of this project.

1.04 All materials used on this project must have a preliminary inspection by the Inspector before being used for construction purposes. Rejected materials shall be immediately removed from the job site.

PART 2 – MATERIALS

2.01 Encasement Pipe: Encasement pipe shall be high strength spiral welded steel meeting ASTM A-252, Grade 2 steel, with minimum yield strength of 35,000 psi. Pipe length, and size shall be as indicated on the Drawings. The minimum wall thickness shall be as follows:

A. N.C. Department of Transportation

Pipe Size (O.D.-inches)	Wall Thickness (inches)
4 - 12-3/4	0.375
16 – 24	0.375
30	0.375
36	0.375
42	0.500

B. Railroad

Pipe Size (O.D.-inches)	Wall Thickness (inches)
24 & under	0.375
30	0.469
36	0.532
42	0.625
48	0.688
54	0.781
60	0.844

2.02 Carrier Pipe: Carrier pipe shall be of the type, size, and joints as indicated on the Drawings and specified in Section, Water Distribution System. Pipe shall be coated inside and outside in accordance with AWWA C203-97.

2.03 Pipe Support: Provide pipe supports designed and manufactured for the support of the carrier pipe size and material to be used for the Project within the encasement size indicated on the Drawings. Supports shall be designed to carry the pipe at the support spacing specified and meet the following minimum requirements:

A. Band Width: 8 inches for pipes 14 inches and under and 12 inches for pipes 16 inches and over.
B. Band, Riser, and Runner Material: 14 gauge steel for band and riser except if the riser is over 6 inches high the steel shall be 10 gauge for riser. Riser shall be of the channel shape. Band shall be bolted together with A325 steel bolts, nuts, and washers.
C. Runner shall be a minimum of 1 inch wide and not more then 1 inch shorter than the bandwidth. Provide 2 top and 2 bottom runners for pipe sizes through 12 inches and 2 top and 4 bottom runners for pipes over 12 inches.
D. Pipe position within casing: Centered and Restrained.
E. Support Spacing:
    1. General: Provide a support within one foot on each side of joints, and a spacer centered on every pipe segment/joint. Three supports per joint shall be provided.
    2. Provide additional supports needed per manufacturer’s recommendations.
    3. Provide a support within one foot of each end of casing.

2.04 Casing End Seal: Provide mortared casing seal on each end of the casing.

PART 3 - INSTALLATION

3.01 BORING AND JACKING

The encasement pipe shall be sized in accordance with the Public Utilities Handbook and as described herein. The spoil material shall be removed through the encasement pipe by means of an auger. New sections of encasement pipe shall be butt-welded onto those previously jacked into place.

If voids are encountered while installing encasement pipe 30-inches and larger, grout holes shall be installed at 10-ft centers in the top section of the encasement pipe. The grout holes shall be used to fill the void spaces with 1:3 Portland cement grout at sufficient pressure to prevent settlement of the roadway, unless NCDOT approval stipulates otherwise. Other grout mixtures may be submitted for approval. The grouting operation shall take place immediately after completion of the bore.

3.02 TUNNELING AND JACKING

Tunneling and jacking is to be employed when the auger encounters refusal and the encasement pipe is sufficiently large to accommodate manual excavation from the inside. The encasement pipe shall be jacked through an opening created by hand working and/or blasting from inside of the encasement pipe. New sections of encasement pipe shall be butt-welded onto those previously jacked into place. Jacking of the pipe shall be done as rapidly as possible and excavation outside of the encasement pipe kept to a minimum. Lubricants may be used to prevent the pipe from freezing.

If voids are encountered while installing encasement pipe 30-inches and larger, grout holes shall be installed at 10-ft centers in the top section of the encasement pipe. The grout holes shall be used to fill the void spaces with 1:3 Portland cement grout at sufficient pressure to prevent settlement of the roadway, unless NCDOT approval stipulates otherwise. Other grout mixtures may be submitted for approval. The grouting operation shall take place immediately after completion of the bore.

END OF SECTION

SECTION 14000
CONSTRUCTION TRAFFIC CONTROL
(REVISED 10-1-14)

PART 1 - GENERAL

1.01 Except as otherwise stated in this specification, all construction traffic control shall be in conformance with the latest edition of the NCDOT "Standard Specifications for Roads and Structures," NCDOT "Roadway Standard Drawings Manual," MUTCD, and NCDOT Supplement to the MUTCD.

1.02 The work covered by this section consists of furnishing, erecting, maintaining, relocating, and removing traffic control devices in accordance with the Contract Documents.

1.03 All traffic control devices furnished by the Contractor shall remain the property of the Contractor, unless otherwise specified by the contract. Traffic control devices shall include, but are not limited to stationary and portable signs, drums, barricades, barriers, electronic variable message boards, cones, delineators, flashing arrow panels, temporary guardrails, temporary concrete median barriers, vehicle-mounted temporary impact attenuators, temporary and permanent pavement markings, raised reflective pavement markers, flaggers, and pilot vehicles.

PART 2 - MATERIALS

2.01 Unless otherwise required, materials used in the fabrication and installation of construction traffic control devices shall be in accordance with the applicable provisions of the MUTCD. When traffic control devices are no longer required for traffic handling in the initial phase of construction requiring their use, they may be reused at various locations throughout the project provided the device is not defaced, is structurally sound, clean and otherwise conforms to the above requirements.

2.02 All enclosed lens (Engineer's Grade) sheeting required for use on traffic control devices shall have an identification mark on the surface. This mark signifies that the sheeting meets the requirements of Federal Specification L-S-300C for Minimum Reflectivity 1 Sheeting and Tape. The identification mark shall not interfere with the function of the device, but shall be visible both day and under illumination at night without the use of special devices. No work on the project shall start until all the traffic control devices required for the particular work activity are inspected and approved by the Engineer.

2.03 Traffic control devices which do not meet the requirements of this section shall not be used. If a device ceases to meet the requirements of this section during the project, it shall be promptly removed and replaced with a conforming device at no additional compensation. The Engineer shall have the authority to determine the acceptability of the traffic control devices.

PART 3 - CONSTRUCTION METHODS

3.01 Existing public streets or highways shall be kept open to traffic at all times by the Contractor unless permission to close these streets, or portions thereof, is granted by the Engineer. A lane closure permit is required for all work inside a travel lane.

3.02 Traffic control devices shall be installed at the inception of construction operations, and shall be properly maintained, relocated as necessary, cleaned, and operated during the time they are in use. They shall remain in place only as long as they are needed and shall be immediately removed thereafter. Where operations are performed in stages, only those devices that apply to the conditions present shall be left in place.

3.03 The location, legends, sheeting, dimension, number of supports, and horizontal and vertical placement of warning signs, barricades, and other traffic control devices shall be as required by the plans or the MUTCD or as directed by the Engineer. The Contractor may submit for the Engineer's consideration a method for handling traffic other than as shown on the plans. The alternate traffic control plans shall not be used until they are approved in writing by the Engineer. During periods when not warranted, warning signs and other devices shall be removed from the work area, covered with specified material, or otherwise positioned so that they do not convey their message to the traveling public. If covered, the covering material shall be exterior plywood and shall cover the entire face of the sign panel. The covering material shall be installed in such a manner that the sign panel will not be defaced. Non-metal washers or other spacing devices shall be used to keep the plywood covering material from direct contact with the sign panel. Covering material shall be maintained in a neat manner during its use.

3.04 Weeds, brush, trees, construction materials, equipment, etc. shall not be allowed to obscure any traffic control device in use. There will be no separate compensation for any trimming or cutting required for this purpose.

3.05 Competent and properly trained flaggers, properly attired and equipped, shall be provided when directed by the Engineer or when the Contractor deems it necessary to safely handle traffic through the construction zone.

3.06 The Contractor shall assume full responsibility for the continuous and expeditious maintenance of all construction warning signs, barricades, and other traffic control devices which in the opinion of the Engineer are damaged by traffic or other means or deteriorated beyond effectiveness. Conditions covered under maintenance shall include but not be limited to replacement due to loss of reflectivity; replacement of broken supports; plumbing of leaning signs; cleaning of dirty signs, barricades, and other devices; repair of defaced sheeting and legend; and replacement of stolen or vandalized items. All items used for traffic control shall be maintained in a satisfactory condition. Failure to maintain all traffic control devices in a satisfactory

condition may be cause for suspension of construction operations until proper traffic control is re-established.

3.07 The Contractor shall follow the construction procedure and maintenance of traffic as shown on the Traffic Control Plan, unless a more workable plan is agreed to by the Engineer prior to or during the execution of the work. The Contractor shall complete each construction phase in the sequence shown (Example: Phase I-A must be completed before I-B).

3.08 Work on the project shall not start until all the traffic control devices required for the particular work activity have been inspected and approved by the Engineer.

3.09 The Contractor shall continuously review and maintain all traffic control measures to assure that adequate provisions have been made for the safety of the public and workers.

3.010 The Contractor shall furnish a material certification for all new and used reflective sheeting.

END OF SECTION

SECTION 15000
PAVEMENT MARKINGS AND
RAISED PAVEMENT MARKERS
(REVISED 10-1-14)

PART 1 - GENERAL

A. All work associated with the furnishing, installing and removing of pavement markings and pavement markers shall be performed in accordance with these contract documents and the latest publication of the North Carolina Department of Transportation “Standard Specifications for Roads and Structures” and “Roadway Standard Drawings.” Permanent Pavement Markings shall be Alkyd/Maleic Thermoplastic.

END OF SECTION

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SECTION 16000
SOIL EROSION AND SEDIMENTATION CONTROL
(REVISED 6-11-21)

PART 1 - GENERAL

1.01 Except as otherwise specified herein, all sedimentation and erosion control measures shall be in accordance with Division 16 of the “NCDOT Standard Specifications for Roads and Structures”, latest edition.

1.02 Temporary and permanent erosion control measures shall be provided for all land disturbing activities in accordance with the Contract Documents and/or an erosion control plan approved by the North Carolina Department of Environment and Natural Resources (NCDENR). Temporary measures shall be installed by the Contractor, then inspected by the City Stormwater Inspector and NCDENR for compliance prior to any land disturbing activity. The inspection and approval process shall be required on each phase of construction. All permanent erosion control measures shall be incorporated into the work at the earliest practical time. All temporary measures shall be maintained until the permanent measures have taken effect. Temporary and permanent measures shall be coordinated to provide effective and continuous erosion control throughout the construction and post-construction period to minimize siltation of streams, lakes, reservoirs, and other impoundments, ground surfaces, and other property. These measures shall remain in effect until final approval for removal is given by the Inspector and/or the NCDENR at which time the Contractor shall remove all temporary erosion control measures.

1.03 The Contractor shall be familiar with the applicable provisions of the Sedimentation Pollution Control Act of 1973, General Statutes, Chapter 113A, Article 4. The Contractor shall be responsible for incorporating conservation procedures necessary to comply with this act in minimizing erosion and sediment pollution associated with the construction of this project as directed by the Engineer.

1.04 The Contractor shall be financially responsible for any and all fines that result from the Contractor's failure to install and/or maintain erosion control measures in accordance with the Contract Documents.

1.05 The Contractor shall check all erosion and sediment control measures for stability and operation following each rainfall event, and no less than once per week. The Contractor shall make any needed repairs immediately to maintain all control measures as designed.

1.06 The Contractor shall clean out all sediment trapping devices when the device reaches 50% trap capacity and shall dispose of the sediment by spreading on the site in a protected area or by hauling away if not suitable for fill.

PART 2 - TEMPORARY MEASURES

2.01 GENERAL

A. Temporary Silt Fence shall be installed around inlets, at the toe of all fill slopes, and any other necessary locations as shown on the plans and as directed by the Engineer. Silt fence shall be erected in accordance with City Standard Drawing Detail SW-20.02 at locations specified on the construction drawings. .

B. Inlet Protection shall be installed around inlets and any other necessary locations as shown on the plans and as directed by the Engineer. Inlet protection shall be erected in accordance with City Standard Drawing Details SW-20.14 and SW-20.15.

C. Diversion Ditches shall be installed at the top of cut and fill slopes and any other necessary locations as shown on the plans and as directed by the Engineer. Diversion ditches shall be installed in accordance with City Standard Drawing Detail SW-20.11.

D. Temporary Silt Ditches shall be installed at the bottom of fill slopes and any other necessary locations as shown on the plans and as directed by the Engineer. Temporary silt ditches shall be installed in accordance with City Standard Drawing Detail SW-20.16.

