



**CLAY COUNTY WATER & SEWER DISTRICT
STANDARD SPECIFICATIONS
AND DETAILS**

**75 RIVERSIDE CIRCLE, SUITE 2
HAYESVILLE, NC 28904**

CLAY COUNTY, NORTH CAROLINA

ADOPTED: 07-21-2022

SECTION 33 05 07 TRENCHLESS INSTALLTION OF UTILITY PIPING

PART 1: GENERAL

1.01 SCOPE OF WORK

- A. The work under this section consists of furnishing all materials, labor, equipment and services required for the complete installation of encasement pipe and carrier pipes under highways and railroads by boring and jacking as shown on the drawings and specified herein.

All work in connection with constructing encasement pipes under highways and railroads shall comply with all current requirements of governing highway and railroad agencies. The Contractor shall be familiar with these requirements.

The Contractor shall inspect the locations at the proposed crossings and shall familiarize himself with the conditions under which the work will be performed, and with all necessary details and the suitability of his equipment and methods for the work required.

PART 2: PRODUCTS

2.01 MATERIALS

- A. Encasement pipe shall be smooth wall welded steel conforming to ASTM Designation A139, Grade B. The outside of the pipe shall be coated in accordance with AWWA Standard C203. Minimum pipe wall thickness shall be as follows:

Pipe - Nominal Diameter Inches	Wall Thickness Inches
16	.250
20	.250
24	.250
30	.312
36	.500

PART 3: EXECUTION

3.01 INSTALLATION

- A. Encasements shall be installed by boring and jacking unless field conditions require otherwise. It shall be the Contractor's responsibility to notify the Engineer immediately if conditions do not permit a jack and bore installation.
- B. The encasement pipe shall be of the diameter indicated for the carrier pipe as shown on the drawing.
- C. Installation of encasement pipe shall include all related work and services such as mobilization of equipment, constructing and maintaining working pits, right-of-way maintenance and restoration, traffic maintenance, mining, excavations, dewatering, sheeting, shoring and bracing for embankments, operating pits, and as elsewhere required shall be placed and maintained in order that work may proceed safely and expeditiously.
- D. Installation of the casing pipe shall be carried out without disturbance of the embankment, pavement, tracks, or other railroad or highway facilities and without obstructing the passage of traffic at any time.
- E. The driven portions of the casing shall be advanced from the lower end of the casing unless specific permission to do otherwise is obtained by the Contractor from the Engineer.
- F. The alignment and grade shall be carefully maintained and the encasement pipe installed in a straight line.
- G. The space outside the encasement and the ground shall be filled with grout, sand or pea gravel, as directed by the Engineer. The Engineer will direct that this space be filled if the space is large enough to cause any earth settling.
- H. Before the pipe is installed in the casing, bolt-on metal skids painted with bitumastic paint shall be rigidly fastened to the barrel of the pipe. After completion of the casing, the Contractor shall insert the pipeline in pre-jointed segments. No contact will be permitted between the casing and the carrier pipeline.

END OF SECTION

SECTION 33 11 00

WATER PIPE AND APPURTENANCES

PART 1: GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, equipment, materials and incidentals necessary to install and complete installation of ductile iron water lines in accordance with the plans. All pipe and appurtenance material shall be of the type and class specified herein.
- B. All water pipe excavation, bedding, pipe laying, jointing and coupling of pipe joints and backfilling shall be completed as described herein.
- C. All waterline installation shall conform to this specification and any standards and specifications that have been adopted by the local water authority. It is the contractor's responsibility to verify with the local water authority if any superseding standards and specifications are applicable.
- D. All materials that come in contact with potable water shall meet the requirements of NSF61.

1.02 SUBMITTALS

- A. The Contractor shall provide six (6) copies of shop drawings or submittals for the following:
 - 1. All sizes and types of pipe on the project.
 - 2. Pipe fittings, valves, meters and boxes, vaults, backflow preventers, and necessary appurtenances.

1.03 DELIVERY, STORAGE AND HANDLING

- A. The Contractor shall unload pipe so as to avoid deformation or other injury thereto. Pipe shall not be placed within pipe of a large size and shall not be rolled or dragged over gravel or rock during handling. When any joint or section of pipe or other material is damaged during transporting, unloading, handling or storing, the undamaged portions of the pipe or material may be used or if damaged sufficiently, the Engineer will reject the material as being unfit for installation.
- B. If any defective material is discovered after installation, it shall be removed and replaced with sound pipe or shall be repaired by the Contractor in an approved manner and at his own expense.

1.04 WARRANTY

All materials shall be guaranteed to be free from defects in materials and workmanship for a period of one (1) year after final acceptance by the Owner.

PART 2: PRODUCTS

2.01 MATERIALS

A. DUCTILE IRON PIPE

1. All materials shall be first quality with smooth interior and exterior surfaces, free from cracks, blisters, honeycombs, and other imperfections, and true to theoretical shapes and forms throughout. All materials shall be subject to the inspection of the Engineer at the plant, trench, or other point of delivery, for the purpose of culling and rejecting material which does not conform to the requirements of these specifications. Such material shall be marked by the Engineer, and the Contractor shall remove it from the project site upon notice being received of its rejection.
2. As specific specifications are cited, the designation shall be construed to refer to the latest revision under the same specification number, or to superseding specifications under a new number, except provisions in revised specifications which are clearly inapplicable.
3. Ductile Iron Pipe shall be manufactured in accordance with AWWA C151. All Ductile Iron Pipe shall be 350 psi Class unless otherwise specified and shall be lined with a cement mortar lining not less than 1/16" thick conforming to AWWA C104. Pipe wall thickness for all Ductile Iron Pipe shall conform to "Thickness Design for Ductile Iron Pipe," AWWA C150. The standard laying condition shall be type 2. The exterior of all Ductile Iron Pipe shall have a protective coating of a coal tar or asphaltic material a minimum of 5 mils thickness conforming to AWWA C110 and C115.
 - a. Flanged Joints:
 - i. Flanged pipe shall have flanges with long hubs, shop fitted on the threaded end of the pipe.
 - ii. Where required, flanges shall be tapped for stud bolts. Flanges shall be accurately faced at right angles to the pipe axis and shall be drilled smooth and true, and covered with coal tar pipe varnish or otherwise protected against corrosion of flange faces. Flange faces shall be cleaned to bare metal with wire brushed before installation of pipe.
 - iii. Ductile Iron Flanged joint pipe shall have a thickness of Class 53 minimum and shall conform to AWWA C110 and

AWWA C115. Pipe shall be ordered in lengths needed as no pipe shall be cut, threaded or flanged in the field. All pipe shall have 125 lb. flanges conforming to AWWA C110 unless otherwise specified.

- iv. In general, flanged joints shall be made up with through bolts of the required size. Stud or tap bolts shall be used only where shown or required. Steel or tap bolts shall be cadmium plated, with good and sound, well-fitting threads, so that the nuts may be turned freely by hand. Cadmium plating shall be by an approved process with a plate thickness of 0.0003" to 0.0005".
- v. Connecting flanges shall be in proper alignment and no external force shall be used to bring them together. Bolts and gaskets shall be furnished by the installer of piping for joints connecting the piping with equipment and piping is furnished by the installer or not.

b. Mechanical Joints:

- i. All mechanical joint pipe shall be manufactured in accordance with AWWA C111. Pipe shall be manufactured in accordance with AWWA C151, and the pipe thickness shall be 350 psi Class as determined by AWWA C150 unless otherwise noted.
- ii. All bolts shall be tightened by means of torque wrenches in such a manner that the follower shall be brought up toward the pipe evenly. If effective sealing is not obtained by tightening the bolts to the specified torques, the joint shall be disassembled and reassembled after thorough cleaning.
- iii. Bolts for mechanical joints shall be high grade steel, low alloy type, with tee or hex head and American Standard threads. Mechanical joint gland shall be gray iron and shall utilize a plain rubber gasket.

c. Slip Joints:

- i. Slip or "push-on" joints shall be manufactured in accordance with AWWA C151. Pipe thickness shall be 350 psi Class as determined by AWWA C150.
- ii. Bells of "slip" joint pipe shall be contoured to receive a bulb shaped circular rubber gasket, and plain ends shall have a slight taper to facilitate installation. The lubricant used in making up the joints shall be furnished by the pipe

manufacturer. The jointing shall be done by guiding the plain end into the bell until contact is made with the gasket and by exerting a sufficient compressive force to drive the joint home until plain end makes full contact with the base of the bell. No joint may exceed a maximum deflection of 4%.

