

## DIVISION 15 – Utilities

<b>15 00 00</b>	<b>UTILITIES</b>	<b>2</b>
<b>15 05 00</b>	<b>COMMON WORK RESULTS FOR UTILITIES</b>	<b>2</b>
15 05 01	UTILITY TRENCH FOUNDATION, BEDDING AND BACKFILL	2
15 05 02	ROCK EXCAVATION FOR UTILITIES	5
15 05 23.13	HORIZONTAL DIRECTIONAL DRILLING (HDD) OF PRESSURE MAINS	7
15 05 23.16	UTILITY PIPE JACKING	10
<b>15 10 00</b>	<b>WATER UTILITIES</b>	<b>14</b>
<b>15 11 00</b>	<b>WATER UTILITY DISTRIBUTION PIPING</b>	<b>14</b>
15 11 13	PUBLIC WATER MAINS	14
<b>15 12 00</b>	<b>WATER UTILITY DISTRIBUTION EQUIPMENT</b>	<b>22</b>
15 12 13	WATER SERVICES	22
15 12 16	WATER VALVES, HYDRANTS, FITTINGS AND MISC. APPURTENANCES	25
15 12 19	PRESSURE TESTING AND DISINFECTION OF WATER MAINS	31
<b>15 30 00</b>	<b>SANITARY SEWERAGE UTILITIES</b>	<b>35</b>
<b>15 31 00</b>	<b>SANITARY UTILITY SEWERAGE PIPING</b>	<b>35</b>
15 31 13	PUBLIC SANITARY SEWER GRAVITY MAINS	35
15 31 16	TESTING OF SANITARY SEWER GRAVITY MAINS	43
15 31 19	SANITARY SEWER MANHOLES, FRAMES AND COVERS	48

## 15 00 00 UTILITIES

### 15 05 00 COMMON WORK RESULTS FOR UTILITIES

#### 15 05 01 UTILITY TRENCH FOUNDATION, BEDDING AND BACKFILL

##### 01. DESCRIPTION

- A. This Section covers the stone bedding and soil or stone backfill materials, installation requirements and compaction standards used in pipe line construction, and other similar installations where shown on the drawings, required in the specifications or as directed by the Director of Engineering.

##### 02. QUALITY ASSURANCE

- A. The Owner (City) shall employ and pay for an independent testing laboratory to perform all testing as specified herein at the discretion of the Director of Engineering. The Contractor will be held liable for additional testing costs associated with work/areas that failed initial tests. The Owner will not be responsible for compensating the Contractor for additional work performed necessary to install the specified material and compact it to required standards.
- B. Testing Services
  - 1. Testing Services to be provided by testing laboratory include the following:
    - a. Test the Contractor's proposed materials in the laboratory and/or field for compliance with the Specifications.
    - b. Perform field moisture content and density tests to assure that the specified compaction of backfill materials has been obtained.
    - c. Report all test results to the Director of Engineering and the Contractor.
  - 2. Authority and Duties of Testing Agency: Technicians representing the testing laboratory shall inspect the materials in the field and perform tests, and shall report their findings to the Director of Engineering and the Contractor. When the materials furnished or work performed fails to fulfill specification requirements, the technician will direct the attention of the Director of Engineering and the Contractor to such failure.
    - a. The technician shall not act as foremen or perform other duties for the Contractor. Work will be checked as it progresses, but failure to detect any defective work or materials shall not in any way prevent later rejection when such defect is discovered, nor shall it obligate the Director of Engineering for final acceptance. Technicians are not authorized to revoke, alter, relax, enlarge, or release any requirements of the specifications, nor to approve or accept any portion of the work.
  - 3. Responsibilities and Duties of Contractor: The use of testing services shall in no way relieve the Contractor of his responsibility to furnish materials and construction in full compliance with the Drawings and Specifications.
    - a. Secure and deliver to the Director of Engineering or to the testing agency, without cost, preliminary representative samples of the materials he proposes to use and which are required to be tested.
    - b. Furnish such casual labor as is necessary to obtain and handle samples at the Project or at other sources of material.
    - c. Advise the testing agency sufficiently in advance of operations to allow for completion of quality tests and for the assignment of personnel.
- C. Reference Standards:
  - 1. The Contractor shall comply with applicable provisions and recommendations of the following:
    - a. ASTM D 422, Particle-Size Analysis of Soils.
    - b. ASTM D 423, Liquid Limit of Soils.
    - c. ASTM D 427, Shrinkage Factors of Soils.

- d. ASTM D 698, Moisture-Density Relations of Soils, using 5.5 lb (2.5 kg) Rammer and 12-in. (304.8 mm Drop).
- e. ASTM D 1140, Amount of Material in Soils Finer than the No. 200 Sieve.
- f. ASTM D 1556, Density of Soil in Place by the Sand-Cone Method.
- g. ASTM D 1557, Moisture-Density Relations of Soils, using 10.0 lb (4.5 kg) Rammer and 18-in. (457 mm) Drop.
- h. ASTM D 2166, Unconfined Compressive Strength of Cohesive Soil.
- i. ASTM D 36, Structural Steel.
- j. ASTM A 328, Steel Sheet Piling.

D. Test Reports

- 1. Submit copies of the following reports directly to the Director of Engineering from the testing service, with a copy to the Contractor:
  - a. Tests on borrow material.
  - b. Tests on select material.
  - c. Field density tests.
  - d. Optimum moisture - maximum density curve for each soil used for backfill.

E. Site Conditions

- 1. Borrow, Select Fill or Granular material that is to be stored on site for a prolonged period of time shall be stabilized and proper erosion control measures installed to prevent erosion of the stockpile, loss of material and discharge into water courses.
- 2. Borrow or Select Fill material shall be tarped or protected from precipitation. Material that is exposed to precipitation and is not in compliance with specified thresholds of the established Optimum Moisture Content (OMC) must be scarified and aerated.

03. MATERIALS

A. General

- 1. All fill material shall be subject to approval of the Director of Engineering.
- 2. For approval of imported fill material, notify the Director of Engineering at least four working days in advance of intention to import material, designate the proposed borrow area, and permit the Director of Engineering to sample as necessary from the borrow area for the purpose of making acceptance tests to prove the quality of the material.

B. On-Site Fill Material

- 1. All on-site fill material shall be soil-rock mixture which is free from organic matter and other deleterious substances. It shall contain no rocks or lumps over four inches in greatest dimension and not more than 15% of the rocks or lumps shall be larger than two inches (2") in greatest dimension.

C. Imported Trench Bedding Material

- 1. All imported trench bedding material for utility pipe installation shall be Standard Size 57stone in accordance with Section 1016 of the NCDOT Standard Specifications for Roads and Structures 2006 Edition or Borrow Aggregate as defined by ASTM C33, Coarse Aggregate Size Number 67.

D. Imported Trench Fill Material

- 1. Where other than local material is used for backfill above the foundation, such material will be classified as select backfill. This material shall be approved by the Director of Engineering and shall meet either of the criteria below as directed by the Director of Engineering.

- E. Select Engineered Fill
  - 1. All Select Engineered Fill material shall be consistent with the following soil and gravel classifications as covered in Section 1016 of the NCDOT Standard Specifications for Roads and Structures 2006 Edition and restated below:
    - a. Class II - Type 1(fine aggregate) or Type 2(granular soil material)
    - b. Class III – Type 1 (natural or manufactured fine aggregate)
- F. Select Borrow
  - 1. Approved borrow material shall meet the statewide and local criteria outlined in Section 1018 of the NCDOT Standard Specifications for Roads and Structures. In addition, this material shall be a soil material which meets the requirements of AASHTO M 145 for class A-2-4 soils. This material shall be a well graded gravelly, silty, or clayey sand with a plasticity index equal to or less than ten (10), and liquid limit equal to or less than forty (40).
- G. Geotechnical Fabric for Soil Stabilization
  - 1. Where soil stabilization woven fabric is specified in the Bid Schedule, called out on the drawings or directed by the Director of Engineering, the Contractor shall furnish and install a woven textile product specially designed and manufactured to stabilize the sub-base of trenches and ditches and control the migration of select fill into the surrounding soils. The product shall meet or exceed AASHTO M288 Specification for serviceability level class 2, and shall be Style 250ST Geotex woven geotextiles manufactured by SI Geosolutions or equal as may be approved by the Director of Engineering.

#### 04. EXECUTION

- A. General
  - 1. The usage and installation of stone bedding shall be in accordance with the specification for the particular item being installed.
  - 2. Select backfill will be used only when directed by the Director of Engineering or when specifically called for in another section of these specifications.
- B. Moisture Conditioning
  - 1. Water or aerate the fill material as necessary and thoroughly mix to obtain a moisture content which will permit proper compaction (+/- 2% of Optimum Moisture Content)
- C. Compaction
  - 1. After subgrade compaction has been approved by the Director of Engineering, spread approved fill material in layers not exceeding six inches (6") in uncompacted thickness.
  - 2. Compact each soil layer to at least the specified minimum degree; repeat compaction process until plan grade is attained.
  - 3. Degree of compaction requirements are as follows and shall be evaluated by Standard Proctor, except where noted
    - a. General Fill:
      - i. Densify all structural fill, including recompacted existing fill and backfill, to a minimum degree of compaction of 90%.
    - b. Structural fill under or within five feet (5') of buildings and pavement areas:
      - i. Compact approved backfill material greater than twelve inches (12") from finished subgrade to a minimum of 95% of Maximum Dry Density (MDD).
      - ii. Compact approved fill within twelve inches (12") of finished subgrade to a minimum of 100% of Maximum Dry Density (MDD).

05. MEASUREMENT AND PAYMENT

A. Geotechnical Fabric for Soil Stabilization

1. Measurement: Measurement of soil stabilization fabric shall be the area of fabric laid within the trench as determined by the horizontal measurement along the trench bottom plus the vertical measurement along the trench walls multiplied by the linear feet of installation.
2. Payment: Payment for soil stabilization shall be the area as measured in square yards incorporated into the completed and accepted work.

B. Pipe Bedding

1. Measurement: Measurement of Bedding shall be the depth of the undercut multiplied by the maximum allowable trench width on each side of the pipe as described in Section 15 11 13 (Water) or Section 15 31 13 (Sewer) multiplied by the linear feet of installation. Depth of undercut is considered the vertical measurement from the centerline of the pipe (to account for haunching) to the bottom of the undercut. Note that six inches (6") of aggregate bedding/conditioning stone required for all gravity sanitary sewer pipe as described in Section 15 31 13 is considered incidental to the cost of pipe installation and will not be paid.
2. Payment: At unit price for the tonnage of stone or approved material (converted from the number of cubic yards incorporated into the completed and accepted work) as verified by weight tickets.
  - a. Payment includes work for excavation, trenching, undercut, and removal of unsuitable material off site.

C. Backfill (Engineered Fill or Select Borrow)

1. Measurement: Measurement of backfill shall be the depth of cut multiplied by the maximum allowable trench width on each side of the pipe as described in Section 15 11 13 (Water) or Section 15 31 13 (Sewer) multiplied by the linear feet of installation. Depth of cut is considered the vertical measurement from the surface grade to the bottom of the invert of the pipe or top of bedding, if used. When different backfills are used within the same trench, the depth of cut is considered the vertical measurement of the bottom of the individual backfill material to the top of the same material.
2. Payment: At unit price for each cubic yard of identified backfill material as listed in the Bid Schedule and part of the completed and accepted work.
  - a. Payment includes work for excavation, trenching, and removal of unsuitable material off site.

D. Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Geotechnical Fabric for Soil Stabilization	Square Yard
Pipe Bedding	TN
Borrow Material	CY
Select Material Class II - Type 1	CY
Select Material Class III - Type 1	CY

15 05 02 ROCK EXCAVATION FOR UTILITIES

01. GENERAL

A. Description

1. The Contractor shall furnish all labor, materials, tools, equipment and all else required for and to excavate rock as hereinafter defined, remove and dispose of unsuitable materials, and protect the public and his own employees from harm during the construction operations.
2. Rock Excavation shall be defined as removal and disposal of solid, ledge rock in place which, in the opinion of the Director of Engineering, cannot be removed practically without the use of specialized pre-splitting methods such as: drilling, blasting, wedging, prying, jacking, hydraulic hammering, etc. Soft, disintegrated rock that can be removed with a picking or scarifying action shall not be classified as Rock

Excavation. Excavated boulders or rock fragments with a volume of One (1) Cubic Yard or less shall not be classified as Rock Excavation.

## 02. QUALITY ASSURANCE

- A. The Contractor shall use licensed and sufficient workmen and competent supervisors in the execution of this portion of the work to ensure adequate, safe and proper execution throughout.
  - 1. It shall be the Contractor's responsibility to have adequate insurance to cover any damages resulting from blasting or other construction activities.
  - 2. It shall also be the responsibility of the Contractor to ensure that any subcontractors hired to perform blasting services shall have adequate insurance to cover any damages.
  - 3. The Contractor shall hold the Director of Engineering and Owner together with its employees harmless from any claims of damages due to blasting or other construction related activities.
- B. A Blasting Permit shall be obtained by the Contractor or his subcontractor from the City of Rocky Mount Department of Engineering.
- C. The Contractor shall take all necessary precautions to protect life and property while engaged in blasting operations.
  - 1. The Contractor shall provide and use an appropriate blast mat at locations where the danger of rock or overburden being thrown by a blast.
  - 2. No blasting shall be allowed unless a galvanometer is used to check cap circuits.
  - 3. Blasting procedures shall conform to all applicable local, state, and federal laws and ordinances.
- D. The Contractor shall be required to keep a blasting log containing the following minimum information:
  - 1. Date of shot
  - 2. Time of shot
  - 3. Foreman's name
  - 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. Weather conditions
- E. Contractor shall comply with all Local, State, and Federal Regulations regarding the receipt, transport and storage of explosives.
- F. Explosives kept on site shall be contained in clearly painted, signed, or otherwise permanently marked container and shall be locked with the key in the possession of the person in charge of the blasting operations.
- G. Rock shall be excavated to the same limits as other trench, roadway, or structure excavations except that the excavations shall extend an additional six (6") Inches vertically below subgrade or bottom of pipe and an additional nine (9") Inches on all sides horizontally to allow for placement and compaction of cushioning material.
- H. Acceptable cushioning material shall be either Class II or III material as defined in ASTM D2321 and restated in Section 2225. Class of bedding material shall be consistent with initial backfill material on typical Bedding Detail or Cross-Section shown on the Drawings.
- I. The excavation shall be filled with select cushioning material to subgrade of the pipe, roadway, or structure and compacted to appropriate compaction density for backfilling in accordance with Section 2225 for trench excavations and Section 2226 for roadways and structures.

- J. Contractor shall remove all rock fragments, boulders, and debris from site and dispose of in an approved waste area.

03. MEASUREMENT AND PAYMENT

A. Trench Rock Excavation

1. Measurement of rock excavation shall be the depth of rock removed within the trench multiplied by the width of rock removed within the trench multiplied by the linear feet of rock removed within the trench. Depth of rock removed is considered the vertical measurement from the surface grade to the bottom of the invert of the pipe or undercut. Width of rock removed is considered the horizontal measurement from rock face to rock face on each side of the trench. Linear feet of rock removed is considered the horizontal measurement along the trench alignment from manhole to manhole. Individual boulders greater than 1 cubic yard will be estimated by multiplying the approximate width, length and height of the boulder.
2. Payment for rock excavation shall be the number of cubic yards excavated from the completed and accepted work.

B. Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Trench Rock Excavation	CY

15 05 23.13 HORIZONTAL DIRECTIONAL DRILLING (HDD) OF PRESSURE MAINS

01. DESCRIPTION

- A. The work in this Section covers the requirements for Horizontal Directional Drilling (HDD) of the furnishing and installation of all pipe required to complete the water and sewer pressure systems as shown on the drawings, as described in these specifications, and as directed by the Director of Engineering.

02. QUALITY ASSURANCE

- A. Experience: Actively engaged in horizontal directional drilling for a minimum of 3 years.
- B. Field Supervisory Personnel: Experience in the performance of the work and tasks as stated herein for a minimum of 3 years.

03. SUBMITTAL

- A. Submit for Information Only:
  1. Presentation of similar experience in the last 3 years
  2. Include, but not limited to, project owner name, address, telephone numbers, contact person, date and duration of work, location, pipe information, and contents handled by the pipeline.
  3. Supervisory field personnel and historical information of HDD experience.
    - a. At least one of the field supervisors must be on site when HDD operations are in progress
- B. Submit with other required material/product information
  1. Size, capacity and arrangement of equipment
  2. Location and size of drilling and receiving pits
  3. Dewatering and methods of removing spoils material
  4. Method of installing detection wire and pipe
  5. Type, location and method of installing locator station
  6. Method of fusion pipe segment and type of equipment

7. Type of cutting head
8. Method of monitoring and controlling line and grade
9. Detection of surface movement
10. Bentonite drilling mud for information only:
  - a. Products information, material specifications and handling procedures
  - b. Material safety data sheet and special precautions required
  - c. Method of mixing and application

04. PRODUCTS

- A. Product requirements for pipe, service pipe, valves, fittings and other materials for this work are included elsewhere in these specifications.
- B. Allowable materials on this project are as follows:
  1. Carrier Pipe
    - a. High Density Polyethylene (HDPE) as per AWWA C906 and ASTM D3350.. Pipe shall be DR11 with a working pressure rating of 160 psi or as directed by the Director of Engineering.
  2. Fittings.
    - a. In accordance with ASTM D3261. Use injected molded fittings with ends suitable for Butt fusion unless otherwise specified.
    - b. Flange Joints to be in accordance with ANSIB/16.1, Class 125 flat face when required herein or as shown on the drawings or Standard Details.
      - i. Pressure rating the same as adjacent pipe
      - ii. HDPE flange adapter, supplied by same manufacturer of pipe with butt fusion jointing technique, ductile iron backup ring and bolts, gaskets, nuts and washers
      - iii. No threaded or solvent welded/glued HDPE joints permitted
  3. Color Coding: The piping shall be permanently coded to provide service identification. Stripes along the entire outside length of pipe, 120 degrees apart, shall be made by co-extrusion or impregnation in accordance with the following schedule. Fully colored pipe co-extruded from permanently pigmented HDPE is also acceptable.

