SECTION 32 93 00 - PLANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Trees, Shrubs, Topsoil and soil amendments, Fertilizers and mulches, Stakes and guys

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 31 Section "Earth Moving" for excavation, filling, rough grading, and subsurface aggregate drainage and drainage backfill.

1.3 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract.

B. Product certificates signed by manufacturers certifying that their products comply with specified requirements.

1. Analysis for other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed landscaping work similar in material, design, and extent to that indicated for this Project and with a record of successful tree and shrub establishment.

1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on the Project site during times that tree and shrub planting is in progress.

B. Provide quality, size, genus, species, and variety of trees and shrubs indicated, complying with applicable requirements of ANSI Z60.1 "American Standard for Nursery Stock."

C. Measurements: Measure trees and shrubs 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 (150 mm) above ground for trees up to 4-inch (100-mm) caliper size, and 12 inches (300 mm) 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.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver freshly dug trees and shrubs. Do not prune before delivery, except as approved by Architect. 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 natural shape. Provide protective covering during delivery. Do not drop trees and shrubs during delivery.

B. Handle balled and burlapped stock by the root ball.

C. Deliver trees and shrubs after preparations for planting have been completed and install immediately. If planting is delayed more than 6 hours after delivery, set trees and shrubs in 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 trees and shrubs stored on site with a fine-mist spray. Water as often as necessary to maintain root systems in a moist condition.

1.6 COORDINATION AND SCHEDULING

A. Coordinate planting of trees and shrubs during normal planting seasons for such work in location of Project.

1. Plant frost-tender trees and shrubs only after danger of frost is past or before planting lawns.

B. Coordination with Lawns: Plant trees and shrubs after finish grades are established and before planting lawns, unless otherwise acceptable to Architect.

1. When planting trees and shrubs after lawns, protect lawn areas and promptly repair damage caused by planting operations.

1.7 WARRANTY

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

B. Special Warranty: Warrant living trees and shrubs for a period of one year after date of Substantial Completion, against defects including death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, or abuse by Owner, abnormal weather conditions unusual for warranty period, or incidents which are beyond Contractor's control.

C. Remove and replace dead trees and shrubs immediately unless required to plant in the succeeding planting season.

D. Replace trees and shrubs that are more than 15 percent dead or in an unhealthy condition at end of warranty period.

E. A limit of one replacement of each tree and shrub will be required, except for losses or replacements due to failure to comply with requirements.

1.8 MAINTENANCE

A. Maintenance:

The Contractor is immediately responsible for all maintenance of plants, turf and facilities until the final acceptance. This includes all necessary watering, one Spring or one Fall application of appropriate fertilizer, (based on planting season, this application will be performed by the Contractor after final acceptance, during the warranty period) any necessary pruning and weed control. All plants are to receive the appropriate application of fungicides and insecticides necessary to maintain plants free from disease and insect activity.

B. Replace planting material that is dead or unhealthy at the end of the warranty period, unless required to plant in succeeding planting season.

PART 2 - PRODUCTS

2.1 TREE AND SHRUB MATERIAL

A. General: Unless otherwise indicated, furnish nursery-grown trees and shrubs conforming to 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.

2.2 SHADE AND FLOWERING TREES

A. Shade Trees: Single-stem trees with straight trunk, well-balanced crown, and intact leader, of height and caliper indicated, conforming to ANSI Z60.1 for type of trees required. Trees have been preselected and shall come from locations as noted on plans.

B. Small Trees: Small upright or spreading type, branched or pruned naturally according to species and type, and with relationship of caliper, height, and branching recommended by ANSI Z60.1, and stem form as follows:

1. Form: Single stem.

2. Form: Multistem, clump, with 3 or more main stems as specified in plant list.

2.3 DECIDUOUS SHRUBS

A. Form and Size: Deciduous shrubs with not less than the minimum number of canes required by and measured according to ANSI Z60.1 for type, shape, and height of shrub.

1. Provide container-grown deciduous shrubs subject to meeting ANSI Z60.1 limitations for container stock.

2.4 CONIFEROUS EVERGREENS

A. Form and Size: Specimen-quality, exceptionally heavy, tightly knit, symmetrically shaped coniferous evergreens conforming to ANSI Z60.1.