E. Tree Protection Fence shall be installed around the drip line of trees in the construction work area as shown on the plans and as directed by the Engineer. The tree protection fence shall be installed in such a manner that it prevents all construction activities from encroaching into the area inside the drip line of the tree. The material and installation specifications for the tree protection fence shall be approved for use by the Engineer prior to installation. Tree Fencing shall be erected in accordance with City Standard Drawing Details SW-20.02 or SW-20.03.

F. Watercourse Buffer Protection Fence shall be installed along watercourse buffers as shown on the plans and as directed by the Engineer. The watercourse buffer protection fence shall be installed in such a manner that it prevents all construction activities from encroaching into the watercourse. The material and installation specifications for the watercourse buffer protection fence shall be approved for use by the Engineer prior to installation. Watercourse Buffer Protection Fence shall be erected in accordance with City Standard Drawing Detail SW-20.22.

G. Sediment and Filter Traps shall be installed at all points where accumulated runoff is released to natural drainage channels as shown on the plans and as directed by the Engineer. Sediment pits and filter basins shall be sized to hold 1800 cubic feet of sediment for every acre of denuded area tributary to the structure. Sediment and filter basins shall be installed in accordance with City Standard Drawing Details SW-20.04 and SW-20.05.

H. Sediment Riser Basins shall be installed at locations as shown on the construction drawings. Sediment Basins shall be installed in accordance with City Standard Drawing Detail SW-20.18.

I. Skimmer Sediment Basins shall be installed at locations as shown on the construction drawings. Skimmer Sediment Basins shall be installed in accordance with City Standard Drawing Details SW-20.19 and SW-20.20.

J. Sediment Basin with Rock Dam shall be installed at locations as shown on the construction drawings. Sediment Basins with Rock Dams shall be installed in accordance with City Standard Drawing Details SW-20.19 and SW-20.21.

K. Rock Pipe Inlet Protection shall be installed at entrances to culvert crossings at locations as specified on the construction drawings. Rock Pipe Inlet Protection shall be installed in accordance with City Standard Drawing Detail SW-20.06.

L. Catch Basin Risers/Filters shall be installed at proposed catch basin locations or at other necessary locations as shown on the plans and as directed by the Engineer. Catch basin risers/filters shall be erected in accordance with City Standard Drawing Detail SW-20.07

M. Construction Entrances shall be installed at all points of access to the construction site and as shown on the construction drawings. Any access point, which does not have a construction entrance, shall be barricaded to prevent its use. Construction entrances shall be installed in accordance with City Standard Drawing Detail SW-20.09

N. Check Dams shall be installed in ditches any and at other necessary locations as shown on the plans and as directed by the Engineer. Check dams shall be erected in accordance with City Standard Drawing Detail SW-20.08.

O. Wattles shall be installed in ditches or curbs at necessary locations as shown on the plans and as directed by the Engineer. Wattles shall be installed in accordance with City Standard Drawing Detail SW-20.23.

P. Silt Fence Outlets shall be installed in low points of silt fence at necessary locations as shown on the plans and as directed by the Engineer. Silt Fence Outlets shall be installed in accordance with City Standard Drawing Detail SW-20.24.

PART 3 - MATTING FOR EROSION CONTROL

3.01 GENERAL

A. Matting for erosion control shall be straw matting, coir fiber mat, excelsior matting, or permanent soil reinforcement matting (PSRM). Matting for erosion control shall not be dyed, bleached, or otherwise treated in a manner that will result in toxicity to vegetation.

B. Straw Matting: Straw matting shall be a machine produced matting of 100% grain straw in accordance with Section 1060-8C of the NCDOT Standard Specifications for Roads and Structures, latest edition.

C. Coir Fiber Mat: Coir fiber shall consist of a 100% coconut fiber (coir) twine woven into high strength matrix and in accordance with Section 1060-14 of the NCDOT Standard Specifications for Roads and Structures, latest edition. Staples shall be the preferred anchors used.

D. Excelsior Matting: Excelsior matting shall be a machine produced mat of curled wood excelsior in accordance with Section 1060-8(B) of the NCDOT Standard Specifications for Roads and Structures, latest edition.

E. Permanent Soil Reinforcement Matting (PSRM): The product shall be a permanent erosion control reinforcement mat and shall be constructed of synthetic or a combination of coconut and synthetic fibers evenly distributed throughout the mat between a bottom UV stabilized netting and a heavy duty UV stabilized top net. The matting shall be stitched together with UV stabilized polypropylene thread to form a permanent three-dimensional structure.

The mat shall have the following minimum physical properties:

Property	**Test Method**	**Value Unit**
Light Penetration	ASTM D6567	9 %
Thickness	ASTM D6525	0.40 in
Mass Per Unit Area	ASTM D6566	0.55 lb/sy
Tensile Strength	ASTM D6818	385 lb/ft
Elongation (Maximum)	ASTM D6818	49 %
Resiliency	ASTM D1777	>70 %
UV Stability *	ASTM D4355	>80 %
Porosity (Permanent Net)	ECTC Guidelines	>85 %
Maximum Permissible Shear Stress (Vegetated)	Performance Bench Test	>8.0 lb/ft2
Maximum Allowable Velocity (Vegetated)	Performance Bench Test	>16.0 ft/s

*ASTM D1682 Tensile Strength and % strength retention of material after 1000 hours of exposure.

Submit a certification (Type 1, 2, or 3) from the manufacturer showing:

(A) the chemical and physical properties of the mat used, and
(B) conformance of the mat with this specification.

F. Wire Staples: Staples shall be machine-made of No. 11 gage new steel wire formed into a “U” shape. The size when formed shall be not less than 6 inches in length with a throat of not less than 1 inch in width.

3.02 CONSTRUCTION METHODS

A. All erosion control matting shall be installed in accordance with Section 1631-3 of the “NCDOT Standard Specifications for Roads and Structures”, latest edition.

PART 4 - RIPRAP DISSIPATION PADS

4.01 GENERAL

A. After construction is complete, all points of stormwater release shall be protected by riprap dissipation pads.

B. Stone for plain riprap shall consist of field stone or rough unhewn quarry stone. The stone shall be sound, tough, dense, resistant to the action of air and water, and suitable in all other respects for the purpose intended. Stone shall vary in weight from 5 to 200 pounds. At least 30 percent of the total weight of the riprap shall be in individual pieces weighing a minimum of 60 pounds each. Not more than 10 percent of the total weight of the riprap may be in individual pieces weighing less than 15 pounds each.

C. Unless otherwise directed by the Engineer, the stone shall be placed on a flat slope or as indicated on the plans. The stone shall be graded so that the smaller stones are uniformly distributed throughout the mass.

D. The Contractor may place the stone by mechanical methods, augmented by hand-placing where necessary, provided that when the riprap is completed it forms a properly graded, dense, neat layer of stone.

E. The completed riprap shall be at least the thickness indicated on the plans, with the top of the riprap pad flush with the surrounding finished grade.

F. Geotextile fabric shall be installed under all riprap unless otherwise noted. Geotextile fabric shall be Type 2 and meet criteria as outlined in Table 1056-1 of the NCDOT Standard Specifications for Roads and Structures, latest edition.

PART 5 – STORMWATER MANAGEMENT DEVICES

5.01 GENERAL

A. Level spreaders shall be constructed in accordance with the NC Division of Water Quality BMP Manual, latest edition.

B. Dry Detention Basins and Wet Detention Basins shall be constructed in accordance with the NC Division of Water Quality BMP Manual, latest edition.

C. Infiltration Basins shall be constructed in accordance with the NC Division of Water Quality BMP Manual, latest edition.

D. Bioretention Areas shall be constructed in accordance with the NC Division of Water Quality BMP Manual, latest edition.

E. Stormwater Wetlands shall be constructed in accordance with the NC Division of Water Quality BMP Manual, latest edition.

F. Filter Strips shall be constructed in accordance with the NC Division of Water Quality BMP Manual, latest edition.

END OF SECTION

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SECTION 17000
TEMPORARY AND PERMANENT GRASSES
(REVISED 10-1-14)

PART 1 - GENERAL

1.01 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil.
B. Manufactured Soil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
C. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
D. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or top surface of a fill or backfill immediately beneath planting soil.
E. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
F. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil, but in disturbed areas such as urban environments, the surfaces oil can be subsoil.

1.02 SUBMITTALS

A. Product Data: For each type of product indicated, including planting soil.

    1. Pesticides and Herbicides: Include product label and manufacturer's application instructions specific to this Project.

B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name and percentage by weight of each species and variety, and percentage of purity, germination, inert matter, noxious weeds by name & % per pound and weed seed. Include the year of production and date of packaging.
C. Product Certificates: For soil amendments and fertilizers, signed by product manufacturer.
D. Qualification Data: For landscape Installer. Include key personnel background and list of similar projects, minimum 3 projects completed and 5 years of experience in turf installation by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.
E. Material Test Reports: For existing surface soil and imported or manufactured topsoil.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Seed: Deliver seed in original sealed, labeled, and undamaged containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws, as applicable.
B. Sod: Harvest, deliver, store, and handle sod according to requirements in Turfgrass Producers International's "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" in its "Guideline Specifications to Turfgrass Sodding." or other approved professional organization such as North Carolina State University's Turf Files or Clemson University. Deliver sod in time for planting within 24 hours of harvesting. Protect sod from breakage and drying.
C. Bulk Materials:

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

1.04 PLANTING TIMES AND RESTRICTIONS

A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion. Variation in schedule shall be pre-approved by Owner.
B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit.

1.08 SITE STABILIZATION TIMEFRAMES

NPDES Stormwater Discharge Permit for Construction Activities (NCGO1) NCDENR/Division of Water Quality		
NEW STABILIZATION TIMEFRAMES (Effective Aug. 3, 2011)		
SITE AREA DESCRIPTION	**STABILIZATION**	**TIMEFRAME EXCEPTIONS**
Perimeter dikes, swales, ditches, slopes	7 days	None
High Quality Water (HQW) Zones	7 days	None
Slopes steeper than 3:1	7 days	If slopes are 10' or less in length and are not steeper than 2:1, 14 days are allowed.
Slopes 3:1 or flatter	14 days	7 days for slopes greater than 50' in length.
All other areas with slopes flatter than 4:1	14 days	None, except for perimeters and HQW Zones.

1.09 SEEDING SCHEDULES

A. Temporary Seeding Schedule

Date	Type	Min.Application Rate
Sept. 15 – Mar. 30	Tall Fescue and	250 lbs/acre
	Winter Rye	50 lbs/acre
Apr. 1 – Sept. 15	Tall Fescue and	250 lbs/acre
	German Millet or	25 lbs/acre
	Sudangrass (small-stemmed var.)	30 lbs/acre

B. Permanent Seeding Schedule for Non-Lawn Areas

For Shoulders, Side Ditches, Slopes (Max 3:1):

Date	Type	Planting Rate
Aug 15–Nov 1	Tall Fescue	300 lbs/acre
Nov 1–Mar 1	Tall Fescue & Abruzzi Rye	300 lbs/acre
Mar 1–Apr 15	Tall Fescue	300 lbs/acre
Apr 15–Jun 30	Hulled Common Bermudagrass	25 lbs/acre
Jul 1–Aug 15	Tall Fescue AND Browntop Millet or Sorghum-Sudan Hybrids***	125 lbs/acre (Tall Fescue); 35 lbs/acre (Browntop Millet); 30 lbs/acre (Sorghum-Sudan Hybrids)

For Shoulders, Side Ditches, Slopes (3:1 to 2:1):

Date	Type	Planting Rate
Mar 1–Jun 1	Sericea Lespedeza (scarified) and use the following combinations:	50 lbs/acre (Sericea Lespedeza);
Mar 1–Apr 15	Add Tall Fescue	120 lbs/acre
Mar 1–Jun 30	Or add Weeping Love grass	10 lbs/acre
Mar 1–Jun 30	Or add Hulled Common Bermudagrass	25 lbs/acre
Jun 1–Sept 1	Tall Fescue AND Browntop Mullet or Sorghum-Sudan Hybrids***	120 lbs/acre (Tall Fescue); 35 lbs/acre (Browntop Mullet); 30 lbs/acre (Sorghum-Sudan Hybrids)
Sept 1–Mar 1	Sericea Lespedeza (unhulled – unscarified) AND Tall Fescue	70 lbs/acre (Sericea Lespedeza); 120 lbs/acre (Tall Fescue)
Nov 1–Mar 1	AND Abruzzi Rye	25 lbs/acre

Consult S&EC Environmental Engineers for additional information concerning other alternatives for vegetation of denuded areas. The above vegetation rates are those that do well under local conditions; other seeding rate combinations are possible.