4. Fittings:

- a. All ductile iron pipe fittings for pipe shall be mechanical joint type in accordance with AWWA C110 and AWWA C111 for underground piping. Where flanged pipe is used ductile iron fittings shall be flanged in accordance with AWWA C110 for exposed piping. All flanges shall be Class 125 unless otherwise noted.
- b. All fittings shall be lined with cement mortar not less than 1/16" thick in conformance with AWWA C104 and suitable for a minimum of 250 psi working pressure unless otherwise specified.
- c. All mechanical joints shall be manufactured in accordance with AWWA C111.

B. POLYVINYL CHLORIDE (PVC) PIPE (1-Inch Up To 4-Inch)

1. All pipe 4 inches or larger to be Ductile Iron Pipe.
2. All materials shall be first quality with smooth interior and exterior surfaces, free from cracks, blisters, honeycombs, and other imperfections, and true to theoretical shapes and forms throughout. All materials shall be subject to the inspection of the Engineer at the plant, trench, or other point of delivery, for the purpose of culling and rejecting material which does not conform to the requirements of these specifications. Such material shall be marked by the Engineer, and the Contractor shall remove it from the project site upon notice being received of its rejection.
3. As specific specifications are cited, the designation shall be construed to refer to the latest revision under the same specification number, or to superseding specifications under a new number, except provisions in revised specifications which are clearly inapplicable.
4. Pressure Rated PVC Pipe shall be manufactured in accordance with AWWA C900 and ASTM 2241. All Pressure Rated PVC Pipe shall have a standard dimension ratio (SDR) as indicated in the drawings. The exterior of all PVC Pipe shall bear a stamp which shows SDR and size.
 - a. All pipes shall have slip or "push-on" joints which are manufactured in accordance with AWWA C151. Pipe shall have a bell with integral rubber gasket.

- b. Bells of "slip" joint pipe shall be contoured to receive a bulb shaped circular rubber gasket, and plain ends shall have a slight taper to facilitate installation. The lubricant used in making up the joints shall be furnished by the pipe manufacturer. The jointing shall be done by guiding the plain end into the bell until contact is made with the gasket and by exerting a sufficient compressive force to drive the joint home until the assembly mark on the pipe barrel is flush with the end of the bell. No joint may exceed a maximum deflection of 4%.
4. Fittings:
- a. Fittings for all PVC pipe shall be ductile iron pipe fittings, mechanical joint type in accordance with AWWA C110 and AWWA C111 for underground piping.
 - b. All fittings shall be lined with cement mortar not less than 1/16" thick in conformance with AWWA C104 and suitable for a minimum of 250 psi working pressure unless otherwise specified.
 - c. All mechanical joints shall be manufactured in accordance with AWWA C111. The Contractor shall provide suitable 3" plugs with stainless steel threaded nipples and sleeves for connection of fittings.
5. All valves and appurtenances shall comply with NSF61/NSF372.
6. All non-ferrous pipe shall be installed with 19-gauge Trace Safe tracer wire or approved equal. Tracer wire will be installed one foot above the top of the pipe and shall be connected to valve boxes and appurtenances per manufacturer requirements.

PART 3: EXECUTION

3.01 INSTALLATION

A. EXCAVATION

1. Trenches will be defined as all excavation for the installation of water pipe, hydrants, valves, water services, water taps, and other unclassified excavation as may be deemed necessary by the Engineer.
2. The excavation shall be done to the lines, grades, typical sections, and details shown on the plans or established by the Engineer. All work covered by this section shall be coordinated with the grading, construction of drainage structures, and other work along the project, and shall be maintained in a satisfactory condition so that adequate drainage is provided at all times. Any roots which protrude into the trench shall be trimmed flush with the sides of the trench. Trenches for pipe lines shall be completed before the pipe is installed unless otherwise permitted by the Engineer.
3. All excavation shall be by open cut unless otherwise authorized by the Engineer. If the bottom of the excavation is found to consist of rock or any materials that cannot be excavated to give a uniform bearing surface, the material shall be removed to a depth at least 6" below established bottom grade and backfilled to grade with #67 washed stone. Any excavations carried below the depths indicated, without specific directions, shall be backfilled in the same manner. The excavation shall be of sufficient width to allow a clearance of not less than 6" between the side of the trench and the outside of the pipe, or in case of pipe with a bell, the outside of the bell of the pipe. This rule will apply at all times, and consequently, proper allowance must be made for additional space required for sheeting the trench where necessary. Maximum trench width, unless as otherwise authorized by the Engineer, as measured at a depth of 2'-0" above the top of the pipe shall be 30" or 10" clearance from each side of the pipe, whichever is greater.
4. Sheeting, Bracing Trenches, and Trench Boxes:

If necessary, the Contractor will be required to keep the sides of the excavation vertical by sheeting and/or bracing or the use of a trench box to prevent movement by slides or settling of the sides of the trench to prevent injury or displacement of the pipe or appurtenances or diminish the working space required at the sides of the pipe. Also, the Contractor may be required, for the purpose of preventing injury to persons or property or adjacent structures in place or to be constructed, to leave sheeting and bracing in place. The Contractor shall provide all means necessary to comply with the latest OSHA requirements.

5. No sheeting or bracing shall extend closer than 2'-0" off the ground surface, or within subgrade, and no timbers shall be left in the trench that may form pockets or cavities that cannot easily be filled during the operation of backfilling and settling or compacting the trench backfill. It is understood that the Owner will be under no obligation to pay for sheeting or bracing left in place by the Contractor. Failure to sheet and brace trenches or other excavation shall be the Contractor's risk, and he will be held responsible for caving, settlement, and all other damage resulting therefrom. If the Engineer is of the opinion, that at any point, sufficient or proper supports have not been provided, he may order additional supports put in at the Contractor's expense, but compliance with such orders shall not release the Contractor from responsibility for the sufficiency of such supports.
6. Excavated materials to be used for backfill will be approved by the Engineer, and if acceptable shall be neatly deposited at the sides of the trenches where space is available. Where stockpiling of excavated material is required, the Contractor shall so maintain his operations as to provide for natural drainage and not present an unsightly appearance.
7. Materials which are excess to the needs of the project will be disposed of by the Contractor.
8. In order to protect existing pavement structures and to make clean-up easier the Contractor shall place a 6" layer of sand on all asphalt or concrete surfaces prior to placing excavated material.
9. Pipe Foundations:
 - a. The preparation of the pipe bedding shall be in accordance with the typical trench cross-sections as shown on the plans for the type of pipe being installed. Unless otherwise noted all pipe shall be installed using a "Type 2" trench foundation as defined in AWWA C151.
 - b. The pipe foundation shall be prepared to be uniformly firm and shall be true to the lines and grades as shown on the plans. Any deviation or field adjustment will require the approval of the Engineer. When an Inspector is present on the site and is so requested by the Contractor, he shall check the position of grades and lines but the Contractor shall be responsible for the finished work conforming to exact and proper line and grade.
 - c. Whenever the nature of the ground will permit, the excavations at the bottom of the trench shall have the shape and dimensions of the outside lower third of the circumference of the pipe, care being taken to secure a firm bearing support uniformly throughout the

length of the pipe. A space shall be excavated under and around each bell to sufficient depth to relieve it of any load and to allow ample space for filling and finishing the joint. The pipe, when thus bedded firmly, shall be on the exact grade.

- d. In case the bed shaped in the bottom of the trench is too low, the pipe shall be completely removed from position, and #67 washed stone of suitable quality shall be placed and thoroughly tamped to prepare a new foundation for the pipe. In no case shall the pipe be brought to grade by blocking up under the barrel or bell of same, but a new and uniform support must be provided for the full length of the pipe.
- e. Where rock or boulders are encountered in the bottom of the trench, the same shall be removed to such depth that no part of the pipe, when laid to grade, will be closer to the rock or boulders than 6". #67 washed stone shall be placed to bring the bottom of the trench to proper subgrade over rock or boulders.
- f. Where the foundation material is found to be of poor supporting value, the Engineer may make minor adjustment in the location of the pipe to provide a more suitable foundation. Where this is not practical, the foundation shall be conditioned by removing the existing foundation material by undercutting to the depth as directed by the Engineer, within limits established on the plans, and backfilling with #67 washed stone as approved by the Engineer.
- g. The Contractor shall remove all water which may be encountered or which may accumulate in the trenches by pumping or bailing and no pipes shall be laid until the water has been removed from the trench. Water so removed from the trench must be disposed of in such a manner as not to cause injury to work completed or in progress.
- h. Whenever the bottom of the trench shall be of such nature as to provide unsatisfactory foundation for the pipe, the Engineer will require the pipe to be laid on a washed stone or concrete cradle foundation. Such foundations whether washed stone or a poured concrete cradle, shall be placed by the Contractor and compensation will be allowed the Contractor for the work.

