02630 – STORM DRAINAGE

(Last revised 6/23/10)

SELECTED LINKS TO SECTIONS WITHIN THIS SPECIFICATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this specification.

B. Section 02275 – Trenching, Backfilling, and Compaction of Utilities

C. Section 02530 – Sanitary Sewer

D. Division 02920 – Seeding, Sodding, and Groundcover

1.2 SUMMARY

This section includes all equipment, labor, material, appurtenances, and services required for complete installation of storm drainage piping, ditches, structures, and specialties for municipal drainage systems.

1.3 DEFINITIONS

A. General

For the purposes of this specification, the following definitions refer to storm water drainage systems and structures that come under the authority of the Town of Clayton, North Carolina as specified within this section and other sections of this manual.

Public Storm Drainage System: Drainage systems and their appurtenances required for the conveyance of public storm water from and across publicly maintained streets, roads, highways, and other public property and located within public rights-of-way and/or easements.

B. The following are industry abbreviations for various pipe materials.

1) **RCP**: Reinforced Concrete Pipe

2) **HDPE**: High Density Polyethylene (NCDOT Approved) double walled pipe.

1.4 SUBMITTALS

A. Submit shop drawings on all non-standard products/materials.

B. Submit product data and shop drawings for the following.

1) Drop/curb inlets
2) Frame and covers
3) Head/end walls
4) Inlet grates
5) Concrete pipe and piping specialties
6) Precast concrete manhole castings
7) HDPE fittings

1.5 QUALITY ASSURANCE

A. Materials and operations shall comply with the latest revision of all applicable Codes and Standards.

B. Piping materials shall be marked clearly and legibly.

1) Reinforced Concrete Pipe shall be marked as follows:

a. Pipe Class and wall type,
b. Manufacturer
c. Date of Manufacture

2) Double walled corrugated HDPE pipe, end sections, tees, elbows and accessories shall be marked as follows:
a. AASHTO Designation
b. The date of manufacture
c. Name or trademark of the manufacturer

1.6 QUALITY STANDARDS

A. Material and operation shall comply with the latest revision of the Codes and Standard listed below:

American Society for Testing and Materials (ASTM)

ASTM C33	Concrete Aggregates
ASTM D698	Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3) (Standard Proctor).
ASTM D1556	Standard Method of Test for Density of Soil in Place by the Sand-Cone Method

ASTM D1557 Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3) (Modified Proctor).

ASTM D2049 Standard Method of Test for Relative Density of Cohesionless Soils

ASTM D2167 Standard Method of Test for Density of Soil in Place by the Rubber-Balloon Method

ASTM D2321 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications

ASTM D2487 Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).

ASTM D2922 Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

ASTM D3212 Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

ASTM D3350 Standard Specification for Polyethylene Plastics Pipe and Fittings Materials

ASTM D3740 Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction

ASTM D4253 Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.

ASTM D4254 Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.

ASTM D4318 Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

ASTM E329 Standard Specification for Agencies Engaged in Construction Inspection and/or Testing

ASTM F477 Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

ASTM F2306 Standard Specification for 12 to 60 in. [300 to 1500 mm] Annular Corrugated Profile-Wall Polyethylene (PE) Pipe and Fittings for Gravity-Flow Storm Sewer and Subsurface Drainage Applications

American Association of State Highway & Transportation Officials

AASHTO M86 Concrete Sewer, Storm Drain, and Culvert Pipe

AASHTO M170 Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

AASHTO M198 Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets.

AASHTO M199 Precast Reinforced Concrete Manhole Sections

AASHTO M206 Reinforced Concrete Arch Culvert Storm Drain and Sewer Pipe

AASHTO M207 Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe

AASHTO M242 Reinforced Concrete D-Load Culvert, Storm Drain and Sewer pipe

AASHTO M259 Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers

AASHTO M273 Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers with Less than 2 feet of Cover Subject to Highway Loadings

AASHTO M294 Corrugated Polyethylene Pipe, 12- to 24-inch Diameter for Type S.

B. Standard abbreviations

AASHTO American Association of State Highway Transportation Officials.

ACI American Concrete Institute

ACPA American Concrete Pipe Association

AISI American Iron and Steel Institute

ANSI American National Standards Institute

AREA American Railway Engineers Association

ASCE American Society of Civil Engineers

ASTM American Society for Testing and Materials

CRSI Concrete Reinforcing Steel Institute

FS Federal Specifications

MSDS	Material Safety Data Sheets
NCMA	National Concrete Masonry Association
OSHA	Occupational Safety and Health Administration
NCDOT	North Carolina Department of Transportation

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

A. **Pipe Condition/Pipe Examination**:

1) **New Pipe Inspection – All pipe**: Inspect materials thoroughly upon arrival. Examine materials for damage. Remove damaged or rejected materials from site. Pipe shall be protected during handling against impact shocks and free fall. Pipe shall be kept clean at all times, and no pipe shall be used in the work that does not conform to the appropriate ASTM Specifications.

a. **Concrete Pipe:** Check bells and spigots closely for smoothness, roundness, and honeycombing (concrete pipe), which may be a source of infiltration. Check for cracks, chips, etc. on both ends. Reject any pipe that will not provide watertight seal or is otherwise structurally deficient.

2) **Pre-Installation Inspection**: Prior to being installed, each section of the pipe shall be carefully examined for damage and conformity with these specifications. All pipes damaged or deemed not to conform to these specifications shall be rejected and removed from site.

a. **Concrete Pipe**: All concrete pipes in which the spigots and bells cannot be made to fit properly, or pipe, which has chipped bells or spigots, will be rejected. The faces of all spigots ends and of all shoulders on the bells of rigid pipe must be true.

b. **Double Walled HDPE Pipe**: All double walled corrugated HDPE pipe in which the pipe and fittings cannot be made to fit properly shall be rejected. Protect pipe during handling using methods recommended by the manufacturer.

