

<p style="text-align: center;">SECTION 450 UTILITY TRENCHES</p>
--

- 451 Excavation and Preparation**
 - A. Preparation**
 - B. Trenching**

- 452 Pipe Laying and Backfilling**
 - A. General Requirements**

- 453 Pavement Repairs**
 - A. Open Trench Pavement Repair**

- 454 Trenchless Pipe Installation**
 - A. Design**
 - B. Materials**
 - C. Installation**

- 455 External Corrosion Protection**

- 456 Rock Excavation**

451 Excavation and Preparation

A. Preparation

1. General Requirements

- a) Trenching for pipelines (water, gravity sewer, and force main), shall be excavated to the required depth to permit the installation of the pipe (inclusive of pipes and structures) along the lines and grades shown on the construction drawings.
- b) Prior to trenching for the construction of any utility mains or connections, the Contractor shall locate all existing utilities within the construction zone. This may include at a minimum contacting the North Carolina One Call Center at 811 or 1-800-632-4949. Where critical Town water and sewer utilities cannot be located by traditional means, specialized utility locating, such as vacuum excavation or ground penetrating radar (GPR) may be required to locate existing utilities before excavating.
- c) In all cases where trenchless methods are planned to cross an existing utility corridor with water, sewer, force main, and/or other Town maintained pipelines, an SUE (subsurface utility exploration) services firm shall be contracted to verify the depths of existing utilities prior to boring.
- d) The Contractor shall be responsible for implementing all required safety provisions for trenching in compliance with the Occupational Safety and Health Administration (OSHA) regulations and all other applicable safety requirements and procedures.
- e) Refer to Section 500 for all Stormwater installations.

B. Trenching

1. Trench Dimensions

- a) The minimum trench width at the top of the pipe shall be at least 16 inches greater than the outside diameter of the pipe, the maximum shall be 24 inches greater than the outside diameter. Rock shall be removed to a depth of at least 6 inches below the bottom of the pipe and the trench backfilled with suitable material.
- b) Open trenches shall not exceed 100-ft.
- c) All trenches shall be confined to the limits of the right-of-way or utility easement. Trenches in paved areas shall not be sloped.

- d) All trenches shall be properly backfilled at the end of each working day.

2. Trench Protection

- a) Wet gravity sewer trenches shall be stabilized with a base layer of #57 stone. The bottom of the trench shall be shaped to provide uniform support along the entire length of the pipeline. Severely unstable trench bottoms requiring undercut excavation shall receive a foundation support system for the pipeline designed by a registered Geotechnical Engineer licensed in the State of NC.
- b) A space shall be excavated at each bell to provide ample space to join the pipes with no misalignment.
- c) The Contractor shall take all necessary measures to prevent water from entering the trench.

3. Dewatering

- a) The ground adjacent to the excavation shall be graded to prevent surface water from entering the trench. The Contractor will, at his expense, remove by pumping or other means approved by the Town, any water accumulated in the trench and shall keep the trench dewatered until bedding and pipe laying are complete. When water is pumped from the trench, the discharge shall follow natural drainage channels. Proper erosion control measures shall be employed. Direct discharge into stream is not permissible.
- b) In gravity sewer trenches where water is present or where dewatering is required, the trench bottom shall be undercut and stabilized with No. 57 or No. 67 stone, having a minimum depth of 8-inches.

452 Pipe Laying and Backfilling

A. General Requirements

1. Embedment Material

- a) Bedding and embedment material classifications shall be defined as follows:
 - 1) CLASS I - Angular, (1/4 to 1-1/2 inch) graded stone, including a number of fill materials that have regional significance such

as coral, slag, cinders, crushed stone, crushed gravel, and crushed shells.