SERVICE	STRIPED PIPE	SOLID COLOR PIPE
Potable Water	Blue Stripes	Blue
Reclaimed Water	Purple Stripes	Purple
Wastewater	Green Stripes	Green

4. Marking on the pipes shall include the following:
  - a. Nominal size and OD base
  - b. Standard Material Code Designation
  - c. Dimension Ratio
  - d. Pressure Class
  - e. AWWA designation
  - f. Material test category of pipe
5. Tracer Wire: All piping shall be installed with a continuous, insulated, solid #10 gauge copper wire for water main or force main location purposes by means of an electronic tracer.
  - a. The wire shall be solid color in accordance with the coding described above and must be zip-tied or securely taped along the pipe every 10 feet. Sections of wire shall be spliced together using Buchanon connectors or a similar approved method for splicing (no twisting of wires).

- b. Upon completion of the directional bore, the contractor shall demonstrate to the City that the wire is continuous and unbroken through the entire run of pipe by providing full signal conductivity
- 6. Locator Station: Contractor shall provide locator station on each side of the bore and as directed by the Director of Engineering.
  - a. Station shall be flush mounted and imbedded in a concrete collar. The tube shall be a minimum of 15" long with a minimum diameter of 2.5 inches made of non corrosive material such as Schedule 40 PVC or HDPE.
  - b. Utilize a factory attached cast iron or high impact plastic collar with ribs to prevent rotation when removing locking lid after station is set in concrete.
  - c. Terminal block made of high dielectric material which is made of penolic resin, plastic, micarta, Lexan or Bakelite for each locator station.

## 05. EXECUTION

### A. Preparation

- a. Excavate bore pits in accordance with Section 15 05 00 and the working drawings.
- b. Provide equipment to guard against electrocution and an alarm system on drilling equipment capable of detecting electrical current as it approaches electric lines

### B. Operation

#### 1. General

- a. Determine the drilling length and equipment pull strength for type of soil encountered.
- b. Provide method to control line and grade.
  - i. Provide and maintain instrumentation that accurately locates pilot hole
  - ii. Drill pilot hole along path following Drawings to these tolerances:
    - a) Vertical alignment plus or minus 0.5 foot. Vertical path of the pilot hole must not establish new high points not shown on the drawings.
    - b) Horizontal alignment plus or minus 1 foot.
  - iii. Include electronic monitoring of the horizontal and vertical drilling head location. Obtain an accuracy range within 1 inch of the actual position of the pipeline. Record position readings at a maximum of 10 foot intervals.
  - iv. At completion of pilot hole drilling, furnish the Director of Engineering tabulations of horizontal and vertical alignment.
- c. When water is encountered:
  - i. Provide and maintain a dewatering system of sufficient capacity to remove water.
  - ii. Keep excavation free of water until backfill operation is in progress.
  - iii. Perform dewatering in such a manner that removal of soil particles is kept to a minimum.
- d. Maintain close observation to detect settlement or displacement. Notify the Director of Engineering immediately if settlement or displacement is detected. Act to maintain safe conditions and prevent damage.

### C. Installation

- 1. Installation shall be in a trenchless manner producing continuous bores.
- 2. Angle entry hole so that the curvature of the pilot or tunneling hole does not exceed the maximum allowable bending radius of the HDPE pipe.
- 3. Tunneling system must be able to make a turn up to 90 degrees and maintain curvature not to exceed the maximum allowable bending radius of the HDPE pipe.
- 4. Tunneling must be performed by a fluid-cutting process (high pressure-low volume) utilizing a liquid clay, i.e., bentonite. The clay lining will maintain tunnel stability and provide lubrication in order to reduce

frictional drag while the pipe is being installed. In addition, the clay fluid must be totally inert and contain no environmental risk. The Contractor shall have a mobile vacuum spoils recovery vehicle on site to remove the drilling spoils from the access pit. The spoils must be then transported from the job site and properly disposed of at no additional cost to the owner. Under no circumstances will the drilling spoils be permitted to be disposed of into sanitary, storm or other public or private drainage systems.

5. Liquid clay type colloidal drilling fluid shall consist of at least 10 percent of high-grade, carefully processed bentonite to consolidate cuttings of the soil, to seal the walls of the holes and to furnish lubrication for subsequent removal of cuttings. The slurry, which is heavier than the surrounding material, shall be high in colloids of the bentonite type and shall deposit a thin filter cake of low permeability material on the walls of the bore. This shall allow only a small amount of the fluid to pass into the surrounding soil and shall also stabilize the bore.
6. After an initial bore has been completed, a reamer will be installed at the termination pit and the pipe will be pulled back to the starting pit. The reamer must also be capable of discharging liquid clay to facilitate the installation of the pipe into a stabilized and lubricated tunnel.
7. The reaming diameter shall be 1.5 times the outside diameter of the HDPE pipe being installed.
8. Provide a swivel to the reaming assembly and pull section of pipe to minimize torsional stress on pull section after drilling pilot hole.
9. Protect pull section as it proceeds during pull back so that it moves freely and is not damaged.
10. Pull detection wire along with HDPE pipe. Extend wire into locator station at each end of HDPE pipe.
11. When connecting to adjacent pulled or non-pulled section of HDPE pipe, allow pull section of pipe to extend past termination point. Make tie-ins the next day after pull back of HDPE pipe.
12. Test pit pipe installation to verify horizontal and vertical alignment at Director of Engineering's direction.
  - a. One test pit for every 500 feet length along the pipeline.
  - b. Director of Engineering may order additional test pit for each test pit that reveals pipeline installation is not in compliance with the Contract Documents or where evidence of settlement or displacement is present at no cost to the owner.

D. Field Quality Assurance

1. Perform water main testing in accordance with Section 15 12 19

06. MEASUREMENT AND PAYMENT

A. Pressure pipe

1. Measurement: By linear foot of various sizes and types provided, measured horizontally along the centerline of the pipe.
2. Payment includes work for location of utilities, excavation of bore pits, drilling, reaming and pulling operations, removal of spoils and slurry, dewatering, test bores, backfill, detectable tracer wire, installation of locator stations and replacement or restoration of any shoulders, ditches, banks and roads and railroads crossed as a result of HDD activities.

B. Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Horizontal Directional Drilling ___ Inch, material type	LF

15 05 23.16 UTILITY PIPE JACKING

01. DESCRIPTION

- A. The work in this Section covers the requirements for bored and jacked steel encasement pipe required to hold utilities as shown on the drawings, as described in these specifications, and as directed by the Director of Engineering.

02. QUALITY ASSURANCE

- A. Experience: Actively engaged in boring and jacking utility encasements for a minimum of 3 years.
- B. Field Supervisory Personnel: Experience in the performance of the work and tasks as stated herein for a minimum of 3 years.

03. SUBMITTAL

- A. Submit for Information Only:
  - 1. Presentation of similar experience in the last 3 years
  - 2. Include, but not limited to, project owner name, address, telephone numbers, contact person, date and duration of work, location, pipe information, and contents handled by the pipeline.
  - 3. Supervisory field personnel and historical information of pipe jacking experience.
    - a. At least one of the field supervisors must be on site when pipe jacking operations are in progress
- B. Submit with other required material/product information
  - 1. Written certification from the encasement pipe manufacturer that the encasement pipe is the type specified herein and of the thickness specified in the proposal.
  - 2. Dewatering and methods of removing spoils material

04. PRODUCTS

- A. Allowable materials on this project are as follows:
  - 1. Encasement Pipe:
    - a. Encasement pipe shall be manufactured of grade 'B' steel with a minimum yield strength of 35,000-psi in accordance with ASTM A139 and A283.
    - b. The encasement pipe shall receive an exterior bituminous protective coating at least 2-mils thick. The coating shall be applied to the outside of all pipe and joints. The coating shall be applied in a continuous and smooth application and allowed ample time to cure prior to installation.
    - c. Encasement pipe shall have the following minimum sizes:

Carrier Pipe Size Ductile Iron w/Slip Joints (inside diameter, inches)	Carrier Pipe Outside Bell Diameter (inches)	Steel Encasement Nominal Diameter (inches)
6	8.9	12 3/4
8	11.16	16
10	13.25	18
12	15.37	20
14	17.73	24
16	19.86	26
18	22.16	28
20	24.28	30
24	28.5	36
30	34.95	42
36	41.37	48

- d. Wall thickness of smooth wall or spiral welded steel encasement pipe shall be as follows unless otherwise dictated by the Engineer:

Encasement Pipe Nominal Diameter (inches)	Minimum Wall Thickness (inches)
4" to 12-3/4"	0.188
14" to 24"	0.250
26" to 30"	0.312
36"	0.375
42" to 48"	0.500

2. Encasement pipe installed for railroad bores shall meet the requirements of the American Railway Engineering Association (AREA) for boring under railroads.
3. Carrier pipe material shall be as shown on the plans.
4. The carrier pipe shall rest on coated steel band or stainless steel casing insulators as manufactured by Spider Manufacturing or approved equal. A minimum of 2 steel spiders per joint of carrier pipe shall be required. The steel spiders shall be spaced evenly along the carrier pipe alignment in such a manner that each spider supports the same unit weight of carrier main. The spacing interval of the steel spiders shall assure the necessary grade, clearance, and support of the carrier main.
5. The carrier pipe bells shall not be allowed to contact the interior of the encasement pipe under any circumstances.

## 05. EXECUTION

### A. Preparation

1. No excavation or other work for the installation of the dry bore and jack shall begin prior to both the bond being approved, and proper notification being acknowledged by the proper authority, either the Railroad Company, the Department of Transportation, or any other applicable party.
2. Excavate bore pits in accordance with Section 15 05 02 and the working drawings. All bore pits shall be properly sheeted to prevent injury and be in accordance with the Occupational Safety and Health Act of 1970, as amended.

### B. Operation and Installation

1. The boring and jacking operation shall be a simultaneous operation consisting of an auger boring, a circular hole progressively ahead of the encasement pipe as it is being jacked into the void. The spoil removal shall not proceed more than eighteen inches (18") ahead of the leading edge of the encasement. As the dry boring process progresses, the spoil is to be augured back into the pit for disposal. Once a section of encasement pipe has been jacked into the void, a new section of pipe shall be butt-welded to the previously installed section.
2. The boring auger shall not be of a greater diameter than the outside of the encasement and the excavated hole shall not be of greater diameter than necessary to keep the casing moving freely.
3. Steel Casing shall extend a minimum of 3' beyond back of curb, sidewalk or pavement edge or as directed by the Director of Engineering or the proper authority.
4. If voids are encountered or occur outside the encasement pipe, grout holes shall be installed in the top section of the encasement pipe at ten (10) foot centers and the voids filled with 1:3 portland cement grout at sufficient pressure to prevent settlement.
5. In the event an obstruction is encountered during the boring and jacking operation, the auger is to be withdrawn and the excess pipe cut off, capped and filled with 1:3 portland cement grout at sufficient pressure to fill all voids before moving to another boring site.
6. In the event the proper grade as shown on the plans is not obtained, and the installation must be abandoned, the installation is to be filled with grout as specified above.

7. Installation of the carrier pipe shall be as shown on the plans. Spacers for installation shall be coated steel band or stainless steel casing insulators as manufactured by Spider Manufacturing or approved equal.
8. Upon completion of the boring operation and the installation of the carrier pipe, the ends of the steel casing pipe shall be filled with concrete or a pull on rubber/HDPE boot installed with stainless steel clamps.

06. MEASUREMENT AND PAYMENT

A. Encasement pipe

1. Measurement: By linear foot, to the nearest half foot, of installed encasement at the specified diameter.
2. Payment: At unit price for each size of encasement dry bored and jacked listed in the Bid Schedule. Payment includes work for location of utilities, excavation and shoring of bore pits, removal of slurry, dewatering, test bores, backfill, grout, installation of casing insulators, replacement or restoration of any shoulders, ditches, banks and roads and railroads crossed as a result of utility pipe jacking activities.

B. Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Jack and Bore Guaranteed Steel Casing Installation __ Inch	LF

## 15 10 00 WATER UTILITIES

### 15 11 00 WATER UTILITY DISTRIBUTION PIPING

#### 15 11 13 PUBLIC WATER MAINS

##### 01. DESCRIPTION

- A. The work in this Section covers the requirements for furnishing and installing all pipe required to complete the water distribution system(s) as shown on the drawings, as described in these specifications, and as directed by the Director of Engineering.

##### 02. QUALITY ASSURANCE

- A. The Contractor shall use sufficient workmen and competent supervisors in the execution of this portion of the work to ensure adequate and proper installation throughout.
- B. The pipe class numbers or pressure ratings shall be clearly shown on the pipe.
- C. Loading, unloading, inspection, storage and handling shall be in accordance with AWWA C600 and AWWA C605 and as specified herein.
- D. Storage: Store pipe, fittings, valves and appurtenances off the ground using sound wood blocks, placed on stable foundation or using other appropriate means. Allow space between rows, individual pieces and bundles with clearance below and above to allow full view for inspection purposes.
  - 1. Store in well-drained area away from brush and accessible for inspection.
  - 2. Do not stack pipe higher than 54 inches
  - 3. Keep spigot ends of pipe clean and clear for dimensioning purposes
  - 4. Do not place excavated or other material over or against stored material.
  - 5. PVC pipe shall be stored so that it does not deform or bend. Pipe stored outdoors or otherwise exposed to direct sunlight shall be covered with canvas or other opaque material with provision for adequate air circulation.
- E. Handling: Unload and handle materials with crane, backhoe, or equipment of adequate capacity, equipped with appropriate slings or padding to protect materials from damage.

##### 03. SUBMITTAL

- A. Prior to the installation of any pipe, the Contractor shall submit and receive the Director of Engineering's approval of shop drawings and/or manufacturer's material certification of compliance with specifications.
- B. Submittals shall be in five (5) copies and shall be provided to the Director of Engineering at least 15 days prior to the planned installation time.

##### 04. PRODUCTS

- A. Product requirements for pipe, service pipe, valves, fittings and other materials for this work are included elsewhere in these specifications.
- B. Allowable materials on this project are as follows:
  - 1. Polyvinyl Chloride (PVC) Pipe - C900, C905 Class 150 or 200
    - a. Pipe 12 inches and smaller shall be in accordance with AWWA C900 and shall be DR18, Class 150 with DIP equivalent outside diameters, except as noted on the plans, suitable for potable water use. Pipe larger than 12 inches shall be in accordance with AWWA C905.

- i. Exception to above is for dedicated fire mains serving sprinklered buildings. Mains located between the Fire Department Connection (FDC) and the building shall be DR14, Class 200.
  - ii. PVC Pipe manufactured more than 12 months from installation will not be accepted.
  - iii. Potable water use: NSF61
  - iv. Pipe lengths: The PVC pipe shall be furnished in standard laying lengths of 20 feet and shall have integral bell and spigot joints.
  - v. Pipe joints: Utilize elastomeric gasket push on joints following AWWA C900 and AWWA C905 except where otherwise noted.
2. Fittings shall be ductile iron, mechanical joint compact fittings and shall conform with ANSI/AWWA C153/A21.53 unless otherwise noted.
    - a. Mechanical joint solid sleeves shall be in accordance with AWWA C110.
    - b. Bolts: High Strength low alloy steel tee head bolts.
    - c. Unless shown otherwise, furnish fittings 3 inch through 24 inch diameter having minimum pressure rating of 350 psi, and furnish fittings larger than 24 inch diameter having a minimum pressure rating of 250 psi.
    - d. Coatings: Ductile iron fittings shall be bituminous coated outside and cement mortar lined in accordance with ANSI/AWWA Standard C104/A 21.4.
  3. Tracer Wire: All PVC piping shall be installed with a continuous, insulated, solid #10 gauge copper wire for water main location purposes by means of an electronic tracer.
    - a. The wire shall be solid color blue and must be zip-tied or securely taped along the pipe every 10 feet. Sections of wire shall be spliced together using Buchanon connectors or a similar approved method for splicing (no twisting of wires). Further detail is explained under Laying of Pipe.
  4. Ductile Iron (DI) Pipe (Mechanical or Push on Joints, standard application)
    - a. Pipe shall be manufactured in accordance with AWWA C150 and C151 and shall be a minimum Pressure Class of 350 and Thickness Class 50, except as noted on the plans, suitable for potable water use.
      - i. Pipe joints: Pipe shall be either the "push-on" or "mechanical joint" in accordance with AWWA C111 unless otherwise shown on the plans and specified herein
      - ii. Coatings: Ductile iron pipe shall be bituminous coated outside and cement mortar lined in accordance with ANSI/AWWA Standard C104/A 21.4.
      - iii. Pipe lengths: 18 to 20 feet
    - b. Fittings shall be ductile iron, mechanical joint compact fittings and shall conform with ANSI/AWWA C153/A21.53 unless otherwise noted.
      - i. Mechanical joint solid sleeves shall be in accordance with AWWA C110.
      - ii. Bolts: High Strength low alloy steel tee head bolts.
      - iii. Unless shown otherwise, furnish fittings 3 inch through 24 inch diameter having minimum pressure rating of 350 psi, and furnish fittings larger than 24 inch diameter having a minimum pressure rating of 250 psi.
      - iv. Coatings: Ductile iron fittings shall be bituminous coated outside and cement mortar lined in accordance with ANSI/AWWA Standard C104/A 21.4.
      - v. All water main fittings shall be installed with thrust restraint. Reaction blocking shall be transit-mixed concrete of 2500 psi 28-day compressive strength placed in adequate quantities for the size and shape of the fitting being installed. Reaction blocking shall be formed and poured such that mechanical joints' bolts remain accessible and the blocking shall be backed by firm, solid earth.