B. Observe manufacturer's directions for delivery and storage of materials and accessories.

C. Protect stored piping from entry of water or dirt into pipe. Protect bells and flanges of special fittings from entry of moisture and dirt.

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

1.8 PROJECT CONDITIONS

Storm Drainage Manholes – No water mains shall pass through or come in contact with any part of a storm drainage manhole. A minimum of 3 feet of horizontal separation shall be maintained between water mains and storm drainage manholes

unless otherwise approved by the Town Engineer. Interference/conflict manholes will not be permitted unless otherwise approved by the Town Engineer.

See also paragraph 1.9 *Project Conditions* of section 02275, *Trenching, Backfilling and Compaction of Utilities*.

1.9 SERVICE INTERRUPTION

Contact the Town of Clayton to coordinate interruption of service, operation of valves, line cut-ins, or placement of a tapping sleeve and valve. If interruption is necessary, the interruption shall be arranged to occur at such a time to cause the least disruption and minimize loss of service. At the direction of the Town Engineer, temporary service may be required to be provided. Provide a minimum of 72 hours notice of the proposed utility interruption or necessary operation of valves.

1.10 COORDINATION

A. Coordinate tie-in to municipal water mains with the Town Engineer. Except as needed for fire suppression purposes, the Town of Clayton will be the sole operator of all valves and hydrants on the Town's water distribution system. Adequate notifications to water customers will be given by the Contractor prior to any interruption of service. Service is to be continuously maintained to customers in the project areas except for the minimum amount of time required to make connections with the existing system. Only in the case of an emergency may a valve be closed by a Contractor. Records shall be kept of any valves closed during an emergency and the Town Engineer shall be notified of the specific valves closed at the earliest reasonable time following such valve closure.

   Before shutting off any main, residents are to be notified by the Town of Clayton's representative in writing at least 24 hours in advance of cut off. The Contractor shall provide assistance to the Town in notification distribution. The Town shall be notified at least 48 hours in advance of request for operation of valves and making either a wet tap or cut-in.

B. Coordinate tie-in to municipal manholes with the Town Engineer.

C. At the direction of the Town Engineer, temporary pumping/bypass of sewerage flow may be required to be provided. See 02530 - *Sanitary Sewer, Bypass Pumping* for bypass pumping requirements and procedure.

D. When traffic signals, loops, or their appurtenances are likely to be damaged or interfere as a result of the construction, coordinate temporary operation with the applicable agency having jurisdiction of the signals. Provide a minimum of 1 weeks' notice prior to anticipated disturbance or interruption. At the discretion of the Town Engineer, the notice may be required to be published in the newspaper.

E. **Repair of pavement markings**: When cuts are made through any paved surface and the cuts extend through the pavement markings, the replaced pavement shall be marked to match the existing.

F. **Water Service Shut-off**

The Town of Clayton requires adherence to the following procedures prior to shutting off water service on any existing Town line:

1) The Contractor must receive approval for shut-off from the Town Engineer. Generally, shut-offs must occur from 9:00 AM to 11:00 AM and 2:00 PM to 4:00 PM on weekdays.

2) After receiving approval, Contractor shall notify affected residents in writing 48 hours in advance of beginning operation.

G. Before Digging, contact ***"NC One Call"*** at 811 and the Town of Clayton at 919-553-1530 for location of services.

PART 2 – PRODUCTS

2.1 PIPE & FITTINGS

2.1.1 CONCRETE PIPE

A. REINFORCED CONCRETE PIPE

RCP shall be a minimum of Class III, Wall B and meet the applicable requirements of AASHTO M170. Concrete pipe joints shall be tongue and groove type unless otherwise specified. RCP shall conform to the requirements of applicable sections of the latest revision of the NCDOT *Standard Specifications for Roads and Structures*.

RCP Class III or IV shall also meet ASTM C76*, Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe*.

Gasketed joints in concrete pipe shall meet the requirements of paragraph 2.2.12, *Performed Plastic Gaskets*. Mortar joints shall meet the requirements of paragraph 3.1.1 F 1), *Mortar Joints*.

2.1.2 HDPE CORRUGATED POLYETHYLENE PIPE

Pipe shall be high-density polyethylene corrugated exterior/smooth interior pipe. 15-inch through 36-inch diameters shall meet all the requirements of AASHTO M294, Type S *Specification for Corrugated Polyethylene Pipe, 12- to 36-inch diameter.* 42-inch and 48-inch diameters shall have minimum pipe stiffness of 20 and 17 psi, respectively, at 5% deflection; and shall meet all other requirements of AASHTO M294. Pipe joints shall be "water-tight" in-line bells with gaskets meeting ASTM F477H *Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe*.

Pipe coupling bands, end treatments, pipe tees, and elbows shall conform to AASHTO M294.

2.1.3 PLAIN CONCRETE PIPE AND CORRUGATED METAL PIPE

Not permitted.

2.2 MISCELLANEOUS APPURTENANCES

2.2.1 BEDDING

See paragraph 3.3.2.C *Bedding for Structures*, 02275, *Trenching, Backfilling, and Compaction of Utilities*.

2.2.2 BRICK

Brick shall be hard clay, grade SM, ASTM C 32, *Standard Specification for Sewer and Manhole Brick (Made From Clay or Shale)* and AASHTO M91.

2.2.3 CONCRETE BLOCK

Concrete block shall conform to the requirements of ASTM C139, *Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes*.