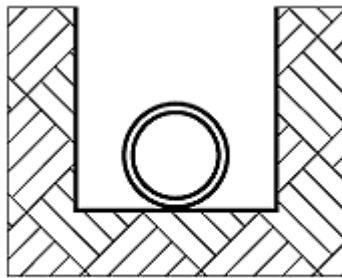
- 2) CLASS II - Coarse sands and gravels with maximum particle size of 1-1/2 inch, including variously graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry. Soil types GW, GP, SW and SP are included in this class.
 - 3) CLASS III - Fine sand and clayey gravels, including fine sands, sand-clay mixtures, and gravel-clay mixtures, Soil Types GM, GC, SM, and SC are included in this class.
 - 4) CLASS IV - Silt, silty clays, and clays, including inorganic clays and silts of medium to high plasticity and liquid limits. Soil Types MH, ML, CH and CL are included in this class. These materials shall not be used for embedment.
- b) Class I foundation material consisting of ¼-inch to 1½ -inch graded stone shall be required in addition to standard bedding and embedment for all sewer installations, regardless of pipe material, when the trench bottom is unstable due to water, rock, infiltration or soil type.
 - c) All bedding, embedment and backfill materials shall be compacted to a minimum of 95% Standard Proctor density regardless of material. In instances where compliance with compaction requirements is questionable as determined by the Town, testing shall be provided by the Contractor and a reputable licensed Geotechnical Engineer to verify compliance.
 - d) The minimum trench width shall be one pipe diameter plus 8 inches on each side of the pipe, with a maximum of 12 inches on each side of the pipe.
 - e) In any area where the pipe will be installed below existing or future ground water levels or where the trench could be subject to inundation, additional Class I material shall be used for bedding.
 - f) If hydraulic jack shoring is utilized for trench walls, it shall be restricted to the area just above the top of the pipe. This will ensure the embedment materials and pipe will not be disturbed when the shoring is removed.

2. Pipe Laying

- a) Open ends of pipe shall be plugged when pipe laying is not in progress to prevent trench water, soil, and debris from entering.
- b) All pipe shall be laid in accordance with the manufacturer's recommendations, all applicable Town Standards, Specifications and Details, and in accordance with construction drawings.
- c) Pipe laying shall be accomplished in a manner and with the required resources to provide a properly aligned and sealed pipeline and joints.
- d) Pipe deflection limits shall not be exceeded in accordance with manufacturer requirements.
- e) All gravity mains shall be installed beginning with the downhill section at the lowest elevation, and advanced upgrade to the terminus of the main. All bell ends shall be oriented facing the uphill direction.
- f) Laying conditions shall be defined as follows:

Type 1:

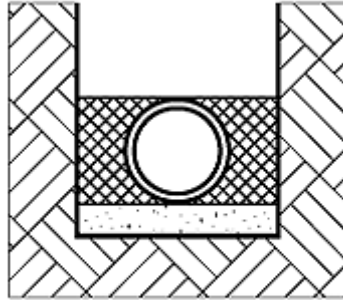
Flat Bottom Trench with Pipe Resting on Stable Undisturbed Earth. Unstable conditions such as wet trench bottoms, intermediate rock layering, partially weathered rock, and other unsuitable soil conditions shall require utilizing more stringent laying conditions. At a minimum, Type 4 laying condition shall be utilized with a minimum of 4-inches of bedding to overcome unstable conditions. For severe unstable soil conditions, undercut excavation and an engineer designed foundation plan shall be provided prior to pipeline installation.



Type 1*

Type 4:

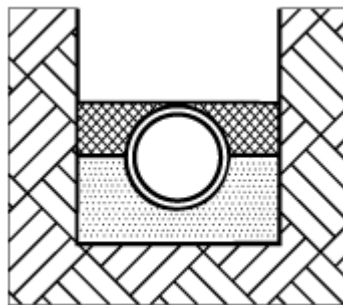
Pipe bedded in Class 1 material, No. 67 or No 57 crushed stone to a depth of 1/8 pipe diameter or a minimum of 6-inches. Embedment material, consisting of Class 1, Class 2 or Class 3 materials, shall be compacted greater than 95% Proctor to the top of the pipe. Careful attention must be allocated to compacting embedment material under the bottom edges of the pipe.



Type 4

Type 5:

Pipe bedded in Class 1 material, No. 67 or No. 57 crushed stone to the center of the pipe and extending a minimum of 6-inches under the pipe. Granular or select embedment, consisting of Class 1 or Class 2 materials, compacted to greater than 95% Proctor installed to the top of the pipe.