5. Ductile Iron (DI) Pipe (Flanged Pipe)
  - a. Where specified by the engineer and as required herein for certain applications, flanged pipe shall be used and in accordance with AWWA C115 and the requirements above.
  - b. Fittings shall be in accordance with AWWA C110. Flanges shall be cast integrally with body and have uniform thickness over their entire circumference.
    - i. Faces: Perpendicular to the access of pipe.
    - ii. Bolt Holes: Equally centered and spaced
    - iii. Flange bolts, nuts and washers: Carbon steel, ASTM A307, Grade B.
    - iv. Nuts: Cold punched, hexagonal, trimmed and chamfered.
    - v. Heads, nuts and threads; ANSI B1.1.
    - vi. Bolts: ¼ inch projection beyond nut when joint and gasket are assembled.
    - vii. Gaskets: Full faced, 1/8 inch thick rubber
    - viii. When flange joints are required for connecting to Class 250 gate valves with flanges, follow ANSI B16.1, Class 250, flat face flanges, unless otherwise specified.
6. Valves, Hydrants and Miscellaneous Appurtenances
  - a. Valves, Hydrants and Miscellaneous Appurtenances shall be in accordance with Section 15 12 16
7. Water Service Connections
  - a. Water Service Connections shall be in accordance with Section 15 12 13

## 05. EXECUTION

### A. Preparation

1. Contact appropriate utility locating agency(ies) prior to any earthwork
2. Dig test pit to determine size, type, composition and exact location of existing pipe to which the proposed pipe network will connect.
3. Excavate sufficient trench in advance and test pit all existing underground utilities or structures, whether shown on the drawings or visually identified in the field to:
  - a. Field verify actual locations
  - b. Make reasonable adjustments to line and grade to avoid conflict, with Director of Engineering's approval.
  - c. Furnish Director of Engineering with location and elevation information when previously unknown or different underground utilities and structures are encountered.
  - d. Additional work performed because above mentioned precautions were not taken will not be compensated by the owner.

### B. Relation of Water Mains to Sewers

1. Lateral Separation of Sewers and Water Mains - Water mains shall be laid at least 10 feet laterally from existing or proposed sewers, unless local conditions or barriers prevent a 10-foot lateral separation, in which case:
  - a. The water main is laid in a separate trench, with the elevation of the bottom of the water main at least 18 inches above the top of the sewer; or
  - b. The water main is laid 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.
2. Crossing a Water Main Over a Sewer - Whenever it is necessary for a water main to cross over a sewer, the water main shall be laid at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer, unless local conditions or barriers prevent an 18 inch vertical separation, in which case both the water main and sewer shall be constructed 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.

3. Crossing a Water Main Under a Sewer - Whenever it is necessary for a water main to cross under a sewer, both the water main and the sewer shall be constructed 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.
4. Where it is impossible to maintain a minimum of 10 feet of horizontal clearance between the water and sewer installations, a vertical separation of 18 inches (water main above sewer) must be maintained.

#### C. Trench Excavation

##### 1. General

- a. Open no more trench in advance of pipe laying than is necessary to expedite the work.
  - b. Excavate trenches to a width that will provide adequate working space, but not more than maximum design width so as not to undercut trench walls.
  - c. Excavate bell holes at each joint to provide full-length barrel support of the pipe and to prevent point loading at the bells or couplings.
  - d. Unless trench banks above the top of the pipe are cut back on a stable slope, sheet and brace trenches as necessary in order to prevent caving and sliding, to provide protection for workmen and the pipe, and to protect adjacent structures and facilities. Do not remove trench sheeting unless the pipe strength is sufficient to support the external loads. The width of the trench at any point below the top of the pipe should not be greater than that necessary to provide adequate room for joining the pipe and compacting the haunching and initial backfill.
  - e. During the course of construction, should the trench be over-excavated below a point 6 inches below the bottom of the pipe, fill that area of over-excavation with an acceptable class of embedment material and compact to a minimum of 90 percent.
2. Where trench construction conditions require the use of a trench box, the trench box shall be sufficient length to extend four (4) feet beyond both ends of one (1) joint of pipe in order to allow the workmen to make-up the pipe joint inside the protection of the trench box. The workmen required to work inside the trench shall:
    - a. Enter and leave the trench box from the ground surface only
    - b. Not travel along the trench bottom outside the protection of the trench box
  3. The trench box shall conform to current OSHA regulations and shall have been designed by a Registered Professional Engineer. The Contractor shall furnish proof of such design to the Director of Engineering upon request.

#### D. Trench Width

1. Trench width at the ground surface may vary and will depend upon depth, type of soils, positions of surface structures, or other conditions authorized by the Director of Engineering.
2. The maximum clear width of the trench excluding sheeting shall not exceed the outside diameter of the pipe plus one foot (1') on each side at the top of the area of initial backfill and one foot (1') above the outside top of pipe. The minimum width of the trench at the top of the pipe when placed shall be a width that will permit the proper construction of joints and compaction of backfill around the pipe, but shall be at least equal to the largest outside diameter of the pipe plus eight inches (8") on each side of the pipe. The sides of the trenches shall be vertical unless otherwise approved by the Director of Engineering. In no case shall the vertical walls project less than two inches (2") above the top of the pipe line laid to a grade unless the finished grade fill depth is less than two feet (2'). The maximum allowable width of trench on each side of the pipe shall not exceed twelve inches (12") for pipe which is twelve inches (12") in diameter or smaller; eighteen inches (18") for pipe which is between fourteen inches (14") and thirty-six inches (36") in diameter; and twenty-four inches (24") for pipe diameters greater than thirty-six inches (36"), unless otherwise approved by the Director of Engineering.

#### E. Parallel Roadway Trenches

1. Where utility installation is to take place upon the shoulder of any paved street or highway, excavate trench to a width that will provide adequate working space but in no case shall the hard-surfaced, traveled portion of roadway be damaged. Where the structural integrity of the roadway pavement is jeopardized, proper sheeting and bracing shall be installed to provide adequate protection to adjacent roadway and structures, and to afford the necessary protection to the workmen and pipe.
2. Excavated material shall not be stored on the pavement if it can be reasonably handled otherwise. In cases where storing of excavated material on pavement is absolutely necessary, same shall be moved as quickly as practical and the pavement shall be thoroughly cleaned.
3. 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.
4. Drainage facilities that are inadvertently damaged must be repaired or replaced immediately.
5. Parallel open trench installations that involve possible damage in the event of rain or other weather events, or which may be hazardous to traffic due to open trench, should be closed without undue delay. In no case should a trench remain open longer than a 24- hour period, except with approval of the Director of Engineering.

F. Trenching Within Pavement

1. Where it is necessary to open-cut asphalt or concrete pavements surface cuts shall be made with a concrete saw with a maximum width of five (5) feet.
2. Where excessive depths of pipe installations are encountered and the structural integrity of the roadway surface and/or the safety of the workmen is in doubt, proper sheeting and bracing of the trench shall be required.
3. Handling and placement of the excavated material within this area shall be handled as in Paragraph E2 above.
4. All excess excavated material shall be removed and disposed of outside the limits of the right-of-way in such a manner as not to interfere with the drainage of the roadway unless otherwise permitted or directed by the Director of Engineering or his representative.
5. Compaction test(s) for open-cut crossings may be required at the discretion of the Director of Engineering in addition to any supplemental or more stringent testing requirements specified in the approved North Carolina Department of Transportation Encroachment Agreement. All geotechnical testing required as specified above to meet the compaction requirements within Section 15 05 00 shall be the responsibility of the Contractor, the cost of which shall be included in the price bid for asphalt roadway (remove & replace).

G. Rock Excavation

1. Rock excavation methods and payment shall be in accordance with Section 15 05 02.

H. Preparation of Pipe Foundation

1. General
  - a. The pipe foundation shall be true to line and grade and uniformly firm. Where bell and spigot type pipe is used, recesses shall be excavated to receive the pipe bells.
2. Unsuitable Foundation Material
  - a. Where the foundation material is found to be of poor supporting value or of rock, the Director of Engineering may make minor adjustment in the location of the pipe to provide a more suitable foundation.
  - b. Where this is not practical, the Contractor shall act upon the directions of the Director of Engineering to stabilize the trench bottom by undercutting and installing: (a) soil stabilization woven fabric; and (b) NCDOT Class VI Stone (clean #57) or (c) approved select or borrow material and compacting to a minimum density of ninety (90%) as directed by the Director of Engineering. Compensation for the undercut will be included in the cost of the foundation material furnished. Approved bedding and backfill material is further specified within Section 15 05 01.

3. Placement of Bedding Material
  - a. In such case as a stone bedding as specified is used, a sufficient depth (minimum six (6) inches, maximum eight (8) inches) of the material shall be placed in the trench bottom of pipe to be installed. For depths greater than sixteen feet (16') the engineer shall direct the depth of bedding.
  - b. In order to ensure that adequate and uniform support is provided along the entire length of pipe, the Contractor shall carefully bring the bedding material to grade along the entire length of pipe prior to installation. Material used for the formation of the pipe bedding and haunch shall be carefully placed by hand shoveling to ensure that sufficient material has been worked under the pipe to form the haunch and to ensure that the pipe does not become dislodged during backfilling. Contractor's workmen shall fill evenly on both sides of the pipe to the centerline and shall compact the fill using hand shoveling or mechanical tamps. Extreme care shall be taken when using mechanical tamps adjacent to the pipe, when removing sheeting, and removing trench boxes so as to avoid disturbing the pipe.
- I. Laying of Pipe
  1. Inspection
    - a. After delivery alongside the trench, all pipeline material shall be carefully examined for both soundness and specifications compliance.
  2. Installation of Pipe
    - a. Water main piping shall be installed in accordance with AWWA C600 and AWWA C605. Pipe shall be installed on even grades and straight alignments and all joints shall be properly fitted. All pipe, fittings and appurtenances shall be properly lowered into the trench so as to prevent damage to material.
    - b. Clean joint contact surfaces immediately prior to jointing. Use lubricants, primers, or adhesives as recommended by the pipe or joint manufacturer. All pipe shall be laid on the prepared foundation, bell end up grade with each joint being checked for proper alignment and grade as the work proceeds. Excavate bell holes for each pipe joint. When jointed in the trench, the pipe shall form a true and smooth line. Whenever practicable, start pipe laying at the lowest point.
    - c. Pipe jointing shall be accomplished according to manufacturer recommendations. Joint deflection shall not exceed 90% of the manufacturer's maximum allowable joint deflection.
    - d. Fittings shall be installed in the locations shown on the approved plans. Mechanical joint and restrained joint fittings shall be properly and tightly installed per the manufacturer's instructions and adequate thrust restraint shall be employed as shown in the plans and described in these specifications.
    - e. Pipe section(s) that are stubbed for future connection shall have a mechanical joint plug at the end which shall be rodded back to a thrust collar located midway along the section. In addition, gate valves for pipe stubs shall be rodded to the thrust collar as well. Rods shall be 5/8" or 3/4" steel.
  3. Tracing Wire
    - a. Tracing wire shall be installed in the trench with the polyvinyl chloride and ductile iron transmission piping. The wire shall be installed on top of the pipe and attached to the pipe with a vinyl or plastic strap spaced no greater than 10 feet on center to prevent the tracing wire from moving during backfilling of the trench. The wire shall run continuously from valve box to valve box with a minimum of splices. The tracing wire shall terminate at the top of each valve box. The tracing wire shall be No. 10 gauge solid copper wire with UL insulation for direct bury rated for 600 volts. At each main line valve box location, the tracing wire shall be turned upward and installed to the top of the valve box.
    - b. Tracing wire shall also be run continuous along all plastic water services from the corporation stop and shall terminate at the top of each meter box. The service tracing wire shall be integrated into the main pipe wiring scheme. Further details for service lines are found within Section 15 12 13.
    - c. Upon completion of a run of pipe agreeable to the Director of Engineering and Contractor, after backfill and prior to substantial completion, the Contractor shall demonstrate continuity in the wire along the main and services with an electronic locator. Any repair of wire or restoration of continuity along the pipe and services shall be at the Contractor's cost.

4. Dewatering
  - a. Keep trenching dry during pipe laying. Divert surface water from the trench area to the greatest extent practicable without causing damage to the adjacent property. Before pipe laying is started remove all water that may have entered the trench and continue to dewater trench by the most expedient method.

J. Backfilling

1. After the bedding has been prepared and the pipe installed, selected material from excavation or borrow, at a moisture content which will facilitate compaction, shall be placed alongside the pipe in layers not exceeding 6 inches in depth. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe. Each layer shall be thoroughly compacted by rolling, tamping and mechanical rammers, or by hand tamping with heavy iron tampers. The tamping face area shall not exceed 25 square inches. The method of filling and compacting shall be continued until the fill has reached an elevation 12 inches above the top of the pipe. The remainder of the trench shall be backfilled and thoroughly compacted in layers not exceeding 12 inches.
2. Care shall be taken during backfill and compaction operations to maintain alignment and prevent damage to the joints. The backfill shall be kept free from stone, frozen lumps, chunks of highly plastic clay, or other objectionable material.
3. All local backfill materials shall be compacted at moisture content satisfactory to the Director of Engineering, which shall be approximately that required to produce the maximum density. The contractor shall dry or add moisture to the local material when required to provide a uniformly compacted and stable embankment.
4. When other than local material is used for backfilling above the foundation, such material will be classified as select backfill material as specified in Section 15 05 01 of these specifications. Use of this select backfill material shall be only when directed by the Director of Engineering or his representative.
5. Backfill over and around the pipe and backfill around and adjacent to all drainage structures shall be compacted to a minimum density of 80 percent as determined by the AASHO Standard Method T-99, except the backfill under pavements and adjacent areas within 4 to 10 feet of the proposed pavement shall be compacted to a minimum density of 100%.
6. Tests for density of compaction may be made at the option of the Director of Engineering, and deficiencies shall be corrected by the Contractor without additional cost to the Owner. The operation of heavy equipment shall be conducted so that no damage to the pipe shall result.
7. Heavy equipment shall not be operated over any pipe until it has been properly backfilled and has a minimum cover of three (3) feet, unless approved otherwise by the Director of Engineering.

K. Testing

1. Testing of new mains shall be in accordance with Section 15 12 19.

L. Disinfection

1. Disinfection of new mains shall be in accordance with Section 15 12 19.

M. Valves, Hydrants and Miscellaneous Appurtenances

1. Installation of Valves, Hydrants and Miscellaneous Appurtenances shall be in accordance with Section 15 12 16

N. Water Service Connections

1. Water Service Connections shall be in accordance with Section 15 12 13.

O. Connections to Existing Mains

1. Connection to existing mains by tapping assembly or sleeve shall be in accordance with Section 15 12 16.

2. Connections that require shutdown of existing mains shall be done as follows:
    - a. Contractor shall notify the owner in writing within three (3) working days of a shutdown and (7) days if bypass services will be required and shall include the following information:
      - i. Work being performed
      - ii. Area/zones being shutoff and valves to be closed
      - iii. Length of time of shutoff
      - iv. Means of notifying all affected customers
      - v. Method/plan of bypass service (if necessary for prolonged shutdowns)
    3. Contractor shall dewater, backfill and compact in accordance with specifications herein.
    4. Contractor shall make the connection safely with the greatest possible speed and with the least amount of disruption to traffic and water service.
    5. Prior to filling of lines, flushing, chlorinating, etc., approval shall be obtained from the Director of Engineering in accordance with Sections 15 12 19.
- P. Temporary Bypass Water Service System
1. Temporary Bypass Water Service System shall be in accordance with Section 15 11 13.01
- Q. Abandonment of Water Mains and Services
1. Cap ends of mains to remain in service as shown on plans and provide required concrete blocking to support cap.
  2. For abandonment of water mains, install approved plug or cap at each location where pipe was cut or valve removed; or Contractor may fill severed abandoned pipe with flowable fill.
  3. Where mains are to be abandoned and removed to a fitting or valve, cut and plug main at the fitting or valve.
    - a. When shown on the Drawings, remove and salvage abandoned valves and hydrants and deliver to the owner
    - b. Pipe, fittings and other appurtenances that are removed but not required to be salvaged become property of the Contractor. Remove and dispose of off site.
  4. For abandonment of house connections two inches (2") and smaller in diameter:
    - a. Close the corporation stop and disconnecting the copper or plastic service tube.
    - b. Cap the corporation stop with an approved cap.
    - c. Remove the meter box and meter. Return to owner if requested.
  5. For abandonment of house connections three inches (3") and larger in diameter, remove the existing gate valve.
    - a. For a mechanical joint gate valve and fittings, remove existing gate valve and install mechanical joint plug to existing tee.
    - b. For tapping sleeve and valve connections, remove existing gate valve from existing tapping sleeve assembly. Install blind flange to existing flange end of tapping sleeve assembly.
    - c. For lead joint valve and fittings, remove existing gate valve and tee.
      - i. Before removing existing tee and valve, clean existing pipe and check pipe diameter and roundness to verify that a solid sleeve will fit.
      - ii. Do not cut existing pipe closer than eighteen inches (18") to joint bell unless joint bell will be removed.
      - iii. Reconnect existing main with new pipe and solid sleeve.