*** **TEMPORARY**: Reseed according to optimum season for desired permanent vegetation. Do not allow temporary cover to grow more than 12" in height before mowing; otherwise, fescue may be shaded out.

C. Permanent Seeding Schedule for Lawn Areas

Date	Type	Min.Application Rate
Apr 1 – July 15	Common Bermudagrass or	75 lbs/acre
	Improved Bermudagrass	
Apr 1 – July 15	Centipedegrass	40 lbs/acre
Apr 1 – July 15	Zoysiagrass	75 lbs/acre
June 1 – Aug 15	Tifway 419 or Tifton 10	6 bushels/1,000 sq ft (sprigs)
	Zoysiagrass	6 bushels/1,000 sq ft (sprigs)
June 1 – Aug 15	Tifway 419 or Tifton 10 Centipedegrass or Zoysiagrass	sod
Sept 1 – Oct 15	Turf Type Tall Fescue	350 lbs/acre
Sept 1 – Oct 15	Turf Type Tall Fescue	sod

PART 2 - PRODUCTS

2.01 SEED

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

B. Seed Species: Seed of grass species as follows, with not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed:

1. Permanent seeding: Common Bermudagrass (Hulled)
   Turf Type Tall Fescue
   Improved Bermudagrass
   Centipedegrass
   Zenith Zoysiagrass

2. Temporary seeding: Tall Fescue and Winter Rye
   Tall Fescue and German Millet or Sudangrass

2.02 TURFGRASS SOD

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

B. Turfgrass Species: Sod of grass species as follows, with not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed.

1. Tifway 419, Tifton 10, Centipedegrass, Zoysiagrass or Turf Type Tall Fescue

2.03 PLANTING SOILS

A. Planting soil: ASTM D 5268, pH range of 5.5 to 7, a minimum of 20 percent organic material content; free of stones 1/2 inch or larger in any dimension and other extraneous materials harmful to plant growth.

1. Soil Source: Reuse surface soil stockpiled on-site. Verify suitability of stockpiled surface soil to produce viable planting soil. Remove roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth. Amend surface soil per soil test recommendations.

2. Supplement with imported or manufactured topsoil from off-site sources when quantities are insufficient.

2.04 FERTILIZER

A. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 4 percent nitrogen and 20 percent phosphoric acid.
B. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

C. Slow-Release Fertilizer: Granular or pelletized fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.
2. Fish-emulsion, compost tea.

D. Other Organic Fertilizer: Contractor is encouraged to utilize other organic fertilizer with a lower nitrogen value, such as worm castings, sewage sludge. Contractor shall submit product information for Architect’s approval prior to application.

2.05 MULCHES

A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.
B. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content: 50 to 60 percent of dry weight.

C. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic; free of plant-growth or germination inhibitors; with maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.
D. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.
E. Asphalt Emulsion: ASTM D 977, Grade SS-1; nontoxic and free of plant-growth or germination inhibitors.

PART 3 - INSTALLATION

3.01 EXAMINATION

A. Examine areas to receive turf and grass for compliance with requirements and other conditions affecting performance. Grade strictly according to the proposed grading plan. Proceed with installation only after Owner approves the subgrade and unsatisfactory conditions have been corrected.

3.02 SITE 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 overspray.

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

3.03 TURF/SEEDBED PREPARATION

A. After construction is complete in any area or phase of the project, the disturbed areas shall receive a permanent ground cover. Seeding and mulching shall be performed immediately behind construction. The Contractor shall provide permanent seeding in all disturbed areas as indicated in the Contract Documents. The Contractor shall adapt permanent seeding operations to protect and to accommodate any temporary seeding and soil and erosion control measures that may already be in place during the work period.

B. When seeding must take place out of season for permanent grass the appropriate temporary seeding shall be done and the contractor shall be responsible for permanent seeding.

C. Contractor shall be responsible for turf maintenance through substantial completion. Slopes must be at 90% coverage at substantial completion review to be accepted. If not at 90% coverage, substantial completion will be delayed until the following growing season.

D. Use following table for seedbed preparation.

Mixture

Agricultural Limestone	2 tons/acre (3 tons/acre in clay soils)
Fertilizer	1,000 lbs/acre – 10-10-10
Superphosphate	500 lbs/acre – 20% analysis
Mulch	2 tons/acre – small grain straw
Anchor	Asphalt emulsion at 300 gals/acre

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

3.04 ESTABLISHMENT OF TEMPORARY AND PERMANENT NON-LAWN AREAS

A. GENERAL

1. After construction is complete in any area or phase of the project, the disturbed areas shall receive a permanent ground cover. Seeding and mulching shall be performed immediately behind construction. The Contractor shall provide permanent seeding in all disturbed areas as indicated in the Contract Documents. The Contractor shall adapt permanent seeding operations to protect and to accommodate any temporary seeding and soil and erosion control measures that may already be in place during the work period.

2. Seed or plant the required grass according to TEMPORARY SEEDING SCHEDULE AND/OR PERMANENT SEEDING SCHEDULE FOR NON-LAWN AREAS TABLE as specified herein.

3. The choice of turfgrass type, variety and propagation form shall be specified in the Contract Documents, as specified in the Itemized Proposal, or as designated by the Engineer.

4. Seed shall be tagged certified seed. Germination shall be a minimum of 90%. Seed shall be 98% pure with less than 2% other-crop seed or debris. Seed shall be free of noxious weed seed.

5. When seeding must take place out of season for permanent grass the appropriate temporary seeding shall be done and the contractor shall be responsible for permanent seeding as specified in season.

6. Contractor shall be responsible for turf maintenance through substantial completion. Slopes must be at 90% coverage at substantial completion review to be accepted. If not at 90% coverage, substantial completion will be delayed until the following growing season.

B. SITE PREPARATION

1. Ground Cover: All disturbed areas shall be dressed to a depth of six (6) inches. The top two (2) inches shall be pulverized to provide a uniform seedbed. Rake or harrow the site to establish a smooth and level final grade. Soil particles should be no larger than marble size, and pea gravel size is even better. Agricultural lime shall be applied at the rate of 95 lbs./1000 sq. ft. immediately before plowing. Grass seed shall be applied at the rates outlined in Tables 1 and 2.

2. 5-10-10 fertilizer shall be applied to all disturbed areas at a rate of 21 lbs./1000 sq. ft. Mulching shall consist of small grain straw applied at a rate of 70 lbs./1000 sq. ft. Mulched areas shall be tacked with asphalt or other approved method sufficient to hold the straw in place, at a rate of 150 to 200 gallons per ton of straw.

3. If active construction ceases in any area for more than thirty (30) days, all disturbed areas must be seeded, mulched, fertilized and tacked.

4. Some areas may require temporary seeding due to an interruption of work exceeding thirty (30) days or seasonal restrictions as specified in the permanent seeding schedule, or a combination thereof. These areas shall be reseeded in accordance with the permanent seeding schedule. If temporary seeding is required due to Contractor delays, there will be no compensation for the temporary seeding. Temporary seeding shall be performed only at the direction of the Engineer or Inspector.

5. When seeding must take place out of season for permanent grass the appropriate temporary seeding shall be done and the contractor shall be responsible for permanent seeding as specified in season.

3.05 ESTABLISHMENT OF PERMANENT LAWN AREAS

A. GENERAL

1. Seed or plant the required grass according to PERMANENT SEEDING FOR LAWN AREAS TABLE as specified herein.

2. The choice of turfgrass type, variety and propagation form shall be specified in the Contract Documents, as specified in the Itemized Proposal, or as designated by the Engineer.

3. Seed shall be tagged certified seed. Germination shall be a minimum of 95%. Seed shall be 98% pure with less than 2% other-crop seed or debris. Seed shall be free of noxious weed seed.

4. Sod, sprigs, plugs or other vegetative plant propagation materials shall be certified free of noxious weeds. Materials shall be in good health and vigor, free of disease or pests, or damage from dryness, adverse temperature, herbicides, fertilizer or other chemicals. Sprigs that are older than 48 hours are not acceptable regardless of condition.

5. The Contractor shall maintain a log of dates that sod, sprigs, plugs, or other seeding installation was completed for each individual property and shall notify the Engineer or Inspector of each day’s progress.

B. SEEDING

1. Apply a starter-type fertilizer to the soil surface for example, 10 pounds of 5-10-10 or 5 pounds of 10-20-20 per 1,000 square feet at the time of seeding.

2. Lightly cover the seed by hand raking or dragging with a mat or chain-link fence. Roll or tamp the soil lightly to firm the surface and provide good seed-to-soil contact.

3. Mulch grass seed with weed-free small grain straw or hay. Use one bale per 1,000 square feet for warm-season grasses and 1 to 2 bales for cool-season grasses. Stabilize small areas of mulch by rolling, watering or tacking with asphalt tacking spray. Twine netting can be used if wind displacement is a problem. If applied evenly and lightly, these materials need not be removed. Larger areas shall be stabilized by asphalt tacking spray or twine netting.

4. Lightly water seeding areas periodically to keep soil moist through the first 7 days to ensure proper germination.

C. SODDING

1. Remove plastic netting or backing from sod.

2. Lay sod as soon as possible after it has been harvested to prevent injury. Sod should be installed within 24 hours of harvesting. While installing, take action as necessary to prevent heat buildup within the unlaid sod. Plan to unstack and unroll the sod if it cannot be laid within 48 hours. Soil should be moist (but not overly wet) before laying sod. Irrigating the soil several days before delivery is often adequate.

1. Start sodding from a straight edge (driveway or sidewalk) and butt strips together, staggering them in a brick-like pattern. Avoid stretching sod. Use a knife or sharp spade for trimming to fit irregularly shaped areas. Lay sod lengthwise across the face of slopes and peg or stake the pieces to prevent slippage. After the sod has been placed, roll the lawn to ensure good sod-to-soil contact.

    a. Lay sod across angle of slopes exceeding 1:3.
    b. Anchor sod on slopes exceeding 1:6 with wood pegs or steel staples spaced as recommended by sod manufacturer but not less than 2 anchors per sod strip to prevent slippage.

3. Water sod immediately after installation. Soak sod thoroughly enough to penetrate soil below the newly installed sod to a minimum depth of two (2) inches. Contractor is responsible for insuring adequacy of water supply. The Contractor shall provided any necessary temporary means to properly water sod, including temporary pumps and sprinklers. Proper irrigation shall be required by the contractor until the project has been inspected and is accepted by the City. (The Contractor shall be required to obtain all applicable watering permits from the City prior to beginning watering activities.)

3.06 HYDROSEEDING

A. Hydroseeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.

1. Mix slurry with a tackifier.
2. Apply slurry uniformly to all areas to be seeded in a one-step process. Apply mulch at a minimum rate of 1500-lb/acre dry weight but not less than the rate required to obtain specified seed-sowing rate.

3.07 TURF RENOVATION

A. Renovate existing turf damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.

1. Reestablish turf where settlement or washouts occur or where minor regrading is required.

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

3.08 MOWING

A. Mowing may be periodically required as directed by the Engineer.

B. Mow at the location and times as directed.

C. Specialized Hand Mowing shall be performed in accordance with Section 1667 of the latest edition of the “North Carolina Standards and Specifications for Roads and Structures”.

3.09 CLEANUP AND INSPECTION:

A. Upon completion of work, the Contractor shall remove from the site all equipment and other articles used. All excess soil, stone, and debris shall be removed and legally disposed. All work areas shall be left in a clean and neat condition. All damage to existing construction caused by landscaping operations shall be repaired to the satisfaction of the City at the Contractor’s expense.

B. Seeded areas shall be protected and replanted as necessary to establish a uniform stand of specified grass. Scattered bare spots, none of which shall be larger that one (1) square foot, will be allowed up to a maximum of 3% of the seeded area for each property. When seeded areas are ready for inspection, the maintained turf areas shall be neatly mowed to the uniform height of approximately two and one-half (2.5) inches. The lawns shall be considered established only when the specified grass is vigorous and growing well in addition to meeting the other requirements specified.

C. An inspection of the completed seeding shall be made at the conclusion of the landscape work upon written notice requesting such inspection submitted by the Contractor to the Engineer, at least ten (10) days prior to the anticipated date of inspection.