Type 5

- g) For installations below the water table, a single layer of engineering fabric shall be installed between the pipe and trench floor/trench wall. The fabric shall fully encapsulate the waterline, bedding, and embedment material with a minimum of 12-inch overlap at the top of the embedment material.

3. DIP Specific Installation Requirements

- a) Ductile iron pipe shall be installed in accordance with the requirements of AWWA C600 and the Ductile Iron Pipe Handbook published by the Ductile Iron Pipe Research Association. Materials at all times shall be handled with mechanical equipment or in such a manner to protect them from damage. At no time shall pipe and fittings be dropped or pushed into ditches.
- b) Pipe shall be installed at laying conditions as specified herein and identified by the plan drawings. Laying conditions for ductile iron pipe shall be as described in AWWA C151 and the Ductile Iron Pipe Research Association.

4. PVC Specific Installation Requirements

The installation of PVC Pipe shall satisfy the requirements of the manufacturer, and/or the following, whichever is more stringent:

- a) For PVC pipe, the pipe shall be produced with bell and spigot end construction. Joining shall be accomplished by rubber gasket in accordance with manufacturer's recommendation. Flexible watertight elastomeric seals in accordance with ASTM D3212-1 may also be used. Each pipe length shall be clearly marked with information including pipe size, profile number and class number.
- b) Installation of PVC pipe shall follow the recommendations of ASTM D-2321 "Underground Installation of Thermoplastic Pipe for Sewers and other Gravity-Flow Applications". For PVC pipe installation, bedding and embedment material shall be Class I, typically No. 67 or No. 57 washed stone. Bedding and embedment materials for PVC gravity sewers other than No. 67 or No. 57 washed stone shall be approved by the Town of Apex prior to use.
- c) Bedding for gravity sewer shall consist of minimum 4-inches of No. 67 or No. 57 stone installed under the pipe (Type 4). Embedment shall extend to the top of the pipe. Bedding and embedment shall be compacted to 95% standard proctor density. Careful attention shall be placed on compacting embedment under the haunches of the pipe to prevent any potential voids.
- d) The bedding and embedment materials shall be in accordance with ASTM D-2321. The embedment materials shall be installed from trench wall to trench wall.
- e) The maximum allowable deflection after installation shall BE LESS THAN 5% for PVC pipe.

- f) All PVC pipe shall be stored properly to prevent UV damage prior to installation. Any PVC pipe with visible fading caused by UV radiation from sunlight shall be rejected.
- g) All PVC pipe shall be free from nicks, scratches and gouges at the time of installation. Such defects can impact the strength of PVC pipe and all pipes with visible gouges shall be rejected.

5. Backfill

- a) Backfill material shall be free from construction material, frozen material, organic material, or unstable material. Backfill with a high clay content or high shrink-swell potential that cannot meet compaction requirements shall be deemed unsuitable and replaced.
- b) Backfill materials that have been allowed to become saturated or with moisture contents non-conducive to meeting compaction requirements shall be deemed unsuitable and replaced.
- c) When original excavated materials have been deemed unsuitable, granular material must be imported to the site to backfill utility trenches and meet compaction requirements. The following materials shall be acceptable forms of granular backfill: aggregate base course, soil type base course, select backfill material, sand or screenings in accordance with NCDOT Specifications.
- d) In all open utility trenches, backfill shall be compacted to 95% maximum dry density as measured by AASHTO method T99. The Contractor shall be responsible for verifying that compaction requirements have been met or exceeded by providing soils testing data from an approved Geotechnical Firm. The soil test results shall be certified by a licensed Geotechnical Engineer.
- e) Backfill for utility trenches shall be placed in lifts of uncompacted soil in accordance with the standard detail and compacted with a mechanical tamp before placing additional layers.
- f) No rocks, boulders, or stones shall be included in the backfill material for at least 2 feet above the top of the pipe. In traffic areas, the final backfill shall be placed and compacted in 6-inch layers. Backfill shall be of such density as to ensure no settlement of the trench.
- g) A compaction test shall be performed every 1,000 feet for utility installations, with a minimum of one test per utility by a licensed Professional Engineer and shall be coordinated and submitted at the Contractor's expense. The location of tests shall be determined by the Town. The Town may request

additional testing. Additional tests that are deemed passing will be at the Town's expense, failed tests shall be paid for by the Contractor. Organic material shall not be permitted for backfill.