06. MEASUREMENT AND PAYMENT

A. Public Water Mains

1. Measurement: By linear foot of various sizes and types provided, measured horizontally along the centerline of the installed pipe as part of the completed and accepted work.
2. Payment: At the unit price for each size and type of pipe installed as listed in the Bid Schedule. Payment includes work for location of utilities, excavation, trenching, backfilling, removal and replacement of driveway pipes, guardrails and other obstructions, connecting to new and existing mains, abandonment of mains and services, installation of concrete blocking, installation and testing of tracer wire, pressure and leakage testing of mains, and disinfecting and testing of mains.

B. Fittings

1. Measurement: By each of the various sizes and types provided to include accessories.
2. Payment: At unit price for each size and type of fitting installed as listed in the Bid Schedule as part of the completed and accepted work. Payment includes work for location of utilities, excavation, trenching, backfilling, removal and replacement of driveway pipes, guardrails and other obstructions, connecting to new and existing mains, installation of concrete blocking, installation and testing of tracer wire, pressure and leakage testing of mains and fittings, and disinfecting and testing of mains and fittings.

C. Payment will be made under:

Pay Item	Pay Unit
___ Inch ___ Water Pipe	LF
___ Inch ___ Degree Bend	Each
___ Inch x ___ Inch Tee	Each
___ Inch x ___ Inch Hydrant Tee	Each
___ Inch ___ Plug	Each

15 12 00 WATER UTILITY DISTRIBUTION EQUIPMENT

15 12 13 WATER SERVICES

01. DESCRIPTION

- A. The Contractor shall furnish all materials and completely install the individual water services called for in this contract, as shown on the drawings and as designated by the Director of Engineering.

02. SUBMITTALS

- A. Prior to the installation of any water services, the Contractor is to submit five (5) copies of shop drawings of all materials to the Director of Engineering for review and approval.

03. MATERIALS

A. Corporation and Curb Stops/Angle Stops

1. Corporation and curb stops for the identified sizes shall be brass manufactured in accordance with AWWA C800. Direct tap shall be on 4" diameter or larger Ductile Iron Pipe or Cast Iron Pipe. Taps onto smaller mains or non ferrous pipe shall be made with a tapping saddle as specified herein.
2. Corporation Stops for 3/4" and 1" services shall be Mueller H-15000 or A.Y. McDonald 4701T with CC threads.
3. Corporation Stops for 1.5" and 2" services shall be Mueller H-15013 with CC threads or approved equal. In addition, 1.5" and 2" services shall have a 2" Iron Body, Bronze Mounted Gate Valve with Iron Pipe Threads and Brass Fittings as manufactured by Mueller. Valve shall be immediately downstream of the tap.
4. Curb stops for 3/4" and 1" services shall be Mueller H-15175 and located within the meter box assembly.

5. Curb stops/angle stops for 1.5" and 2" services shall be Mueller H-14277 and located within the meter box assembly.
- B. Tapping Saddles
1. General:
    - a. Use for 2" and smaller connections
    - b. Manufactured saddles with clamps for underground services shall:
      - i. Be rated for minimum service of 150 psi
      - ii. Provide full support around the circumference of the pipe without distorting, scratching or damaging the pipe when tightened.
      - iii. Contain a thick tapping boss which has been precision machined with full length threads for a watertight connection that resists pullout.
      - iv. Have threads in accordance with AWWA C800 with a standard corporation stop thread.
      - v. Use watertight gaskets meeting ASTM D2000 around the tap hole.
  2. Saddles for Cast Iron or DIP 4" and above shall be Ford Meter Box Company, Style No. 202B Double Strap or Mueller Company, Model BR2B Double Strap.
  3. Saddles for PVC AWWA C900 and C905 Pipe shall be manufactured specifically for this application with stainless steel wide band straps, nuts and washers. Saddles shall be Ford Meter Box Company, Model 202BS or Mueller Company, Series DR2S.
- C. Service Pipe and Fittings
1. Water service pipe to be copper, Type K, soft conforming to ASTM Specification B-88 (latest edition), or Class 200 SP Water Service Tubing (C.T.S. - O.D.) meeting the requirements of Type III, Grade 3, Class C material as described in Standard Specifications for Polyethylene (PE) Plastic Pipe (SDR-PR), ASTM Designation D-2239.
  2. All Fittings, compression joints, end connectors and couplings shall be in accordance with AWWA C800.
- D. Meter Box
1. All meter boxes shall be cast iron body, Ford Crescent Box (Model CB111-233 for ¾" and Model CB111-444) or approved equal. Meter box shall include bituminous coated, cast iron base, inner barrel, and outer barrel with 1-7/8" touch-read hole in lid.
  2. All meter boxes for 1.5" or 2" services shall have minimum dimensions of 24" wide x 36" long x 30" deep and shall be manufactured by CDR Systems Corporation or approved equal. Vault top and frame shall be made of 11,000 psi fiber reinforced concrete and the top shall have a meter lid with 1-7/8" touch-read hole.
  3. Meters larger than 3" shall be installed within a vault per the Plans or Standard Details.
  4. Meter boxes shall not be installed within paved or sidewalk area unless approved by the Director of Engineering.
- E. Meters
1. Shall be furnished and installed by City of Rocky Mount.
  2. All meters three inches (3") or larger shall have a swinging dismantling joint on the upstream side in order to facilitate easy removal and maintenance. Fitting shall be the Romac DJ 400 Dismantling Joint or approved equal.
- F. Pressure Reducing Valves
1. All pressure reducing valves shall meet the requirements of ASSE Standard 1003 (ANSI A112.26.2) listed by IAPMO. Pressure reducing valves shall have bronze body construction, renewable stainless steel seat, stainless steel integral strainer, reinforced EPDM diaphragm, and EPDM valve disc. Pressure reducing valves shall be Watts Series N35B or approved equal.

G. Backflow Prevention Devices

1. Double check valves or Reduced Pressure Assemblies, their appurtenances and installation shall be in accordance with the most current City of Rocky Mount Administrative Policy for Backflow Prevention and Cross Connection Control. This policy can be obtained from the City of Rocky Mount Utilities Division website.

04. EXECUTION

A. Installation

1. Install water house connections from main water line to property lines at elevations indicated on the Drawings, Standard Details or at the Director of Engineering's discretion.
  - a. When elevations are not shown, install water house connections with a minimum cover of 36 inches.
2. Perform tapping of water main and insertion of corporation stop by qualified personnel.
  - a. Maintain 60 psi pressure during service connection tapping process
  - b. Tapping of PVC pipe shall be in accordance with AWWA C605 and pipe manufacturer's recommendations.
  - c. Tap should be made at a 45 degree angle to perpendicular to the pipe.
  - d. Use wrenches with smooth jaws of proper size to install corporation stops and connect pipes thereto. Do not use wrenches with jaws that will score brass or copper.
  - e. Maintain a minimum of 18 inches between taps, a minimum of 18 inches clear from DIP bells, and a minimum of 24 inches clear from PVC bells.
  - f. Install service saddle when tapping 3" or 4" diameter water mains and for all taps larger than 1 inch on a 6 inch through 12 inch water main. Service saddles shall be used for all PVC taps.
  - g. After making tap and installing all required valves and curb stop, blow off at curb stop, pressurize, check for leaks to valving and curb stop and leave corporation stop in open position.
  - h. Backfill excavated area around pipe per Section 15 11 13. Do not dry tap ductile iron mains without Director of Engineering's approval. If permitted, keep trench open at tap until water main has been placed in service so that tap can be inspected for leakage.
  - i. Install the water meter box as identified on the plans or at the property line/easement line.

05. MEASUREMENT AND PAYMENT

A. Water Service Lines

1. Measurement: By linear foot of various sizes (3/4"/1" or 1.5"/2") and types provided, measured horizontally along the centerline of the installed service from the centerline of the main to the property line (or directed location) as part of the completed and accepted work.
2. Payment: At the unit price for each size and type of pipe installed as listed in the Bid Schedule. Payment includes work for location of utilities, excavation, backfilling, bedding, service pipe, connection to new and existing mains, corporation stop, valve, valve boxes, curb stop and testing of service line.

B. Meter Box Assembly

1. Measurement: By each of the various sizes (3/4"/1" or 1.5"/2") furnished and installed as part of the completed and accepted work.
2. Payment: At the unit price for each size meter box assembly installed as listed in the Bid Schedule. Payment includes work for location of utilities, excavation, backfilling, bedding, connection to new or existing service lines, meter setting, angle stops and meter boxes. Furnishing and installation of the meter will be by others unless directed by the Director of Engineering.

C. Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
___ Inch ___ Water Service Line Service (Open-Cut)	LF
___ Inch ___ Water Service Line Service (Bore)	LF
___ Inch Meter Box Assembly	Each
___ Inch Water Meter	Each
Relocate Water Meter	Each
Reconnect Water Meter	Each
___ Inch DCV Back-Flow Preventer	Each
Relocate ___ Inch DCV Back-Flow Preventer	Each
___ Inch RPZ Back-Flow Preventer	Each
Relocate ___ Inch RPZ Back-Flow Preventer	Each
___ Inch Pressure Reducing Valve	Each

15 12 16 WATER VALVES, HYDRANTS, FITTINGS AND MISC. APPURTENANCES

01. DESCRIPTION

- A. The work covered in this Section includes the furnishing and installation of all valves, hydrants, fittings, blowoffs and other miscellaneous appurtenances as shown on the drawings, required in these specifications, or as directed by the Director of Engineering.

02. QUALITY ASSURANCE

- A. The Contractor shall use sufficient workmen and competent supervisors in the execution of this portion of the work to ensure adequate and proper installation throughout.
- B. The class numbers or pressure ratings shall be clearly shown on the valve or fitting.
- C. Loading, unloading, inspection, storage and handling shall be in accordance with AWWA C600 and AWWA C605 and as specified herein.
- D. Storage: Store pipe, fittings, valves and appurtenances off the ground using sound wood blocks, placed on stable foundation or using other appropriate means. Allow space between rows, individual pieces and bundles with clearance below and above to allow full view for inspection purposes.
1. Store in well-drained area away from brush and accessible for inspection.
  2. Keep ends of valves and fittings clean and clear for dimensioning purposes
  3. Do not place excavated or other material over or against stored material.
  4. PVC pipe shall be stored so that it does not deform or bend. Pipe stored outdoors or otherwise exposed to direct sunlight shall be covered with canvas or other opaque material with provision for adequate air circulation.
- E. Handling: Unload and handle materials with crane, backhoe, or equipment of adequate capacity, equipped with appropriate slings or padding to protect materials from damage.

03. SUBMITTAL

- A. Prior to the installation of any pipe, the Contractor shall submit and receive the Director of Engineering's approval of shop drawings and/or manufacturer's material certification of compliance with specifications.
- B. Submittals shall be in five (5) copies and shall be provided to the Director of Engineering at least 15 days prior to the planned installation time.

## 04. PRODUCTS

### A. Allowable materials on this project are as follows:

#### 1. Fittings

- a. Fittings shall be in accordance with Section 15 11 13

#### 2. Gate Valves

- a. All gate valves shall open turning left (counter-clockwise). Valves for direct burial shall have non-rising stems (NRS) with a two inch (2") square (four sided) operating nut.
- b. All gate valves shall have a minimum rated working pressure of two hundred (200) psi, four hundred (400) psi minimum test pressure.
- c. Two inch (2") gate valves shall be iron body, bronze mounted, double-disc parallel seated and fully bituminous. Two inch gate valves shall be Mueller or approved equal.
- d. Three inch (3") through twelve inch (12") gate valves shall be Resilient-Seated type manufactured in accordance with AWWA C509.
  - i. The body and bonnet shall be coated with fusion bonded epoxy both interior and exterior, complying with AWWA C550 and be NSF 61 approved. Each valve shall have maker's name, pressure rating and year in which manufactured cast on the body.
  - ii. The wedge shall be of cast iron completely encapsulated with rubber.
  - iii. The sealing rubber shall be permanently bonded to the cast iron wedge to meet ASTM Test for rubber metal bond ASTM D429.
  - iv. Stems for NRS assemblies shall be cast bronze with integral collars in full compliance with AWWA. OS & Y stems shall be bronze. The NRS stem stuffing box shall be the o-ring seal type with two o-rings located above thrust collar and one o-ring below. The two o-rings above the thrust collar shall be replaceable with valve fully open and subjected to full rated working pressure.
  - v. There shall be two low torque thrust bearings located above and below the stem collar. The stem nut shall be independent of wedge and shall be made of solid bronze. There shall be a smooth unobstructed waterway free of all pockets, cavities and depressions in the seat area.
  - vi. Valves shall be Clow, Mueller or approved equal.
- e. Sixteen inch (16") through Forty-Eight inch (48")- For use on tapping sleeves only
  - i. Gate valves shall be iron body, bronze mounted, double disc parallel seated and fully bituminous coated.
  - ii. Gate valves shall have a minimum working pressure of one hundred fifty (150) psi, three hundred (300) psi test pressure.

#### 3. Butterfly Valve (16" and Larger)

- a. Unless otherwise shown on the Drawings, all valves on water mains sixteen inch (16") in diameter and larger, except tapping valves, shall be rubber seated, butterfly valves manufactured in accordance with AWWA C504.
  - i. All butterfly valves shall be Class 150(B) minimum with a rated working pressure of one hundred and fifty (150) psi, three hundred (300) psi minimum test pressure.
  - ii. Unless otherwise noted on the Drawings, all butterfly valves shall be provided with mechanical joint or "Victaulic," grooved end connections.
  - iii. Valves shall have ductile iron bodies and discs with full epoxy coatings, twelve (12) mils minimum, in accordance with AWWA C500. Valve seats shall be stainless steel, bronze matting or resilient material. Resilient seats shall be mechanically attached to the valve disc or body and shall be fully field adjustable by mechanical means. Valve disc shafts shall be stainless steel of either the stub or through-shaft design. Valve shaft bearings shall be heavy duty bronze.

- iv. All butterfly valves shall be provided with an integral manual operator with a two inch (2") square (4 sided) operating nut which shall open turning left (counter clockwise). The valve and operator shall be assembled for installation in a horizontal line with the main valve and the operator shaft and operating nut aligned vertically. Valve operators shall be worm gear type manufactured by Philadelphia or approved equal.
4. Valve Boxes
  - a. All valve boxes, except as noted otherwise, shall be two (2) piece adjustable (telescoping) screw type of cast iron construction and fully bituminous seal coated with tops marked "Water" or "Sewer" as appropriate for the installation. Cast iron valve boxes shall conform to ASTM A48 Class 30. Boxes shall be East Jordan Iron Works 8550 or approved equal.
5. Tapping Sleeve and Valve
  - a. Tapping sleeves shall be cast iron mechanical joint or stainless steel meeting the requirements of ANSI B.16.1 and NSF 61 with one hundred and fifty (150) psi minimum working pressure, ductile flanged valve connection, test tap and plug.
    - i. If stainless steel sleeves are utilized, all bolts, nuts and components shall be stainless as well.
  - b. All tapping valves furnished under these specifications shall be resilient seat gate valves and shall conform with AWWA Standard C509 and as described above. Valves shall be furnished with the tapping flange having a raised face or lip conforming to MSS SP-60 Standard designed to engage the corresponding recess in the tapping sleeve to assure the proper alignment required to prevent damage by a misaligned shell cutter.
6. Check Valve
  - a. Check valve shall be iron body, bronze mounted swing type with flanged ends manufactured in accordance with AWWA C508.
    - i. Check valve shall have a cast iron clapper with bronze face and bronze seat ring. Check valve shall provide "full flow," clear passageway for nominal diameter of pipe when fully open.
    - ii. Valves shall have an adjustable external lever and weight or external lever and spring operation. Working parts of the valve shall be fully removable through top cover.
    - iii. Valves shall be rated for one hundred and seventy-five (175) psi minimum working pressure and three hundred (300) psi test pressure.
    - iv. Valves shall be fully bituminous or epoxy coated for use in potable water systems.
    - v. All check valves shall be housed in a precast manhole or vault as depicted on the Plans or approved by the Director of Engineering.
  - b. Check valve shall have a swinging dismantling joint on the upstream side in order to facilitate easy removal and maintenance. Fitting shall be the Romac DJ 400 Dismantling Joint or approved equal.
7. Fire Hydrants
  - a. All fire hydrants furnished shall be Dry-Barrel Type manufactured in accordance with AWWA C502.
    - i. All hydrants shall be compression type, dry top, traffic model using breakaway flanges, clips, couplings, or lugs as the union between the upper and lower barrel.
    - ii. All hydrants furnished are to be bronze to bronze threads between the seat or seat-ring and the seat attaching assembly with a bronze drain ring.
    - iii. Hydrant valve opening shall be four and one-half inches (4-1/2"). Operating nut shall be National Standard. Operating nut threads and hydrant rod threads shall be completely enclosed in "O" ring sealed, lubricating chamber.
    - iv. Hydrants shall have two (2) 2-1/2" hose nozzles and one (1) 4-1/2" pumper nozzle, all with National Standard threads, complete with caps and chains. Hydrant barrel shall be designed for traffic safety flange or breakable couplings at the ground line.
    - v. Hydrant inlet connection shall be a six inch (6") mechanical joint, complete with mechanical joint accessories
    - vi. All hydrants shall open left and have a minimum bury of 3-1/2 feet.