2.2.4 CONCRETE FLARED END SECTIONS

Concrete flared end sections shall meet all applicable requirements of AASHTO M170 except those pertaining to design. All concrete flared end sections shall be reinforced. The concrete used in flared end sections shall be air entrained and shall attain strength of 3500 psi when tested in accordance with AASHTO T22. 3:1 slopes are required on flared ends.

2.2.5 CONCRETE PIPE TEES AND ELBOWS

With the approval of the Town Engineer, tees and elbows may be used for 60-inch and larger pipe. Concrete pipe tees and elbows shall meet or exceed all applicable requirements of AASHTO M170 for the class of pipe tee or elbow specified on the plans.

2.2.6 GEOTEXTILE FABRIC:

Geotextile fabric shall be protected from mud, dirt, dust, sunlight, and debris during transport and storage. Material shall be inert to commonly encountered chemicals; resistant to mildew, rot, insects, and rodents; and biologically and thermally stable. Geotextile fabric for subsurface installation shall not be exposed to direct sunlight for more than 24 hours before or during installation.

A. **Filter Fabric for Rip Rap**: Filter Fabric for Rip Rap and Rip Rap Beddings shall conform to Section 1056 – *Engineering Fabrics* of the NCDOT *Standard Specifications for Roadways and Structures*, latest revision for Type 2 engineering fabric.

B. **Fabric for Subsurface Drains**: Non-woven needle-punched fabric for subsurface drains shall conform to Section 1056 – *Engineering Fabrics* of the NCDOT *Standard Specifications for Roadways and Structures*, latest revision for Type 1 engineering fabric.

2.2.7 MORTAR FOR CONCRETE BLOCK & BRICK

Mortar shall be type M, ASTM C 270, *Standard Specification for Mortar for Unit Masonry* and ASTM C 144, *Standard Specification for Aggregate for Masonry Mortar.* Mortar shall be prepared from cement in perfect condition and shall be prepared in boxes for that purpose. No mortar that has stood beyond 45 minutes shall be used.

If hollow concrete masonry units (CMU) are approved by the Town Engineer, the grout for cellular fill of block or voids is required and shall be comprised of 3000-psi ready mix concrete with pea gravel aggregate. Do not provide air entrainment unless specified by the Town Engineer.

2.2.8 MISCELLANEOUS CONCRETE

Concrete Classes (NCDOT) to Design Compressive Strength at 28 days (f'c):

Class AA	General	4,500-psi
Class A	General	3,000-psi
Class B	Massive or Lightly Reinforced	2,500-psi

Ready mixed concrete shall comply with ASTM C94, *Standard Specification for Ready-Mixed Concrete.* All exposed concrete shall be air entrained. Concrete strength shall be as specified on standard details and drawings. Unless otherwise specified, all concrete shall be Class A, minimum.

2.2.9 PORTLAND CEMENT

Type I, CSA normal, ASTM C150 *Standard Specification for Portland Cement*.

2.2.10 PRECAST REINFORCED CONCRETE MANHOLES

A. Precast reinforced concrete manholes shall be designed and manufactured in accordance with ASTM C478, *Standard Specification for Precast Reinforced Concrete Manhole Sections*, latest revision and AASHTO M199. Either an "O" ring joint conforming to the requirements of AASHTO M198 and ASTM C443 *Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets* or joints conforming to AASHTO M199 and ASTM C990 *Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants* may be used.

Type Concrete used in the construction of the manholes shall have a minimum 28-day compressive strength of 4000-psi air entrained (with 4 to 6 percent air) conforming to ASTM C33 *Standard Specification for Concrete Aggregates* and ASTM C94 *Standard Specification for Ready-Mixed Concrete*. Manholes shall have monolithic base and eccentric cone or flattop as applicable. Structures are to have steps. Manholes shall have extended bases with appropriate reinforcing. Acceptable manufacturers are: Hanson Pipe and Precast, Oldcastle Precast, Contech, Stay-Right Tank, or Tindall Precast Concrete Products, Inc.

2.2.11 PRECAST UNDERGROUND CONCRETE UTILITY STRUCTURES

A. Structures of precast reinforced concrete shall be designed and manufactured in accordance with ASTM C913, *Standard Specification for Precast Concrete*

Water and Wastewater Structures and ASTM C858, *Standard Specification for Underground Precast Concrete Utility Structures*, latest revision with preformed butyl rubber joint sealant meeting ASTM C990, *Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed flexible Joint Sealants*, latest revision. Type Concrete used in the construction of the Utility Structures shall have a minimum 28-day compressive strength of 4000-psi air entrained (with 4 to 6 percent air) conforming to ASTM C33 *Standard Specification for Concrete Aggregates* and ASTM C94 *Standard Specification for Ready-Mixed Concrete*. Unless shown otherwise on the drawings, structures are to have steps. Steel reinforcing shall conform to the requirements of ASTM C857, *Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures,* latest revision. Structures shall be designed for an H20-44 loading in traffic areas. Acceptable manufacturers are: Hanson Pipe and Precast, Oldcastle Precast, Contech, Stay-Right Tank, or Tindall Precast Concrete Products, Inc.

B. Concrete to be minimum 4000 PSI. Provide all reinforcing steel which meets ASTM A615 for grade 60 and welded wire fabric conforming to ASTM A185. Welded wire fabric may be substituted for rebar as long as the same area of steel is provided.

C. Place non-penetrating lift holes or pins in accordance with OSHA standard 1926.704.

D. Provide Precast structures over 4'-0" in depth with steps unless directed otherwise by the Town Engineer.

2.2.12 PREFORMED PLASTIC GASKETS (JOINT SEALER)

Preformed plastic gaskets shall meet federal specification SS-S-21A AASHTO M-198, Type B – Butyl Rubber. Sag or flow resistance and Chemical resistance shall meet ASTM C990. Preformed butyl gaskets shall be used with structures meeting ASTM C478, ASTM C990 and AASHTO M199. Preformed plastic gaskets shall equal or exceed "Ram-Nek" as manufactured by the Henry Company, Sealants Division, Houston, TX.