- h) Should any water line trench exhibit settlement, the Contractor shall correct the deficiency to the complete satisfaction of the Town. Where a utility line is in or crosses existing State roads or other public roads, the backfill shall be compacted to at least 95% standard density as measured by AASHTO Method T-99, or in accordance with NCDOT specifications, whichever is more stringent.
- i) For permitted open-cut utility installations and/or tie-ins, the Town may require that "flowable fill" be used for backfill material. If required, 1 foot of approved natural backfill material shall be compacted over the main per Apex Specifications, the remaining excavated trench shall be backfilled with "flowable fill". Within seven (7) days after the excavation has been filled, the open-cut area shall be repaired per the Standard Detail.

6. Pipe Identification and Marking

a) Marking Tape

- 1) Installation: Marking tape shall be installed continuously and longitudinally along all mains and services for new construction and for any repair or retrofit construction using open trench methods. For service connections, the marking tape shall extend from the main line to the meter or first cleanout off the main/manhole. Marking tape shall be installed directly above the center of the pipe and at least 18-inches deep from final grade to a maximum depth of 24-inches below final grade.
- 2) Specifications: The marking tape shall be made of polyethylene (or approved equivalent) material, 6-inches wide and a minimum of 6 millimeters thick. The marking tape shall have detectable markers embedded in the tape and spaced adequately to provide continuous detection along the tape from above the buried pipe at final grade. The tape color shall be in accordance with the utility being installed:
 - a. Blue for water and shall be marked with words "CAUTION WATER LINE BURIED BELOW" (or an approved equivalent wording).
 - b. Green for gravity sewer and force mains and shall be marked with words "CAUTION SEWER LINE BURIED BELOW" (or an approved equivalent wording).

3) The wording shall be repetitive along the full length of the tape.

b) Tracer Wire

- 1) Tracer wire shall be installed with all water and forcemain piping and color coded blue for water or green for forcemain.
- 2) Tracer wire access must be provided utilizing an approved grade level/in-ground trace wire access box, located in line over the utility to be located. The grade level/in-ground trace wire access box shall be delineated using a concrete marker with a brass plate per Standard Detail.
- 3) All tracer wire and trace wire products shall be domestically manufactured in the U.S.A.
- 4) All tracer wire shall have HDPE insulation intended for direct bury, blue in color for water and green in color for sewer, coated per APWA standard.
- 5) Tracer wire systems must be installed as a single continuous wire, except where using approved connectors. No looping or coiling of wire is allowed.
- 6) Wire installation method requirements are:
 - a. Open Trench - Trace wire shall be #12 AWG Copper Clad Steel, High Strength with minimum 450 lb. break load, with minimum 30 mil HDPE insulation thickness.
 - b. Directional Drilling/Boring - Trace wire shall be #12 AWG Copper Clad Steel, Extra High Strength with minimum 1,150 lb. break load, with minimum 30 mil HDPE insulation thickness.
 - c. Pipe Bursting/Slip Lining - Trace wire shall be 7 x 7 Stranded Copper Clad Steel, Extreme Strength with 4,700 lb. break load, with minimum 50 ml HDPE insulation thickness.
- 7) Direct bury wire connectors – shall include 3-way lockable connectors and mainline to lateral lug connectors specifically manufactured for use in underground trace wire installation. Connectors shall be dielectric silicon filled to seal out moisture and corrosion, and shall be installed in a manner so as to

prevent any uninsulated wire exposure.

- 8) Non locking friction fit, twist on or taped connectors are prohibited.
- 9) Termination and access requirements as follows:
 - a. Tracer wire access points are to be no more than 500' apart.
 - b. All tracer wire termination points must utilize an approved tracer wire access box (grade level/in-ground access box as applicable), per Standard Detail.
 - c. All grade level/in-ground access boxes shall be appropriately identified with "water" or "sewer" cast into the cap, per Standard Detail.
 - d. A minimum of 2 ft. of excess/slack wire is required in all trace wire access boxes after meeting final elevation.
 - e. All tracer wire access boxes must include a manually interruptible conductive/connective link between the terminal(s) for the tracer wire connection and the terminal for the grounding anode wire connection.
 - f. Grounding anode wire shall be connected to the identified (or bottom) terminal on all access boxes.
- 10) Test Stations shall be 2 ½" diameter with 2 terminals, green and be equivalent to Bingham and Taylor model P225 SR or Copperhead model LD12 TP and shall be installed in a valve box per Standard Detail.
- 11) A grounding anode shall be installed at each test station equivalent to Copperhead model ANO-1005.