- vii. The main valve assembly must be removable through the upper barrel section. Removal of the nozzle section of disassembly at the ground-line shall not be required for this removal.
  - viii. Hydrant shall be painted in accordance with the City's standard color scheme.
  - ix. Hydrants furnished shall be Mueller Super Centurion 250 (A-421), American Flow Control's American-Darling Mark-73-1, or approved equal, in full compliance with AWWA Standard C-502.
8. Post (Blow-Off) Hydrant
- a. Blow-off hydrants shall be installed to facilitate line flushing, especially at line termini for water mains 4 inches (4") and larger when a fire hydrant is not required and as directed by the Director of Engineering. Blow-off hydrant shall be a non-freezing post hydrant self-draining type.
    - i. Hydrant shall have a non-turning operating rod and shall open counter-clockwise.
    - ii. The outlet shall also be bronze 2-½ inch NST and fitted with protective cap.
    - iii. Hydrants shall be locked to prevent unauthorized use.
    - iv. Blow-off hydrants shall be Mueller A412, Eclipse or approved equal.
9. Blow-Off Hydrant (Buried)
- a. When directed by the Director of Engineering, in-ground blow-offs shall be a non-draining type for placement in pavement.
    - i. Blow-off shall be a compression type closing with pressure and furnished with a two inch (2") FIP Inlet.
    - ii. Blow-off shall be operated by use of a portable stop cock coupling with the hydrant at or near ground level.
    - iii. All working parts shall be brass and removable from the hydrant without the need for excavation.
    - iv. Brass thread protector shall have a 2" square nut.
    - v. Blow-off shall be encased in a standard valve box as described herein
    - vi. Blow-off shall be Eclipse 2000-B or approved equal.

## 05. EXECUTION

### A. Installation

#### 1. Fittings

- a. Fittings shall be installed in accordance with Section 15 11 13

#### 2. Gate Valves and Valve Boxes

##### a. General

- i. All valves shall be installed in accordance with the manufacturer's recommendations, as directed by the Director of Engineering and as herein specified.
- ii. Valves shall be installed at locations as shown on the drawings or as directed by the Director of Engineering.
- iii. Before installation, exercise valve to ensure proper working order.
- iv. Installed valves shall be properly aligned, plumbed, and braced when required.

##### b. Buried Valves

- i. Valve boxes shall be installed for each buried valve. Boxes shall be centered over valve operating nut and shall be adjusted to finished ground elevation, unless otherwise directed by the Director of Engineering.

- ii. Valves and boxes shall be installed as shown on drawings and backfilled and compacted per the pipeline installation requirements described in Section 15 11 13 and as directed by the Director of Engineering.
  - iii. Valves buried greater than 48" in depth shall be equipped with a solid steel extension stem. Stem shall be extended to within 12" of final grade.
  - iv. Valves which are at a line terminus with a stubbed section shall be rodded with at least two rods to a thrust collar located on the stubbed section. Rods shall be a ¾" or 5/8" diameter steel rods.
  - v. Testing of valves shall be an integral part of the pipeline installation.
  - vi. Buried valves shall be properly bedded to prevent settlement. Valves in pits shall be properly supported.
  - vii. Buried valves off of the right-of-way, in unpaved areas or as depicted on the plans and/or directed by the Director of Engineering shall have a valve marker sign installed.
- c. Valve Boxes
- i. Valve boxes shall be provided for each buried valve and installed as shown on the drawings. Boxes will be centered over the valve operating nut and will be set plumb. Top of boxes shall be adjusted to be flush with finished ground elevation, unless otherwise directed by the Director of Engineering.
  - ii. All valve boxes in roadways shall be encased in 2' x 2' x 6" concrete pads (3,000 psi) beneath the asphalt pavement.
  - iii. All valve boxes outside of roadways shall be encased in 1' x 1' x 6" concrete pad (3,000 psi) flush with the ground.
  - iv. Valve boxes shall not be considered to be properly set unless the valve wrench fits easily on the valve.
3. Tapping Sleeve and Valve
- a. General
- i. Before placing sleeve, clean existing pipe and check pipe outside diameter and roundness to verify that the sleeve will fit.
  - ii. Keep closest edge of sleeve a minimum of 12 inches (12") from face of existing joint bell for ductile iron and gray iron pipe
  - iii. For cast iron sleeves on gray iron or DIP, field coat tapping sleeve with approved primer as necessary
  - iv. Hydrostatically test sleeve following manufacturer's instructions to ensure watertightness in presence of Director of Engineering before making tap.
- b. PVC Pipe Tapping:
- i. Use only cutting/tapping tools and machines made specifically for cutting AWWA C900 or C905 pipe.
  - ii. Keep closest edge of sleeve a minimum of 15 inches (15") from face of existing joint bell.
  - iii. Install tapping machine without damage, scarring or distortion to pipe.
  - iv. Support tapping sleeve and valve so that its weight is not carried by the pipe.
  - v. Before backfilling, fill void under sleeve with compacted granular material or flowable fill.
4. Fire Hydrants
- a. General
- i. Hydrants shall be located in accordance with the Drawings.
  - ii. Base beneath hydrant, lead and valves shall be firm, compacted and level.

- iii. Hydrants shall be rodded back to valves with at least two tied rods as shown on Drawings; tie rods shall be either 3/4" or 5/8" diameter steel rods.
- iv. Centerline of pumper cap shall be approximately eighteen (18) to twenty-four (24) inches above finished ground line. The pumper connection shall be set parallel with the lead.
- v. Ten (10) cubic feet of clean stone shall be furnished and placed at the base of the hydrant by the Contractor and hydrant body shall be plumb; a concrete thrust block shall be placed behind hydrant tee and the hydrant shall sit on a concrete setting slab as depicted in the Standard Details.
- vi. Hydrant tees shall be used at all hydrants unless otherwise directed by the Director of Engineering.
- vii. Hydrant valve shall be within eight (8) feet of hydrant unless otherwise directed by the Director of Engineering.
- viii. Backfill and compaction of material around hydrant and valves shall be in accordance with the pipeline installation requirements described in Section 15 11 13.

5. Post (Blow-Off) Hydrants

a. General

- i. Post Hydrants shall be installed per manufacturer's recommendation.
- ii. Two (2) cubic feet of clean stone shall be furnished and placed at the base of the hydrant by the Contractor and hydrant body shall be plumb; a concrete thrust block shall be placed behind hydrant tee and the hydrant shall sit on a concrete setting slab as depicted in the Standard Details.
- iii. Centerline of the outlet connection shall be approximately eighteen (18) to twenty four (24) inches above the finished ground line.

6. Blow-Off Hydrants (Buried)

a. General

- i. Post hydrants shall be installed per manufacturer's recommendation.
- ii. Buried blow-offs shall only be installed as depicted on plans or as approved by the Director of Engineering.
- iii. Blow-offs shall be connected to a water main via a 2" brass or copper pipe running from a mechanical joint tapped plug off of the main to the blow-off tee. See Standard Details.
- iv. Two (2) cubic feet of clean stone shall be furnished and placed at the base of the hydrant by the Contractor and hydrant body shall be plumb; a concrete thrust block shall be placed behind blow-off tee and the hydrant shall sit on a concrete setting slab as depicted in the Standard Details.
- v. Valve box encasing the blow-off shall be installed as described herein.

06. MEASUREMENT AND PAYMENT

A. Water Valves

- 1. Measurement: By each of the various sizes and types provided and installed as part of the completed and accepted work.
- 2. Payment: At unit price for each size and type of valve installed as listed in the Bid Schedule.
  - a. Payment includes work for location of utilities, excavation, trenching, bedding backfilling, connection to water mains, field priming, furnishing and installation of valve boxes and riser stems, installation of thrust restraints and rods, installation of tracing wire, installation of concrete valve box pad, pressure and leakage testing, and disinfection.

- b. Payment for non-buried valves shall also include any painting or assembly that may be required. Compensation for valve pits or vaults shall be considered a separate pay item unless otherwise identified by the Director of Engineering.

B. Fittings

- 1. Measurement and payment as identified in Section 15 11 13.

C. Hydrants (Fire and Post)

- 1. Measurement: By each of the various types provided to include accessories.
- 2. Payment: At unit price for each size and type of hydrant installed as listed in the Bid Schedule as part of the completed and accepted work. Payment includes work for location of utilities, excavation, trenching, bedding backfilling, connection to watermains, furnishing and installation of hydrant assembly and associated fittings, installation of concrete thrust restraints and concrete setting slabs, installation of rods, installation of tracing wire, pressure and leakage testing, and disinfection.

D. Blow-Off Hydrants (Buried)

- 1. Measurement: By each provided to include accessories.
- 2. Payment: At the unit price for each type installed as listed in the Bid Schedule as part of the completed and accepted work. Payment includes work for location of utilities, excavation, trenching, bedding backfilling, connection to water mains to include 2" brass or copper pipe, furnishing and installation of blow-off assembly and associated fittings, installation of concrete thrust restraints and concrete setting slabs, installation of rods, installation of tracing wire, pressure and leakage testing, and disinfection.

E. Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
___ Inch Valve	Each
___ Inch Tapping Sleeve and Valve	Each
___ Inch Air release Valve	Each
___ Inch Blow-Off Hydrants (Buried)	Each
Post (Blow-Off) Hydrant	Each
Fire Hydrant	Each
Relocate Fire Hydrant	Each

15 12 19 PRESSURE TESTING AND DISINFECTION OF WATER MAINS

01. DESCRIPTION

- A. The work covered in this Section includes requirements for properly disinfecting and hydrostatically testing all new water mains or appurtenances put into use.

02. QUALITY ASSURANCE

- A. Disinfection shall be performed in accordance with rules and regulations of the Public Water Supply Branch of the North Carolina Department of Environment, Health and Natural Resources, Division of Environmental Health.
- B. Pressure testing shall be performed prior to the disinfection of the water mains unless otherwise directed by the Director of Engineering.

### 03. PRODUCTS

#### A. Hydrostatic Testing Materials

1. The contractor shall provide all materials, labor, equipment, tools, etc. to perform all work and services necessary for, and incidental to, a complete pressure test of the Water Distribution System in accordance with the Contract Documents and AWWA C600 and AWWA C605.

#### B. Pressure Gauge

1. Pressure gauge shall have a three inch (3") minimum diameter face, two hundred (200) psi minimum operating pressure, and maximum dial gradation increments of one (1) psi.

#### C. By-Pass Pump

1. By-pass pump with motor, pressure-relief valve, shut-off valve and hoses rated for a minimum of 150% of required actual test pressure.

#### D. Disinfection Materials

1. The contractor shall provide all materials, labor, equipment, tools etc to perform all work and services necessary for and incidental to a complete disinfection of the Water Distribution System in accordance with the Contract Documents and State Requirements.
2. Water Required
  - a. The water required for filling, flushing, disinfecting and sampling shall be furnished by the City at such times, or times when the quantity is available. The Contractor is to notify the City no less than 48 hours prior to filling, flushing, disinfecting or sampling.
3. Disinfecting Agent
  - a. The disinfecting agent shall be an approved dry chemical compound such as High Test Hyperchlorite (HTH), and such disinfecting agent shall be provided by the Contractor.

### 04. EXECUTION

#### A. Pressure Testing

##### 1. General

- a. All testing shall be witnessed by the Director of Engineering or his appointed representative.
- b. Prior to pressurization of lines, all trenches shall be backfilled to ground surface and all blocking shall have had sufficient curing time to achieve a minimum compressive strength of twenty-five hundred (2500) psi
- c. Prior to pressurizing the system for tests, air shall be vented from the system at high points using services, hydrants, or taps specifically installed for air release. No additional payment shall be made for taps made specifically for air release or pressure testing.
- d. Pressure and leakage test shall be run for a minimum of two (2) hours measured from the time that the pump is turned off. Tests may be run concurrently.
- e. Minimum test pressure shall be one hundred and fifty (150) psi measured at the lowest elevation in the test section. Dedicated fire mains to buildings shall be tested at two hundred (200) psi.
- f. Maximum length of main(s) to be included in a single test shall be five thousand (5000) feet.
- g. Pressure test shall be complete before any service taps are made unless otherwise authorized by the Director of Engineering.

2. Allowable Leakage

- a. Allowable leakage shall be calculated in accordance with AWWA C600 and AWWA C605; an excerpt has been included below:

Allowable Leakage Formula

$$L = \frac{S D \sqrt{P}}{148,000}$$

- Where: L= allowable leakage, in gallons per hour  
 S= length of pipe tested, in feet  
 D= nominal diameter of the pipe, in inches  
 P= average test pressure during the leakage test, in pounds per square inch (gauge)

Excerpt of Allowable Leakage Table

Average Test Pressure	Allowable Leakage In Gallons Per 1000 Feet Of Pipeline											
	Nominal Pipe Diameter in Inches											
(psi)	3	4	6	8	10	12	14	16	18	20	24	30
175	0.27	0.36	0.54	0.72	0.89	1.07	1.25	1.43	1.61	1.79	2.15	2.68
150	0.25	0.33	0.50	0.66	0.83	0.99	1.16	1.32	1.49	1.66	1.99	2.48
125	0.23	0.30	0.45	0.60	0.76	0.91	1.06	1.21	1.36	1.51	1.81	2.27

- b. If the main(s) being tested contain(s) sections of various diameters, the allowable leakage shall be the sum of the computed leakage for each size using the above Formula or Table.

3. Line Acceptance

- a. Line acceptance shall be based upon Allowable Leakage being greater than or equal to the actual leakage measured during the Leakage Test.  
 b. Leakage during test shall be measured using either an approved flow recording meter or direct measurement in a clean cylindrical container of known volume.  
 c. Leakage amount shall be the actual volume of water required to pump the test section back to the initial test pressure at the start of the test.

4. Correction and Retesting

- a. Any sections of watermain, services, fittings, valves or appurtenances that do not pass the minimum test requirements shall be replaced and/or corrected prior to the retesting as approved by the Director of Engineering.  
 b. No additional compensation shall be paid to the Contractor for correcting and retesting.

B. Disinfection

1. General

- a. Bacteriological testing services on the water distribution system will be provided by the City of Rocky Mount's state approved testing laboratory. All costs associated with the bacteriological sampling and testing shall be the responsibility of the Contractor and shall be in accordance with the current City of Rocky Mount administrative policy.  
 b. The Contractor will coordinate with the Director of Engineering's representative for the coordination of sampling and testing. The Contractor shall be responsible for providing tools and manpower necessary for filling, flushing, sampling, etc.  
 c. All additions to or replacements of the water distribution system including fire lines shall be disinfected. Such additions and or replacements to the water distribution system so disinfected shall receive a negative bacteriological test result prior to being placed in service.  
 d. The Director of Engineering or his appointed representative shall be present during the chlorination process and during sampling. A scheduling notice of at least forty-eight (48) hours shall be given

to the City of Rocky Mount Water Plant personnel prior to the Contractor performing any of the chlorination process.

- e. Any additional service taps necessary for: (1) a water source from existing system; (2) injection of chlorine solution; (3) flushing; and (4) sampling, shall be made directly to the water main and in accordance with Section 15 12 13 for 3/4" or 1" service tap with the exception that no meter box or meter will be required. Service taps for injection of chlorine solution and sampling shall be installed during pipe installation at intervals of 1,000 feet. No payments shall be made for additional taps necessary for filling, flushing, testing, or disinfecting. The Contractor may use water services scheduled for existing lots of record as shown on the Drawings or directed by the Director of Engineering.

## 2. Disinfection Procedure

- a. Prior to chlorination, all newly installed water mains and service laterals shall be opened and thoroughly flushed to remove sediments or other debris introduced during the manufacture, transportation, storage, and/or construction processes.
- b. Valve(s) at connection(s) to existing system shall be closed tightly during chlorination process to prevent backflow of highly chlorinated solution into the City Water Supply
- c. All necessary taps shall be made by the Contractor at: (1) tie-ins to existing water distribution system; (2) 1,000 foot intervals along the length of the water main being disinfected; and (3) extreme ends of a system addition. The purpose of these taps is to provide uniform distribution of the strong chlorine solution, sampling of strong solution and sampling for bacteriological contamination.
- d. Disinfection of all additions to, or replacements of, the water distribution system, including fire lines, shall be accomplished using a strong solution of water containing HTH. The HTH solution shall be introduced into the water main by regulated pumping and by operation of: (1) main line valves; (2) lateral valves; and (3) service valves or curb stops. The HTH solution shall be of a concentration that the water main at each sample point shall have a uniform concentration of not less than fifty (50) parts per million (ppm) free chlorine and not more than one hundred (100) parts per million (ppm) free chlorine.
- e. Upon authorization by the Director of Engineering, the Contractor shall begin chlorination of the water main by dosing the strong chlorine solution at the sampling point immediately on the downstream side of the valve separating the new water main from the water distribution system. The distribution system valve shall be cracked open allowing a positive flow of water from the water distribution system into the new water main. Simultaneously, the fire hydrant or flushing valve at the far end of the new water main being tested shall be opened in order to provide a positive flow of water to achieve uniform distribution of the strong chlorine solution along the entire length of the water main being disinfected. The Laboratory shall sample the chlorine concentration at each sample point sequentially downstream from the dosing point on the water main to determine if the requirement for a uniform concentration of not less than fifty (50) parts per million (ppm) free chlorine and not more than one hundred (100) parts per million (ppm) free chlorine has been met.
- f. The chlorine solution shall remain in contact with the water lines for a minimum of twenty-four (24) hours. At the end of the twenty-four (24) hour contact period, the minimum available chlorine content at each sample point shall be twenty-five (25) parts per million (ppm).
- g. If minimum available chlorine content at any sample point is below twenty-five (25) parts per million (ppm) at the end of the twenty-four (24) hour contact period, then all lines in test shall be rechlorinated.
- h. If minimum available chlorine content is equal to or greater than twenty-five (25) parts per million (ppm) at the end of the twenty-four (24) hour contact period, then the water mains shall be flushed until residual chlorine levels at each sample point on the water main being disinfected are equal to background levels on the existing system (> 1.0 parts per million (ppm) combined chlorine residual).
- i. During flushing and testing operations the Contractor shall exercise sufficient precautions to prevent both erosion and damage to property. Flushing duration may have to be limited to lessen impact on surrounding drainage ditches. Temporary retention basins or other measures such as chemical dechlorination, may be necessary to prevent chlorinated water from damaging property or entering natural water courses.