D. A final inspection shall be performed when a satisfactory stand of seeded turf grass has been produced, upon written notice requesting such inspection submitted by the Contractor to the Engineer, at least ten (10) days prior to the anticipated date of inspection. If a satisfactory stand of turf has not been produced at the time of final inspection, necessary repairs shall be performed in conformance with the requirements of this section. Upon completion of these repairs, the seeded grass shall be reinspected upon written notice as above.

END OF SECTION

SECTION 18000
TRAFFIC SIGNALS
(REVISED 10-1-14)

PART 1 - GENERAL DESCRIPTION

A. The work covered by this section consists of installing a permanent traffic signal or revising an existing signal at the intersection shown on the plans in Raleigh, North Carolina.

B. Unless otherwise stated in this Section, the Contractor shall conform to the latest publications of the North Carolina Department of Transportation (NCDOT) “Standard Specifications for Roads and Structures”, the NCDOT “Roadway Standard Drawings”, the NCDOT “Traffic Signal Specifications” (including all addenda and supplements), the traffic signal plans, the latest version of the “Manual on Uniform Traffic Control Devices” (MUTCD), and the NCDOT “North Carolina Supplement to the MUTCD.”

C. Copies of the latest publication of the NCDOT “Standard Specifications for Roads and Structures” and “Roadway Standard Drawings” may be obtained by calling (919) 250-4128 or writing to the following address:

Special Services Engineer
NC Department of Transportation
P.O. Box 25201
Raleigh, NC 27611-5201

D. Copies of the latest publication of the NCDOT “Traffic Signal Specifications” and NCDOT “North Carolina Supplement to the MUTCD” may be obtained by calling (919) 733-3915 or writing to following address:

Traffic Engineering Branch
N.C. Department of Transportation
P.O. Box 25201
Raleigh, NC 27611-5201

E. Unless otherwise stated in this Section, the Contractor shall furnish, store, deliver, and install all equipment, material, tools, and incidental hardware necessary to complete the required traffic signal work.

F. Unless otherwise stated in this Section, furnish new material meeting the requirements of the “Traffic Signal Specifications,” the “Standard Specifications for Roads and Structures,” and the traffic signal plans. In the event of a conflict between the Project Special Provisions and these documents, the Project Special Provisions shall govern.

G. The NCDOT has a Qualified Products List (QPL) available for use by the Contractor. Products on the QPL may or may not meet all the requirements of individual projects in the City of Raleigh. The QPL website is: http://www.doh.dot.state.nc.us/preconstruct/traffic/TMSSU/SMS/QPL/ Furnish the Engineer with three (3) copies of a materials list of the proposed materials for use on the project. Include three copies of the catalog cuts for all materials with the materials list. Identify by a reproducible means on the catalog cuts the proposed materials with the line code number. Material lists shall contain the material description, brand name, manufacturer's address and phone number, stock number, size, identifying trademark or symbol, and other appropriate ratings to sufficiently identify the material. Do not fabricate or order material until receipt of the Engineer's approval of the catalog cuts.

PART 2 - MAST ARMS

A. The Contractor shall conform to the latest publications of the NCDOT "Standard Specifications for Roads and Structures" except as follows: **ALL MAST ARMS SHALL BE MONOCURVED TYPE MAST ARMS IN THE CITY OF RALEIGH**. All shop drawings and signal plans shall reflect the exclusive use of monocurved mast arms.

PART 3 - CONTRACTOR'S LICENSE REQUIREMENTS

A. If the successful bidder does not hold the proper license to perform the electrical work of this contract, he will be required to sublet such work to a Contractor properly licensed in accordance with Article 4 of Chapter 87 of the General Statutes (licensing of electrical contractors).

PART 4 - WORK TO BE DONE BY THE CONTRACTOR

A. The Contractor shall install the traffic signal equipment and all other specified materials at the referenced intersection in order to complete the signal installation work at the intersection referenced in "General Description" within this section. The Contractor shall notify the Engineer at least one week in advance of the estimated date of the signal being placed in service and confirm the notification one (1) day prior to that date.

B. The Contractor will be responsible for contacting the proper electrical utility company to provide power for the traffic signal.

PART 5 - ELECTRICAL REQUIREMENTS - GENERAL

A. All Contractor supplied electrical materials and all work performed on the project shall meet the latest requirements of the National Electrical Code and all applicable City of Raleigh ordinances.

B. The Contractor shall comply with all applicable City of Raleigh ordinances and regulations prior to beginning any electrical work. He shall obtain all permits and licenses required by the State and the City of Raleigh. After completion of the work,

all systems must be inspected. After receiving written approval by the electrical inspectors having jurisdiction in the locality, the Contractor shall furnish written certification to the Engineer that the installation meets the approval of the electrical inspector(s). Upon the Engineers' receipt of this written certification and the Contractor's written request for a final inspection of the signal installation, the Engineer will determine if a final inspection by the Engineer and a representative of the Traffic Engineering Branch of the Department of Transportation should be conducted. Inspection by the licensed electrical inspector shall neither eliminate nor take the place of inspections by Department of Transportation and City of Raleigh personnel to insure compliance with the Contract Documents.

PART 6 - UTILITY LOCATION RESPONSIBILITY

A. The Contractor's attention is called to the existence of underground utilities and structures, limited space on aerial facilities, and other obstructions within the project limits. The Contractor is advised to perform a field check of all physical conditions prior to submitting his cost proposal and to exercise extreme caution during construction. Neither the City of Raleigh nor the State of North Carolina will assume any responsibility or honor any claims due to costs incurred to the Contractor as a result of damage to existing facilities.

B. The Contractor will be provided a clear right of way for the signal installation. The Contractor shall contact One Call Center locating service at (800) 632-4949 and/or the affected local utility for immediate location of all underground utilities in the vicinity of the project. The Contractor shall be responsible for any damages to utilities resulting from work performed by the Contractor according to the latest version of the NCDOT “Standard Specifications for Roads and Structures.”

C. The Contractor shall maintain minimum clearance from existing utilities as required by the utility having jurisdiction over the pole to which conductors, conduit, etc. are attached by the Contractor. The Contractor shall install standoffs where necessary to maintain these distance requirements.

PART 7 - TIMING OF THE TRAFFIC SIGNALS

A. The Contractor shall implement the timing values for the traffic signal controllers as shown on the plans. The Engineer shall reserve the right during the course of the project to make minor field timing changes necessary for pattern optimization and to eliminate identifiable potential hazards to the motoring public.

PART 8 - MAINTENANCE OF TRAFFIC

A. The Contractor shall be responsible for maintaining traffic in a safe and efficient manner at all work sites. City of Raleigh ordinances involving the time of day a Contractor may work are to be observed. The Contractor shall not narrow or close any lane of traffic between the hours of 7:00 AM through 9:00 AM and 4:00 p.m. through 6:00 p.m. Monday through Friday. Traffic control shall be in accordance

with the latest version of the North Carolina Department of Transportation “Standard Specifications for Roads and Structures.”

B. The use of police and/or trained flagmen to control traffic through the intersection will be provided by the Contractor as required. The Contractor will be responsible for obtaining trained personnel to direct traffic and contracting with local authorities for the use of police for traffic control. Proper traffic control devices such as advance construction warning signs, flashing arrow panels, cones, etc., shall be used as prescribed by the NCDOT “Roadway Standard Drawings”, the MUTCD, the NCDOT “North Carolina Supplement to the MUTCD,” or as directed by the Engineer.

C. All traffic control devices shall be in place before beginning work each day, and removed at the end of the work day or during times of construction inactivity.

D. The existing signal shall remain in operation until all new work is completed for a traffic signal upgrade. The controller and cabinet will be moved to their new locations at this time and placed in operation. City of Raleigh Police will be needed to direct traffic during this time, which shall be limited to the hours of 9:00 a.m. to 3:00 p.m. The Contractor should give the Engineer 48 hours notice prior to need for Police to direct traffic.

PART 9 - FINAL ACCEPTANCE AND TEN DAY OBSERVATION PERIOD

A. Upon completion of all construction as defined in these Contract Documents and special provisions for the project and after the traffic signal installation has been approved, inspected, put into permanent operation and demonstrated to the Engineer to be totally operational, a 10-day observation period shall begin upon written notification to the Contractor by the Engineer. The purpose of this observation period is to assess the adequacy of the installation and operation of the equipment. During this 10-day observation period, the Contractor shall repair any defects in the installation work of the traffic signals performed by the Contractor, and make any adjustments deemed necessary by the Engineer. Should any failures occur during this observation period, the Contractor shall begin to make necessary repairs within four (4) hours of notification. Should such necessary repairs not be completed within twenty-four hours of notification, the observation period shall stop and resume only after such repairs and replacement of materials have been made, inspected and approved. During this observation period, the Contractor shall repair or replace any material and equipment furnished by him that becomes defective, lost, or damaged.

B. The Contractor will repair, acceptable to the Engineer, scratches, dents, or other damage to the cabinets, which occur while the cabinets are under his responsibility. Unless otherwise noted, cabinets shall be unpainted natural aluminum.

C. Completion and final acceptance of the project shall be contingent upon successful completion of the Observation Period. The Observation Period shall be considered to be part of the work required to be completed by the final completion date specified herein.

D. Upon completion of the project, and prior to final acceptance by the City of Raleigh or NCDOT, the Contractor will furnish to the City one (1) signal inventory control sheet and one (1) set of plans showing “as-built” conditions.

END OF SECTION 18000

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SECTION 19000
PROJECT SPECIAL PROVISIONS
(Revision 01-05-22)

ROADWAY CONSTRUCTION

GENERAL

All construction shall conform to pertinent OSHA requirements, City of Raleigh Standards and Specifications, and NCDOT Standard Specifications for Roads and Structures. Specification editions in effect at the time of the bid date shall govern.

1. SITE CONDITIONS

The Contractor shall accept the actual conditions at the site and perform the work specified without additional compensation for possible variation from grades and conditions shown whether surface or subsurface, except as provided for by the Contract Documents. If existing conditions are at variance with the drawings, the Engineer shall be notified before proceeding with the work, and adjustments shall be made only as directed by the Engineer.

The Contractor shall inspect existing buildings, sidewalks, curb and gutter, pavement, light posts, and other physical features within and in the proximity of the project limits, and shall notify the Engineer, in writing, prior to beginning any construction, of any distress or existing damage such as cracking, settlement, and spalling or light malfunctions. Documentation of such distress or existing damages shall include date stamped photographs or motion video as necessary to provide eveidence of such damage prior to the beginning of construction operations. Any damage to these items resulting from the work of this contract shall be promptly repaired by the Contractor in a manner approved by the Engineer.

2. CITIZEN NOTIFICATION

The Contractor shall be responsible for notifying, in writing all residents and business/property owners as per article 104-13, Citizen Notification of the Contract General Conditions.

3. MEETINGS

The Contractor shall have his job supervisor or superintendant attend project meetings with the City, as he deems necessary to ensure proper coordination of construction. These meetings shall be scheduled by the Engineer.

4. PREPARATION OF SITE

Excavation shall be done in such a manner as to provide for safe working conditions for the duration of the project.

5. ADJACENT PROPERTY ACCESS

Driveway and roadway access to properties adjoining the project must be maintained at all times during construction. The Contractor shall provide all labor and materials necessary to accomplish this work. There shall be no separate compensation for this work.

6. GRADING, SHOULDERS AND SLOPES:

Shoulders and slopes (for a depth of 4 to 6 inches) shall be free of all stone and clods that exceed one inch in diameter. Fine grading (raking) shall take place just before seeding and mulching. The inspector must approve all areas to be seeded prior to seeding.

7. EXCESS TOPSOIL EXCAVATION

All excess excavation incluing topsoil shall be hauled off-site at a site approved by the City, or as an alternative, the topsoil may be blended with on-site borrow, which will reduce the total quantity of off-site borrow. If a blending option is a preferred method, the soil blending ratio shall be as directed by the Geotechnical Engineer and the Geotechnical Engineer and/or City Inspector shall observe the blending operations.

8. SEEDING/MULCHING IN ESTABLISHED AREAS:

Special attention shall be given in the seeding and mulching in established areas. Lawn quality care shall be taken and appropriate seed used to match existing lawn types on a lot per lot basis. All seeding areas shall be measured prior to installation so the City inspector may verify the correct amount of seed, fertilizer, lime and any other supplements required for the seeding area in accordance with the Contract Documents. Seeding, mulching and seedbed preparation shall be approved by both the Project Engineer and the Project Inspector prior to acceptance and payment.

Compensation for seeding and mulching shall include the initial seeding, repair seeding at the time of final inspection (if necessary), and repair seeding at the end of the one-year warranty period (if necessary).