c) Marker Tape and Tracer Wire Testing

- 1) Testing of the marker tape and tracer wire shall be performed by the Contractor at the completion of the project to assure they are all working properly. It is the Contractor's responsibility to provide the necessary equipment to perform all testing. Any defective, missing, or otherwise non-locatable units shall be replaced.

453 Pavement Repairs

A. Open Trench Pavement Repair

1. General Requirements

- a) All pavement cuts shall be repaired within a maximum of three (3) days from the date the cut is made. If conditions do not permit a permanent repair within the given time limit, permission to make a temporary repair must be obtained from the Town.
- b) Pavement repairs shall be made in accordance with the Details.
- c) All asphalt pavement utilized to repair open trenches shall comply with all applicable Town of Apex asphalt pavement material and installation Specifications.
- d) All pavement patches shall be provided in such a manner that a uniform and smooth driving surface free of depressions and/or bumps is obtained. Pavement patches not meeting this standard shall be milled and replaced.
- e) All utility mains installed by open cut across Town or NCDOT roadways shall include steel encasement, sized in accordance with tables found in this specification.

454 Trenchless Pipe Installation

A. Design

1. General Requirements

- a) All utility crossings within Town streets shall be made by trenchless methods. State maintained streets within the Town ETJ should also be crossed using trenchless methods. In cases where utility conflicts, rock, or other obstructions prevent trenchless crossings, the Town may consider approving other methods.
- b) The preferred trenchless method shall be auger boring. Alternate trenchless methods including microtunneling, guided boring, conventional tunneling, horizontal directional drilling or hand tunneling may be approved after thorough evaluation by the Water Resources Department.

- c) In addition to meeting or exceeding all Town requirements, all trenchless crossings shall be approved by and meet the requirements of all controlling legal authorities, such as NCDOT, Norfolk Southern Railway, CSX Corporation, Colonial Pipeline, Cardinal Pipeline, and Dixie Pipeline.
- d) Direct bores may be made without a casing pipe on pipelines 6-inches in diameter and smaller.
- e) Encasement pipe shall be installed with all trenchless construction methods (excluding horizontal directional drilling when it is approved and as noted above). There shall be a minimum cover of 4-ft between the pavement subgrade and the top of the casing pipe. Under no circumstances shall the pavement subgrade be disturbed.
- f) Permanent easements shall be provided at all trenchless pits to allow for future access to casing pipes.

B. Materials

1. Encasement Pipe

- a) Encasement pipe shall be new and manufactured of grade 'B' steel with minimum yield strength of 35,000-psi in accordance with ASTM A139 and A283.
- b) All casing pipe shall have machine cut, bevel ends that are perpendicular to the longitudinal axis of the casing. Ends shall be plumb and welded without the use of filler material.
- c) Size and minimum wall thickness of smooth wall or spiral welded steel encasement pipe shall be as shown in the below table. Actual wall thicknesses shall be determined by the casing installer based on their evaluation of the required forces to be exerted on the casing when it is installed.

Minimum Wall Thickness of Steel Encasement Pipe

Encasement Pipe Outside Diameter (inches)	Minimum Wall Thickness (inches)
14	0.375
16	0.375
18	0.375
20	0.375
24	0.375
26	0.500
28	0.500
30	0.500
36	0.625
42	0.625
48	0.750
54	0.750
60	0.750
66	0.750

- d) Encasement pipe installed for railroad bores shall meet the requirements of the American Railway Engineering Association (AREA) for boring under railroads.
- e) Encasement pipe shall be sized in accordance with the standard detail.