- j. Valve boxes shall be installed for each buried valve. Boxes shall be centered over valve operating nut and shall be adjusted to finished ground elevation, unless otherwise directed by the Director of Engineering.
3. Bacteriological Testing
- a. After flushing has been completed, and the residual chlorine content of the water line being tested is no greater than the residual chlorine content of the source (> 2.0 ppm combined residual chlorine), upon notification by the Director of Engineering, the Laboratory personnel shall conduct bacteriological contamination tests.
  - b. Test samples to determine bacteriological contamination shall be taken only from 3/4 inch services installed directly on the water main. These sampling points shall be provided by the Contractor.
  - c. Test Samples shall be taken by Laboratory personnel every twenty-four (24) hours for two (2) consecutive business days following flushing and disinfection.
  - d. The results of each bacteriological contamination test shall be made available to the Director of Engineering thirty (30) hours after taking the bacteriological sample.
  - e. If positive results are obtained on any test, the Director of Engineering shall instruct the Contractor as to additional flushing and testing. If the Director of Engineering determines that flushing and retesting is not sufficient to achieve negative bacteriological test results, then he shall direct the Contractor to rechlorinate the water mains until negative test results are obtained.
  - f. Upon obtaining negative test results for two consecutive samples, written notice of the negative bacteriological contamination testing shall be given by the Laboratory to the Water Plant Superintendent, who, in turn, shall give written approval of the water mains tested to the Director of Engineering or his representative. The Director of Engineering shall then give written certification to the Contractor that the water mains may be placed into service. No water mains shall be placed into service until written approval based on satisfactory bacteriological test results is issued by the City of Rocky Mount Water Plant Superintendent, and until written certification is issued by the Director of Engineering stating that the water mains have been installed in accordance with the Drawing and Specifications.

#### 05. MEASUREMENT AND PAYMENT

- A. Work associated with pressure testing and disinfection of water mains shall be considered incidental to the work performed during installation of water mains described within Section 15 11 13.

## 15 30 00 SANITARY SEWERAGE UTILITIES

### 15 31 00 SANITARY UTILITY SEWERAGE PIPING

#### 15 31 13 PUBLIC SANITARY SEWER GRAVITY MAINS

##### A. Description

1. The work in this Section covers the requirements for furnishing and installing all piping required to complete the sanitary sewer collection system(s) as shown on the drawings, as described in these specifications, and as directed by the Director of Engineering. Wastewater Utility Pump Stations are specified within Section 15 32 16. Sanitary Sewer Force Mains are specified within Section 15 34 00.

##### 02. QUALITY ASSURANCE

1. The Contractor shall use sufficient workmen and competent supervisors in the execution of this portion of the work to ensure adequate and proper installation throughout.
2. The pipe class numbers or pressure ratings shall be clearly shown on the pipe.
3. Contractor shall follow the procedures and recommendations contained in the UNI-Bell Plastic Pipe Association "Handbook of PVC Pipe," for receiving, storing, and handling of pipe, fittings, joint lubricant and other items necessary to construct the pipeline. Contractor shall also follow the procedures recommended by the pipe manufacturer.
4. Storage: Store pipe, fittings, valves and appurtenances off the ground using sound wood blocks, placed on stable foundation or using other appropriate means. Allow space between rows, individual pieces and bundles with clearance below and above to allow full view for inspection purposes.
  - a. Store in well-drained area away from brush and accessible for inspection.
  - b. Do not stack pipe higher than 54 inches; packages shall be supported by racks to prevent damage to the underside of the pipe
  - c. Keep spigot ends of pipe clean and clear for dimensioning purposes
  - d. Do not place excavated or other material over or against stored material.
  - e. PVC pipe shall be stored so that it does not deform or bend. Pipe stored outdoors or otherwise exposed to direct sunlight shall be covered with canvas or other opaque material with provision for adequate air circulation.
5. Handling: Unload and handle materials with crane, backhoe, or equipment of adequate capacity, equipped with appropriate slings or padding to protect materials from damage.
6. Workmanship: Pipe and fittings shall be homogenous throughout and free from visible cracks, holes, foreign inclusions or other injurious defects. Pipe and fittings shall be as uniform as commercially practical in color, opacity, density and other physical properties.
7. Non C900 or C905 PVC pipe shall conform to the ASTM standards and testing requirements:
  - a. Pipe Flattening: ASTM D3034
  - b. Impact Resistance: ASTM D2444
  - c. Pipe Stiffness: ASTM D2412
  - d. Extrusion Quality: ASTM D2152

##### B. Submittal

1. Prior to the installation of any pipe, the Contractor shall submit and receive the Director of Engineering's approval of shop drawings and/or manufacturer's material certification of compliance with specifications.
2. Submittals shall be in five (5) copies and shall be provided to the Director of Engineering at least 15 days prior to the planned installation time.

### 03. PRODUCTS

#### A. Allowable materials on this project are as follows:

1. Solid Wall Polyvinyl Chloride Pipe (PVC) 4 inch to 15 inch
  - a. Allowable standard dimension ratios (SDR) and ASTM Designations shall be determined as follows for all gravity sewer mains and services:
    - i. For excavation depths of zero (0) to eight (8) feet the SDR shall not exceed thirty-five (35) and the pipe shall conform to the requirements of ASTM D3034.
    - ii. For excavation depths of eight (8) to eighteen (18) feet the SDR shall not exceed twenty-six (26) and shall conform to the requirements of ASTM D3034.
    - iii. For excavation depths greater than eighteen (18) but less than twenty two (22) feet the SDR shall not exceed twenty-one (21) and shall conform the requirements of ASTM D2241 or conform with AWWA C900 with a Diameter Ratio (DR) not to exceed eighteen (18).
    - iv. PVC sewer pipe shall not be laid in depths greater than twenty-two (22) feet.
2. Solid Wall Polyvinyl Chloride Pipe (PVC) 18 inch to 24 inch
  - a. Allowable standard dimension ratios (SDR) and ASTM Designations shall be determined as follows:
    - i. For excavation depths of zero (0) to eight (8) feet the SDR shall not exceed thirty-five (35) and the pipe shall conform to the requirements of ASTM F679.
    - ii. For excavation depths of eight (8) to eighteen (18) feet the SDR shall not exceed twenty-six (26) and shall conform to the requirements of ASTM F679.
    - iii. For excavation depths greater than eighteen (18) but less than twenty two (22) feet the conform with AWWA C905 with a Diameter Ratio (DR) not to exceed eighteen (18).
    - iv. PVC sewer pipe shall not be laid in depths greater than twenty-two (22) feet.
3. Profile Wall Polyvinyl Chloride Pipe (PVC) 8 inch to 24 inch
  - a. Profile Wall pipe is allowable for excavation depths not to exceed eight (8) feet and shall be in accordance with either ASTM 749, ASTM 949 or ASTM F1803.
4. Pipe Joints
  - a. Pipe joints shall meet the requirements or exceed the requirements of ASTM D3212 or D3139 and shall be "push-on" type using elastomeric gaskets in accordance with ASTM F477.
    - i. Pipe shall be joined by means of an integral bell formed with a race design to accept the gasket in accordance with ASTM 3212.
    - ii. When assembled, the gasket shall be compressed radially on the pipe spigot so as to affect a positive seal under all combinations of joint tolerances and shall be the only element depended upon to make the joints flexible and watertight.
    - iii. PVC main connection to DIP mains shall be made with a Mechanical Joint Solid Sleeve with transitional gasket to connect DIP to PVC.
5. Ductile Iron (DI) Pipe (Mechanical or Push on Joints, standard application)
  - a. Pipe shall be manufactured in accordance with AWWA C150 and C151 and shall be a minimum Pressure Class of 350 and Thickness Class 50, except as noted on the plans.
    - i. Pipe joints: Pipe shall be either the "push-on" or "mechanical joint" in accordance with AWWA C111 unless otherwise shown on the plans and specified herein
    - ii. Coatings: Ductile iron pipe shall be bituminous coated outside and cement mortar lined in accordance with ANSI/AWWA Standard C104/A 21.4.
    - iii. Pipe lengths: 18 to 20 feet

- iv. Ductile iron pipe used within encasements and in aerial lines, shall be furnished with mechanical joints according to ANSI/AWWA C151/A 21.51.

6. Connection Appurtenances

- a. Connections of 6" and larger shall be made by way of a Doghouse Manhole built over existing sewer main per the Standard Details.
- b. For connecting new service laterals to new sewer mains:
  - i. Laterals shall be wye branches of the same material of the pipe.
  - ii. Plugs for stub outs shall be of the same material as the pipe and with the same gasket material as the pipe joint. The plug shall be secured to withstand test pressures specified hereinafter.
- c. Saddles: For connecting sewer house connections to existing sewer mains 6" to 15"
  - i. Saddles shall be wye connections unless approved by the Director of Engineering.
  - ii. For PVC main, contractor shall follow manufacturer's recommendation
  - iii. Fernco Flexible Tap with stainless steel bands, or approved equal, is approved for connecting to asbestos cement, vitrified clay, concrete, cast iron or ductile iron pipe.
- d. For point repairs, contractor shall use Fernco Joint Sealer Co. with shear ring
- e. For connecting pipes to sewer manholes, see Section 15 39 13

04. EXECUTION

A. Preparation

- 1. Contact appropriate utility locating agency(ies) prior to any earthwork
- 2. Dig test pit to determine size, type, composition and exact location of existing pipe to which the proposed pipe network will connect.
- 3. Excavate sufficient trench in advance and test pit all existing underground utilities or structures, whether shown on the drawings or visually identified in the field, to:
  - a. Field verify actual locations
  - b. Make reasonable adjustments to line and grade to avoid conflict, with Director of Engineering's approval.
  - c. Furnish Director of Engineering with location and elevation information when previously unknown or previously unidentified underground utilities and/or structures are encountered.
  - d. There will be no compensation for additional work performed because the above mentioned precautions were not taken.

B. Relation of Water Mains to Sewers

- 1. Lateral Separation of Sewers and Water Mains - Sewer mains shall be laid at least 10 feet laterally from existing or proposed water mains, unless local conditions or barriers prevent a 10-foot lateral separation, in which case:
  - a. The water main is laid in a separate trench, with the elevation of the bottom of the water main at least 18 inches above the top of the sewer; or
  - b. The water main is laid 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.
- 2. Crossing a Sewer Main Under a Water Main - Whenever it is necessary for a sewer main to cross under a water main, the sewer main shall be laid at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer. If local conditions or barriers prevent an 18-inch vertical separation, both the water main and sewer main shall be constructed of ferrous materials with joints that are equivalent to water main standards for a distance of 10 feet on each side of the point of crossing.
- 3. Crossing a Sewer Main Over a Water Main - Whenever it is necessary for a sewer main to cross over a water main, both the water main and the sewer main shall be constructed of ferrous materials with joints

equivalent to water main standards for a distance of ten (10) feet on each side of the point of crossing. A section of sewer main pipe shall be centered at the point of crossing.

4. Where it is impossible to maintain a minimum of ten (10) feet of horizontal clearance between the water and sewer installations, a vertical separation of eighteen (18) inches (water main above sewer) must be maintained.

### C. Trench Excavation

#### 1. General

- a. Open no more trench in advance of pipe laying than is necessary to expedite the work.
  - i. Excavate trenches to a width that will provide adequate working space, but not more than maximum design width so as not to undercut trench walls.
  - ii. Excavate bell holes at each joint to provide full-length barrel support of the pipe and to prevent point loading at the bells or couplings.
  - iii. Unless trench banks above the top of the pipe are cut back on a stable slope, sheet and brace trenches as necessary to prevent caving and sliding, to provide protection for workmen and the pipe, and to protect adjacent structures and facilities. Do not remove trench sheeting unless the pipe strength is sufficient to support the external loads. The width of the trench at any point below the top of the pipe should not be greater than that necessary to provide adequate room for joining the pipe and compacting the haunching and initial backfill.
  - iv. During the course of construction, should the trench be over-excavated below a point 6 inches below the bottom of the pipe, contractor shall fill that area of over-excavation with an acceptable class of bedding material and compact to a minimum of 90 percent.
- b. Where trench construction conditions require the use of a trench box, the trench box shall be sufficient length to extend four (4) feet beyond both ends of one (1) joint of pipe in order to allow the workmen to make-up the pipe joint inside the protection of the trench box. The workmen required to work inside the trench shall:
  - i. Enter and leave the trench box from the ground surface only
  - ii. Not travel along the trench bottom outside the protection of the trench box
- c. The trench box shall conform to current OSHA regulations and shall have been designed by a Registered Professional Engineer. The Contractor shall furnish proof of such design to the Director of Engineering upon request.

#### 2. Trench Width

- a. Trench width at the ground surface may vary and will depend upon depth, type of soils, positions of surface structures, or other conditions authorized by the engineers.
- b. The maximum clear width of the trench excluding sheeting shall not exceed the outside diameter of the pipe plus one foot (1') on each side at the top of the area of initial backfill and one foot (1') above the outside top of pipe. The minimum width of the trench at the top of the pipe when placed shall be a width that will permit the proper construction of joints and compaction of backfill around the pipe, but shall be at least equal to the largest outside diameter of the pipe plus eight inches (8") on each side of the pipe. The sides of the trenches shall be vertical unless otherwise approved by the Director of Engineering. In no case shall the vertical walls project less than two inches (2") above the top of the pipe line laid to a grade unless the finished grade fill depth is less than two feet (2'). The maximum allowable width of trench on each side of the pipe shall not exceed twelve inches (12") for pipe which is twelve inches (12") in diameter or smaller; eighteen inches (18") for pipe which is between fourteen inches (14") and thirty-six inches (36") in diameter; and twenty-four inches (24") for pipe diameters greater than thirty-six inches (36"), unless otherwise approved by the Director of Engineering.

#### 3. Parallel Roadway Trenches

- a. Where utility installation is to take place upon the shoulder of any paved street or highway, contractor shall excavate the trench to a width that will provide adequate working space but in no case shall the hard surfaced, traveled portion of the roadway be damaged. Where the structural integrity of the roadway pavement is jeopardized, proper sheeting and bracing shall be installed to

provide adequate protection of adjacent roadway and structures and to afford the necessary protection to the workmen and pipe.

- b. Excavation material shall not be stored on the pavement if it can be reasonably handled otherwise. In cases where storing of excavated material on pavement is absolutely necessary, same shall be moved as quickly as practical and the pavement shall be thoroughly cleaned.
- c. 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.
- d. Drainage facilities that are inadvertently damaged must be repaired or replaced immediately.
- e. Parallel open trench installations that involve possible damage in event of precipitation or other weather events, or which may be hazardous to traffic, shall be closed without undue delay. In no case shall a trench remain open longer than twenty-four (24) hours, except with approval of the Director of Engineering.

#### 4. Trenching Within Pavement

- a. Where it is necessary to open-cut asphalt or concrete pavements, surface cuts shall be made with a concrete saw with a maximum width of ten (10) feet.
- b. Where excessive depths of pipe installations are encountered and the structural integrity of the roadway surface and/or the safety of the workmen is in doubt, proper sheeting and bracing of the trench shall be required.
- c. Handling and placement of the excavated material within this area shall be handled as in Paragraph 3.03 C.
- d. All excess excavated material shall be removed and disposed of outside the limits of the right-of-way in such a manner as not to interfere with the drainage of highways unless otherwise permitted or directed by the Director Engineering or his representative.
- e. Compaction test(s) for open-cut crossings may be required at the discretion of the engineer in addition to any supplemental or more stringent testing requirements specified in the approved North Carolina Department of Transportation Encroachment Agreement. All geotechnical testing required as specified above to meet the compaction requirements within Section 15 05 01 shall be the responsibility of the Contractor, the cost of which shall be included in the price bid for asphalt roadway (remove & replace).

#### D. Rock Excavation

- 1. Rock excavation methods and payment shall be in accordance with Section 15 05 02.

#### E. Preparation of Pipe Foundation

##### 1. General

- a. The pipe foundation shall be true to line and grade and uniformly firm. Where bell and spigot type pipe is used, recesses shall be excavated to receive the pipe bells.

##### 2. Unsuitable Foundation Material

- a. Where the foundation material is found to be of poor supporting value or of rock, the Director of Engineering may make minor adjustments in the location of the pipe to provide a more suitable foundation.
- b. Where this is not practical, the Contractor shall act upon the directions of the Engineer to stabilize the trench bottom by undercutting and installing: (a) soil stabilization woven fabric; and (b) NCDOT Class VI Stone (clean #57) or (c) approved select or borrow material and compacting to a minimum density of ninety (90%) as directed by the Director of Engineering. Compensation for the undercut will be included in the cost of the foundation material furnished. Approved bedding and backfill material is further specified within Section 15 05 01.