B. Provide balled and burlapped coniferous evergreens.

1. Container-grown coniferous evergreens will be acceptable in lieu of balled and burlapped coniferous evergreens subject to meeting ANSI Z60.1 limitations for container stock.

2.5 BROADLEAF EVERGREENS

A. Form and Size: Normal-quality, well-balanced, broadleaf evergreens, of type, height, spread, and shape required, conforming to ANSI Z60.1.

B. Provide balled and burlapped broadleaf evergreens.

1. Container-grown broadleaf evergreens will be acceptable in lieu of balled and burlapped broadleaf evergreens subject to meeting ANSI Z60.1 limitations for container stock.

2.6 BALLED AND BURLAPPED STOCK

A. Provide trees and shrubs dug with firm, natural ball of earth in which they are grown.

B. Ball Size: Not less than diameter and depth recommended by ANSI Z60.1 for type and size of tree or shrub required. Increase ball size or modify ratio of depth to diameter to encompass enough fibrous and feeding-root system necessary for full recovery of trees and shrubs.

C. Wrap, tie, and rigidly support earth ball as recommended by ANSI Z60.1 for size of balls required. Drum-lace balls with a diameter of 30 inches (760 mm) or greater.

2.7 TOPSOIL

A. Topsoil: Shall be natural, fertile, agricultural soil, capable of sustaining vigorous plant growth. It may be developed by amending the existing soil or removing the existing soil and replacing with new soil. It shall be of uniform composition throughout, with admixture of subsoil. It shall be free of stones, lumps, live plants and their roots, sticks, and other extraneous matter. Topsoil shall not be used while in a frozen or muddy condition.

Topsoil shall contain the following specified percentages of constituents:

Maximum 30% clay (red clay, well pulverized); clay shall be sterile.

Minimum 5% well-rotted sawdust, leaf mold or other approved partially decomposed organic matter.

Maximum 50% silt.

Maximum 45% coarse sand free of rock.

Topsoil shall have an acidity range of ph 5.6 to 7.0 and shall contain not less than six percent (6%) organic matter, as determined by loss on ignition of moisture-free samples dried at 50 degrees centigrade.

Topsoil Source: Verify suitability of surface soil to produce Planting Mix requirements and amend when necessary. Supplement with imported topsoil when quantities are insufficient. Imported topsoil shall come from an area that has good drainage and not from a marsh or bog. A sample of proposed topsoil shall be submitted to the landscape architect 15 calendar days prior to installation and be approved prior to installation.

2.9 SOIL AMENDMENTS

A. Lime: ASTM C 602, Class T, agricultural limestone containing a minimum 80 percent calcium carbonate equivalent, with a minimum 99 percent passing a No. 8 (2.36 mm) sieve and a minimum 75 percent passing a No. 60 (250 micrometer) sieve.

1. Provide lime in the form of dolomitic limestone.

B. Aluminum Sulfate: Commercial grade, unadulterated.

C. Sand: Clean, washed, natural or manufactured sand, free of toxic materials.

D. Perlite: Horticultural perlite, soil amendment grade.

E. Peat Humus: Finely divided or granular texture, with a pH range of 6 to 7.5, composed of partially decomposed moss peat (other than sphagnum), peat humus, or reed-sedge peat.

F. Sawdust or Ground-Bark Humus: Decomposed, nitrogen-treated, of uniform texture, free of chips, stones, sticks, soil, or toxic materials.

1. When site treated, mix with at least 0.15 lb (2.4 kg) of ammonium nitrate or 0.25 lb (4 kg) of ammonium sulfate per cu. ft. (cu. m) of loose sawdust or ground bark.

G. Manure: Well-rotted, unleached stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.

H. Herbicides: EPA registered and approved, of type recommended by manufacturer.

I. Water: Potable.

2.10 FERTILIZER

A. Bonemeal: Commercial, raw, finely ground; minimum of 4 percent nitrogen and 20 percent phosphoric acid.

B. Superphosphate: Commercial, phosphate mixture, soluble; minimum of 20 percent available phosphoric acid.

C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea-form, 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.