2.2.13 MANHOLE FRAMES AND COVERS

Standard Frames and Covers: Manhole frames and covers shall be meet ASTM A48 *Standard Specification for Gray Iron Castings*, Class 35B, traffic frame and cover as manufactured by Capitol Foundry, US foundry or East Jordan Iron Works. Standard manhole frames and covers shall be manufactured to the dimensions and configurations shown on **Standard Detail C06.01** and shall have a minimum of four 1-inch diameter holes in the flange of the frame. Minimum inside diameter of the opening shall be 23 1/2 inches. Manholes castings shall be bituminous coated. The bearing surface of the frames and covers shall be machined and the cover shall seat firmly into the frame without rocking. Weights shall not vary more than 5% +/- of the weight shown on **standard detail C06.01**.

Cast-in-Place Frames and Covers: Manhole frames and covers shall be meet ASTM A48 *Standard Specification for Gray Iron Castings*, Class 35B, traffic frame and cover as manufactured by Capitol Foundry, US foundry or East

Jordon Iron Works. Cast-in-place manhole frames and covers shall have a minimum inside opening diameter of 24 inches. Manhole frames and covers shall be bituminous coated. The bearing surface of the frames and covers shall be machined and the cover shall seat firmly into the frame without rocking.

Covers are to be embossed along the perimeter with the words "Storm" and "Drains to Waterway." See **Standard Detail 633.03**.

Acceptable Manufacturers and models are:

Standard Frames & Covers		
Manufacturer	**Standard**	**Standard Detail**
Capitol Foundry	**-**	**-**
US Foundry	**700KL**	**C06.01**
East Jordan Iron Works	**V-1384**	**C06.01**
Cast-in-place Frames & Covers		
East Jordan Iron Works	**V-1890**	**-**

2.2.14 MISCELLANEOUS GRAY IRON CASTINGS

Catch basin frames and grates: Supply gray iron castings meeting the requirements of ASTM A48 *Standard Specification for Gray Iron Castings*, Class 35B as manufactured by Capitol Foundry, US foundry or East Jordan Iron Works. Boldly fillet castings at angles, and provide arrises that are sharp and perfect. No sharp, unfilleted angles or corners are permitted. Provide castings that are true to pattern in form and dimension, free from pouring faults, sponginess, cracks, blowholes, and other defects affecting their strength and value for the service intended. Welding is not allowed for the purpose of making a casting structurally sound. Welding for cosmetic or other purposes is not allowed without approval of the Town Engineer.

2.2.15 DROP INLETS

A. Drop inlet tops and bases shall be precast and shall conform to the requirements of *paragraph 2.2.11, Precast Underground Concrete Utility Structures*, as well as all applicable sections of the latest revision of the *NCDOT Standard Specifications for Roads and Structures*. Refer to **Standard Details 633.02 633.03, 633.04, 634.01, 634.02, and 639.01**.

B. Drop inlet bases may be either precast reinforced concrete or concrete block.

C. Inlet grates shall conform to the requirements of paragraph 2.2.14, *Miscellaneous Gray Iron Castings,* and the applicable sections of the latest revision of the NCDOT *Standard Specifications for Roads and Structures*.

2.2.16 REINFORCING STEEL

Reinforcing steel shall conform to ASTM A615 *Specification for Deformed Billet-Steel Bars for Concrete Reinforcement,* Grade 60.

2.2.17 RIP RAP AND RIP RAP BEDDING

Rip Rap and Rip Rap Bedding shall conform to Section 1042 – *Rip Rap Material* of the NCDOT *Standard Specifications for Roadways and Structures*, latest revision for Class A, B, 1 and 2 rip rap.

2.2.18 SUBSURFACE DRAINAGE

Subsurface drains shall conform to Section 1044 – *Subsurface Drainage Materials* of the NCDOT *Standard Specifications for Roadways and Structures*, latest revision.

2.2.19 MISCELLANEOUS STORMWATER APPURTENANCES

All miscellaneous stormwater appurtenances including but not limited to Endwalls, Headwalls, and Flared end sections shall conform to all applicable sections of the latest revision of the NCDOT *Standard Specifications for Roads and Structures*.

PART 3 – EXECUTION

3.1 PIPE INSTALLATION - GENERAL

3.1.1 CONSTRUCTION – ALL PIPE

A. **Trench Width**: Trench width shall be per **Standard Detail 511.02** unless approved otherwise by the Town Engineer.

B. **Pipe Laying Direction**: Place piping beginning at low point and progress uphill. Place on grade, with unbroken continuity in invert, horizontally and vertically, and on alignment as indicated on plans. Place bell or groove ends of piping facing upstream. Install gaskets, seals, sleeve, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements. Place non-woven Geotextile fabric around joints as specified in paragraph 3.1.1.F 3), *Wrapping Pipe Joints*.

C. **Directional changes in gravity lines**: Use manholes for changes in direction of gravity lines. The Town Engineer may permit horizontal curves in pipe alignment for pipe greater than 48 inches in diameter where pipe has been manufactured with a beveled end for the specific project application. Shop drawings shall be submitted to the Town Engineer for review and approval prior to ordering pipe. Contractor is responsible for maintaining and documenting grade check through curve to ensure conformity with vertical grade.

D. **Stringing out Pipe**: When pipe is strung out during unloading, it shall be set on high ground and in a position to prevent silt deposits, storm water, or other matter from entering the pipe prior to its placement in the trench.