##### 3. Placement of Bedding Material

- a. Stone bedding shall be placed beneath all gravity sewers six inches ( 6") in diameter or larger. Bedding shall be a minimum of four inches (4") deep beneath the pipe, and shall be along the sides of the pipe at least up to the springline, unless shown otherwise in the pipe specifications or plans. Bedding width shall be at least the width of the pipe outside diameter (O.D.) plus twenty-four inches (24"). This stone bedding shall not be a separate pay item, but will be included in the unit

price bid for Sanitary Sewer Pipe. (Stone required by the Director of Engineering beneath this sewer bedding will be paid for a unit price bid in accordance with Section 15 05 01.)

- b. In order to ensure that adequate and uniform support is provided along the entire length of pipe, the Contractor shall carefully bring the bedding material to grade along the entire length of pipe prior to installation. Material used for the formation of the pipe bedding and haunch shall be carefully placed by hand shoveling to ensure that sufficient material has been worked under the pipe to form the haunch and to ensure that the pipe does not become dislodged during backfilling. Contractor's workmen shall fill evenly on both sides of the pipe to the centerline and shall compact the fill using hand shoveling or mechanical tamps. Extreme care shall be taken when using mechanical tamps adjacent to the pipe, removing sheeting, and removing trench boxes so as to avoid disturbing the pipe.

F. Laying Pipe

1. Inspection

- a. After delivery alongside the trench, all pipeline material shall be carefully examined for both soundness and specifications compliance.

2. Installation of Pipe

- a. Installed sewer pipe shall be checked for tolerance to proper line and grade from manhole to manhole as soon as the sewer pipe has been installed and prior to the installation of the next run of pipe. Any tolerance error shall not be cumulative beyond the run of a specific sewer line from manhole to manhole. The invert elevation of the influent pipe of the upstream manhole shall always be taken as the beginning elevation for the next run of sewer pipe to be installed. If the grade tolerance error for the previous run of sewer line from manhole to manhole exceeds the allowable drop in the upstream manhole as shown on the Drawings, then this condition defines an unacceptable sewer line installation and will be re-installed at the Contractor's expense.
- b. Sanitary sewer mains shall be installed in accordance with the minimum grades shown on the approved Drawings but at no time shall mains be installed with grades flatter than the minimum grades mandated by the North Carolina Administrative Code as shown below:

Diameter of Pipe (inches)	Minimum Slope (feet per 100 feet)
6	0.60
8	0.40
10	0.28
12	0.22
14	0.17
15	0.15
16	0.14
18	0.12
21	0.10
24	0.08
27	0.07
30	0.06
36 & Larger	0.05

- c. Clean joint contact surfaces immediately prior to jointing. Use lubricants, primers, or adhesives as recommended by the pipe or joint manufacturer. All pipe shall be laid on the prepared foundation, bell end up grade with each joint being checked for proper alignment and grade as the work proceeds. Excavate bell holes for each pipe joint. When jointed in the trench, the pipe shall form a true and smooth line. Whenever practicable, start pipe laying at the lowest point.
- d. Four (4) feet minimum cover shall be provided for all PVC sewer pipes. Where the cover is less than four feet (4') the Director of Engineering shall direct the Contractor as to the most acceptable condition; i.e. installation of ductile iron pipe or mounding over the PVC.

3. Steep Slope Protection
    - a. Sewers on twenty percent (20%) slopes or greater shall be anchored securely with concrete, or approved equal, with the anchors spaced as follows:
      - i. Not greater than thirty-six (36) feet center to center on grades 21% to 35%; and
      - ii. Not greater than twenty-four (24) feet center to center on grades 35% to 50%; and
      - iii. Not greater than sixteen (16) feet center to center on grades 50% and over.
  4. Cutting and Beveling PVC Pipe
    - a. For shorter than standard pipe lengths, field cuts may be made using special pipe cutters for PVC pipe. Pipe ends shall be cut square and perpendicular to the pipe centerline axis. Spigots shall have burrs removed and ends smoothly beveled by a mechanical beveler tool or by hand with a rasp or file. Field spigots shall be stop-marked with a felt tip marker or wax crayon for the proper length of assembly insertion. The angle and depth of field bevels and length to stop-mark shall be comparable to factory pipe spigots.
  5. Dewatering
    - a. Keep trenching dry during pipe laying. Divert surface water from the trench area to the greatest extent practicable without causing damage to the adjacent property. Before pipe laying is started, remove all water that may have entered the trench and continue to dewater the trench by the most expedient method.
- G. Manhole Installation
1. Manholes are to be furnished and installed per Section 15 31 19.
- H. Backfilling
- a. After the bedding has been prepared and the pipe installed, selected material from excavation or borrow, at a moisture content which will facilitate compaction, shall be placed alongside the pipe in layers not exceeding 6 inches (6") in depth. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe. Each layer shall be thoroughly compacted by rolling and tamping with mechanical rammers, or by hand tamping with heavy iron tampers. The tamping face area shall not exceed 25 square inches. The method of filling and compacting shall be continued until the fill has reached an elevation 12 inches (12") above the top of the pipe. The remainder of the trench shall be backfilled and thoroughly compacted in layers not exceeding 12 inches (12").
  - b. Care shall be taken during backfill and compaction operations to maintain alignment and prevent damage to the joints. The backfill shall be kept free from stone, frozen lumps, chunks of highly plastic clay, or other objectionable material.
  - c. All local backfill materials shall be compacted at a moisture content satisfactory to the Director of Engineering, which shall be approximately that required to produce the maximum density. The contractor shall dry or add moisture to the local material when required to provide a uniformly compacted and stable embankment.
  - d. When other than local material is used for backfilling above the foundation, such material will be classified as select backfill material as specified in Section 15 05 01 of these specifications. Use of this select backfill material shall be only when directed by the Director of Engineering or his representative.
  - e. Backfill over and around the pipe and backfill around and adjacent to all drainage structure shall be compacted to a minimum density of 80 percent as determined by the AASHO Standard Method T-99, except the backfill under pavements and adjacent areas within 4 to 10 feet of the proposed pavement shall be compacted to a minimum density of 100%.
  - f. Tests for density of compaction may be made at the option of the Director of Engineering, and deficiencies shall be corrected by the Contractor without additional cost to the Owner. The operation of heavy equipment shall be conducted so that no damage to the pipe shall result.
  - g. Heavy equipment shall not be operated over any pipe until it has been properly backfilled and has a minimum cover of three (3) feet, unless approved otherwise by the Director of Engineering.

- I. Aerial Crossings
  - 1. Aerial pipe crossings, including steel casing pipe and pier construction, shall be in accordance with the Plans and shall be compensated as per the Bid Schedule.
- J. Sewer Service Connections
  - 1. Connection to new sewer main shall be done as follows:
    - a. Tie into new wye fitting at main and run service at 2 percent minimum grade. If 2 percent cannot be obtained, remand to engineer for resolution.
    - b. Service line material shall be SDR 26 PVC or ductile iron and bedded, backfilled and compacted in accordance as specified for mains hereinabove.
    - c. Place cleanout at the property line or as depicted on the plans or as directed by the Director of Engineering. Cleanouts shall be in accordance with the Standard Details and shall be flush to grade. In non traffic areas, a plastic, watertight cap may be installed. For traffic areas, riser section of cleanout shall be protected by cast iron sleeve for the final 18" and a brass plug cap
  - 2. Connection to existing sewer main shall be done as follows:
    - a. Tap existing sewer main with motor driven tapping machine utilizing the appropriate drill bit.
- K. Testing
  - 1. Testing and television inspection of new sewer mains shall be in accordance with Section 15 31 16.
- L. Abandonment of Sewer Mains and/or Services
  - 1. For abandonment of sewer mains, install approved plug or cap at each location where pipe was cut or valve removed. Contractor also has the option of filling severed abandoned pipe with flowable fill.
  - 2. For abandonment of house connections:
    - a. If the service is to be abandoned at the sewer main and the connection to the sewer main is with a tee, wye or saddle, remove house service and install a watertight plug at the cleanout, along the service line, or as shown on the drawings.
    - b. If the service is to be abandoned at the sewer main and connection to the main is with a thimble, remove the thimble and perform mainline point repair.

05. MEASUREMENT AND PAYMENT

- A. Public Sanitary Sewer Gravity Mains
  - 1. Measurement: By linear foot of various sizes and types provided at the measured depth. The installed pipe shall be measured horizontally along the centerline of the installed pipe from manhole to manhole as part of the completed and accepted work. Depth shall be measured from the invert of the pipe to the top of the ditch bank along the completed and accepted alignment.
  - 2. Payment: At the unit price for each size and type of pipe installed at the measured depth as listed in the Bid Schedule. Payment includes work for location of utilities, excavation, trenching, backfilling, removal and replacement of driveway pipes, guardrails and other obstructions, connecting to new and existing mains, abandonment of mains and services, installation of stone bedding, and pressure and mandrel testing of mains.
- B. Sewer Services
  - 1. Measurement: By linear foot of various sizes and types provided, measured horizontally along the centerline of the installed service from the centerline of the main to the property line (or directed location) as part of the completed and accepted work.
  - 2. Payment: At the unit price for each size and type of fitting installed as listed in the Bid Schedule as part of the completed and accepted work. Payment includes work for location of utilities, excavation, trenching, backfilling, removal and replacement of driveway pipes, guardrails and other obstructions, connecting to new and existing mains, furnishing and installation of fittings, installation of cleanouts and associated plugs and fittings, and pressure testing and deflection testing of mains.

C. Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
___ inch _____ Sewer Pipe, ___ - ___ feet	LF
4 inch Short-Side Sewer Service (Open-Cut)	LF
4 inch Long-Side Sewer Service (Bore)	LF
___ Inch _____ Encasement Pipe	LF

15 31 16 TESTING OF SANITARY SEWER GRAVITY MAINS

01. DESCRIPTION

- A. The work in this Section covers the requirements for conducting pressure testing and deflection testing for all new sanitary sewer gravity mains. Testing for Sanitary Sewer Manholes is specified with Section 15 31 19. Testing for Sanitary Sewer Force Mains is specified within Section 15 34 00.

02. QUALITY ASSURANCE

- A. The Contractor shall use sufficient workmen and competent supervisors in the execution of this portion of the work to ensure adequate and proper testing.
- B. Testing shall be in segments from manhole to manhole and all stubs-outs and/or service laterals for future connection shall be included in testing.
- C. Copies of all certified reports and logs of all tests and inspections conducted shall be submitted to the Director of Engineering.

03. PRODUCTS

- A. Low Pressure Air Testing Materials
1. The contractor shall provide all materials, labor, equipment, tools, etc. to perform all work and services necessary for and incidental to a complete low pressure air test of the sanitary sewer gravity system.
    - a. Pressure Gauge
      - i. Pressure gauge shall have a four inch (4") minimum diameter face with maximum gradation increments of .10 psi.
    - b. By-Pass Pump
      - i. Pump or pressurizing equipment shall have a pressure relief valve or regulator to avoid damaging the lines.
      - ii. The Contractor shall provide all temporary plugs and blocking as necessary for administering the required testing

B. Deflection Test Materials

1. The Contractor shall provide all materials, labor, equipment, tools etc to perform all work and services necessary for and incidental to a complete Deflection Test. Final long term deflection shall not exceed five percent (5%).

a. Mandrel

i. The mandrel (go/no-go) device shall be cylindrical in shape and constructed with nine (9) or ten (10) evenly spaced arms or prongs. Mandrels with fewer arms (in odd or even numbers) will be rejected as insufficiently accurate. The contact length "L" of the mandrel's arms and the actual mandrel diameter "D" (ID of the proving ring) shall equal the dimensions in Table 1. Critical mandrel dimensions shall carry a tolerance of  $\pm 0.01$  inch. Larger mandrel dimensions shall be provided by the Director of Engineering.

TABLE 15 31 13.03			
NOMINAL DIAMETER	L	ASTM D3034 SDR 35	
		5 %	7.5 %
8"	8"	7.52"	7.33"
10"	10"	9.41"	9.16"
12"	10"	11.19"	10.90"
15"	12"	13.70"	13.34"

ii. The Director of Engineering shall be responsible for approving the mandrel. Proving rings may be used to assist in this. Drawings of the mandrel with complete dimensions shall be furnished by the Contractor to the engineer for each diameter and specification of pipe.

C. Television Inspection

1. The City will perform a television inspection to verify accuracy of alignment, freedom from debris or obstruction, displacement of gaskets or joints and leaks at joint and manhole connections. Any of the above discrepancies observed shall be corrected by the Contractor at no additional cost to the City.
2. The cost of the initial television inspection and the first reinspection to confirm correction of previously identified deficiencies will be borne by the City. In the event additional television inspections are necessary due to inadequate or otherwise unacceptable repairs, the costs for such inspection shall be charged to the Contractor.

04. EXECUTION

A. Pre -Testing

1. General

a. Gravity mains will be checked by the Director of Engineering to determine whether any displacement, cracking, deflection, or any other damage to the pipe has occurred after the trench has been filled to two feet (2') above the pipe and tamped as specified and upon completion of the project. The test will be a physical inspection of each joint for pipe of forty-eight inch (48") in diameter and larger or, for pipes smaller than forty-eight inch (48") in diameter, by light flashed between manholes, or, if the manholes have not as yet been constructed, between the locations of the manholes by means of a flashlight or by reflecting sunlight with a mirror. If the interior or exterior of the pipe shows any misaligned pipe, displaced pipe, concrete pipe with cracks greater than 0.01", deflections greater than five percent (5%) for steel and plastic sewer pipe, or any other defects, the defects designated by the Director of Engineering shall be remedied by the Contractor at his expense.

- b. Prior to other tests, all sewer outfall lines shall be cleaned by flushing, pigging, or flushing with an appropriately sized sewer cleaning ball. In some cases, cleaning by high velocity jet or other method may be necessary.
  - c. All low pressure tests and deflection tests shall be witnessed by the Director of Engineering or his representative.
2. Low Pressure Air Test
- a. The Contractor shall flush and clean the sewer line prior to testing. Plug all pipe outlets sufficiently to resist the test pressure.
  - b. During construction, all manhole connections for future laterals shall be properly capped or plugged to avoid loss of test pressure.
  - c. Determine the test duration for the section under test by computations from the applicable equations as per ASTM C828 for ductile iron pipe and reinforced concrete pipe, or as per UNI-B-6 for PVC corrugated pipe and PVC solid-wall pipe. (See Table 1 or 2)
  - d. Determine groundwater elevation and head above the section of line to be tested. Adjust test pressure for groundwater by adding 0.43 psig per foot of groundwater head above pipe invert (each foot of groundwater divided by 2.31 is equivalent to 0.43 psig.) At no time shall the starting test pressure exceed 9.0 psig.
  - e. The pressure holding time is based on an average holding pressure of 3 psig or a drop from 3.5 to 2.5 psig.

**TABLE 1**  
**AIR TEST TABLE**  
**FOR DUCTILE IRON PIPE, VITRIFIED CLAY PIPE, AND CONCRETE PIPE**  
 (Based on Equations from ASTM C828)

Specification time (min:sec) required for pressure drop from 3½ to 2½ psig when testing one pipe diameter only

Line Length (ft)	Pipe Diameter Nominal Size (in)								
	4	6	8	10	12	15	18	21	24
25	0:04	0:10	0:18	0:28	0:40	1:02	1:29	2:01	2:38
50	0:09	0:20	0:35	0:55	1:19	2:04	2:58	4:03	5:17
75	0:13	0:30	0:53	1:23	1:59	3:06	4:27	6:04	7:55
100	0:18	0:40	1:10	1:50	2:38	4:08	5:56	8:05	10:34
125	0:22	0:50	1:28	2:18	3:18	5:09	7:26	9:55	11:20
150	0:26	0:59	1:46	2:45	3:58	6:11	8:30	9:55	11:20
175	0:31	1:09	2:03	3:13	4:37	7:05	8:30	9:55	11:20
200	0:35	1:19	2:21	3:40	5:17	7:05	8:30	9:55	12:06
225	0:40	1:29	2:38	4:08	5:40	7:05	8:30	10:25	13:36
250	0:44	1:39	2:56	4:35	5:40	7:05	8:31	11:35	15:07
275	0:48	1:49	3:14	4:43	5:40	7:05	9:21	12:44	16:38
300	0:53	1:59	3:31	4:43	5:40	7:05	10:12	13:53	18:09
350	1:02	2:19	3:47	4:43	5:40	8:16	11:54	16:12	21:10
400	1:10	2:38	3:47	4:43	6:03	9:27	13:36	18:31	24:12
450	1:19	2:50	3:47	4:43	6:48	10:38	15:19	20:50	27:13
500	1:28	2:50	3:47	5:14	7:34	11:49	17:01	23:09	30:14

**TABLE 2  
AIR TEST TABLE  
FOR CORRUGATED AND SOLID-WALL POLYVINYL CHLORIDE PIPE**  
(Based on Uni-Bell's Recommended Practice)

Specification time (min:sec) required for pressure drop of 1 psig for size and length of pipe indicated for q=0.0015

Line Length (ft)	Pipe Diameter Nominal Size (in)						
	4	6	8	10	12	15	18
100	3:46	5:40	7:34	9:26	11:20	14:10	17:00
150	3:46	5:40	7:34	9:26	11:20	14:10	19:13
200	3:46	5:40	7:34	9:26	11:24	17:48	25:38
250	3:46	5:40	7:34	9:53	14:15	22:15	32:03
300	3:46	5:40	7:36	11:52	17:05	26:42	38:27
350	3:46	5:40	8:52	13:51	19:56	31:09	44:52
400	3:46	5:42	10:08	15:49	22:47	35:36	51:16
450	3:46	6:24	11:24	17:48	25:38	40:04	57:41
Time for Longer Lengths (Seconds per total length in feet)							
	0.380(L)	0.854(L)	1.520(L)	2.374(L)	3.418(L)	5.342(L)	7.692(L)

- f. The Contractor shall manipulate the air valves and gauges during the test in the presence of the Director of Engineering or his representative. Add air until the internal air pressure of the sewer line is raised to 4.0 psig. After an internal pressure of 4.0 psig is obtained in the pipe, allow time for the pressure to stabilize. The pressure will normally show some drop until temperature of the air in the test section of pipe stabilizes.
  - g. When the pressure has stabilized and is at or above the starting test pressure of 3.5 psig, commence the test.
  - h. Before starting the test, the internal pressure in the section of pipe being tested may be allowed to drop to 3.5 psig or the adjusted value due to groundwater head. Record the drop in pressure for the test period. If the pressure has dropped more than 1.0 psig during the test period, the line has failed and the Contractor shall not be paid for his work until the condition is corrected and the line does pass the test. The test may be discontinued when the prescribed test time has been completed even though the 1.0 psig drop has not occurred.
  - i. No one shall be allowed inside the manholes during testing.
3. Deflection Test with Mandrel
- a. The Contractor shall have a deflection test conducted no earlier than thirty days after reaching final trench backfill for all PVC pipe provided, in the opinion of the Director of Engineering, that sufficient water densification or rainfall has occurred to settle the soil thoroughly throughout the entire trench depth.
  - b. If this densification condition cannot be achieved in the time after installation of the pipe but prior to the project completion date, then the testing of pipe deflection or deformation shall be conducted using a mandrel for which the size has been increased to measure one-third (1/3) less of the deflection allowance. Under these testing conditions the entire length of the sewer outfall shall be tested by means of a rigid go/no-go mandrel to ensure that a pipe deflection or deformation of three and one-third (3-1/3%) percent or greater has not occurred.