B. INSTALLING PIPE AND APPURTENANCES

1. Laying Pipe:

- a. All piping is to be installed in strict accordance with the manufacturer's recommendations and AWWA C600, AWWA C605,

and the contract material specifications. Installation manuals from various material suppliers will be furnished the Engineer for his review and approval prior to installation of any materials. The Engineer may augment any manufacturer's installation recommendations if, in his opinion, it will best serve the interest of the Owner.

- b. No pipe shall be laid except in the presence of the Engineer or his Inspector, or with special permission from the Engineer.
- c. Proper tools, implements and facilities satisfactory to the Engineer shall be provided and used for the safe and convenient prosecution of pipe laying. All pipe, fittings, valves, and other materials used in the laying of pipe will be lowered into the trench piece by piece by means of suitable equipment in such a manner to prevent damage to the pipe, materials, to the protective coating on the pipe materials, and to provide a safe working condition to all personnel in the trench. Each piece of pipe being lowered into the trench shall be clean and free of defects. It shall be laid on the prepared foundations, as specified elsewhere to produce a straight line on a uniform grade, each pipe being laid so as to form a smooth and straight inside flow line.
- d. Pipe shall be removed at any time if broken, injured or displaced in the process of laying same, or of backfilling the trench.
- e. When cutting short lengths of pipe, a pipe cutter, as approved by the Engineer, will be used and care will be taken to make the cut at right angles to the center line of the pipe or on the exact skew as shown on the plans. In the case of push-on pipe, the cut ends shall be tapered with a portable grinder or coarse file to match the manufactured taper.
- f. All pipe joints shall be constructed in strict accordance with the pipe manufacturer's specifications and materials and any deviation must have prior approval of the Engineer.
- g. The maximum deflection per joint of flexible joint pipe shall be that deflection recommended by the manufacturer. However, at no time will a deflection greater than 4° be allowed.
- h. All water lines shall have a minimum cover of 3'-0" unless otherwise approved by the engineer. All water lines shall have a minimum 18" vertical separation from storm sewer and shall have a minimum of 10'-0" horizontal separation from sanitary sewer or 18" vertical separation with the water line over the sewer line. In the event these separations cannot be met, both water line and sanitary

sewer shall be constructed of ductile iron pipe as directed by the Engineer or as shown on the drawings.

2. Thrust Blocks:

- a. All plugs, caps, tees, bends, and other fittings shall be provided with adequate thrust blocks. Thrust blocks shall be constructed to the minimum dimensions shown on the drawings or as directed by the Engineer, or as per City of Asheville standards. Thrust blocks shall be made of ready mix concrete having a compressive strength of 28 days of 4000 psi and shall bear directly against the undisturbed trench wall. Where possible, the concrete shall be so placed that the fitting joints will be accessible for repair. All bolts and pipe joints shall be protected against contact with thrust block concrete by the installation of a 20 mil polyethylene film placed between the fittings and the concrete. Where any section of a main is provided with concrete thrust blocks, the hydrostatic pressure test shall not be made until three days after installation of the concrete thrust blocks unless otherwise approved by the Engineer. Where trench conditions are, in the opinion of the Engineer, unsuitable for thrust blocks, the Contractor shall provide steel tie rods and socket clamps to adequately anchor the piping. All tie rods and clamps shall be given a bituminous protective coating or shall be galvanized.
- b. Concrete for thrust blocks shall consist of a ready mix of Portland Cement, Fine Coarse aggregate and water to produce concrete with a minimum compressive strength at 28 days of not less than 4000 psi when tested in accordance with ASTM C39 or C42. Sakrete or any similar material will not be permitted under any circumstances.

C. BACKFILLING AND COMPACTION

1. Backfill trenches immediately after approval of the pipeline construction.
2. Use select backfill carefully placed in uniform layers not exceeding 6" in thickness to a depth of 2'-0" over the top of the pipe. Place material and fill the area under the pipe haunches. Place each layer, moisten as necessary; then uniformly compact by use of hand, pneumatic, or mechanical tampers exercising care to prevent lateral displacement. Areas of backfill 2'-0" over top of pipe to top of trench, shall be backfilled with a select material containing no rocks larger than 6" in the greatest dimension and shall be free of material with an exceptionally high void content. The initial backfill shall meet the same requirements except no rocks over 4" in diameter will be allowed.
3. Moisten backfill as necessary above 2'-0" over the top of the pipe and place in 8" layers. Compact each layer with hand, pneumatic or mechanical

compactor. Puddling or flooding of trench for consolidation of backfill or use of wheel rolling by construction equipment will not be permitted.

4. All backfill shall be compacted so as not to damage the pipe and appurtenances and shall be compacted to 95% of the maximum dry density as determined by Standard Proctor Test for the various types of backfill material for the full trench depth in non-paved areas. In paved areas, backfill shall be compacted to 98% of the maximum dry density as determined by Standard Proctor Test for the top 24" below subgrade. Methods of backfilling shall be in strict accordance with the pipe manufacturer's recommendations. All backfill material shall have been approved by the Engineer. Select backfill material shall be used when requested by the Engineer.
5. Roadways and Road Crossings:

Use select backfill placed in uniform layers not exceeding 6" in thickness for full trench depth and width, thoroughly compacted with mechanical tampers under optimum moisture conditions to 95% compaction (98% for the top 2'-0" of sub grade beneath pavements). Replace removed paving and base course with new material of equal or better quality and of the same texture and type as the adjacent roadway.
6. 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 roots, stones, frozen lumps, chunks of highly plastic clay, or other objectionable material. All pipe backfill areas shall be graded and maintained in such a condition that erosion or saturation will not damage the pipe bed or backfill.
7. Heavy equipment shall not be operated over any pipe until it has been properly backfilled and has a minimum cover as required by the plans. Where any part of the required cover is above the proposed finish grade, the Contractor shall place, maintain, and finally remove such material at no cost to the Owner. Pipe which becomes miss-aligned, shows excessive settlement, or has been otherwise damaged by the Contractor's operations, shall be removed and replaced by the Contractor at no cost to the Owner.
8. The Contractor shall maintain all pipes installed in a condition that they will function continuously from the time the pipe is installed until the project is accepted.
9. Cleanup:
 - a. Grade all areas disturbed to a finish ordinarily obtained from a blade grader with no abrupt changes in grade or irregularities that will hold water. Prior to final inspection and acceptance, remove all

rubbish and excess material and leave area in a neat, satisfactory condition.

- b. Cleanup and seeding is part of the pipeline installation. No more than 3,000 L.F. of water line may be laid prior to completion of cleanup of the first section of pipeline laid. To facilitate this the Owner reserves the right to withhold up to 30% of the unit price bid for water line if in the opinion of the Owner and Engineer completed sections have not been properly cleaned.

3.02 QUALITY CONTROL

A. TESTING

1. General: Perform all hydrostatic testing in accordance with AWWA C600, Section 4, unless otherwise specified. When a section of pipe of a length deemed adequate by the Engineer is ready for testing, blow the line free from air and conduct a leakage test. All new water service connections, from taps on the main up to and including meter yokes, meter setters and spool piece for meters in vaults, shall be installed and included in the hydrostatic testing and disinfection processes.
2. Buried Lines: Whenever conditions permit in the opinion of the Engineer, test pipelines before the trench is backfilled. All joints may then be examined during open trench test and all leaks entirely stopped. Should the Contractor wish to minimize the maintenance of lights, and barricades and the obstruction of traffic, he may, at his own risk, backfill the entire trench as soon as practicable after installation of pipe. The Contractor, however, remains responsible for removing and later replacing such backfill, at his own expense, should he be ordered to do so in order to locate and repair or replace leaking or defective joints of pipe.
3. Exposed Lines: Test all exposed lines prior to field painting.
4. Temporary Bulkheads: Furnish, install and remove all temporary bulkheads, flanges, or plugs necessary to permit the required pressure test. Install corporation stops at all high points on the line for blowing lines free from air. Install corporation stops at the test pump location. Install a test pump and means for accurate measurement of water introduced into the line during testing. Keep pump, meters, and gages in use during pressure and leakage tests.