E. **OSHA Trench Protection**: Adhere to all OSHA requirements for trench slope protection, particularly Subpart P, *Excavations*, of 29 CFR 1926, latest revision. Contractor is responsible for determining the proper and applicable slope based on type soil in order to meet Subpart P, *Excavations*, latest requirements. Contractor shall employ the services of a Geotechnical engineer for direction and guidance if unstable or difficult soils are encountered. In any event, the Contractor shall hold the Town of Clayton harmless for injuries and/or damages

resulting from failure to properly adhere to trench protection regulations/requirements in force at the time of a failure or mishap.

F. **Pipe Laying**: Pipe shall be bedded per paragraph 3.2.7.B and D, *Trench Preparation For Pipe*, Section 02275, *Trenching, Backfilling and Compaction of Utilities*. The pipe and fittings shall be laid in the trench so that its interior surface shall conform to the grade and alignment as shown on the plans. Pipe laying shall be done in such a way as to disturb as little as possible the pipe that has already been laid. The alignment and grade of the storm main may be field adjusted whenever, in the opinion of the Town Engineer, it is necessary, so long as the changes are consistent with the Town of Clayton policy in affect at the time of the change. Changes in either grade or alignment may only occur at manholes. Where bell and spigot pipe is used, recesses shall be excavated to receive the pipe bells.

Before laying, the bell and spigot will be wiped free from any dirt or other foreign matter. All surfaces of the portion of the pipe to be joined, and the factory-made jointing material, shall be clean and dry. Jointing material shall be used as recommended by the pipe or joint manufacturer's specifications. The jointing material or factory-fabricated joints shall then be placed, fitted, and adjusted in such skillful manner as to obtain the degrees of water tightness required. Lifting holes shall be plugged according to the manufacturer's recommendations. A sheet of geo-fabric shall be placed over the plugged lifting hole extending 18" from either side of the hole.

Trenches shall be kept as dry as possible during bedding, laying and jointing and for as long a period as required until the trench is backfilled. As soon as possible after the joint is made, sufficient backfill material shall be placed along each side of the pipe to offset conditions that might tend to move the pipe off line or grade. The greatest care shall be used to secure water tightness and to prevent damage to or disturbing of the joints during the backfilling process, or at any other time.

After the trench foundation has been properly graded to receive the pipe, the pipe shall be carefully lowered into the trench with approved methods. Under no circumstances shall the pipe or accessories be dropped or dumped into the trench. All damaged pipe shall be replaced at the Contractor's expense.

All joints shall be left exposed for inspection purposes during the working day and a suitable ladder affording easy and safe access for such inspection shall be furnished.

The Contractor at his own expense shall make any defects due to settlement good.

1) **Mortar Joints:** The mortar in the joints shall be composed of 1 part Portland cement and two parts clean sharp sand with 15% hydrated lime, by volume, added to the mixture. The pipe shall be clean and moist when mortar is applied. The lower portion of the bell or groove shall be filled with mortar sufficient to bring the inner surface flush and even when the next joint is fitted into place. The remainder of the joint shall then be filled with mortar and a bead or ring of mortar formed around the outside of the joint. The application of mortar to the inside of joints may be delayed until fill in completed where the pipe is in excess of 30 inches in diameter. The inside

of all mortar joints shall be clean and smooth upon completion of the work. Competed mortar joints shall be cured and protected by permanently wrapping the exposed outside of the mortar joint with a layer of 30# roofing felt or a nonwoven Geotextile fabric.

2) **Flexible Plastic Joint:** Flexible joints meeting the requirements of paragraph 2.2.12, *Preformed Plastic Gaskets* may be used in lieu of mortar joints. The outside of the pipe may be required to be wrapped in fabric. See paragraph 3 Wrapping Joints, below.

3) **Wrapping Joints**: In silts and sandy soils, wrap each storm drainage pipe joint with a non-woven Geotextile fabric. Fabric is to be placed a minimum of 18 inches on each side of the joint and shall lap itself a minimum of 18 inches. Where the Town Engineer directs, for subgrade drainage purposes, that the invert of the pipe joint is to be left open, placement of a non-woven Geotextile fabric is mandatory.

G. **Temporary Suspension of Work**: When the trench is left for the night or if pipe laying is suspended, all exposed ends of the pipe shall be plugged to keep out dirt, water, animals and other foreign matter or substances. This plugs shall be kept in the ends of the pipeline at all times when laying is not in actual progress.

H. **Cutting or Fitting Pipe**: Whenever a pipe requires cutting to bring a pipe to the required location, the work shall be done in a satisfactory manner with an approved cutting tool or tools that will leave a smooth end at right angles to the axis of the pipe and not otherwise damage the pipe. The method of cutting pipe shall be in accordance with manufacturer's recommendations. Such cuts shall be made by the Contractor without extra compensation.

I. **Joining Pipe of Different Size or Material**: A drainage structure box is required at all pipe intersections (vertical or horizontal) and changes in pipe size or pipe material. Lateral taps and branches are not permitted without a junction box. See also paragraph 2.2.5 Concrete Pipe Tees and Elbows.

3.1.2 REINFORCED CONCRETE PIPE

A. Pipe support for pipe shall provide uniform bearing for the pipe barrel along its entire length. The pipe shall be carefully laid on the prepared foundation/bedding, groove end upgrade with the tongue fully inserted and each joint checked for alignment and grade as the work proceeds.

B. Minimum pipe bedding: Provide a minimum of 4 inches of #57 stone bedding.

1) Fill haunches to springline of pipe with either #57 stone consolidated or select granular fill compacted to a minimum of 95% of the standard Proctor maximum dry density.