9. MAINTENANCE AND REMOVAL OF EROSION CONTROL MEASURES

All erosion control measures shall include the installation, maintenance, and removal of these measures. This shall also include any modifications to the erosion control measures during the course of the project due to grade changes around the location of the installed measures.

10. GEOGRID REINFORCEMENT

Geogrid Reinforcement shall be a regular grid structure formed by biaxially drawing a continuous sheet of select polypropylene material and shal have aperture geometry and rib and junction cross section sufficient to permit significant mechanical interlock with the material being reinforced. The geogrid shall have high flexural rigidity and high tensile modulus in relation to the material being reinforced and shall also have high continuity of tensile strength through all ribs and junctions of the grid structure. The geogrid shall maintain its reinforcements and interlock capabilities under repeated dynamic loads while in service and shall also be resistant to ultraviolet degradation, resistant to damage under normal construction practices, and resistant to all forms of biological or chemical degradation normally encountered in the material being reinforced. The goegrid material shall be type BX1100 or UX1100 as manufactured by Tensar Corp. (or approved equal). The contractor shall receive approval from the Engineer and/or Geotechnical Engineer prior to performing any work under “Geogrid Reinforcement”.

11. SUPPLEMENTAL CONCRETE REMOVAL:

Remove additional concrete curbs, sidewalks, structures, or other miscellaneous concrete items that are not shown as to be removed on the contract documents and as directed by the ENGINEER.

12. INCIDENTAL STONE BASE

Description

Place incidental stone base on driveways, mailboxes, etc. immediately after paving and do not have the paving operations exceed stone base placement by more than one week without written permission of the Engineer.

Materials and Construction

Provide and place incidental stone base in accordance with Section 545 of the NCDOT Standard Specifications for Roads and Structures, latest edition.

13. ASPHALT PAVEMENTS - SUPERPAVE:

Revise the NCDOT Standard Specifications for Roads and Structures, latest edition as follows:

Page 6-3, Article 605-7 APPLICATION RATES AND TEMPERATURES, replace this article, including Table 601-1, with the following:

Apply tack coat uniformly across the existing surface at target application rates shown in Table 605-1.

TABLE 605-1 APPLICATION RATES FOR TACK COAT	
Existing Surface	**Target Rate (gal/sy)**
	Emulsified Asphalt
New Asphalt	0.04 ± 0.01
Oxidized or Milled Asphalt	0.06 ± 0.01
Concrete	0.08 ± 0.01

Apply tack coat at a temperature within the ranges shown in Table 605-2. Tack coat shall not be overheated during storage, transport or at application.

TABLE 605-2 APPLICATION TEMPERATURE FOR TACK COAT	
Asphalt Material	**Temperature Range**
Asphalt Binder, Grade PG 64-22	350 - 400°F
Emulsified Asphalt, Grade RS-1H	130 - 160°F
Emulsified Asphalt, Grade CRS-1	130 - 160°F
Emulsified Asphalt, Grade CRS-1H	130 - 160°F
Emulsified Asphalt, Grade HFMS-1	130 - 160°F
Emulsified Asphalt, Grade CRS-2	130 - 160°F

Page 6-7, Article 609-3 FIELD VERIFICATION OF MIXTURE AND JOB MIX FORMULA ADJUSTMENTS, lines 35-37, delete the second sentence of the second paragraph.

Page 6-18, Article 610-1 DESCRIPTION, lines 40-41, delete the last sentence of the last paragraph.

Page 6-19, Subarticle 610-3(A) Mix Design-General, line 5, add the following as the first paragraph:

Warm mix asphalt (WMA) is allowed for use at the Contractor's option in accordance with the NCDOT Approved Products List for WMA Technologies available at:
https://connect.ncdot.gov/resources/Materials/MaterialsResources/WMA%20Approved%20Lists.pdf

Page 6-21, Subarticle 610-3(C) Job Mix Formula (JMF), replace Table 610-1 with the following:

TABLE 610-1
DESIGN MIXING TEMPERATURE AT THE ASPHALT PLANT[A]

Binder Grade	HMA JMF Temperature	WMA JMF Temperature Range
PG 64-22	300ºF	225 - 275ºF
PG 70-22	315ºF	240 - 290ºF
PG 76-22	335ºF	260 - 310ºF

A. The mix temperature, when checked in the truck at the roadway, shall be within plus 15º and minus 25º of the temperature specified on the JMF.

Page 6-21, Subarticle 610-3(C) Job Mix Formula (JMF), lines 4-6, delete first sentence of the second paragraph. Line 7, in the second sentence of the second paragraph, replace “275ºF” with “275ºF or greater.”

Page 6-22, Article 610-4 WEATHER, TEMPERATURE AND SEASONAL LIMITATIONS FOR PRODUCING AND PLACING ASPHALT MIXTURES, lines 15-17, replace the second sentence of the first paragraph with the following:

Do not place asphalt material when the air or surface temperatures, measured at the location of the paving operation away from artificial heat, do not meet Table 610-5.

Page 6-23, Article 610-4 WEATHER, TEMPERATURE AND SEASONAL LIMITATIONS FOR PRODUCING AND PLACING ASPHALT MIXTURES, replace Table 610-5 with the following:

TABLE 610-5
PLACEMENT TEMPERATURES FOR ASPHALT

Asphalt Concrete Mix Type	Minimum Surface and Air Temperature
B25.0B, C	35°F
I19.0B, C, D	35°F
SF9.5A, S9.5B	40°F
S9.5C, S12.5C	45°F
S9.5D, S12.5D	50°F

Page 6-26, Article 610-7 HAULING OF ASPHALT MIXTURE, lines 22-23, in the fourth sentence of the first paragraph replace “so as to overlap the top of the truck bed and” with “to”.

14. ASPHALT BINDER CONTENT OF ASPHALT PLANT MIXES:

The approximate asphalt binder content of the asphalt concrete plant mixtures used on this project will be as follows:

Asphalt Concrete Base Course	Type B 25.0__	4.4%
Asphalt Concrete Intermediate Course	Type I 19.0__	4.8%
Asphalt Concrete Surface Course	Type S 4.75A	6.8%
Asphalt Concrete Surface Course	Type SA-1	6.8%
Asphalt Concrete Surface Course	Type SF 9.5A	6.7%
Asphalt Concrete Surface Course	Type S 9.5__	6.0%
Asphalt Concrete Surface Course	Type S 12.5__	5.6%

The actual asphalt binder content will be established during construction by the Engineer within the limits established in the NCDOT Standard Specifications for Roads and Structures, latest edition.

15. ASPHALT CONCRETE SURFACE COURSE COMPACTION

Compact the asphalt surface course on this project in accordance with Subarticle 610-9 of the NCDOT Standard Specifications for Roads and Structures, latest edition and the following provision:

Perform the first rolling with a steel wheel roller followed by rolling with a self-propelled pneumatic tired roller with the final rolling by a steel wheel roller.

16. TEMPORARY SEEDING & MULCHING

Modify Sections 1615-4 and 1620-4 in the NCDOT Standard Specifications to state…

Repair any damage to earthwork or temporary seeding which is due to carelessness or neglect on the part of the Contractor.

17. SPECIAL AGREEMENTS

The special agreements listed in Appendix A – Right of Way Agreements are hereby considered part of this contract.

18. STREET SIGNS AND MARKERS AND ROUTE MARKERS

Move any existing street signs, markers, and route markers out of the construction limits of the project and install the street signs and markers and route markers so that they will be visible to the traveling public if there is sufficient right of way for these signs and markers outside of the construction limits.

Near the completion of the project and when so directed by the Engineer, move the signs and markers and install them in their proper location in regard to the finished pavement of the project.

Stockpile any signs or markers that cannot be relocated due to lack of right of way, or any signs and markers that will no longer be applicable after the construction of the project, at locations directed by the Engineer for removal by others.

The Contractor will be responsible to the owners for any damage to any street signs and markers or route markers during the above described operations.

19. PAVEMENT MARKINGS

All temporary pavement markings shall be paint and all permanent pavement markings shall be thermoplastic unless otherwise noted on the plans. The pavement marking contractor shall premark all pavement markings and have the Engineer approve the premarking prior to completing these pavement markings in case any adjustments are required based on actual site conditions. Any pavement markings placed prior to approval of the Engineer are subject to removal and replacement as directed by the Engineer.

20. PERMANENT TRAFFIC SIGNAGE

Permanent traffic signage shall be considered full compensation for all equipment, materials, labor, and incidentals for work associated with the installation of new permanent traffic signage at locations as shown on the plans. The work shall include, but is not limited to signage fabrication and installation, including 3 lb. galvanized steel U-channel posts, bolts, and any incidentals required to install the traffic signage

21. GUARDRAIL ANCHOR UNITS, TYPE 350

Revision Date: 08-16-11

DESCRIPTION

Furnish and install guardrail anchor units in accordance with the details in the plans, the applicable requirements of Section 862 of the NCDOT Standard Specifications for Roads and Structures, latest edition, and at locations shown in the plans.

MATERIALS

The Contractor may at his option, furnish any one of the guardrail anchor units.

Guardrail anchor unit (ET-P) as manufactured by:

TRINITY INDUSTRIES, INC.
2525 N. STEMMONS FREEWAY
DALLAS, TEXAS 75207
TELEPHONE: 1-800-644-7976

The guardrail anchor unit (SKT 350) as manufactured by:

ROAD SYSTEMS, INC.
3616 OLD HOWARD COUNTY AIRPORT
BIG SPRING, TEXAS 79720
TELEPHONE: (915) 263-2435

Prior to installation the Contractor shall submit to the Engineer:

1. FHWA acceptance letter for each guardrail anchor unit certifying it meets the requirements of NCHRP Report 350, Test Level 3, in accordance with Section 106-2 of the NCDOT Standard Specifications for Roads and Structures, latest edition.

2. Certified working drawings and assembling instructions from the manufacturer for each guardrail anchor unit in accordance with Section 105-2 of the Specifications.

No modifications shall be made to the guardrail anchor unit without the express written permission from the manufacturer. Perform installation in accordance with the details in the plans, and details and assembling instructions furnished by the manufacturer.

CONSTRUCTION METHODS

Guardrail end delineation is required on all approach and trailing end sections for both temporary and permanent installations. Guardrail end delineation consists of yellow reflective sheeting applied to the entire end section of the guardrail in accordance with Article 1088-3 of the NCDOT Standard Specifications for Roads and Structures, latest edition.

22. MODULAR BLOCK RETAINING WALL

DESCRIPTION:

This work consists of designing, furnishing and installing retaining wall including any and all materials required in accordance with the details and location shown in the plans. The wall may be of a Keystone ® Retaining Wall System or similar type, or of a custom design.

DETAILED DESIGN:
The Contractor shall develop a design for the retaining wall and shall submit it to the City of Raleigh for approval. Construction may begin only after the design has been approved by the Engineer. Any wall installed by the Contractor prior to approval by the Engineer may be subject to removal and replacement.

CONSTRUCTION:

Perform installation in accordance with the details in the plans and details and assembling instructions furnished by the Manufacturer.

UTILITY CONSTRUCTION

23. ADJUSTMENT OF MANHOLES

The Contractor's attention is directed to Section 858-3 of the NCDOT Standard Specifications for Roads and Structures, latest edition.

The use of cast iron or steel fittings in the adjustment of manholes will not be permitted on this project except where it is considered by the Engineer to be in the best interest of the Department to allow rings to be used. When rings are permitted for the adjustment of manholes, the rings shall have satisfactory bearing on the existing manhole frames and 50 percent of the circumference shall be tack welded at four equally spaced locations as directed by the Engineer. If the existing covers do not fit the rings, furnish and install new covers at no additional expense to the City. The Contractor shall be responsible for the removal, maintenance, and replacement of manhole rings and covers. Upon removal of the manhole rings and covers, the Public Works Director or his representative shall inspect them for defects or damage.

Unless otherwise stipulated in the Contract Documents, the Contractor shall only be compensated one time for the adjustment of each manhole as called out in the construction drawings. Any additional adjustments required by the Contractor beyond the first adjustment of a manhole will be the responsibility of the Contractor.

24. ADJUSTMENT OF VALVE BOXES AND METER BOXES

The Contractor's attention is directed to Article 858-3 of the NCDOT Standard Specifications for Roads and Structures, latest edition.