5. Test Pressure and Allowable Leakage: Keep the section to be tested full of water for a period of 24 hours before the pressure and leakage tests are conducted.
6. Hydrostatic Testing: A section of line which is to be hydrostatically tested, shall be slowly filled with water at a rate which will allow complete evacuation of air from the line. Hand pumps shall not be used for the pressure testing of water mains.
 - a. The hydrostatic test shall be witnessed by the Water Engineering Division during the full two-hour duration.
 - b. The line shall be tested to a minimum pressure of 200 psi with a maximum of 250 psi at the lowest elevation for a duration of 2 hours. The pressure gauge used in the hydrostatic test shall be calibrated in increments of 10 psi or less. Pressure shall be maintained at a minimum of 200 psi +/- 5 psi at the highest point throughout the duration of the test by pumping additional water into the test section as often as necessary. At the end of the test period, the leakage shall be measured with an accurate water meter furnished by the City, or other approved means.
 - c. The line to be tested must utilize a backflow prevention assembly. All water for testing must be drawn through this assembly. Prior to connecting to the existing water line the new water line extension shall be pressure tested, disinfected and a clear water sample obtained.
 - d. **The allowable leakage shall be no more than indicated in the table below. Allowable leakage based on the formula:**

$$L=[S*D*(P)^{1/2}]\sqrt{148,000}$$

L = testing allowance (makeup water), 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 hydrostatic test, in pounds per square inch (gauge)

ALLOWABLE LEAKAGE PER 1000 FEET OF PIPELINE (GPH)													
Avg. Test Pressure PSI	Pipe Diameter in Inches												
	3	4	6	8	10	12	14	16	18	20	24	30	36
250	0.32	0.43	0.64	0.85	1.07	1.28	1.50	1.71	1.92	2.14	2.56	3.21	3.85
225	0.30	0.41	0.61	0.81	1.01	1.22	1.42	1.62	1.82	2.03	2.43	3.04	3.65

200	0.29	0.38	0.57	0.76	0.96	1.15	1.34	1.53	1.72	1.91	2.29	2.87	3.44
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	3.22
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	2.98
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	2.72
100	0.20	0.27	0.41	0.54	0.68	0.81	0.95	1.08	1.22	1.35	1.62	2.03	2.43

e. All visible leaks are to be repaired regardless of the amount of leakage.

7. Defective Materials and Workmanship: Carefully examine all exposed pipe fittings, valves, hydrants, and joints during the test. Locate and repair leaks and replace defective materials if the water loss during the test periods exceeds the allowable leakage. Make the necessary repairs, replace defective material and repeat the hydrostatic test until the leakage does not exceed the allowable leakage as defined herein.

B. STERILIZATION

1. Disinfection to be in compliance with AWWA C651.
2. All new water service connections, from taps on the main up to and including meter yokes, meter setters and spool piece for meters in vaults, shall be installed and included in the hydrostatic testing and disinfection processes.
3. All additions or replacements to the water system shall be chlorinated before being placed in service. Such disinfection shall take place under the continuous supervision of the Engineer or Engineer's Inspector. The maximum total length of water main which may be disinfected at the same time is 3000 linear feet.
4. Disinfection, flushing and sampling of a completed line shall be carried out in the following manner:
 - a. Taps with extended copper tubing will be made at the control valve at the upstream end of the line and at all extremities of the line including valves. These additional taps will not be necessary where a suitable permanent tap is already available as approved by the City.
 - b. Prior to introducing the chlorine solution into the pipe, all blow-offs shall be checked to confirm that all air has been expelled from the pipe and the pipe is filled with water. During the introduction of chlorinated solution into the pipe, the operation of blow-offs shall be carefully controlled to make sure the

solution enters all main lines, branch lines, and service lines thoroughly and that no air is introduced.

- c. All gauge pressure and residual chlorine field test equipment shall be properly calibrated. All equipment used in the disinfection process shall be cleaned and suitable for potable water application.
- d. A solution of water containing high test sodium hypochlorite (70% available chlorine) shall be introduced into the line by regulated pumping at the control-valve tap. The solution shall be of such a concentration that the line shall have a uniform concentration of 50 ppm total chlorine immediately after disinfection. The chart below shows the required quantity of 70% HTH compound to be contained in solution in each 1000 feet section of line to produce the desired concentration of 50 ppm.

PIPE SIZE, INCHES	POUNDS HIGH TEST HYPOCHLORITE (70%) PER 100 FEET OF LINE
6	0.88
8	1.56
10	2.42
12	3.50
14	4.76
16	6.22
20	9.76
24	14.00

- e. Once the new main is uniformly chlorinated at the required concentration as confirmed by the Water Engineering Division Inspector, entrances and blow-offs shall be properly secured and the solution shall be retained in the system for a minimum of 24 hours, during which time all intermediate valves and hydrants shall be operated several times to insure disinfection of the inside faces of these appurtenances. At the end of the 24-hour period, the Inspector shall check entrance points and blow-offs to insure that the pipe is still full of solution without trapped air and the solution at each point checked has retained a chlorine residual of not less than 10 mg/l.
- f. Following the 24-hour period, with the approval of the Inspector, the chlorine solution shall be thoroughly flushed from the new main. Flushing shall not be completed until the residual chlorine measured by the Inspector at the end points of the new main has a measured chlorine residual within +/- 0.5 mg/l of the water supplied for flushing from the active water main.

- g. Disposal of the chlorinated solution during flushing shall comply with all federal, state, and local regulations. Where a sanitary sewer is located nearby, with the approval of the sewer authority, the chlorinated solution may be discharged to the sanitary sewer with a positive air gap to prevent backsiphonage. Disposal directly to surface waters without removal of chlorine is strictly prohibited.
 - h. After flushing is completed as described in f) above, the new water mains shall be isolated without introducing air by closing all entrance and blow-off points and allowing the new water mains to sit for another 24-hour period. At the end of this 24-hour period, an authorized employee of an accredited testing firm shall collect samples from randomly selected end points of the new water mains and perform bacteriological analysis of the samples in a state-approved certified laboratory. Results of the testing shall be documented and certified by the signature of the laboratory technician and Water Production Supervisor or Superintendent. Test results shall be provided to the contractor and Water Engineering Division. The disinfection process is not completed until the results of all testing are certified as negative for bacteriological contamination.
 - i. If the bacteriological tests fail to produce satisfactory results, the new main shall be reflashed by repeating steps f) through h) above. If bacteriological tests fail the second time, the entire disinfection process shall be repeated.
- 5. For mains required to be immediately returned to service after disinfecting, take a bacteriologic sample after connection or repair to provide a record by which the effectiveness of the procedure used can be determined.

END OF SECTION

PART 1: GENERAL

1.01 SCOPE OF WORK

- A. This specification covers the requirements for furnishing and installing valves and other appurtenances for the various water system improvements shown on the Drawings.
- B. Furnish all labor, equipment, materials and incidentals necessary to install and complete water valve and appurtenance installation in accordance with the plans and specifications. All valves and appurtenance material shall be of the type and class specified herein.
- C. All water valve and appurtenance excavation, bedding, pipe laying, jointing and coupling of pipe joints and backfilling shall be completed as described herein.
- D. All valves and appurtenances shall conform to current NCDENR Standards and Specifications.

1.02 SUBMITTALS

The Contractor shall provide six (6) copies of shop drawings or submittals for the following:

- 1. All valves, valve boxes, hydrants, air relief valves, tapping sleeves, meters, manholes, or any other items required for completion of the project.

1.03 DELIVERY, STORAGE AND HANDLING

- A. The Contractor shall unload valves and appurtenances so as to avoid deformation or other injury thereto. The Contractor shall store valves and appurtenances above storm drainage levels. All valves shall be drained and so stored as to protect them from freezing.
- B. If any defective material is discovered after installation, it shall be removed and replaced with sound pipe or shall be repaired by the Contractor in an approved manner and at his own expense.

1.04 WARRANTY

All materials shall be guaranteed to be free from defects in materials and workmanship for a period of one (1) year after final acceptance by the Owner.

PART 2: PRODUCTS

2.01 MATERIALS

A. BALL VALVES

Ball valves shall be installed on existing/new 2" water main and service lines and all conform to AWWA C800. Valves shall be made of heavy brass components with a PTFE coated ball on a "blow-out" proof stem with double O-ring seals, and shall be rated for 300 psig working pressure. Operating nut shall be "curb key" design for quarter turn open or close and shall open left. Ball valves shall be as required on the Approved Manufacturers Products List.