2) The remainder of the soil to ground surface shall be suitable material such as material conforming to ASTM D2321, Class I, II or III (see also Division *02275, Trenching, Backfilling, and Compaction of Utilities*, paragraph 2.1.1.F for list of satisfactory soils). Compact as specified in Table 2275.3 of 02275 *Trenching, Backfilling and Compaction of Utilities*. Compaction lift thickness to conform to Table 2275.4.

C. Pipe with varying wall class must not be mixed between manholes or boxes.

D. **Bury Limitations**: **Table 2630.1** shall govern as the maximum allowable bury for concrete storm pipe:

Table 2630.1

Bury Limitations on RCP (15 through 60 inches)

Pipe Class	Maximum Depth of Bury[a]			
	Class III wall (feet)	**Class IV wall** (feet)	**Class V wall** (feet)	**Max Trench Width** (feet)
15-inch	9.5	14.5	23	4.0
18-inch	9.5	15.0	32.5	4.0
24-inch	11.5	23.0	50	4.0
30-inch	11.0	19.5	44.5	5.0
36-inch	10.5	18.0	35	6.0
42-inch	11.0	19.0	36.5	6.5
48-inch	11.5	19.5	37.5	7.0
54-inch	12.0	20.0	38.5	7.5
60-inch	12.0	20.5	38.5	8.0

[a] Based on saturated clay weighing 120 pcf, trench width as specified, class C stone bedding, 1350 plf per ft of internal diameter for class III and 2000 plf per ft of internal diameter for class IV, 3000 plf per ft of internal diameter for class V, $D\text{-}_{0.01\ crack}$

E. Join concrete pipe using either mortar or bitumastic material to seal joint.

F. As each joint is laid, visually inspect to be certain that no jointing compound gasket, or trash is protruding from the joint or lying inside the pipe.

3.1.3 DOUBLE WALLED CORRUGATED HDPE PIPE:

A. Pipe support shall provide uniform bearing for the pipe barrel along its entire length. The pipe shall be carefully laid on the prepared foundation/bedding and each joint checked for alignment and grade as the work proceeds. Each joint shall be wrapped in a non-woven geo-fabric overlapping the joint and itself by at least 18".

B. Installation of double walled corrugated exterior/smooth interior HDPE pipe shall be in accordance with ASTM D2321, *Standard Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe, latest revision* and as directed by the Town Engineer.

C. Minimum pipe bedding class: Pipe bedding to be Class B. See *02275, Trenching, Backfilling, and Compaction of Utilities*, paragraph 2.1.2 *Pipe Bedding Definitions* for a description of Class B bedding.

D. Backfill and compaction shall conform to the applicable provisions of *02275, Trenching, Backfilling, and Compaction of Utilities*. To prevent displacement of

pipe, backfill shall be brought up evenly on both sides of the pipe. Backfill shall be suitable material such as free-draining sands and gravel conforming to ASTM D2321, Class I, II or III (see also Division *02275, Trenching, Backfilling, and Compaction of Utilities*, paragraph 2.1.1.F for satisfactory soils). Lift thickness and compaction requirements for backfill shall conform to the requirement of Section *02275, Trenching, Backfilling, and Compaction of Utilities*, Tables 2275.3 and 2275.4.

E. **Bury Limitations**: Minimum cover over pipe shall be 18 inches in a quality backfill envelope and where subject to traffic loads. Non-traffic areas shall have a minimum of 12 inches of fill in a quality backfill envelope. Maximum cover over pipe shall be limited to 10 feet. At the discretion of the Town Engineer, deeper bury may be permitted provided calculations are submitted and sealed by a NC Professional Engineer for the proposed application.

F. Leakage testing: Leakage rates of pipe shall not exceed 50 gallons/inch diameter/mile/day.

3.2 MANHOLE CONSTRUCTION FOR STANDARD MANHOLES AND DROP INLET BASES

A. **Standard Manholes and Drop Inlet Bases**: Manholes shall be constructed in accordance with the NCDOT Standard Details and the Town of Clayton **Standard Detail 532.03** with the following exceptions:

Flexible boots and precast concrete inverts will not be required.

Joints will be as specified in the product section of this specification.

The pipe opening in precast units shall be at least 4 but not more than 8 inches larger than the outside diameter of the pipe. Pipe openings shall be formed, drilled, or neatly cut as approved by the Engineer.

The Contractor may use brick and masonry block or concrete pipe cutoffs in conjunction with mortar to fill the void between pipe culverts and precast structures. Such materials shall be thoroughly wetted and bonded with mortar. The remaining exterior and interior void shall be filled and sealed/slicked with mortar to the contour of the precast structure.

The standard joint shall be sealed on the interior of the structure, after installation, with a non-shrink hydraulic cement mortar.

Do not plug weep holes. Place a non-woven Geotextile fabric over weep holes.

Pour concrete inverts in all structures. Concrete shall be in compliance with products section for miscellaneous concrete of these specifications. Shape manhole channel with a smooth semicircular bottom matching inside diameter of the connecting pipe/pipes. Change directions of flow with a smooth curve of as large a radius as the manhole size will permit. Change size and grade of channels gradually and evenly. Shape the shelf to provide a slope between 1 and 2 inches per foot towards the invert.

Manholes shall be installed plumb.

B. **Adjustments**: The Contractor shall exercise care in the ordering of structures so that the use of brick for leveling and adjustments can be minimized. Where adjustment of a manhole is required, grade rings shall not be used unless otherwise approved by the Town Engineer. Where adjustment of the inlet is required, the use of bricks is approved, provided that the entire void between the flat-top and inlet is also filled with brick and mortar to uniformly distribute loading of the inlet. The depth of bricks shall not exceed 12 inches before removal of the cone or flat-top is necessary for adjustment (see **standard detail C06.03**).