2. Casing Pipe Spacers and End Closures

- a) The carrier pipe shall rest on steel pipe alignment spacers. The spacers shall have either a bituminous or epoxy coating. A minimum of 3 steel spacers per joint shall be required on carrier pipe less than 36-inches. Carrier pipe greater than or equal to 36-inches shall have a fourth spacer. The steel spacers shall be located evenly along the carrier pipe alignment in such a manner that each spacer supports the same unit weight of carrier main. The spacing interval of the steel spacers shall assure the necessary grade, clearance, and support of the carrier main. The spacers shall be manufactured for the specific carrier pipe and casing pipe diameters being used such that the risers do not allow the pipe to float within the casing.
- b) In cases where the encasement pipe is installed in within the easement of facilities with stray current, such as gas lines, high voltage power transmission lines, petroleum lines, railroad tracks, etc., the spacers shall be a composite material such as an ultra-high molecular weight polyethylene plastic to prevent transmitting the stray current to the carrier pipe.

- c) In cases where PVC carrier pipe is installed in an encasement pipe, steel spiders with soft contact surfaces rated for use with PVC pipe shall be used.
- d) The carrier pipe bells shall not be allowed to contact the interior of the encasement pipe under any circumstances.
- e) No blocks or temporary spacers shall be wedged between the carrier pipe and the top of the encasement pipe.
- f) The ends of the encasement pipe shall be sealed using solid 8-inch bricks and a non-shrink grout.
- g) A 2-inch galvanized vent pipe shall be provided on the upper end of the casing on all stream and railroad crossings.

3. Carrier Pipe

- a) All carrier pipe shall be manufacturer provided restrained joint ductile iron pipe except for sewer force mains in which restrained PVC C900 may be utilized in compliance with Section 0800.

4. Polyethylene (PE) Pressure Pipe

- a) Pipe shall be certified and listed for potable water distribution products in accordance with NSF 61 and bear the NSF seal on each section of pipe.
- b) Outside diameter shall conform with ductile-iron pipe.
- c) Material for pipe manufacturing shall be PE 3408 high density polyethylene (HDPE) meeting ASTM D3350 cell classification of 345444C.
- d) Pipe shall be pressure class PC 250 with a standard dimension ratio (DR) of 9.
- e) Fittings shall be made of material meeting the same requirements as the pipe.

5. Fusible Polyvinylchloride Pipe

- a) Fusible polyvinylchloride pipe shall conform to AWWA C900. Testing shall be in accordance with AWWA standards.

- b) Pipe shall be DIPS standard dimensions with a minimum pressure rating of 235 psi (DR18) and the size as indicated on the Drawings.
- c) Piping shall be made from a PVC compound conforming to cell classification 12454 per ASTM D1784.
- d) Fusible polyvinylchloride pipe shall be extruded with plain ends. The ends shall be square to the pipe and free of any bevel or chamfer. There shall be no bell or gasket of any kind incorporated into the pipe.
- e) Fusible polyvinylchloride pipe shall be manufactured in standard 40 foot nominal lengths.
- f) Fusible polyvinylchloride pipe shall be blue in color for water use or green in color for wastewater use.
- g) Pipe generally shall be marked per industry standards, and shall include as a minimum:
 - 1. Nominal pipe size
 - 2. PVC
 - 3. Dimension Ratio
 - 4. Pipe legend or stiffness designation, or AWWA pressure class
 - 5. AWWA Standard designation number
 - 6. Extrusion production-record code
 - 7. Trademark or trade name
 - 8. Cell Classification 12454 and/or PVC material code 1120 may also be included.
- h) Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, or other visible deleterious faults.

C. Installation

1. General Requirements

- a) As the trenchless operation progresses, each new section of encasement pipe shall be joined using full penetration seal welds prior to installation of the casing. Joints shall be electric-fusion welded by operators qualified in accordance with the American Welding Society's standard procedure for arc welds. The welds shall be capable of transmitting all thrust and other loads across the joints.
- b) If voids are encountered while installing encasement pipe thirty (30) inches and larger, 2-inch or larger grout holes shall be installed at ten (10) foot centers in the top section of the encasement pipe. The grout

holes shall be used to fill the void spaces with 1:3 Portland cement grout at sufficient pressure to prevent settlement of the roadway, unless NCDOT approval stipulates otherwise. Other grout mixtures may be submitted for approval.