B. GATE VALVES

All gate valves shall be designed for a minimum working pressure of 200 psi unless otherwise specified. Valves shall have a clear waterway equal to the full nominal diameter of the pipe. Valves shall be opened by turning counterclockwise. Each valve shall have the initials or name of the maker, pressure rating and year of manufacture cast on the body. Prior to shipment from the factory, each valve shall be tested by hydraulic pressure equal to twice the specified working pressure. Valves shall be operated by hand wheel for above ground installations or 2" square operating nut for below ground installations. Valves shall have an arrow cast in the metal indicating the direction of opening.

Valves to be installed underground (Buried) shall be of the non-rising stem type and shall have mechanical joint connections.

Valves installed above ground or in structures shall have rising stems with outside stem and yoke and 18" diameter minimum hand wheel and shall have flanged ends with 125# flanges unless others noted.

1. Gate Valves Smaller than 2"
 - a. Gates valves smaller than 2" shall be all brass, single disc type, double seat tapered wedge type built to manufacturer's standards with material and construction conforming to AWWA C-500.
 - b. Each valve shall have a 2" operating nut. Valves shall have screwed ends conforming to NPT standards.
2. Resilient Seated Wedge Valve
 - a. Gate valves 2" through 24" diameter size shall be of the ductile iron body, resilient seated wedge type meeting the requirements set

forth in AWWA C-509 and AWWA C-500. All valves shall be from one manufacturer and parts interchangeable.

- b. Gate valves shall have body, bonnet and gate manufactured of ductile iron conforming to ASTM A-536. The shell thickness of all components shall conform to the thicknesses in Table 2, Section 4.4 of AWWA C-509 and C-500. The valve body and bonnet shall be coated on both the interior and exterior surfaces with a fusion bonded epoxy paint conforming to AWWA C-550.
- c. The gate shall be fully covered with a rubber cover over all exterior and interior ferrous surfaces. The rubber shall be securely bonded to the gate body, including the part which houses the stem nut. The gate and rubber coat shall conform to ASTM D429.
- d. Valve stems shall be cast bronze. The stuffing box shall use "O"-ring seal type with two rings located above the thrust collar. The rings shall be replaceable with the valve fully open and under pressure.
- e. Valves larger than 12" diameter shall be designed for horizontal installation with beveled gear boxes with reduction gears to reduce the number of turns required to operate valve.

3. Double Disc Type Gate Valves

- a. Gate valves larger than 24" diameter size shall be of the ductile iron body, double disc parallel seat type meeting the requirements set forth in AWWA C-500. All valves shall be from one manufacturer and parts interchangeable.
- b. Gate valves shall have body, bonnet and gate manufactured of ductile iron conforming to ASTM A-536. The shell thickness of all components shall conform to the thicknesses in C-500. The valve body and bonnet shall be coated on both the interior and exterior surfaces.
- c. The gates shall be high strength cast iron, sturdily proportioned without pockets on the backs. All cam surfaces shall open to the bottom. Gate rings shall be rolled into a dovetail groove under pressure to make a single insertable finish.

- d. Valves shall use bottom wedging type design with a two-part floating wedge contact. The wedge and hook shall be separate castings and not a single piece.
- e. Valve stems shall be cast bronze. The stuffing box shall use "O"-ring seal type with two rings located above the thrust collar. The rings shall be replaceable with the valve fully open and under pressure.
- f. Valves shall be designed for horizontal installation with beveled gear boxes with reduction gears to reduce the number of turns required to operate valve. Valves shall have bronze rollers, tracks, and scrapers.
- g. All valves shall be supplied with a bypass as a part of the valve. Bypass shall be a minimum of 3" diameter with a 3" resilient seated wedge valve.

C. VALVE BOXES

All valve boxes shall be cast iron and shall conform to ASTM A48. Valve boxes shall be of the adjustable screw type with a base to fit the valve yoke with a removable cover with the word "water" cast thereon.

D. FIRE HYDRANTS

1. GENERAL:

- a. All fire hydrants shall meet or exceed the requirements of AWWA C-502, be listed by Underwriters Laboratories, Inc. and have Factory Mutual Research approval. All hydrants shall be rated 250 PSI working pressure minimum and be tested to 500 PSI minimum. The rated working pressure shall be cast on the hydrant barrel. Hydrants shall be of the compression type, constructed such that the main valve closes with water pressure to assure no loss of water in the event of damage to the upper portion of the hydrant. The diameter of the main valve seat shall be four and one-half inches (4 1/2") minimum. The hydrant shall open counter clockwise against the pressure and close clockwise with the pressure.
- b. The bonnet assembly shall have a lubrication reservoir which is sealed from the waterway and all external contaminants by the use of "O" ring seals. A port to add lubricant to the reservoir, without removal of the bonnet, is required.

- c. Fire hydrant shall be manufactured with 1 1/2-inch Pentagon operating nut and thrust nut made of low zinc bronze complying with ASTM B-61, B-62 or B-96, with thrust bearings located both above and below the thrust collar and with operating nut protected by a cast iron weather shield. In lieu of the bronze operating nut, an integral ductile iron operating nut and weather shield will be acceptable.
- d. Hydrants shall be a 3-way type with two (2) outlet nozzles, two and one-half inches (2 1/2") NST and (1) Steamer nozzle four and one-half inches (4 1/2") NST. All nozzles shall be made of low zinc brass complying with ASTM B-61, B-62 or B-96. All nozzles shall be mechanically locked into the barrel and have "O" ring pressure seals. Caps shall be provided with chains and chain hooks.
- e. The hydrant shall have a traffic "breakaway" coupling which is designed to fracture when the hydrant is impacted by a vehicle. The breakaway coupling shall be made of cast iron or steel and shall allow for 360-degree rotation of the upper barrel to position the nozzles without removing the breakaway coupling or shutting down. All pins, clips, and or retainer rings associated with the "breakaway" coupling shall be stainless steel.
- f. The main valve seat shall have bronze to bronze seating arrangement of low zinc bronze complying with ASTM B-61, B-62 or B-96. A bronze seat ring shall be threaded into bronze sub-seat located in the hydrant elbow. All "O" rings sealing the main valve seat ring shall bear against a non-corrodible low zinc bronze surface.
- g. The main valve assembly shall include double drain valves to operate automatically each time operated without the aid of springs, pins or toggles. The valve upper plate and valve lower plate shall be made of ductile iron or low zinc bronze complying with ASTM B-61, B-62 or B-96. The entire valve and stem assembly must be capable of removal and reassembly by the use of a small lightweight wrench without disassembly of the upper barrel.
- h. The shoe casting, lower barrel casting, and flanges below ground shall be manufactured in accordance with ASTM A- 126, Class B, Grey Iron or Ductile Iron. All ferrous metal surfaces in the hydrant shoe are to be fully coated with a minimum four (4) mills epoxy not to exclude the lower valve plate assembly.

- i. The hydrant will have three and one-half foot (3 1/2') of bury, unless otherwise noted. The hydrant will have a six inch (6") inlet connection of the (mechanical joint) type, unless otherwise noted. Painting and coating of the hydrant shall be as prescribed in AWWA C-502, latest revision. The color above the ground line flange shall be YELLOW.
- j. Fire hydrants shall be as required in the Approved Manufacturers Products List.

E. AIR RELIEF VALVE

- 1. The air release valve shall fully conform to AWWA C512 (latest revision) and suitable for use with clean water. It shall be float operated and automatically release accumulated air from the pipeline or system while in operation and under pressure.
- 2. Valves with 1" (25mm) or larger connection size shall be compound lever type with adjustable seat, smaller size valves shall be simple lever type.
- 3. The valve's venting orifice diameter shall be selected for 300 PSI (2,069 KPa) maximum working pressure.
- 4. The valve body and cover shall be rated for 300 PSI (2,069 KPa) and made from cast iron conforming to ASTM A126 Class B.
- 5. The float ball, orifice and internal linkage mechanism shall be made from Type 316 stainless steel. Non-metallic components are not acceptable.
- 6. The seat shall be replaceable and made from Buna-N rubber or other suitable elastomer compounds.
- 7. The exterior of the valve shall be shop coated with enamel primer.

F. MANHOLE SECTIONS AND APPURTENANCES

- 1. Precast concrete manhole bases, risers and cones shall conform to ASTM C478, latest revision, for precast reinforced concrete manhole sections. Tapered sections and transition sections, where required, shall be of eccentric cone design, having the same wall thickness and reinforcement as the cylindrical ring sections. Flat slab tops shall be required for very shallow manholes and where shown or specified. Cast iron manhole covers and assemblies shall be cast into slab tops for access into manholes.