On all storm manholes, a mastic joint material shall be placed between the frame and cover and the cone or grade ring.

When applicable, during the installation of manholes, if frame and cover is near or within wheel path in roadway, turn cone to place the frame out of wheel path.

C. **Replacement/Rehabilitation of Existing Manholes**:

When a new manhole is necessary, the old manhole must be completely removed and a new precast manhole set in its place. Where the old manhole is of satisfactory quality, the Contractor will make connection thereto as directed by the Town Engineer at no additional cost even if it is necessary to modify the bottom of the manhole to meet the new grade. Such extras are considered incidental to the manhole connection cost.

3.3 PRECAST REINFORCED CONCRETE STORM DRAINAGE STRUCTURES (Flush Wall, Waffle and Knockout Panel Type):

A. **Design Requirements**: See paragraph 2.2.11, Precast Underground Concrete Utility Structures
   1) **Formed Inverts**: All boxes shall have formed inverts. Invert forming is to be performed after the pipe penetrations have been made, the annular space around the pipe grouted and the pipe sawn flush with the interior face of the structure.
   2) Seal joints with a flexible butyl rubber.

B. **Box Size**: The outside pipe diameter plus 2” or the opening required for frame and grate is the minimum structure size whichever is greater.

C. **Maximum Depth** (manhole junction boxes and catch basins): Limit maximum depth to top of bottom slab for waffle wall structure to 10’-0”; limit solid wall structure to 15’-0” unless approved otherwise by the Town Engineer.

D. **Grade Adjustment**: Precast storm drainage boxes with knockout panels shall be set to the prescribed grade designated on the construction drawings. Boxes shall be placed on a stone bed of a minimum of 6 inches of #57 stone. Boxes shall be adjusted to final grade by the addition of either precast reinforced concrete grade rings or solid clay or concrete masonry with type M mortar. Boxes may not be saw cut to lower the grade unless first approved by the Town Engineer and then by no more than 2 inches. Due to the potential for grade variation in setting the structures, and to avoid cutting the boxes, it is recommended that boxes be ordered slightly short of the depth required to

permit final grade adjustment by adding risers. However, the total depth of riser ring or masonry adjustment shall not exceed 8 inches.

E. **Pipe Penetration(s) Into Boxes**:
   1) Cut or form openings for pipe to provide required size and location. Remove knockout panels by saw cutting. Cut to pipe OD plus 2 inches.
   2) Orient waffle wall structures so that pipes enter through the knockout/waffle panels only.
   3) Pipes may enter through the corners of solid wall boxes if a minimum of 6" of wall is provided above the hole.
   4) Patching: The pipe shall be placed in the hole and the annular opening grouted the full 360 degrees of the pipe diameter with concrete. The grouted pipe penetration shall be inspected prior to backfilling. Once the concrete collar has set (4 days minimum), pipe(s) protruding into the box shall be cut flush with the inside face of the box and the annular edge grouted to form a smooth entrance.

F. **Manhole Junction Boxes**: Every junction box shall have manhole access. No blind manholes are permitted.

G. Frame and grate height may be adjusted with concrete or brick in accordance with Town of Clayton specifications. Use manhole frame and cover as indicated on the plans. Reinforce manhole opening in top as shown on standard details or as designed by NC Professional Engineer for required loading condition.

H. Precast boxes may be used for the following standard details: NCDOT standard details 840.01, 840.02, 840.04, 840.05, 840.11, 840.12, 840.14, 840.15, 840.17, 840.18, 840.19, 840.26, 840.27, 840.28, 840.31, 840.32 and 840.41 and for the Town of Clayton **Standard Details 633.02, 633.04**, and **634.01**.

3.4 MASONRY STRUCTURES:

A. **Design Requirements**:
   1) **Invert Forming**: All boxes shall have formed inverts. Invert forming is to be performed after the pipe penetrations have been made, the annular space around the pipe grouted and the pipe sawn flush with the interior face of the structure.

B. Masonry construction shall conform to Section 834, *Block Masonry Construction – General and* Section 840, *Minor Drainage Structures* of the NCDOT *Standard Specifications For Roads and Structures,* latest edition. Clay brick structures are not permitted.

C. **Maximum Depth/Wall Thickness**: The maximum height of an unreinforced masonry drainage structure with 8-inch walls shall be limited to 8'-0" from invert of the outlet pipe to the top of the casting. Depths greater than 8 feet shall have 12-inch walls. Basins over 12 feet, measured from invert of the outlet pipe to the top of the casting, shall be designed by a NC Professional Engineer and approved by the Town Engineer. 4-inch masonry walls are not permitted on drainage structures. Bottom slabs on drainage structures shall be reinforced when the box depth exceeds 8 feet, the box width exceeds 5 feet in width by 5 feet in length, or the box is subjected to H20 loading from truck traffic.

Top and bottom slabs to be designed by NC Professional Engineers and approved by Town Engineer for H20 loading condition.

D. **Maximum Wall Span**: The maximum horizontal span of an 8-inch thick wall shall not exceed 8 feet for boxes 8 feet or less in depth and 10 feet for boxes 12 feet or less in depth.

E. **Manhole Junction Boxes**: Every junction box shall have manhole access. No blind manholes are permitted.

F. **Pipe Penetrations**: Inside of boxes shall allow for 6 inches of clearance on both sides of pipe. The dimension shown on the structures in the standard details are minimum box dimensions. For boxes with greater dimensions, either corbel walls, add a reinforced concrete top slab, or lengthen the box by adding additional grates and frames.