D. Slow-Release Fertilizer: Granular 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.

2.11 MULCHES

A. Organic Mulch: Organic mulch, free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:

1. Type: Double Hammered Hardwood Mulch.

2.12 STAKES AND GUYS

A. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, redwood, or pressure-preservative-treated softwood, free of knots, holes, cross grain, and other defects, 2 by 2 inches (50 by 50 mm) by length indicated, pointed at one end.

B. Guy and Tie Wire: ASTM A 641 (ASTM A 641M), Class 1, galvanized-steel wire, 2-strand, twisted, 0.106 inch (2.7 mm) in diameter.

C. Hose Chafing Guard: Reinforced rubber or plastic hose at least 1/2 inch (13 mm) in diameter, black, cut to lengths required to protect tree trunks from damage.

D. Flags: Standard surveyor's plastic flagging tape, white, 6 inches (150 mm) long.

2.13 MISCELLANEOUS MATERIALS

A. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive trees and shrubs for compliance with requirements and for conditions affecting performance of work of this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Architect's acceptance of layout before planting. Make minor adjustments as may be required.

3.3 PLANTING SOIL PREPARATION

A. Before mixing, clean topsoil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.

B. Mix specified soil amendments and fertilizers with soil at rates specified below. Delay mixing of fertilizer if planting will not follow mixing of planting soil within a few days. Mix as follows:

1. For groundcovers, shrubs and trees:

Native soil/imported topsoil - [illegible]

Ground pine bark or peat humus - [illegible]

Fertilizer per label directions

Superphosphate - 30 lbs. per 1000 square feet of surface area

Lime - 100 lbs. per 1000 square feet of surface area

1. For seasonal color beds and ericaceous plants:

Native soil - 33%

Sand - 33%

Ground pine bark or peat humus - 33%

Fertilizer per label directions

Superphosphate - 30 lbs. per 1000 square feet of surface area

Lime - Apply no lime for ericaceous plants, apply 100 lbs. per 1000 square feet of surface area in seasonal color beds.

C. For tree pit and match type backfill, mix planting soil prior to backfilling and stockpile at site.

D. For planting beds, mix planting soil either prior to planting or apply on surface of soil and mix thoroughly before planting.

Mix lime with dry soil prior to mixing of fertilizer.

Prevent lime from contacting soil zone or roots of acid-loving plants.

Apply phosphoric acid fertilizer.

3.4 EXCAVATION

A. Excavation: No excavation or planting shall be done in soil that, in the opinion of the Architect, is too wet, too dry or not properly conditioned as provided in these specifications. All excavations shall be in accordance with Typical Planting Detail, or as otherwise specified.

Separate subgrade soil from the upper topsoil portions and remove subgrade soils immediately, wherever encountered, during planting operations. Loosen remaining subgrade soils to a depth of 6 inches prior to planting.

B. Detrimental Soil Conditions: Notify the Architect in writing of all soil conditions which the Contractor considers detrimental to growth of plant material. State condition and submit proposal in writing to the Architect for correcting condition.

C. Obstructions: If rock, underground construction work, tree roots, or other obstructions are encountered in the excavation of plant pits, alternate locations may be selected by the Architect. Where locations cannot be changed as determined by the Architect, remove the obstructions to a depth of not less than 6 inches below the required pit depth. Proceed with work after approval of the Architect.

3.6 PLANTING TREES AND SHRUBS

A. Planting Beds: The extent of the planting bed shall be as indicated on the construction plans. The planting bed for shrubs, groundcover plants, and trees shall be prepared wide enough to accommodate all roots without crowding or twisting. The entire planting bed shall be amended according to planting mix herein before specified to a depth of 8" for ground cover and seasonal color, 18" for shrubs and for depth of rootball for trees, being tilled prior to planting.

B. All planting beds shall have a 4" V-cut trench installed at the perimeter of the planting bed and adjacent to concrete walks, curbing, and grassed areas. The V-cut trench shall form the bed line edge. Trench depth and width shall be consistent and uniform throughout.