2. Minimum compressive strength of concrete shall be 4000 psi and the maximum permissible absorption shall be 6.5%. Risers shall be reinforced with a single cage of steel placed within the center third of the wall. The tongue or the groove of the joint shall contain one line of circumferential reinforcement equal in area to that in the barrel of the manhole riser. The minimum cross-sectional area of steel per linear foot shall be 0.12 square inches for larger sizes. Precast manhole sections shall fit together readily and shall have a self-contained "O"-ring rubber gasket conforming to ASTM C443.
3. The quality of materials, the process of manufacture, and the finished manhole sections shall be subject to inspection and approval by the Engineer and his inspector. The manhole sections shall be perpendicular to their longitudinal axis, within the limits listed in ASTM C478.
4. Castings for manhole frames and covers shall be tough, even grained soft gray iron, free from burnt on sand and other injurious defects and conform to the requirements of ASTM A48, latest revision, Class 30, with "WATER" cast into the cover.
5. Brick for manholes and other structures shall conform to applicable requirements of ASTM C62, latest revision, Grade SW.

G. TAPPING SLEEVE AND VALVE

1. Tapping sleeves shall consist of two piece split ductile iron, jointed by bolts manufactured of high strength cast iron and incorporating a longitudinal compound rubber gasket. The sleeves shall include split end gasket and two piece mechanical joint glands suitable for the class of pipe around which sleeves are to be placed. Glands will be joined by steel bolts and fastened to the bell openings of the sleeves to form totally enclosed rubber water tight seals around the periphery of the pipe and along the longitudinal joints.
2. The sleeves shall have flanged outlets which will accommodate the tapping valves. Valves will be identical to resilient wedge gate valves elsewhere specified with inlet and outlet ends adaptable to the tapping machine and to provide mechanical joint connections to discharge pipes.

H. HYDRAULIC CHECK VALVE

1. GENERAL: Check valves shall be swing-check type conforming to AWWA C508. Valves conforming to AWWA C508 shall have iron body and cover and fully bronze mounted stainless steel hinge pins. Valves shall

have clear port opening. Valves shall be spring loaded and shall have flanged ends.

2. **CASTING MARKINGS:** Cast integral with either the bonnet or the body, the manufacturer's identification, the size of valve, the year of manufacture, and the maximum working pressure.
3. **PAINTING:** Coat all ferrous parts of the valves, except finished or bearing surfaces, with 2 coats of coal-tar varnish pipe dip or other approved material. After the valves are assembled and tested apply a third coat to the exterior.
4. **TESTING:** Test each valve at the manufacturer's plant for performance in water tightness and resistance to distortion under internal pressure. Subject each valve to hydrostatic tests under pressure at the working pressure cast on the valve and at 350 PSI.

I. All valves and appurtenances shall comply with NSF61/NSF372.

PART 3: EXECUTION

3.01 INSTALLATION

A. EXCAVATION

1. The work covered by this section consists of the excavation and satisfactory disposal of all materials excavated in the construction of trenches.
2. Trenches will be defined as all excavation for the installation of storm sewers, sanitary sewers, water pipe, manholes, catch basins, hydrants, watergates, sewer services, water taps, drainage structures, drainage ditches and other unclassified excavation as may be deemed necessary by the Engineer.
3. The excavation shall be done to the lines, grades, typical sections, and details shown on the plans or established by the Engineer. All work covered by this section shall be coordinated with the grading, construction of drainage structures, and other work along the project, and shall be maintained in a satisfactory condition so that adequate drainage is provided at all times. Any roots which protrude into the trench shall be trimmed flush with the sides of the trench. Trenches for pipe lines shall be completed before the pipe is installed unless otherwise permitted by the Engineer.

4. All excavation shall be by open cut unless otherwise authorized by the Engineer. If the bottom of the excavation is found to consist of rock or any materials that cannot be excavated to give a uniform bearing surface, the material shall be removed to a depth at least 6" below established bottom grade and backfilled to grade with suitable bedding material thoroughly compacted in place. Any excavations carried below the depths indicated, without specific directions, shall be backfilled in the same manner. The excavation shall be of sufficient width to allow a clearance of not less than 6" between the side of the trench and the outside of the pipe, or in case of pipe with a bell, the outside of the bell of the pipe. This rule will apply at all times, and consequently, proper allowance must be made for additional space required for sheeting the trench where necessary. Maximum trench width, unless otherwise authorized by the Engineer, as measured at a depth of 2'-0" above the top of the pipe shall be 18" clearance on each side of the pipe.

5. Sheeting, Bracing Trenches, and Trench Boxes:

If necessary, the Contractor will be required to keep the sides of the excavation vertical by sheeting and/or bracing or the use of a trench box to prevent movement by slides or settling of the sides of the trench, in such manner as the Engineer may direct to prevent injury or displacement of the pipe or appurtenances or diminish the working space required at the sides of the pipe. Also, the Contractor may be required as directed by the Engineer for the purpose of preventing injury to persons or property or adjacent structures in place or to be constructed, to leave sheeting and bracing in place.

6. No sheeting or bracing shall extend closer than 2'-0" off the ground surface, or within subgrade, and no timbers shall be left in the trench that may form pockets or cavities that cannot easily be filled during the operation of backfilling and settling or compacting the trench backfill. It is understood that the Owner will be under no obligation to pay for sheeting or bracing left in place by the Contractor. Failure to sheet and brace trenches or other excavation shall be the Contractor's risk, and he will be held responsible for caving, settlement, and all other damage resulting therefrom. If the Engineer is of the opinion, that at any point, sufficient or proper supports have not been provided, he may order additional supports put in at the Contractor's expense, but compliance with such orders shall not release the Contractor from responsibility for the sufficiency of such supports.

7. Excavated materials to be used for backfill will be approved by the Engineer, and if acceptable shall be neatly deposited at the sides of the trenches where space is available. Where stockpiling of excavated

material is required, the Contractor shall so maintain his operations as to provide for natural drainage and not present an unsightly appearance.

B. INSTALLING VALVES AND APPURTENANCES

1. Thrust Blocks:

- a. All plugs, caps, tees, bends, reducers and other fittings shall be provided with adequate thrust blocks. Thrust blocks shall be constructed to the minimum dimensions shown on the drawings or as directed by the Engineer. Thrust blocks shall be made of concrete having a compressive strength of 28 days of 4000 psi and shall bear directly against the undisturbed trench wall. Where possible, the backing shall be so placed that the fitting joints will be accessible for repair. All bolts and pipe joints shall be protected against contact with thrust block concrete by the installation of a polyethylene film placed between the fittings and the poured concrete. Where any section of a main is provided with concrete thrust blocks, the hydrostatic pressure test shall not be made until three days after installation of the concrete thrust blocks unless otherwise approved by the Engineer. Where trench conditions are, in the opinion of the Engineer, unsuitable for thrust blocks, the Contractor shall provide steel tie rods and socket clamps to adequately anchor the piping. All tie rods and clamps shall be given a bituminous protective coating or shall be galvanized.
- b. Concrete for thrust blocks shall consist of a mix of Portland Cement, Fine Coarse aggregate and water to produce concrete with a minimum compressive strength at 28 days of not less than 4000 psi when tested in accordance with ASTM C39 or C42. Sakrete or any similar material will not be permitted under any circumstances.

2. Valves:

Before setting each valve, the Contractor shall make sure the interior is clean and test opening and closing. Valves shall be set with stems plumb, unless horizontal installation is called for on the plans, and at the exact locations shown. Trench backfill shall be tamped thoroughly for a distance of 3'-0" on each side of valves boxes.

3. Valve Boxes:

A valve box shall be installed over each underground valve. All boxes shall be set plumb with their top flush with finished grade.

4. Fire Hydrant:

Fire hydrants shall be located as shown. Each hydrant shall be connected to the main with a 6" branch line having at least as much cover as the distribution main. Hydrants shall be set plumb with the pumper nozzle facing the roadway and with the center of the lowest outlet not less than 18" above the finished grade. Hydrants shall be thoroughly blocked with concrete or shall be rodded to the 6" branch tee. Unless otherwise specified, the backfill around hydrants shall be thoroughly compacted to the final grade immediately after installation in order to put the hydrant into service as soon as practicable. Not less than seven (7) cubic feet of clean crushed stone shall be placed around the base of the hydrant to insure drainage of the hydrant barrel. A cap block shall be set under the fire hydrant foot for a solid bottom.