Cast iron or steel fittings will not be permitted for the adjustment of meter boxes and valve boxes on this project. The Contractor shall be responsible for the removal, maintenance, and replacement of valve boxes and water meter boxes. Upon removal of the above mentioned items, the Public Works Director or his representative shall inspect them for defects or damage.

Unless otherwise stipulated in the Contract Documents, the Contractor shall only be compensated one time for the adjustment of each valve box or meter box as called out in the construction drawings. Any additional adjustments required by the Contractor beyond the first adjustment of a valve box or meter box will be the responsibility of the Contractor.

25. MINIMUM SEPARATIONS

Minimum separations between existing and proposed utilities shall be as specified in the City of Raleigh Public Utilities Handbook and Details. If utility separation conflicts occur during construction, the Contractor shall coordinate required adjustments with the Engineer prior to proceeding with the work.

26. UTILITY TRENCHES

Contractor shall ensure all utility trenches are backfilled to comply with Section 10000 of these specifications. The City will selectively test trench compactions, but the Contractor shall be held financially responsible for remedial repairs of any settlement or other failures associated with utility installations to meet the City of Raleigh or NCDOT requirements for final acceptance.

27. MISCELLANEOUS UTILITY CONSTRUCTION

The proposed utility construction shall meet the applicable requirements of the City of Raleigh Public Utilities Handbook, current edition, and the details as shown on the plans, as outlined in the following provisions, or as directed by the Engineer.

Owner and Owner's Requirements:

The existing water and sewer mains to be relocated are owned by the City of Raleigh or private residents. The Contractor shall provide access for the owners' representatives to all phases of construction. The owners shall be notified two weeks prior to commencement of any work and one week prior to service interruption. Only authorized personnel of the owners shall operate valves in the existing public water distribution or sewer collection systems.

Existing Well Water Testing

Provide turbidity, manganese and iron sample results and a 30-minute well pumping test reported in gallons per minute (gpm) at the following construction intervals: 0% Before Construction begins, 50% Construction Complete, and 100% Construction Complete. Provide sampling and results for the following well locations and OWNER. Water quality sampling results to be certified by a State certified testing lab. A well testing plan shall be submitted for review and approval to OWNER prior to accessing home owners well. Bacterial testing shall be completed if the private well head is disturbed. Negative results are required prior to placing the well back in service.

-L- Station	Offset	Property Address
134+31	63.3' RT	11212 Leesville Road
137+59	62.1' RT	11220 Leesville Road
143+03	52.2' RT	11308 Leesville Road
143+40	55.4' RT	11312 Leesville Road
145+64	58.6' RT	11400 Leesville Road
145+98	63.3' RT	11404 Leesville Road

The 0% Before Construction sample will establish the baseline for the well water quality and quantity parameters and if the 50% construction or the 100% construction samples return elevated and greater than or equal to 50% of the difference between the Before Construction sample and the levels set forth below, then the contractor will be responsible for corrective action prior to processing the next pay request.
Turbidity Maximum Level = 1.0 NTU
Total Manganese concentration Maximum Level = 0.05 mg/l
Total Iron concentration Maximum Level = 0.30 mg/l
Well Pumping Rate = cannot reduce the flow rate more than 25% of pre-construction rate.

Water Well Corrective Action

If the existing well water quality or quantity thresholds are not met, then corrective action may require one or all of the following:

A. Installation of a whole house filter (ion-exchange, oxidation, or pressure filtration unit, inclusive of 18 replacement filters),
B. Redevelopment of the existing well,
C. Abandonment of existing well and drilling of new well, or
D. Connection to the City of Raleigh's community water system.

Corrective actions other than connection to the City's system will require a post filter water quality sample or pump test confirming water quality or quantity to the Before Construction sample.

Example 1: 0% sample equals 0.5 NTU, 50% sample equals 0.65 NTU. Result of 0.65 NTUs is less than the trigger concentration of 0.75 NTUs. Calculation 0.5+(1.0+0.5)/2 = 0.65. No Contractor action required.

Example 2: 0% sample equals 0.28 mg/l total iron, 100% sample equals 0.33 mg/l total iron. Result of 0.33 mg/l exceeds the trigger concentration of 0.29 mg/l. Calculation: 0.28 mg/l + (0.30-0.28)/2 = 0.29. Contractor action required.

Well Installation

Install new residential well as part of the corrective action for an existing well that meets the water quality and quantity thresholds as set forth in these project special provisions. All new wells must be permitted, constructed and tested in accordance with NCAC 02C standards by a North Carolina certified well contractor. All plumbing and electrical work must be performed by licensed plumbers and electricians. The well head shall have a new insulated well enclosure.

Concrete Cradle

Install concrete pipe cradle as indicated on drawings and details so to provide support for pipelines that are in proximity to the water or sewer utility pipe.

Electrical Conduit For Street Lighting

Install electrical conduit using Utility provided- 2-inch diameter HDPE for installation of street

lighting power wiring from light poles. This work to be coordinated with Progress Energy or their contractors as illustrated on the Utility by Others (UBO) drawings. Progress Energy will provide all conduit and elbows for the project. Contractor is responsible for any material needed outside those provided by Progress Energy. Ends of conduit shall be sealed with duct tape. Five foot sections of conduit shall be used in place of cable markers at each new street light locations buried with at least 18-inches above grade for locating purposes. Depth and method of installation to be coordinated with other utility installation as necessary.

Utility by Others

GENERAL:

The owners of utilities within this project are, but are not limited to:

COMPANY	CONTACT	PHONE NO.
City of Raleigh Water/Sewer	Dennis Lassiter	919-996-3477
Progress Energy	Sheila Talton	919-481-6126
AT&T	Robert Doreauk	919-785-7744
Public Service Company	Duncan Warren	919-367-2715
Level 3	Matthew Prink	720-888-2639
Time Warner Cable	Joseph Fahey	919-632-3688

END OF SECTION 19000

SECTION 20000
Project Special Provisions Traffic Signals
(Revised 06-14-22)

Insert latest edition of NCDOT of Signals and Intelligent Transportation Systems
Latest edition can be found here:
https://connect.ncdot.gov/resources/safety/its%20and%20signals%20resources/forms/allitems.aspx

SECTION 21000
APPENDIX

[* This entire section is project-specific and may include the following attachments for the Contractor's information or use during bidding or construction (for example):

- **Subsurface/soils reports**
- **Form letter for Notifying Adjacent Property Owners**
- **NCDOT Encroachment Agreement(s)**
- **NCDENR Land Disturbance Approval**
- **City Grading Permit**
- **404 Permit from USACE**
- **401 Permit from Division of Water Resources**
- **Property Specific Requirements from Real Estate Acquisition**
- **Special operation and/or maintenance information**
- **Project-specific attachments or correspondence as deemed necessary by project manager**

SECTION 329300
EXTERIOR PLANTS

(Revised 02-03-23)

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. The scope of work includes all labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for, and incidental to performing all operations in connection with furnishing, delivery, and installation of plant (also known as "landscaping") complete as shown on the drawings and as specified herein.

B. This Section consists of all planting Work and related items as indicated on the Drawings and/or as specified herein, and includes, but is not limited to, the following :

1. Planting soil
2. Preparation of planting soil.
3. Locate, purchase, deliver and install all specified plants.
   i. Shrubs.
   ii. Non-woody perennial plants.
4. Water all specified plants.
5. Mulch, fertilize, stake, and prune all specified plants.
6. Clean up and disposal of all excess and surplus material.
7. Maintenance of all specified plants during the warranty period.
8. Plant Warranty.

1.3 RELATED DOCUMENTS AND REFERENCES

A. Drawings and general provisions of contract including general and supplementary conditions and Division I specifications apply to work of this section.

B. Related Specification Sections
1. Section 02000 Submittals
2. Section 04000 Earthwork
3. Section 09000 and 10000 Utilities
4. Section 02940 2 Year Landscape Maintenance Specification

C. References: The following specifications and standards of the organizations and documents listed in this paragraph form a part of the specification to the extent required by the references thereto.

In the event that the requirements of the following referenced standards and specification conflict with this specification section the requirements of this specification shall prevail. In the event that the requirements of any of the following referenced standards and specifications conflict with each other the more stringent requirement shall prevail or as determined by the Owners Representative.

1. ANSI Z60.1 American Standard for Nursery Stock, most current edition.
2. ANSI A 300 – Standard Practices for Tree, Shrub and other Woody Plant Maintenance, most current edition and parts.
3. *USDA Plant Hardiness Zone Map*, Latest edition. United States Department of Agriculture (USDA).
4. Interpretation of plant names and descriptions shall reference the following documents. Where the names or plant descriptions disagree between the several documents, the most current document shall prevail.
   a. USDA - The Germplasm Resources Information Network (GRIN) http://www.ars-grin.gov/npgs/searchgrin.html
   b. Manual of Woody Landscape Plants; Michael Dirr; Stipes Publishing, Champaign, Illinois; Most Current Edition.
5. Pruning practices shall conform to recommendations “Structural Pruning: A Guide For The Green Industry” most current edition; published by Urban Tree Foundation, Visalia, California.
6. Glossary of Arboricultural Terms, International Society of Arboriculture, Champaign IL, most current edition.
7. *City of Raleigh City Tree Manual, Arboricultural Specifications and Standards of Practice,* Latest Edition. City of Raleigh.

1.4 DEFINITIONS

A. All terms in this specification shall be as defined in the “Glossary of Arboricultural Terms” or as modified below.

B. Balled and Burlapped Stock: Exterior plants dug with firm, natural balls of earth in which they are grown, with ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of tree or shrub required; wrapped, tied, rigidly supported, and drum-laced as recommended by ANSI Z60.1.

C. Container-Grown Stock: Healthy, vigorous, well-rooted exterior plants grown in a container with well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for kind, type, and size of exterior plant required.

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

E. Healthy: Plants that are growing in a condition that expresses leaf size, crown density, color; and with annual growth rates typical of the species and cultivar’s horticultural description, adjusted for the planting site soil, drainage and weather conditions.

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

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

H. Reasonable and reasonably: When used in this specification relative to plant quality, it is intended to mean that the conditions cited will not affect the establishment or long term stability, health or growth of the plant. This specification recognizes that it is not possible to produce plants free of all defects, but that some accepted industry protocols and standards result in plants unacceptable to this project.

When reasonable or reasonably is used in relation to other issues such as weeds, diseased, insects, it shall mean at levels low enough that no treatment would be required when applying recognized Integrated Plant Management practices.

This specification recognizes that some decisions cannot be totally based on measured findings and that professional judgment is required. In cases of differing opinion, the Owner's Representative's expert shall determine when conditions are judged as reasonable

I. Root ball: The mass of roots including any soil or substrate that is shipped with the tree within the root ball package.

J. Root ball package. The material that surrounds the root ball during shipping. The root package may include the material in which the plant was grown, or new packaging placed around the root ball for shipping.

K. Root Flare: Also called "trunk flare". The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk. Root flare shall be set at or slightly above grade.

L. Shrub: Woody plants with mature height approximately less than 15 feet.

M. Stem: The trunk of the tree.

N. Stem girdling root: Any root more than ¼ inch diameter currently touching the trunk, or with the potential to touch the trunk, above the root collar approximately tangent to the trunk circumference or circling the trunk. Roots shall be considered as Stem Girdling that have, or are likely to have in the future, root to trunk bark contact.

O. Structural root: One of the largest roots emerging from the root collar.

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

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

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

S. Tree: Single and multi-stemmed plants with mature height approximately greater than 15 feet.

1.5 SUBMITTALS

A. Product Data and Testing

1. Planting Soil Analysis: For existing surface soil and imported or manufactured topsoil.
   a. Contractor shall deliver samples to testing laboratory, have testing reports sent directly to the Owner. Report shall be submitted at least thirty- (30) days prior to the start of Work under this Section.
   b. Mechanical and chemical (pH soluble salts) analysis shall be in accordance with the current "Standards" of the Association of Official Analytical Chemists (AOAC).
   c. Soil Test Report shall include a mechanical sieve analysis with soil classification including gradation of sand, silt, and clay content. Organic matter content and Cation Exchange Capacity (CEC) shall be reported. Chemical analysis shall include pH (1:1 soil-water ratio), buffer pH, Soluble Salts (1:2 soil-water ratio), Nitrate Nitrogen, Ammonium Nitrogen, Phosphorus, Potassium, Calcium, Aluminum, Magnesium, Manganese, Ferric Iron and Sulfate.
   d. Soil test report shall clearly recommend appropriate application of deficiencies and to adjust planting soil as necessary to support successful plant growth and to meet the requirements of planting soil as specified, herein.
   e. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action
   f. Based on the test results, state recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil.

2. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
3. Pesticides and Herbicides: Include product literature, manufacturer’s application instructions, and recommended treatment specific to this Project. Comply with City of Raleigh Parks and Recreation Pesticide Policy.
4. Inorganic Soil Amendments: Include product label and manufacturer’s application instructions specific to this Project.
5. Organic Soil Amendments: Include product label and manufacturer’s application instructions specific to this Project.
6. Fertilizer: Include product literature and manufacturer’s application instructions specific to this Project. Submit fertilization rates for fertilizer product based upon soil testing, analysis, and recommendations as described in this Section at least thirty- (30) days prior to the start of Work under this Section.

B. Nursery Sources: Submit a list of all nurseries that will supply plants, along with a list of the plants they will provide and the location of the nursery. Plants shall have been grown within the cold hardiness zone for the project site.

C. Trees and Shrubs: Provide digital photos from the nursery with height identified (where applicable for trees) for review by Owner prior to digging. All trees and shrubs shall be reviewed, approved and tagged by Owner prior to arrival on site, either at place of purchase, nursery or holding yard.

D. Mulch: 1 pound sample of each mulch to be used. Submit in sealed plastic bags labeled with source of mulch. Sample shall be typical of the lot of materials to be delivered and installed on the site; provided an accurate representation of color, texture, and makeup of the material.

E. Qualification Data:
   1. Landscape Installer: Submittal shall include key personnel background and list of similar projects, minimum 3 projects completed and 5 years of experience in landscape installation by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.
   2. Arborist: Submit proof of certification as a International Society of Arboriculture (ISA) Certified Arborist for all arborists to be employed on the Project for approval by the Owner at least thirty- (30) days prior to the start of Work under this Section. Submittal shall include key personnel background and list of similar projects, minimum 3 projects completed and 5 years of experience demonstrating Arborist's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.
   3. Pesticide Applicator: Submit proof a North Carolina commercial pesticide applicator licensing and certification.

G. Water Supply Method and Schedule: Submit proposed methods of providing a water source and the schedule for watering for new plantings during the specified construction establishment/maintenance period for approval by the Owner at least thirty- (30) days prior to the start of Work under this Section.

H. Planting Schedule: Submit Schedule for Planting to the Owner for approval to ensure that the Schedule of Work will minimize the potential for plant damage and to insure timely installation of all material.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer shall be a licensed Landscape Contractor. Only a landscape Contractor as defined by the General Statutes of North Carolina and licensed in North Carolina shall be permitted to perform this work. A copy of the Landscape Contractor's License or License Number shall be presented to the Owner's representative at the time the contract is executed.

   1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when exterior planting is in progress.
   2. Pesticide Applicator: North Carolina licensed, commercial.
   3. Trees shall be installed by or under the supervision of an ISA Certified Arborist or approved professional.

B. Planting Soil Testing Laboratory Qualifications: A public extension service agency or a certified private testing laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

C. All exterior plants shall comply with applicable requirements in ANSI Z60.1, "American Standard for Nursery Stock."

D. Tree and Shrub Measurements: Measure according to ANSI Z60.1 with branches and trunks or canes in their normal position. Do not prune to obtain required sizes. Take caliper measurements 6 inches above ground for trees up to 4-inch caliper size, and 12 inches above ground for larger sizes. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip-to-tip.

E. Observation and Rejection: Owner shall observe trees and shrubs at place of purchase, nursery holding yard, or at site before planting for compliance with requirements for genus, species, variety, size, and quality. Owner retains right to observe trees and shrubs further for size and condition of balls and root systems, insects, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

F. Substitutions:

1. Substitutions for the listed plant material will be considered if the listed material cannot be located or confirmed by known suppliers. Plant suppliers must be researched and located prior to submittal. If plant material substitutions are to be made after award of the contract, the substitution must be of similar growth habit, form, and characteristics; similar in specified size; and subject to approval or rejection by the Owner.
2. If for any reason trees cannot be installed according to the plans, the Contractor shall inform the Owner prior to plant material delivery, and alternate planting locations shall be selected by the Owner.

1.7 DELIVERY, STORAGE, AND HANDLING

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

B. Bulk Materials:

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

C. Do not prune trees and shrubs before delivery, except as approved by Owner. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and

tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of exterior plants during delivery. Do not drop exterior plants during delivery.

D. Handle planting stock by root ball. Heavier material shall be handled with straps on the root ball and appropriate equipment such as a small skid steer loader.

E. Deliver bare-root stock plants freshly dug. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting.

F. Deliver exterior plants after preparations for planting have been completed and install immediately. If planting is delayed more than six hours after delivery, set exterior plants in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

1. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
2. Do not remove container-grown stock from containers before time of planting.
3. Water root systems of exterior plants stored on-site with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly-wet condition.
4. Heel-in bare-root stock. Soak roots that are in dry condition in water for two hours. Reject dried-out plants.

1.8 COORDINATION

A. Pre-Installation Conference: Arrange a pre-installation conference with the Owner two (2) weeks prior to the initiation of any planting activities. Submit installation schedule in accordance with Planting Schedule requirements.

B. Planting Restrictions:

1. Shrubs: Planting shall only occur between October 1 and April 31.
2. Non-woody plantings: Planting shall be installed during the commonly recognized planting times consistent with the specified plant species.
3. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.
4. If overall project Substantial Completion occurs prior of the specified planting dates, planting shall not be installed until specified planting dates.

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

D. Coordination with Lawns: For all exterior plants to be installed adjacent to lawns, plant exterior plants after finish grades are established and before planting lawns unless otherwise approved to Owner. When planting trees and shrubs after lawns, protect lawn areas and promptly repair damage caused by planting operations.

1.9 CERTIFICATE OF ACCEPTANCE

A. Following completion of all plant material installation, the Contractor shall request the Owner in writing for a formal inspection of the planting.

B. If a substantial number of plants are sickly or dead at the time of final inspection, acceptance will not be granted, and the Contractor's responsibility for maintenance of all plants shall be extended until replacements are made. All dead and unsatisfactory plants shall be promptly removed from the project. Replacements shall conform in all respects to the specifications for new plants and shall be planted in the same manner and location. The Contractor shall maintain replacements during the Maintenance Period.

C. If plant materials and workmanship are acceptable, written notice will be given by the Owner to the Contractor stating that the plantings has received provisional acceptance and that the Maintenance Service period shall commence.

1.10 MAINTENANCE SERVICE

A. Provide complete Maintenance Service by skilled employees of landscape installer. Maintain as required in Part 3. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established for not less than twelve (12) months from Substantial Completion.

B. Following planting and anytime during the Maintenance Period, plantings that show obvious decline or loss of ten (10%) percent of healthy growth shall be inspected by a licensed Arborist or Horticulturist to determine the cause of the decline. The plant shall then be treated and if further decline or loss occurs the plant shall be removed and replaced during the maintenance period. All plants of the same species shall also be inspected. Replacements shall conform in all respects to the specifications for new plants and shall be planted in the same manner.

C. Following planting and anytime during the Maintenance Period, plantings that die or show obvious decline or loss of more than ten (10%) percent of healthy growth, shall be removed and replaced at once unless designated otherwise in writing by the Owner. Replacements shall conform in all respects to the specifications for new plants and shall be planted in the same manner and location.

D. Maintenance Service: Submit to Owner on the first day of each month a Maintenance Report Form (provided) showing weekly maintenance completed the month prior.

1.11 WARRANTY

A. Warrant all installed exterior plants for the warranty period indicated against defects including death and unsatisfactory growth.

1. Warranty Period for all plants: *[write months]* (#) months from date of Substantial Completion, unless plantings are installed during their required planting date following Substantial Completion. End of Warranty period will be tied to *[write months]* (#) months from Substantial Completion.

2. Plants shall be alive and in satisfactory growth at the end of the Warranty Period. Plants that die or show obvious decline or loss of healthy growth during the Warranty Period shall be removed and replaced, unless designated otherwise by the Owner. Each plant shall show at

least ninety- five (95%) percent healthy growth and shall have the natural character of a plant of its species in accordance with the American Nurserymen's Association Standards. Dead or unsatisfactory plants shall be replaced only during the specified planting season.

3. All replacements shall be plants of the same species, variety, and size specified in the PLANT SCHEDULE and all material, installation.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, sizes, and other features indicated in Plant Schedule or Plant Legend shown on Drawings and complying with ANSI Z60.1, with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock free of disease, insects, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

B. All woody trees and shrubs shall be balled and burlapped or grown in containers; bare-rooted trees or shrubs shall not be permitted.

C. A complete list of plants, including a schedule of species, varieties, sizes, quantities and other requirements, are shown on the Drawings. In the event that quantity discrepancies or material omissions occur between the list of plant materials on the Plant Schedule or Plant Legend and the Drawings, the higher number of plants shall govern.

D. Furnish plants of quality, grades, and ball or container sizes complying with ANSI Z60.1 for types, sizes, and form of plants required. Plants of larger size may be used if acceptable to Owner, with a proportionate increase in size of roots or balls.

E. Label each plant with a securely attached, waterproof tag bearing legible designation of botanical and common name. Include nomenclature for hybrid, variety, or cultivar, if applicable.

F. All plant material shall be free of all pests, diseases, and cankers, in healthy condition, and free of mechanical damage at the time of planting.

G. Collected and non-nursery grown plant material shall not be accepted unless approved by Owner

H. Balled and burlapped trees and shrubs: Burlap shall be 100% cloth burlap and must be moved with the root systems as solid units with balls of earth firmly wrapped with untreated eight (8) ounce burlap, firmly held in place by a stout cord. No poly-burlap shall be allowed on plant materials. Any use of wire cages shall be approved in writing by the Owner. Wire must not be galvanized or aluminum wire. Any balled and burlapped trees and shrubs delivered to the site with materials other than 100% cloth burlap shall automatically be rejected and the installer shall remove them from the site within twenty-four (24) hours.

1. The diameter and depth of the balls of earth must be sufficient to encompass the fibrous root feeding system necessary for the healthy development of the plant.

2. No plant shall be accepted when the ball of earth surrounding its roots has been badly cracked or broken preparatory to or during the process of planting or after the burlap, staves, ropes or platform required in connection with its transplanting have been removed.
3. The plants and root balls shall remain intact during all operations.
4. All plants that cannot be planted at once shall be heeled in by setting on the ground, covering the balls with soil, and watering them to maintain moisture level.

I. The height of the trees (measured from the crown of the roots to the tip of the top branch) shall not be less than the minimum size designated. Take caliber measurement six (6”) inches above ground level up to and including four (4”) inch caliber sizes and twelve (12”) inches above the ground for larger sizes. The trunk of each tree shall be a single trunk growing from a single unmutilated crown of roots. No part of the trunk shall be conspicuously crooked as compared with normal trees of the same variety. The trunk shall be free from sunscald, frost cracks, or wounds resulting from abrasions, fire or other causes. No pruning wounds shall be present having a diameter exceeding two inches and such wounds must show a vigorous bark on all edges. Plants shall not be pruned prior to delivery.

J. Shrubs shall meet the requirements for spread or height specified in the Plant Schedule. The measurements for height shall be taken from the ground level to the average height of the shrub and not to the longest branch. The thickness of each shrub shall correspond to the trade classification "No. 1." Single stemmed or thin plants will not be accepted. The side branches must be generous, well twigged, and the plant as a whole well branched to the ground. The plants must be in a moist vigorous condition, free from dead wood, bruises, or other root or branch injuries. Plants shall not be pruned prior to delivery.

K. All plants shall be of size, age and/or condition listed in the Plant Schedule. Plants shall be healthy, free of insects and diseases. Perennials shall be container-grown...

2.2 PLANTING SOIL MIX

A. Planting soil: Fertile, friable soil containing less than 5% total volume of the combination of subsoil, refuse, heavy, sticky or stiff clay, stones larger than 1/2 inches in diameter, noxious seeds, sticks, brush, litter, or any substances deleterious to plant growth. The percent (%) of the above objects shall be controlled by source selection not by screening the soil. Planting soil shall be suitable for the support of vegetative growth. Planting soil shall not contain weed seeds in quantities that cause noticeable weed infestations in the final planting beds. Planting soil shall meet the following physical and chemical criteria:
   1. ASTM D 5268
   2. pH range of 5.5 to 7.
   3. Minimum of 10 percent organic material content
   4. Free of stones 1/2 inch or larger in any dimension and other extraneous materials harmful to plant growth.
   5. Free of hard clods, stiff clay, hardpan, sods, weeds, roots, rhizomes of undesirable grasses, partially disintegrated stone, stone over one-half (1/2”) inch in diameter, lime, excessive amounts of small stones or gravel, cement, ashes, slag, concrete, tar residues, tarred paper, boards, chips, glass, sticks, or any other undesirable material.
   6. Soluble salt level: Less than 2 mmho/cm.