B. Backfilling: Shrubbery and ground covers shall be removed from containers. Set plant materials upright, plumb, and oriented to give the best appearance or relationship to each other and adjacent structures.

C. Set plant material 2"-3" above the finish grade on setting layer of compacted planting soil. Cut the ball ties, wire basket, etc., and remove the burlap from the top and side of the ball. No burlap shall be pulled from under the balls. Do not use planting stock if ball is cracked or broken before or during planting operation.

D. No filling shall be done around actual trunks or stems of plant material. Backfill around plant root ball to be done with specified planting mixture. Firm down backfill to eliminate all air pockets.

Backfill one-half (1/2) of remaining hole with planting mixture herein before specified, and water thoroughly. Backfill rest of hole with planting mixture. Firm down, eliminating all air pockets. Do not pack. Build a four inch (4") high berm around the edge of the root ball to form a basin for holding water. The bottom of the basin shall be at surrounding finish grade.

Shrubbery and ground covers shall be removed from containers. Set plant materials upright, plumb, and oriented to give the best appearance or relationship to each other and adjacent structures.

Form 2" high collar around outer perimeter of drip zone of individual plants within planting beds which are not irrigated. Top dress soil with a specified granulated fertilizer at the recommended rate prior to mulch application. Fertilizer contact with foliage and plant stem shall be avoided. Should fertilizer come in contact with foliage or stem, remove immediately.

Mulch shall not be placed against tree trunks, taper mulch to finish grade at tree trunk.

E. Watering: Containerized plants shall be watered prior to planting so as to provide adequate moisture to the plant during the planting process.

Thoroughly water all plants immediately after planting. This shall mean fill and thorough saturation of all backfill in the pits and beds during the same day of planting. Apply water only by open-end hose at a very low pressure to avoid air pockets and injury to the roots. When planted, watered, and fully settled, the plants shall be vertical and the top of the root ball shall not be below the existing grade.

Fill basin with water, being careful not to break down berm with hose stream, or to gouge out holes in the backfill.

3.7 PRUNING

A. Pruning: All pruning shall be performed in accordance with American Standard for Nursery Stock standards. Prune only after initial inspection and approval by the Architect. Prune in a manner to preserve natural character of plant and in a manner appropriate to its particular requirement in the landscape design.

Pruning of evergreen plants shall be limited to that required for correcting irregularities. Remove soft wood or sucker growth, and broken or badly bruised branches. Prune with sharp tools; make cuts flush and clean.

3.8 GUYING AND STAKING

A. Stake trees 2 to 3 inches in caliper with (3) 1" x 2" x 18" wood stakes per tree.

Stake trees 5" and above with 4 stakes. Stakes shall be driven into undisturbed soil. Place rubber hose ½ to 1 inch in diameter, around the tree trunk to prevent damage to bark by supporting wire. No hose required with nylon strapping.

Use ¼" sisal rope, ½" polypropylene rope, or ½"-3/4" nylon strapping.

3.9 MULCHING

A. Mulching Application: Within two (2) days after planting, mulch all planting areas, individual tree pits, entire shrub and groundcover beds with a 3 inch layer of mulching material.

PRIOR TO MULCHING APPLY PRE EMERGENT HERBICIDE

3.10 INSTALLATION OF MISCELLANEOUS MATERIALS

A. Apply antidesiccant using power spray to provide an adequate film over trunks, branches, stems, twigs, and foliage.

1. When deciduous trees or shrubs are moved in full-leaf, spray with antidesiccant at nursery before moving and again 2 weeks after planting.

3.11 CLEANUP AND PROTECTION

A. During tree and shrub work, keep pavements clean and work area in an orderly condition.

B. Protect trees and shrubs from damage due to landscape operations, operations by other contractors and trades, and trespassers. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged landscape work as directed.

3.12 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of it off the Owner's property.

3.13 FINAL ACCEPTANCE

A. Upon completion of all planting operations, including cleanup, the Contractor shall notify the Architect and accompany him or her on inspection of planting. Any items found to be unsatisfactory shall be corrected prior to approval for final acceptance. The one-year guarantee period shall start at the date of final acceptance.