5. Air Relief Valves:

Each air relief valve shall be installed at the exact location shown in a plastic meter box with cast iron lid.

6. Jumper:

A backflow prevention and testing device or a "jumper" is required at all potable water tie-in while water main extension is under construction per CDC detail.

C. BACKFILLING AND COMPACTION

1. Backfill trenches immediately after approval of the pipeline construction.

2. Roadways and Road Crossings:

Use select backfill placed in uniform layers not exceeding 6" in thickness for full trench depth and width, thoroughly compacted with mechanical tampers under optimum moisture conditions to 95% compaction (98% for the top 24" of subgrade beneath pavements). Replace removed paving and base course with new material of equal or better quality and of the same texture and color as the adjacent roadway.

3. All backfill shall be compacted so as not to damage the pipe and appurtenances and shall be compacted to 95% of the Standard Proctor Test (98% for the top 24" of subgrade beneath pavements) for the various types of backfill material. Methods of backfilling shall be in strict accordance with the pipe manufacturer's recommendations. All backfill material shall

SECTION 33 12 13

DOMESTIC WATER SERVICE CONNECTION

PART 1: GENERAL

1.01 SCOPE OF WORK

The work covered under this section shall consist of furnishing all materials, labor, equipment and services for the complete installation of a domestic water service connection from the water main line to the property to be served.

PART 2: PRODUCTS

2.01 MATERIALS

- A. The service line shall be constructed of Type "K" flexible copper tubing.
- B. Corporation stops shall be constructed of brass.
- C. Meter box shall be of round style and made of Polyvinyl Chloride Plastic with a minimum wall thickness of .375". Meter box shall be sized to accept a 5/8" water meter and shall have a minimum inside diameter of 18" with a 30" depth. Meter box shall have a non-locking cast iron lid.
- D. The inlet and outlet pipes that pass through the box wall shall be brass and shall be locked in place with brass hex nuts on straight external pipe threads. The inlet and outlet of these nipples shall have external tapered pipe threads and shall be protected by Polyethylene Cap Plugs. An In-Line quarter turn shut off valve with internal tapered pipe thread inlet and water meter coupling outlet shall be used upstream of the water meter. The valves shall be soft seating with a padlock wing. The valves internal components shall be removable from the top of the valve body. An In-Line Dual Check Valve with independent acting checks shall be used downstream of the water meter. The check valve shall have a meter coupling inlet and shall be contained inside the box. The internal parts of the check valve shall be removable without disconnecting the check valve the outlet piping. All brass materials used in contact with the water shall have a minimum copper content of 80% and a maximum zinc content of 10%.
- E. All domestic water services and connections shall conform to current local municipality standards and specifications.

PART 3: EXECUTION

3.01 INSTALLATION:

- A. The standard service connection shall connect to the main at a brass corporation stop tapped to the main line.
- B. The water service line shall be constructed of Type "K" flexible copper tubing placed a depth providing a minimum cover of 3'-0".
- C. The meter box until shall be a complete until with all the pipe nipples, valves, yoke, and bottom installed and connected prior to the delivery.
- D. Meters under 2" in size shall be provided and installed by the local municipality. All meters above 2" in size shall meet all local municipality standards and specifications and be provided and installed by a licensed and approved contractor.

SECTION 33 30 00 - SUBMERSIBLE EFFLUENT PUMPS

PART 1: GENERAL

1.01 Summary of Work

- A. The Contractor shall install and put into satisfactory service two (2) new, submersible effluent pumps, capable of pumping effluent from the field dosing tank to the pressure manifold constructed as part of the wastewater treatment system.
 - 1. The submersible effluent pumps shall meet performance requirements below and shall submit Shop Drawings for Engineer approval.

1.02 Submittals

- A. Shop drawings shall include, at a minimum:
 - 1. A complete description of the equipment, system, and process/function, including a list of system components and features, drawings, and catalogue information and cuts, and manufacturer's specifications.
 - 2. Performance data and curves as well as horsepower requirements.
 - 3. Functional description of any integral instrumentation and controls supplies, including a list of parameters monitored, controlled, and alarmed.
 - 4. Addresses and phone numbers of service centers nearest to the Owner as well as a listing of the manufacturer's or manufacturer's representative's services available at these locations. Also include addresses and phone numbers of the nearest parts warehouses capable of providing full parts replacement and/or repair service for the pumps.

PART 2: PRODUCTS

2.01 General

- A. Each pump shall be capable of pumping wastewater effluent from a pump tank:
 - 1. Each pump shall be equipped with the submersible electric motor, rated for a 230-volt, three (3) – phase, 60-hertz service.
 - a. The pump shall be provided with an adequate length of jacketed-type SO power cord suitable for submersible pump applications to reach the above grade disconnect panel without splicing. The power

cable shall also be sized according to NEC and ICEA standards and also meet with P-MSHA approval.

- b. Starting box shall be provided with the pump.
2. All pumps shall be designed for continuous operation at the design point and at any head condition within 20 percent of the design total dynamic head (TDH).
 3. Each pump shall be retrievable and replaceable without entering the pump tank and without requiring that the pump tank be drained.
 - a. The retrieval system for each pump shall consist of ½” diameter nylon braid lifting rope or stainless steel chain. The manufacturer shall furnish special mounting accessories, if required, to accommodate the discharges as shown on the Contract Drawings.
 4. Type 316 stainless steel anchor bolts shall be provided for mounting of all items within the pump tank.
 5. Contractor may choose to use a pump station control system, as packaged by the pump manufacturer or supplier, in lieu of integrating a control panel. The control system must conform to all requirements shown on the Contract Drawings and as specified in “Section 33 30 10 - Instrumentation and Controls.”
 6. Pump shall be corrosion resistant and include the following:
 - a. Heavy wall stainless steel pump shell.
 - b. Stainless steel hex drive pump shaft.
 - c. Stainless steel discharge and mounting ring.

2.02 **Pump Performance**

- A. Each of the two (2) effluent pumps shall conform to the following requirements:
 1. Pump Operating Conditions:
 - a. 30 gpm @ 29 ft TDH
 2. Discharge Diameter: 2”
 3. Minimum Horsepower: One half (1/2) horsepower.

- C. The pump manufacturer shall perform the following inspections and tests on each pump before shipment from factory:
1. Motor rating, and electrical connection shall first be checked for compliance with the purchase order.
 2. A motor and cable insulation test for moisture content or insulation defects shall be made.
 3. Prior to submergence, the pump shall be run dry to establish correct rotation and mechanical integrity.
 4. The pump shall be run for 30 minutes submerged a minimum of six (6) feet under water.
 5. The insulation test is to be performed again.
 6. A written report stating the foregoing steps have been done shall be supplied with each pump at the time of shipment.

2.03 Submersible Pump Design and Construction

- A. The effluent pump(s) shall be equal in all respects to Xylem Goulds Model 3885 WE 05HH.

2.04 Submersible Pump Lubricants

- A. The pump manufacturer shall furnish, with each pumping unit, all lubricants (oils and greases) necessary for the initial lubrication of the pump and the drive motor.
1. The lubricants furnished shall be appropriately identified by viscosity and/or class number.
 2. Each lubricant furnished shall be identified by the name of the producer of the lubricant and by the trade name given to the lubricant by the producer.

2.05 Submersible Pump Warranty

- A. The pump manufacturer shall warrant the units being supplied to the Owner against defects in workmanship and material under normal use, operation, and service for a minimum of one (1) calendar year from the date of final acceptance of the project, at no additional cost. The warranty shall be in printed form and apply to all similar units.

PART 3: EXECUTION

3.01 GENERAL

- A. Install all equipment and accessories as shown on the Contract Drawings and according to the manufacturer's instructions and recommendations.

- B. Start-up services are detailed in "Section 33 30 10 – Instrumentation and Controls." A trained representative of the submersible pump supplier or manufacturer shall certify the installation and verify that all control and instrumentation loops operate as intended by the Contract Documents.

- C. The warranty period for all pumps furnished under this section shall not begin until the date on which the Contractor's Certificate of Completion is issued.

END OF SECTION

SECTION 33 34 00 - FORCE MAINS & GRAVITY SEWERS

PART 1: GENERAL

1.01 SCOPE OF WORK

The Contractor shall furnish all labor, materials, equipment and supplies and shall perform all work necessary for the construction of the sewers, complete, tested and ready for use. The sewers shall be constructed to the lines and grades shown and shall be the size shown on the plans.