G. **Steps**: For structures over 4'-0" in depth, provide steps. Steps are to be located on a nonpipe wall. Steps to meet OSHA requirements.

H. **Grade Adjustment**: Frame and grate height may be adjusted with concrete or brick in accordance. Use manhole frame and cover as indicated on the plans. Reinforce manhole opening in top as shown on standard details or as designed by NC Professional Engineer for required loading condition.

I. Mortar in masonry structures is to be minimum type M.

J. Masonry boxes may be used with the Town of Clayton **Standard Details 633.02, 633.04,** and **634.01** and with the applicable NCDOT standard details shown with masonry.

3.5 CONSTRUCTION OF MISCELLANEOUS APPURTENANCES

End walls and other miscellaneous storm drainage items shall be constructed in accordance with the latest edition of the NCDOT *Standard Specifications For Roads and Structures* and the applicable NCDOT standard details.

3.6 ABANDONING STORM DRAINAGE LINES & MANHOLES

A. **Storm Lines**: Unless directed otherwise by the Town Engineer, when an existing storm drainage line is designated to be abandoned in place, the low end of the line is to be plugged and lean concrete grout (flowable fill) pumped into the line until line is completely filled.

B. **Manholes**: When an existing manhole, either partially or wholly, is designated to be abandoned and the storm lines, either entering or exiting the manhole, have been abandoned according to the preceding paragraph, the upper portion of the manhole shall be removed to a minimum of 18 inches below the proposed finished grade, or as determined by the Town Engineer, NCDOT #57 stone dumped into the manhole, and the stone vibrated to effect consolidation of the stone. The remainder of the fill between the top of the manhole and the finished subgrade is to be backfilled as follows. Where the manhole is located within a roadway right of way, backfill around manhole with NCDOT # 57 Stone and consolidate. Outside roadway right of ways, filter fabric shall be placed

over the stone, suitable material of a compactable nature shall be placed over the top of the manhole, and the material tamped.

3.7 SLOPE ANCHORS

All lines on slopes equal to or greater than 20% slope shall have concrete anchors placed around the pipe directly below the bell end of the line. The anchors shall be spaced every other joint unless otherwise shown on the plans and constructed to the dimensions shown on the construction.

3.8 EXCAVATION OF DRAINAGE CHANNELS

A. Open storm drainage channels and ditches shall be graded and shaped in accordance with the elevations, slopes, widths, and lengths indicated on the plans except that the side slopes shall be 3:1 or flatter. The outfall elevation of the new channels and ditches shall be graded to match the flow elevations of all existing or natural channels, unless indicated or specified otherwise.

B. The drainage channels shaped with fill materials shall be compacted within the limits and in accordance with the related backfill work specified elsewhere.

C. The drainage channels shall be prepared, seeded, and mulched in accordance with the related work specified elsewhere. Where indicated on the drawings, specified, or otherwise directed by the Town Engineer, erosions control measures, such as temporary liners, rip rap, concrete liners, etc., shall be provided.

3.9 PLACEMENT OF RIP RAP AND RIP RAP BEDDING

Placement of Rip Rap and fabric shall conform to Section 876 – *Rip Rap* of the NCDOT *Standard Specifications for Roadways and Structures*, latest revision.

3.10 SUBSURFACE DRAINAGE

Installation of subsurface drainage systems shall conform to the requirements of Section 815 – *Subsurface Drainage* of the NCDOT *Standard Specifications for Roadways and Structures*, latest revision using non-woven needle-punched fabric.

3.11 INSPECTION

At any time during construction up to and including completion of entire pipe installation, the Town Engineer may inspect the work in part or as a whole in order to satisfy himself/herself that every portion of the project has been faithfully carried out in accordance with the plans, specifications, and standard details, as applicable.

If, in the opinion of the Town Engineer, a defect exists in the pipeline or its appurtenances, in some place not accessible except by uncovering, the Town Engineer may order the line to be uncovered. If it is found that after the pipe has been uncovered at the order of the Town Engineer, no defect exists or that the defects were not the fault of the Contractor, then the expense so incurred by the Contractor shall be borne by the Town.

Flush all sand, dirt, and debris from the lines prior to inspection. Provide lights and mirrors and inspect lines in the presence of the Town's representative.

Inspect the system for conformance with line and grades shown on the plans and provide record drawing measurements on record drawings.

Visual Inspection: All lines and manholes shall be visually inspected by the Town of Clayton from every manhole by use of mirrors. At the direction of the Town Engineer, areas of questionable construction may be inspected by the Town using television cameras. The lines shall exhibit a fully circular pattern when viewed from one manhole to the next. Lines, which do not exhibit a true and correct line and grade, have obstruction or structural defects, shall be corrected to meet these specifications and the barrel left clean for its entire length.

Laying Tolerance: Place pipe to the grades and alignment shown on the plans and within a tolerance of 1:1000 vertical and 1:500 horizontal, unless otherwise directed by the Town Engineer.

3.12 MAINTENANCE

The developer shall maintain all pipe installations in such a condition that they will function continuously from the time the pipe is installed until the development/project is accepted for maintenance by the Town. Prior to acceptance by the Town, all pipe shall be clean of sediment and free of debris. Furthermore, soil erosion and sedimentation control measures shall be installed wherever necessary, including at curb inlets for example, and maintained for the duration of the development until the project is fully stabilized. Once permanent groundcover has been established, temporary erosion control measures shall be removed and the disturbed areas landscaped and seeded.

3.13 MEASUREMENT & PAYMENT

See Section 1.4 of 00950, *Measurement and Payment.*

END OF SECTION 02630

Back to top

bj.TOC2630_Storm_Drainage_FINAL.doc