- c) In the event that an obstruction is encountered during the trenchless operations, the equipment shall be withdrawn. The pipe shall be cut off, capped, and filled with 1:3 Portland cement grout at a sufficient pressure to fill all voids before moving to another boring site.
- d) Restrained joint ductile iron carrier pipe shall be pulled into the casing pipe. Pipe lined with Protecto 401 for sewer application shall never be pushed into a casing.

2. Settlement Surveying

- a) For all trenchless operations of 100-ft or more, the ground surface elevations shall be recorded prior to beginning work.
 - 1. At a minimum, survey points shall be identified with a nail or hub located as follows:
 - i. Road crossings: Centerline and each shoulder/curb
 - ii. Utility and Pipeline Crossings: Directly above and 10-ft each side of the crossing
 - iii. All locations: Points shall not exceed 50-ft spacing
 - 2. Elevations at each point shall be recorded with an accuracy of 0.01-ft.
- b) Settlement observations shall be made each day until the pipe/casing is fully installed. Once installed, observations shall be made weekly for a period of at least four (4) weeks.
- c) Readings shall be reported to the Infrastructure Inspector.
- d) In the case of observed settlement, the monitoring points and observation frequency shall be increased as determined by the Town.

3. Horizontal Directional Drilling

a) General

1. Drill pilot hole along the path shown on the Drawings to the following tolerances:
 - a. Vertical Location - Plus or minus 1 foot
 - b. Horizontal Location - Plus or minus 3 feet.
2. At the completion of the pilot hole drilling, provide a tabulation of coordinates referenced to the drilled entry point which accurately describes the location of the pilot hole.
3. Perform reaming diameter to 1.25 to 1.5 times the outside diameter of the pipe being installed. Prepare pipe to facilitate connection to the remainder of the pipeline being installed.
4. Use care to protect the pipe from scarring, gouging, or excessive abrasion.
5. Method of connection between HDD pipe and other pipe materials shall be as indicated on the Drawings.
6. Pipe shall be deflected within the tolerances as provided by the pipe manufacturer.
7. For drills under structural conditions (i.e., roadways), perform reaming diameter to 2 inches maximum greater than outside diameter of the pipe being installed. If larger size is necessary, provide statement from North Carolina Professional Engineer stating that "an overbore in excess of 2-inches will arch and no damage will be done to pavement or sub-grade".

b) Fusible Polyvinylchloride (FPVC) pipe

1. General

- a. Installation guidelines from the pipe supplier shall be followed for all installations.
- b. The fusible polyvinylchloride pipe will be installed in a manner so as not to exceed the recommended bending radius guidelines.

2. Handling and Storage

- a. Pipe shall be offloaded, loaded, installed, handled, stored and stacked per the pipe supplier's guidelines. These guidelines include compliance with the minimum recommended bend radius and maximum safe pull force for the specific pipe being used.

3. Fusion Joints

- a. Fusible polyvinylchloride pipe lengths shall be assembled in the field with butt-fused joints. The fusion technician shall follow the pipe supplier's guidelines for this procedure. All fusion joints shall be completed as described in this specification.

4. Fusion Process

- a. Fusible polyvinylchloride pipe will be handled in a safe and non-destructive manner before, during, and after the fusion process and in accordance with this specification and pipe supplier's guidelines.
- b. Fusible polyvinylchloride pipe will be fused by qualified fusion technicians holding current qualification credentials for the pipe size being fused, as documented by the pipe supplier.
- c. Pipe supplier's procedures shall be followed at all times during fusion operations.

5. Installation

- a. Once installed according to manufacturer's requirements, the contractor shall make connections to the open cut pipe by means of mechanical joint fittings, taking care to correct horizontal or vertical alignment with the fittings rather than the Fusible PVC.

455 External Corrosion Protection

1. General Requirements

- a) External corrosion can occur at an accelerated rate in metallic pipelines such as steel and ductile iron when they are installed in aggressive soils

or when they are installed near other structures or utilities that carry impressed currents. Such facilities that typically utilize impressed current cathodic protection are gas pipelines, such as owned by Colonial Pipeline, Cardinal Pipeline and Dixie Pipeline. Other potential sources that may create stray currents that contribute to accelerated pipeline corrosion are high voltage power transmission lines and railroad crossings.