B. At the end of the one year guarantee period, and upon written notice [illegible] to the Contractor at least ten days before the anticipated date, an inspection will be made [illegible] and the Contractor. At this one year inspection, the Contractor [illegible] all guy [illegible], collars, and guy stakes from all guyed plants.

SECTION 33 41 00 - STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

A. This Section includes drainage systems outside the building.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 31 Section "Earth Moving" for excavation and backfilling.

1.3 DEFINITIONS

A. Drainage Piping: System of pipe, fittings, and appurtenances for gravity flow of storm drainage.

B. RCP: Reinforced Concrete Pipe

C. PVC: Polyvinyl Chloride Plastic

D. CMP: Corrugated Metal Pipe

E. HDPE: High Density Polyethylene Pipe

1.4 PERFORMANCE REQUIREMENTS

A. Gravity-Flow, Nonpressure-Piping Pressure Ratings: At least equal to system test pressure.

1.5 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Precast concrete manholes and other structures, including frames, covers, and grates. Contractor to provide a list of structures that will be waffle boxes.

C. Reports and calculations for design mixes for each class of cast-in-place concrete.

D. Inspection and test reports specified in the "Field Quality Control" Article.

1.6 QUALITY ASSURANCE

A. Product Options: Drawings indicate sizes, profiles, connections, and dimensional requirements of system components and are based on specific manufacturer types indicated. Other manufacturers' products with equal performance characteristics may be considered.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic structures in direct sunlight.

B. Do not store plastic pipe or fittings in direct sunlight.

C. Protect pipe, pipe fittings, and seals from dirt and damage.

D. Handle precast concrete manholes and other structures according to manufacturer's rigging instructions.

1.8 PROJECT CONDITIONS

A. Site Information: Perform site survey, research public utility records, and verify existing utility locations.

B. Locate existing structures and piping to be closed and abandoned.

C. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Architect not less than two days in advance of proposed utility interruptions.

2. Do not proceed with utility interruptions without Architect's written permission.

PART 2 - PRODUCTS

2.1 PIPES AND FITTINGS

A. Reinforced-Concrete Pipe and Fittings: ASTM C 76, Class III, Wall B, for gasketed joints.

1. Gaskets: Butyl mastic compression joints. Use O-ring gaskets where indicated.

B. PVC Pipe and Fittings:

1. PVC Sewer Pipe and Fittings, NPS 15 (DN 375) and Smaller: ASTM D 3034, SDR 35, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.

2.2 MANHOLES

A. Heavy-Traffic Precast Circular Concrete Manholes: ASTM C 913, designed according to ASTM C 890 for A-16, heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for rubber gasketed joints. Concrete manholes used in vehicular travel ways should have pipe penetrations and gasket connections fabricated in the factory. All openings around pipe shall be securely mortared in and watertight. Adhere to all NCDOT Specifications.

1. Ballast: Increase thickness of one or more precast concrete sections or add concrete to structure, as required to prevent flotation.

2. Gaskets: Joint sealants shall meet the requirements of AASHTO M198, type B.

3. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch-diameter frame and cover. Grade rings to be used to raise grate to grade.

4. Steps: Manufactured from deformed, 1/2-inch steel reinforcement rod complying with ASTM A 615 and encased in polypropylene complying with ASTM D 4101. Include pattern designed to prevent lateral slippage off step. Cast or anchor into sidewalls with steps at 12- to 16-inch intervals. Omit steps for manholes less than 42 inches deep.

B. Manhole Frames and Covers: ASTM A 536, Grade 60-40-18, ductile-iron castings designed for heavy- duty service. Include 24-inch (610-mm) ID by 7- to 9-inch (178- to 229-mm) riser with 4-inch (100-mm) minimum width flange, and 26-inch- (660-mm-) diameter cover. Include indented top design with lettering "STORM SEWER" cast into cover. Ring and cover shall comply with local standards and construction trails.

2.3 CATCH BASINS

A. Heavy-Traffic, Precast Concrete Catch Basins: ASTM C 913, precast, reinforced concrete; designed according to ASTM C 890 for A-16, heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for rubber gasketed joints.