B. Amend planting soil per required soil test recommendations and notify Owner of type and quantity of amendments.

2.3 INORGANIC SOIL AMENDMENTS

A. Inorganic soil amendments shall be used to counteract soil deficiencies as recommended by the soil analysis and as approved by the Owner.

B. Lime for adjustment of pH: ASTM C 602, agricultural limestone containing a minimum 80 percent calcium carbonate equivalent and as follows:

1. Class: Class T, with a minimum 99 percent passing through No. 8 sieve and a minimum 75 percent passing through No. 60 sieve.
2. Provide lime in form of dolomitic limestone.

C. Sulfur for adjustment of pH: Granular, biodegradable, containing a minimum of 90 percent sulfur, with a minimum 99 percent passing through No. 6 sieve and a maximum 10 percent passing through No. 40 sieve.

D. Sand: Clean, washed, natural or manufactured, free of toxic materials, particle size as approved by Owner. Sand shall not be used in clay soils unless approved by Owner.

E. Provide manufacturer’s literature and material certification that the amendment product meets the above requirements.

2.4 ORGANIC SOIL AMENDMENTS

A. Organic soil amendments shall be used to counteract soil deficiencies as recommended by the soil analysis and as approved by the Owner.

B. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 3/4-inch sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings. Source material shall be yard waste trimmings blended with other plant or manure based material designed to produce Compost high in fungal material. Compost shall be commercially prepared compost and meet US Compost Council STA/TMECC criteria. Provide manufacturer’s literature and material certification that the amendment product meets the above requirements.

C. Manure: Well-rotted, unleached, stable or cattle manure not less than eight months and not more than two years old. It shall be free from sawdust, shavings or refuse of any kind and shall not contain over twenty-five percent straw. Manure shall be free of toxic substances, stones, sticks, soil, weed seed, and other material harmful to plant growth.

2.5 FERTILIZER

A. Fertilizers shall be used to counteract soil deficiencies as recommended by the soil analysis and as approved by the Owner.

B. Commercial fertilizer shall be a product complying with North Carolina and United States fertilizer laws. Fertilizer shall be delivered to the site in the original unopened containers, which shall bear the manufacturer's Certificate of Compliance covering analysis, which shall be furnished to the

Owner. At least 50% by weight of the nitrogen content shall be derived from organic materials. Phosphorus shall be soluble. Fertilizer shall contain not less than the percentages by weight of ingredients as needed to meet all recommendations of the soil analysis. Fertilizers shall also contain required micro-nutrients as needed to meet all recommendations of the soil analysis.

C. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 4 percent nitrogen and 20 percent phosphoric acid.

D. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

E. Slow-Release Fertilizer: Granular or pelletized fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.
2. Fish-emulsion, compost tea.

F. Other Organic Fertilizer: Contractor is encouraged to utilize other organic fertilizer with a lower nitrogen value, such as worm castings, sewage sludge. Contractor shall submit product information for Owner’s approval prior to application.

G. Provide manufacturer’s literature and material certification that the amendment product meets the above requirements.

2.6 MULCHES

A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of newly-installed plant material, consisting of one of the following:

1. Type:
    a. Ground or shredded hardwood. **No color additives allowed.** Hardwood mulch shall be aged a minimum of six (6) months. The mulch shall be dark brown in color, free of chunks and pieces thicker than 1/4 inch. Mulch must be free of stringy material, and shall not contain, in the judgment of the Owner, an excess of fine particles. No large peel strips and decayed material will be permitted.

2.7 WATER

A. The Contractor shall be responsible for furnishing his own supply of water to the site. Any plant material injured or damaged due to the lack of water, or the use of too much water, shall be the Contractor's responsibility to correct. Water shall be free from impurities injurious to vegetation.

2.8 PESTICIDES AND HERBICIDES

A. Pesticides: Shall be registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project

conditions and application. Do not use restricted pesticides. Obtain approval of use by Owner prior to use.

B. Pre-Emergent herbicide: Shall be used for controlling the germination of growth of weeds within planted areas at the soil level directly below the mulch layer. Obtain approval of use by Owner prior to use.

C. Post-Emergent Herbicide: Shall be used for controlling weed growth that has already germinated. Obtain approval of use by Owner prior to use.

PART 3 - EXECUTION

3.1 GENERAL

A. Furnishing and planting of any plant material, complete, includes the digging of the holes for individual plants and local excavation required for planting beds, provisions of soil additives and screened loam for planting soil mix. The Contractor shall furnish and plant all plant species as shown on the Drawings, as specified, and in quantities, sizes and varieties as shown on the Plant Schedule or Legend. No substitutions in species, variety, or size shall be permitted without prior written approval from the Owner. Included in the Work shall be the labor of planting and mulching, guying and anchoring, and maintenance as specified herein.

B. If indicated on the Drawings or by Owner, Contractor shall strictly adhere to the limits of motorized vehicular access, including allowable limits of machine excavation of plant beds. All Work outside the limits of motorized vehicular access shall be done by hand or other approved methods as determined by the Owner.

3.2 PREPARATION

A. Examine areas to receive exterior plants for compliance with requirements and conditions affecting installation and performance. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Protect structures, utilities, sidewalks, pavements, and other facilities, and lawns and existing exterior plants from damage caused by planting operations.

C. Provide 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.

D. Stake the location for each individual tree and all clearly mark outlines for planting areas on the ground by the Contractor for approval by the Owner before any individual plant pits or plant beds are dug. If unknown large rock, underground obstructions, or utilities are encountered, the Owner shall be notified immediately.

E. If planting is done after lawn preparation or installation, proper protection of lawn areas shall be provided and any damage resulting from planting operations shall be repaired immediately.

3.3 PLANT INSTALLATION

A. Shrub and Perennial Planting

1. All planting beds shall be approved in the field by the Owner prior to plant installation.

2. Planting soil shall be amended with organic soil amendments, inorganic soil amendments, and fertilizers as per by the soil test results, specific to the type of plant(s) to install in each planting area.

3. Depth of planting soil shall be at least six inches (6”) deeper than the ball or as shown on Drawings.

4. Loosen subgrade of planting beds to a minimum depth of twelve inches (12”) prior to mixing any amendments. Remove subgrade stones larger than 1 inch in any dimension, sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

5. Thoroughly blend planting soil with any required amendments before spreading.

    a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
    b. Mix lime with dry soil before mixing fertilizer.

6. Spread planting soil mix to a depth as indicated on Drawings but not less than required to meet finish grades after natural settlement.

    a. Spread approximately one-half the thickness of planting soil mix over loosened subgrade, then mix thoroughly into top 6 inches of subgrade. Spread remainder of planting soil mix.
    b. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
    c. When planting soil is at finish grade, smooth planting beds to a uniform surface plane with loose, uniformly fine texture. Roll and rake soil, remove ridges, and fill depressions to meet finish grades.
    d. Restore planting beds if eroded or otherwise disturbed after finish grading and before planting.

7. Set shrubs plumb and in center of pit top of root ball and root flare one (1) inches to two (2) inches above adjacent finish grades. Never place root flare below finish grade.

8. Perennial plants shall be carefully removed from containers or flats immediately prior to planting and set to the same depths as they were grown in the nursery bed or container. Place at correct spacing indicated on the Drawings. Roots shall be arranged in their natural position and planting soil worked in among them, taking care to avoid bruising or damaging the roots. No later than one hour after planting, all plants shall be thoroughly settled in with water.

9. Place planting soil around root ball in six-inch (6”) layers. When pit is approximately one-half backfilled, add water to thoroughly settle the soil and eliminate voids and air pockets. Repeat watering until no more water is absorbed. After watering, continue backfilling the planting soil

until level with top of root ball. Water again after placing final layer of planting soil. Adjust soil level to compensate for any settlement that may occur.

B. Mulching: Apply mulch to thickness shown on the Drawings. Extend mulch 12 inches (12”) minimum beyond edge of planting pit or planting area or as shown on Drawings.

1. No mulch shall be applied prior to the first watering of plant materials.
2. No mulch shall ever be place directly in contact or mounded around plant stems or trunks. Mulch shall always lie flat on the ground. Keep mulch away from stem(s) of plant leaving a minimum of three (3”) inches of exposed soil around the trunk. Root flare shall be visible at base of all trees.

C. Absolutely no debris may be left on the site. Excavated material shall be removed as directed by the Landscape Architect. Repair any damage to site or structures to restore them to their original condition as directed by the Landscape Architect.

3.4 WATERING

A. All plants shall be flooded with water twice within the first twenty-four (24) hours of the time of planting. In case of drought or late planting the leaves of all plants shall be misted with water and/or an antidessicant shall be applied.

B. All plants for the first three (3) months shall be watered at least once each week unless sufficient rainfall has occurred. Supplemental water shall be applied during the establishment period as frequently as 3 times per week and during periods of drought or excessive heat.

C. Watering volumes should be based upon delivery of 1 inch of moisture per week to the plant if precipitation does not meet that amount during the active growing season defined as April 1 through November 1. Trees shall receive a minimum of ten (10) gallons of water each week. Shrubs, ground cover, perennials, and annuals shall receive a minimum of five gallons of water each week.

D. At each watering the soil around each plant shall be thoroughly saturated. If requested by the Owner, the Contractor shall test soil moisture with tensiometers water gauges to ensure that plants have received sufficient moisture. If sufficient moisture is retained in the soil, as determined by the Owner, the required watering may be reduced.

E. If an irrigation system is not available individual trees shall be watered by laying a hose at the base of the plant and allowing water to trickle for 30-60 minutes depending on seasonal conditions. To water entire beds of plants, a soaker hose shall be used.

F. Commercially available water bags are acceptable to ensure the root ball is soaked. All watering bags shall be removed from trees starting November 1 until April 1 of following year.

G. Schedule watering to comply with the latest City of Raleigh Water Conservation Ordinance.

3.5 PLANT MAINTENANCE

A. Maintenance shall begin immediately after each plant is planted and shall continue through both Substantial Completion and the minimum twelve (12) month maintenance period as specified, herein.

B. Maintain plantings throughout maintenance period by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep plants free of insects and disease.

1. Plants shall be inspected for watering needs at least twice each week during the growing season and watered as necessary to promote plant growth and vitality.
2. Mulched planting beds and individual plant pits shall be kept free of weeds, and mulch shall be replaced as required to maintain the specified layer of mulch.
3. Beds and individual pits shall be neat in appearance and maintained to the designed layout.
4. Fill in as necessary soil subsidence that may occur because of settling, rutting or damage by equipment or other processes. Replace mulch materials damaged or lost in areas of subsidence.
5. Insect pests, diseases, and weed control shall be included during the maintenance period. Apply treatments as required to keep plant materials, planted areas and soils free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

C. After installation and before Substantial Completion, remove nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, plantings, and Project site. Remove tree stabilization materials at the end of the maintenance period, or as approved by Owner. Nursery tags with species name shall remain until the end of the maintenance period.

D. Mulch shall be refreshed at the end of the maintenance period.

E. For maintenance of plantings associated with stormwater devices, refer to Owner’s Best Management Practice operation and maintenance manual.

F. During the maintenance period, any decline in the condition of planted material shall require the Contractor to take immediate action to identify potential problems and undertake corrective measures. If required, the Contractor shall engage professional arborists and/or horticulturalists to inspect plant materials and to identify problems and recommend to the Owner corrective procedures.

3.6 PESTICIDE AND HERBICIDE APPLICATION

A. Apply pesticides and other chemical projects and biological control agents in accordance with the product label. Coordinate applications with owner’s operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Pre-Emergent Herbicide: Apply to tree, shrub and ground-cover areas in accordance with manufacturer’s written recommendations. Do not apply to seeded areas.

C. Post-Emergent Herbicide: Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer’s written recommendations.

3.7 CLEANUP AND PROTECTION

A. During planting operations, keep adjacent pavements and other adjacent areas clean and work area in an orderly condition.

B. During the course of the Project, protect exterior plantings from damage due to landscape operations, operations by other contractors and trades, and others. Maintain protection during installation and maintenance periods.

C. Disposal: Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property

END OF SECTION 329300