- b) In cases where metallic steel and ductile iron pipelines or encasement pipes are planned for installation in close proximity to any potential sources of stray current or aggressive soils, zinc coated pipe shall be specified and a field analysis consisting of stray current evaluation and soil testing shall be conducted by an experienced technician, as certified by the National Association of Corrosion Engineers, (NACE), to determine the potential for external corrosion and the need for additional protection measures. In cases where stray current conditions and/or aggressive soils are prevalent, a corrosion specialist certified by the NACE or other applicable certification board shall be consulted regarding the design of pipeline protection measures.
- c) At a minimum, all stray current protection systems should include bonded joints and sacrificial anodes with a 50-year or longer design life and test facilities in lieu of polyethylene encasement, unless otherwise approved by the Town of Apex. The cathodic protection element of the pipeline design package shall be sealed by Professional Engineer licensed in the State of NC.
- d) Full impressed current cathodic protection shall only be utilized when extreme corrosion potential has been proven and/or as otherwise directed by the Water Resources Department and the certified corrosion engineer of record.
- e) When field conditions require cathodic protection, the Engineer must provide alignment showing no practical alternative, as well as calculations and design of cathodic protection system. Design shall include, but not be limited to, the provisions of all instruments, anodes, wiring, appurtenant equipment, and accessories and must be specifically called out on the drawings for a complete and operating cathodic protection system.
- f) All ductile iron pipe that is installed within 60 feet of any gas line shall be wrapped with a dual layer of 8 mil polyethylene encasement. The dual polyethylene encasement shall meet AWWA C105 requirements for dielectric strength of 800 volts per mil (12,800 volts per a 16-mils thick dual polyethylene system) to shield the ductile pipe from elevated stray currents.

- g) Perpendicular crossings of gas lines/easements with ductile iron pipe shall include a dual layer of 8 mil polyethylene encasement across the entire easement width plus a distance of 60 feet on each side of the easement.

456 Rock Excavation

1. General Requirements

- a) Rock shall be defined as that solid material that cannot be excavated, in the opinion of the Water Resources Director, by any means other than drilling and blasting, drilling and wedging, or boulders and broken concrete exceeding ½ cubic yard in volume. Rock shall be excavated to the same limits as earth excavation except that the trench shall be made 6- inches lower than the outer bottom of the pipe. This 6-inches shall be refilled with 6-inches of #67 stone and thoroughly compacted to the sub-grade level. All blasting shall be done under the supervision of the Town Inspector or Engineer and subject to all applicable regulations. The Town reserves the right to require the removal of rock by means other than blasting where any pipe or conduit is either too close to or so situated with respect to the blasting as to make blasting hazardous. Rock taken from the ditch shall immediately be hauled away and disposed of by the contractor.

- b) Blasting procedures shall conform to all applicable local, state and federal laws and ordinances. A blasting permit shall be obtained from the Town's Fire Marshal's Office, prior to any blasting. The application shall be obtained 24-hours before any blasting takes place, and the Fire Marshal may specify the hours of blasting. The contractor shall take all necessary precautions to protect life and property, including the use of an approved blasting mat where there exists the danger of throwing rock or over-burden. The contractor shall keep explosive materials that are on the job site in special constructed boxes provided with locks. Failure to comply with this specification shall be grounds for suspension of blasting operations until full compliance is made. No blasting shall be allowed unless a galvanometer is employed to check cap circuits. Where blasting takes place within five-hundred feet of a utility, structure or property which could be damaged by vibration, concussion or falling rock, the contractor shall be required to take seismograph readings and to keep a blasting log containing the following information for each and every shot:
 - 1) Date of shot
 - 2) Time of shot
 - 3) Crew Supervisor
 - 4) Number and depth of holes

- 5) Approximate depth of overburden
 - 6) Amount and type of explosive used in each hole
 - 7) Type of caps used (instant or delay)
 - 8) The weather
 - 9) Seismograph instrument and readings
- c) This blasting log shall be made available to the Water Resources Director upon request and shall be kept in an orderly manner. It shall be the contractor's responsibility to have adequate insurance to cover any damages resulting from blasting so to hold the Town of Apex harmless from any claims.