1. Gaskets: Joint sealant shall meet requirements of AASHTO M198, type B.

2. Grade Brick: Use 2 or 3 courses of concrete brick to raise the grate to grade. Mortar joints between brick to be 3/8 to 5/8" thick. Both brick faces to be mortared in and water tight.

3. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch-diameter frame and cover. Grade rings to be used to raise grate to grade.

4. Steps: Manufactured from deformed, 1/2-inch steel reinforcement rod complying with ASTM A 615/A 615M and encased in polypropylene complying with ASTM D 4101. Include pattern designed to prevent lateral slippage off step. Cast or anchor into sidewalls with steps at 12- to 16-inch intervals. Omit steps for manholes less than 60 inches deep.

B. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for heavy-duty service. Provide grate and frame conforming to jurisdictional requirements and as indicated on drawings.

1. Size: As indicated

2. 3-A NCDOT H20 rated knockout waffle boxes are approved for use at curb line locations and lawn areas only. They are not to be used in vehicular travel ways. If these boxes are used in the approved locations, the contractor shall take measures to score or otherwise weaken the opening cutout prior to punching in opening. A maximum gap from pipe to edge of punch out opening shall be 3". All openings around pipe shall be securely mortared in and watertight. Waffle Boxes shall be used to maximum 10'-0" depth [illegible]. Adhere to all NCDOT Specifications.

2.4 WAFFLE BOXES

A. Waffle/Knock-out boxes are not allowed.

2.5 OUTFALLS

A. Performed, reinforced concrete flared end section [illegible]

B. Riprap: Broken stone, irregular size and shape, [illegible] as indicated on drawings.

2.6 CONCRETE

A. General: Cast-in-place concrete according to ACI 318, [illegible], and the following:

1. Cement: ASTM C 150, Type II.

2. Fine Aggregate: ASTM C 33, sand.

3. Coarse Aggregate: ASTM C 33, crushed gravel.

4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi (27.6 MPa) minimum, or as indicated, with 0.45 maximum water-cementitious ratio.

1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.

2. Reinforcement Bars: ASTM A 615, Grade 60, deformed steel.

2.7 CLEANOUTS

A. PVC Cleanouts: PVC body with PVC threaded plug. Include 4" PVC pipe fitting and riser to cleanout of same material as sewer piping.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 IDENTIFICATION

A. Materials and their installation are specified in Division 31 Section "Earth Moving." Arrange for installation of green warning tapes directly over piping and at outside edges of underground structures.

1. Use warning tapes or detectable warning tape over ferrous piping.

2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.3 INSTALLATION, GENERAL

A. General Locations and Arrangements: Drawings (plans and details) indicate the general location and arrangement of underground sewerage and drainage systems piping. Location and arrangement of piping layout take into account many design considerations. Install piping as indicated, to extent practical.

Install piping beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's recommendations for use of lubricants, cements, and other installation requirements. Maintain swab or drag in line and pull past each joint as it is completed.

Use manholes for changes in direction, except where fittings are indicated. Use fittings for branch connections, except where direct tap into existing sewer is indicated. Use proper size increasers, reducers, and couplings, where different sizes or materials of pipes and fittings are connected. Reduction of the size of piping in the direction of flow is prohibited.

D. Install gravity-flow-systems piping at constant slope between points and elevations indicated. Install straight piping runs at constant slope, not less than that specified, where slope is not indicated.

E. Extend drainage piping and connect to building's storm drains, of sizes and in locations indicated. Terminate piping as indicated.

F. Install drainage piping pitched down in direction of flow, at slope indicated.

G. Use proper size increasers, reducers, and couplings, where different sizes or materials of pipes and fittings are connected.

3.4 STORM PIPE BEDDING

A. RCP - Lay gravity storm sewer lines with Category I, II or III bedding as per Design Data 40 by American Concrete Pipe Association. Compaction per Design Date 40, Type 3 installation. Class IA, IB and II per ASTM D321 may also be used. Class IA and IB must be used in wet conditions. Bedding material shall be placed on trench bottom 4 inch minimum depth. Haunching material to be Category I, II, or III, compaction per Type 3 installation. Initial backfill from the top of the haunching material up to 12 inches above pipe top consisting of select finely divided earth, hand placed and compacted before placing the remaining backfill.