- c. The go/no-go mandrel shall be hand pulled by the Contractor through the sewer outfall. No mechanical equipment such as winches or heavy machinery shall be used for pulling or pushing the mandrel through the sewer outfall.
- 4. Correction and Retesting
  - a. Any sections of sewer outfall that do not pass minimum test requirements for any of testing parameters enumerated hereinbefore shall be replaced and/or corrected prior to retesting when directed by the Director of Engineering.
  - b. No additional compensation shall be paid to the Contractor for correcting and retesting defective sewer outfall lines.

05. MEASUREMENT AND PAYMENT

A. Testing of Sanitary Sewer Gravity Mains

- 1. Work associated with Testing of Sanitary Sewer Gravity Mains shall be considered incidental to the work performed during installation of sewer mains described within Section 15 13 13.

15 31 19 SANITARY SEWER MANHOLES, FRAMES AND COVERS

01. DESCRIPTION

- A. The work in this Section covers the requirements for furnishing, installing, and testing of sanitary sewer manholes and appurtenances.

02. QUALITY ASSURANCE

- A. The Contractor shall use sufficient workmen and competent supervisors in the execution of this portion of the work to ensure adequate and proper installation throughout.
- B. Manholes shall comply with all pertinent codes and regulations, and with these specifications. Where the provisions of the codes and standards conflict with these specifications, the more stringent provisions shall apply
- C. Handling: Unload and handle materials with crane, backhoe, or equipment of adequate capacity, equipped with appropriate slings or padding to protect materials from damage.
- D. Workmanship: Manholes, frames and covers shall be free from visible cracks, holes, foreign inclusions or other injurious defects.

03. SUBMITTAL

- A. Before any materials covered in this section are delivered to the job site, the Contractor shall submit in five (5) copies, shop drawings for these items to the Director of Engineering for review and approval. Shop drawings shall include all manhole materials, precast manhole units, invert and critical elevations, steps, ring and cover units, gaskets and flexible manhole sleeves.

04. PRODUCTS

A. Precast Reinforced Concrete Manhole Sections

- 1. Design
  - a. Design of precast sections shall be in strict accordance with ASTM C 478 (latest) and H-20 loading standards.
  - b. Wall thicknesses shall be a minimum of five inches (5") for four foot (4') inside diameter manholes and six inches (6") for five foot (5') inside diameter manholes.

- c. Bases of all manholes shall have a minimum thickness of six inches (6") over an eight inch (8") stone base for leveling. Cast top sections shall have eccentric cones, unless shown otherwise on the drawings.
  - d. Risers and grade rings shall all be of one type.
  - e. Joints shall be formed with male and female ends and sealed with a flexible joint material meeting Federal Specifications SS-5-00210 "Sealing Compound, Preformed Plastic for Pipe Joints," Type I, rope form, or Type II, flat type.
  - f. Manholes for use on pipelines eighteen inches (18") and larger, over fifteen feet (15') deep (top rim to lowest point) and/or manholes with inside drops shall be 5'-0" in diameter. Either an approved reinforced concrete slab or pre-cast reducer section will be acceptable. The reinforced concrete slab shall have the following minimum design:
    - i. 1'-0" thick minimum (3,000 psi) plus the depth of the riser groove;
    - ii. Reinforced at the top with No. 4 bars at 12" on center each way;
    - iii. Reinforced at the bottom with No. 5 bars at 6" on center each way for manhole depths from 22' to 32', and No. 7 bars at 6" on center each way for manhole depths greater than 32'; and
    - iv. Bottom half of this slab shall have the equivalent of six (6) extra No. 6 bars as beam reinforcement around the opening for the 4' riser section.
  - g. In the case where total base to 4' riser section reductions greater than 2' are desired or necessary, a minimum of 36" of vertical riser section shall be used between successive reducers, unless otherwise approved. Four-foot base diameters shall not be reduced further except for placement of ring and cover. Both the tongue and groove of joints shall have reinforcing steel equal in area to that of the wall sections.
  - h. Except where restricted by shallow cuts or otherwise shown on the Contract Drawings, minimum heights for base sections (excluding poured base thickness) shall be as follows:
    - i. 46" for 4' diameter; and
    - ii. 48" for 5' diameter
  - i. The base section shall not have a monolithic pre-cast base slab. The pre-cast base riser section shall be placed in a reinforced concrete (3,000 psi) slab to a depth equal to the length of the groove of the riser section. The slab shall have a diameter or side of at least 1' greater than the manhole base section outside diameter. The slab shall be a minimum of 1'-0" thick plus the depth of the riser groove and shall be reinforced top and bottom with a minimum of No. 4 bars at 12" o.c. EWEF for 4' and 5' diameter sections.
2. Steps
- a. The pre-cast manholes shall have cast in place non-skid manhole steps of press set plastic or other approved material. Step irons shall be generally located at 90 degrees from the direction of flow on the vertical wall. The steps shall be set in the wall a maximum of 12" and/or 16" maximum on centers vertically as required by OSHA standards. All steps shall have a minimum vertical load resistance of 750 pounds with no permanent deflection and pullout resistance of 1,000 pounds. Steps shall be imbedded in the wall a minimum of 4" and project from the wall a minimum of 6" and shall be a minimum of 12" in width with lateral foot stops.
3. Flexible Manhole Sleeves
- a. Sleeves shall be used at each entry hole of all sewer manholes. The sleeve flange shall be integrally cast into the manhole wall forming a waterstop and the sleeve portion shall extend through the base at right angles to the wall into which the pipe is inserted.
  - b. Physical properties of the material for this sleeve are: (1) Minimum tensile strength - 1500 psi, (2) Elongation at rupture, min. - 450%, (3) Compression set, max. 25% ASTM D-396, Method B, and (4) Durometer 50 5, ASTM D 2240.
  - c. A stainless steel sealing clamp shall secure the sleeve to the pipe.

B. Manhole Frame and Cover

1. General

- a. The frames and covers shall be constructed of tough, gray cast iron and must meet the requirements of ASTM Specification A-48 latest revision, Class Thirty (30). The covers shall be machined, lie flat on the frame seat, and shall not rattle under the impact of traffic. Covers shall be solid with no holes. Frames and covers shall be thoroughly cleaned and then hot-dipped in asphaltum or coal-tar varnish. Frame and cover shall weigh not less than three hundred (300) lbs. Manhole covers for sanitary sewers shall indicate "Sanitary Sewer" on the cover. Sealed manhole covers shall be furnished with four (4) brass flat head machine screws at 90° and a single polyvinyl gasket between cover and frame seat.
- b. For standard applications, manhole frame and cover shall be manufactured by East Jordan Iron Works, Neenah Foundry or approved equal

2. Special Applications

- a. Manhole frames and covers that are below the required base flood elevation + two (2) feet shall be watertight. Rings/Frames shall be bolted down into the concrete manhole tops and have a minimum of three bolts and a gasket to sit the cover to the frame. Frame and Cover shall be the V-2384 Watertite Frame and Cover manufactured in the United States by East Jordan Iron Works, Inc. or approved equal.
- b. For manholes with rim elevation three feet (3') or more above grade, all castings shall be revolution type frames and covers manufactured in the United States of America by East Jordan Iron Works, Inc., or approved equal. The cover shall rotate horizontally away from the frame, allowing access to the manhole.

C. Vent Pipes

1. Vent pipes, when called for on the Contract Drawings or in the Proposal shall be made of 4-inch diameter, Schedule 40 steel pipe. They shall be furnished and installed with 3/8 inch mesh galvanized screen to cover outside opening.

D. Drop Manholes

1. Drops shall be constructed as shown on the Drawings and/or Standard Details at the location(s) where the invert elevation of a main entering a manhole is two feet (2') or more above the lowest invert of the manhole. Inside drops will not be allowed unless authorized by the engineer. Inside drops shall be RELINER, as manufactured by Duran, or approved equal.

05. EXECUTION

A. General

1. All outfall manholes shall be placed with a minimum of two (2) feet reveal from the top of rim to the existing surface grade with no more than four (4) feet of reveal. It is at the contractor's discretion for raising the manhole above the minimum required amount, though compensation will only be made for the first two feet. For any manholes within the flood hazard areas, they must be vented or raised to the base flood elevation (BFE) + two (2) feet as identified on the Construction Drawings.

B. Excavation and Backfill

1. Undercut below all manhole footings and/or precast bases to a depth not less than six (6) inches nor greater than twelve (12) inches. Backfill this area with stone bedding material as specified in Section 15 05 01 of these specifications.
2. Where concrete footings are to be poured, the area in which the concrete is to be placed must be kept dry until concrete has set-up.

C. Inverts

1. The invert channels shall be smooth and semi-circular in shape conforming to the inside of the adequate sewer section. Changes in direction of flow shall be made with a smooth curve of as large a radius as the size of the manhole will permit. Changes in size and grade of the channels shall be made gradually and evenly. The invert channels shall be formed directly in the concrete of the manhole base, or shall be built up with brick and mortar, or shall be half tile laid in concrete, or shall be constructed by laying full-section sewer pipe through the manhole and breaking out the top half after the surrounding concrete has cured. The floor of the manhole outside the channels shall be smooth and shall slope toward the channels not less than 1 inch per foot nor more than 2 inches per foot.

D. Walls

1. Mortar for jointing and plastering shall consist of one part portland cement and two parts fine sand. For brickwork, lime may be added to the mortar in the amount of not more than 25 percent of the volume of cement. The joints shall be completely filled and shall be smooth and free from surplus mortar on the inside of the manhole. Brick manholes shall be plastered with 1/2 inch of mortar over the entire outside surface of the walls. Brick shall be laid radially with every sixth course laid as a stretcher course.

E. Rings and Covers

1. The rings and covers shall be set so that the top of the cover will be flush with or higher than finish grade, as per the Plans or as directed by the Director of Engineering.
2. All manhole rings in roadways shall be encased in a concrete collar 18" x 6" of 3,000 psi concrete beneath the asphalt, with the cover flush with the top of the pavement.

F. Pipe to Manhole Connections (for new and existing manholes)

1. Cut pipe square before installation. Place so springline edges of pipe are flush with inside wall or extend a maximum of 2.5" in accordance with manufacturer's recommended installation procedures.
2. Where pipe is extended into manhole, coordinate slope of pipe and slope of notch in invert to ensure smooth transition.
3. Fit flexible gasket connector between pipe and manhole described herein except for the following connections:
  - a. Where the pipe enters manhole at slope greater than 10%
  - b. Where pipe enters the manhole at an angle
  - c. Where manhole is built over existing sewer pipe, except when existing sewer is PVC
  - d. When either DIP or RCP is connected to existing brick manhole
  - e. Parallel connection
4. Insert pipe following connector manufacturer's written recommendations.
  - a. Ensure that pipe is centered in connector, that full barrel portion of pipe is fully inserted, and that pipe is properly bedded immediately to the manhole.
  - b. When flexible gasket connector is not used for reasons stated above, use quick non-shrink grouted pipe to manhole connections and bentonite collar.
  - c. Keep excavation dry and wait a minimum of 2 hours before backfilling to permit grout to cure.
5. When AWWA C900 and C905 is to be grouted using solvent cement:
  - a. Apply solvent cement following manufacturer's instructions to entire exterior portion of pipe to be grouted into wall
  - b. Coat softened pipe exterior with concrete sand and allow pipe exterior to harden,.
  - c. Grout sand-coated pipe into wall.
6. New connections to existing manholes shall be made by core drilling through the walls. Flexible seals as described herein shall be used for the pipe penetration. Apply a protective epoxy coating to the cored concrete and the ends of any exposed reinforcement.

G. Backfilling

1. After the bedding has been prepared and the manhole installed, selected material from excavation or borrow, at a moisture content which will facilitate compaction, shall be placed alongside the manhole in layers not exceeding 6 inches (6") in depth. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe lines. Each layer shall be thoroughly compacted by rolling or tamping with mechanical rammers, or by hand tamping with heavy iron tampers, the tamping face area of which shall not exceed 25 square inches. The method of filling and compacting shall be continued until the fill has reached an elevation 12 inches (12") above the top of the pipes. The remainder of the trench shall be backfilled and thoroughly compacted in layers not exceeding 12 inches.
2. Care shall be taken during backfill and compaction operations to maintain alignment and prevent damage to the joints. The backfill shall be kept free from stones, frozen lumps, chunks of highly plastic clay, or other objectionable material.
3. All local backfill materials shall be compacted at a moisture content satisfactory to the Director of Engineering, which shall be approximately that required to produce the maximum density. The Contractor shall dry or add moisture to the local material when required to provide a uniformly compacted and stable embankment.
4. When other than local material is used for backfilling above the foundation, such material will be classified as select backfill material as specified in Section 15 05 01 of these specifications. Use of this select backfill material shall be only when directed by the Director of Engineering or his representative.

H. Manhole Sealing

1. All manholes shall be sealed with plastic cement putty meeting Federal Specifications SS-C-53. O-ring joints shall conform to the requirements of ASTM C443. A rubber water stop shall be supplied with the manholes to tie the pipe to the barrel section. These gaskets and clamps shall meet the requirements of ASTM C923.

I. Manhole Testing

1. All manholes shall be tested after assembly and prior to backfilling using a vacuum tester manufactured by P.A. Glazier or MMVT, Inc.. Tester shall be provided by the Contractor.
  - a. Procedure for Vacuum Test
    - i. All lift holes shall be plugged with a non-shrink grout. All pipes entering the manhole shall be plugged. All plugs must be braced to keep plug from being drawn into the manhole. The inside of the manhole shall be wetted down to visibly indicate areas of leakage (if any) after the test is performed. Test head shall be placed on or in the cone section and the seal inflated as per the manufacturer's specifications. A vacuum of 10 inches of mercury shall be drawn and the vacuum pump shut off. With the valve closed, the Contractor shall measure the time it takes for the vacuum to drop to 9 inches. The manhole shall pass if the time is greater than the values in the table below:

Manhole Depth	Manhole Diameter		
	48"	60"	72"
10' or less	60 Sec	75 Sec	90 Sec
10' – 15'	75 Sec	90 Sec	105 Sec
Over 15'	90 Sec	105 Sec	120 Sec

- ii. If the manhole fails, necessary repairs shall be made using a non-shrink grout while the vacuum is still being drawn. Retesting shall proceed until the manhole is acceptable.

06. MEASUREMENT AND PAYMENT

A. Sanitary Sewer Manholes

1. Measurement: By linear foot of height of various sizes, measured to the nearest tenth vertically from the inside bottom (invert) to the final finished top of the manhole ring (not to exceed two (2) feet above grade) as part of the completed and accepted work.
2. Payment: At unit price for each diameter size and depth of manhole installed as listed in the Bid Schedule as part of the completed and accepted work. Payment includes work for location of utilities, excavation, trenching, backfilling, removal and replacement of driveway pipes, guardrails, mailboxes, and other obstructions, connecting to pipes, base construction, incidental concrete and grout used for sealing and invert construction, bedding stone, furnishing and installing appropriate manhole frame and covers, and vacuum testing of manholes.

B. Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
___ Ft Diameter Precast Sewer Manhole, ___ Ft - ___ Ft	EA
___ Ft Diameter Precast Sewer Manhole, ___ Ft - ___ Ft (Drop)	EA
___ Ft Diameter Precast Sewer Manhole, ___ Ft - ___ Ft (Sealed)	EA
___ Ft Diameter Precast Sewer Manhole, ___ Ft - ___ Ft (Sealed & Vented)	EA