B. PVC-Lay gravity storm sewer lines with Class IA, IB, or II bedding as per ASTM D321. Granular bedding material shall be loosely placed, firm but not hard, on trench bottom 6 inch minimum depth. Haunching shall be Class IA, IB or II material and extend up the sides of the pipe to at least ½ pipe outside diameter. Haunching material to be compacted at 90 percent STD proctor. Initial backfill from the top of the granular bedding material up to 12 inches above pipe top consisting of select finely divided earth, hand placed and compacted before placing the remaining backfill. Type IA and IB must be used in wet conditions.

3.5 PIPE JOINT CONSTRUCTION AND INSTALLATION

A. General: Join and install pipe and fittings according to the following.

B. Install with top surfaces of components, except piping, flush with final finished surface.

C. Concrete Pipe and Fittings: Install according to ACPA "Concrete Pipe Handbook." Use the following seals:

1. Round Pipe and Fittings: Butyl Mastic Joint

D. Polyvinyl Chloride (PVC) Plastic Pipe and Fittings: As follows:

1. Join solvent-cement-joint pipe and fittings with solvent cement according to ASTM D 2855 and ASTM F 402.

2. Join pipe and gasketed fittings with elastomeric seals according to ASTM D 2321.

3. Join profile sewer pipe and ribbed drain pipe and gasketed fittings with elastomeric seals according to ASTM D 2321 and manufacturer's written instruction.

4. Install according to ASTM D 2321.

3.6 STORM DRAINAGE INLET AND OUTFALL INSTALLATION

A. Construct riprap of broken stone, as indicated.

B. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.

3.7 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated.

B. Form continuous concrete channels and benches between inlets and outlet.

C. Set tops of frames and covers flush with finished surface.

D. Install precast concrete manhole sections with gaskets according to ASTM C 891.

3.8 CATCH-BASIN INSTALLATION

A. Construct catch basins to sizes and shapes indicated.

B. Set frames and grates to elevations indicated.

3.9 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318, ACI 350R, and as indicated.

3.10 CLEANOUT INSTALLATION

A. Install cleanouts and riser extension from pipe to cleanout at grade. Install piping so cleanouts open in direction of flow in pipe.

B. Set cleanout frames and covers in pavement in cast-in-place concrete block, 12 by 12 by 8 inches deep.

C. Set cleanout frames and covers in non-paved areas with tops flush with surface.

3.11 FIELD QUALITY CONTROL

A. Clear interior of piping and structures of dirt and superfluous material as the work progresses. Maintain swab or drag in piping and pull past each joint as it is completed.

1. In large, accessible piping, brushes and brooms may be used for cleaning.

2. Place plug in end of incomplete piping at end of day and whenever work stops.

3. Flush piping between manholes and other structures, if required by authorities having jurisdiction, to remove collected debris.

B. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of the Project.

1. Submit separate reports for each system inspection.

2. Defects requiring correction include the following:

a. Alignment: Less than full diameter of inside of pipe is visible between structures.

b. Deflection: Flexible piping with deflection that prevents passage of a ball or cylinder of a size not less than 92.5 percent of piping diameter.

c. Crushed, broken, cracked, or otherwise damaged piping.

d. Infiltration: Water leakage into piping.

e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials and repeat inspections until defects are within allowances specified.

4. Reinspect and repeat procedure until results are satisfactory.

C. Test new piping systems and parts of existing systems that have been altered, extended, or repaired for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.

2. Test completed piping systems according to authorities having jurisdiction.

3. Schedule tests, and their inspections by authorities having jurisdiction, with at least 24 hours' advance notice.

4. Submit separate reports for each test.

Replace leaking piping using new materials and repeat testing until leakage is within allowances specified.

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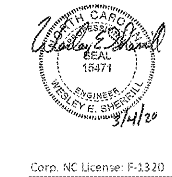
Seals:



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