1.02 RELATED WORK

See the following sections for related specifications:

31 23 00 Excavating, Backfilling & Compacting for Utilities and Structures

PART 2: PRODUCTS

2.01 MATERIALS

All materials for sewer pipe shall be new and shall be furnished by the Contractor in accordance with the following requirements unless shown otherwise on the plans.

A. GRAVITY SEWERS (4-INCH THROUGH 6-INCH)

1. PVC Pipe:

Pipe: ASTM D1785; SCH 40 PVC with a minimum cell classification of 12454.

Fittings: ASTM D2466; SCH 40 PVC

B. GRAVITY SEWERS (8-INCH THROUGH 16-INCH)

1. Ductile Iron Pipe:

Pipe: Latest revision ANSI/AWWA C150 "Thickness Design of Ductile Iron Pipe", 8" through 12" pressure class 350 psi, 14" through 16" pressure class 250 psi, and latest revision AWWA C151 "Ductile Iron Pipe, Centrifugally Cast for Water and Other liquids, unless shown otherwise on the drawings.

Fittings: AWWA C110, grey or ductile iron, or compact ductile iron conforming to AWWA C153.

Joints: AWWA C111 push-on unless shown otherwise.

Linings: AWWA C104 cement lining, standard thickness, bituminous seal coat.

2. PVC Pipe:

Pipe: ASTM D3034; "Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings." SDR 35 with a minimum cell classification of 12454-B.

Fittings: ASTM D3034. Fittings in sizes through 8" shall be molded in one piece with elastomeric joints and minimum socket depths as specified in Sections 6.2 and 7.3.2. Fittings 10" and larger shall be molded or fabricated in accordance with Section 7.11 with manufacturer's standard pipe bells and gaskets.

Joints: ASTM D3212, Elastomeric gaskets conforming to ASTM F477.

C. FORCE MAINS

1. Ductile Iron Pipe (3-Inch Through 12-Inch):

Pipe: Latest revision ANSI/AWWA C150 "Thickness Design of Ductile Iron pipe", 3" through 12" pressure class 350 psi, and latest revision AWWA C151 "Ductile Iron Pipe, Centrifugally Cast for Water and other liquids, unless shown otherwise on the drawings.

Fittings: AWWA C110, grey or ductile iron.

Joints: AWWA C111 push-on unless shown otherwise.

Linings: AWWA C104 cement lining, standard thickness, bituminous seal coat.

2. PVC Pipe (4-Inch Through 12-Inch):

Pipe: AWWA C900 "Polyvinyl Chloride (PVC) pressure pipe. Pipe provided shall be cast iron pipe equivalent O.D. Pipe shall be pressure Class 150 (DR=18) unless shown otherwise on the drawings.

Fittings: Cement lined, cast or ductile iron fittings conforming to AWWA C110, or compact ductile iron conforming to AWWA C153.

Joints: Pipe, elastomeric gasket, push-on joints, conforming to AWWA C900. Joints may be either integral bell and spigot or couplings. Fittings; AWWA C111, push-on.

3. PVC Pipe (1-Inch Through 4-Inch):

Pipe: ASTM D-2241 "Polyvinyl Chloride (PVC) pressure water pipe. Pipe provided shall be iron pipe size. Pipe shall be pressure Class 200 (SDR 21) unless shown otherwise on the drawings.

Fittings: Cement lined, gray-iron or ductile iron conforming to AWWA C104 and C110 for fittings size 4-inch through 12-inch or compact fittings conforming to AWWA C153. Fittings less than 4-inch shall be PVC, Class 200, IPS with bells conforming to ASTM F477.

Joints: Pipe or compact ductile iron fittings conforming to AWWA C153, elastomeric gasket, push-on joints, conforming to ASTM F477 and ASTM 3139. Joints may be either integral bell and spigot or couplings.

4. Sewage Air and Vacuum Valves in sewer force mains shall be the type specifically designed for use with sewage. Valves shall be designed to vent large quantities of air when the line is being filled and to allow air to re-enter the line when it is being drained. Overall height of valve body without accessories shall be not less than 15 inches. Materials shall include cast iron body and cover, bronze float stem and guide, rubber seat and stainless steel float. Valves shall be furnished with provisions for backflushing. Valves shall be designed for working pressure of 150 psi.

5. Sewage Air Release Valves in sewer force mains shall be the type designed for use with sewage. Valves shall be designed to operate (open) while pressurized allowing entrained air in a sewer force main to escape through the air release orifice and prevent media from escaping. Materials shall include cast iron body and cover, rubber seat, stainless steel float

stem and internal linkages. The valves shall be sized according to the detail drawings and designed for minimum working pressures of 150 psi.

6. Utility Line Marking Tape shall be acid and alkali resistant polyethylene film two inches wide and 4 mil thick. The tape shall be manufactured with integral wires, foil backing or other means to enable detection by a metal detector when the tape is buried up to three feet. The metallic core of the tape shall be encased in a protective jacket or by other means to prevent corrosion. The tape shall bear a continuous printed marking describing the specific utility, i.e. "SEWER".

PART 3: EXECUTION

3.01 TRENCH EXCAVATION AND BACKFILL

- A. Excavation shall conform to the lines and grades shown on the drawings. No trench shall be opened more than two hundred (200) feet in advance of the completed pipe work without the written permission of the Engineer. The lines of excavation of trenches shall be made so there will be a clearance of at least eight (8) inches on each side of the barrel of the pipe. Excavation shall not be carried below the established grades and any excavation below the required level shall be backfilled and thoroughly tamped as directed by the Engineer, at the Contractor's expense. Bell holes shall be excavated accurately by hand.
- B. During excavation, Contractor shall separate materials suitable for backfill from those defined unsuitable. Do not use the following materials for pipe foundation or trench backfill within the zones indicated below:
 - All zones: material classified as peat (PT), organic soil (OL)(OH) under the Unified Soil Classification (USC) System, ASTM D2487 and all materials too wet or too dry to achieve minimum compacted density requirements,
 - Six inches beneath pipe: soft or unstable material and rock,
 - Beside pipe: any material containing more than 75% fines passing #200 sieve.

Suitable material shall be stockpiled near the trench for use as backfill. Unsuitable material shall be removed immediately or shall be stockpiled separately for dewatering or drying and later removal. Where no excavated material is suitable for backfill, furnish suitable material from borrow sites at no additional cost to the Owner.

- C. All unstable soil, organic soil, or soil types classified as inorganic clays and inorganic elastic silts (Class IV, Unified Class CL or lower) that are encountered

at the bottom of pipe trenches or structure excavations shall be removed to a depth and width determined by the Engineer and properly disposed of. The resulting undercut shall be backfilled and compacted with sandy soils which meets or exceeds the requirements of Class I or Class II soil, Unified Class SP or better. Placement and compaction shall conform to the compaction specifications herein and on the plans.

- D. All necessary dewatering pumping, and bailing shall be performed in such a manner as to keep the trench in a satisfactory condition for pipe laying.
- E. Backfilling shall be done with material free from large clods, frozen earth, organic material and any foreign matter.
 - 1. Around the pipe and to a depth of 12-inches above the pipe the backfill shall be carefully placed and compacted in layers not-to-exceed 6-inches compacted thickness. The backfill shall be select and free of rock. Do not place backfill material on either side of the gravity sewer that is finer than the material upon which it is placed. Backfill with coarser material to the top of the pipe.
 - 2. Twelve (12) inches above the crown of the pipe the backfill may contain rock but less than 6-inches in diameter. Backfill layers shall be horizontal and not exceed 12-inches loose or 8-inches compacted.
- F. Compaction shall be performed with suitable pneumatic compactors or approved equal equipment. Compaction equipment specifically designed for trench compaction shall be present, operational and at the jobsite at all times. Compaction equipment shall be utilized throughout the length and depth of the trench to achieve uniform compaction density.
- G. Compaction density shall be determined by the Standard Proctor Test (ASTM D698) and shall meet the minimum standards in Section 02220, Excavating, Backfilling & Compacting for Utilities and Structures
- H. Surplus material shall be disposed of by the Contractor at his expense.
- I. Clean shoulders and pavement of excess material immediately after backfilling is complete.

3.02 LAYING SEWERS

A. GRAVITY SEWERS

- 1. All sewers shall be laid and jointed in accordance with approved manufacturer's recommendations and shall be laid true to line and grade proceeding upgrade with the spigot pointing in the direction of flow. The

sections of pipe shall be laid and fitted together so that, when complete, the sewer will have smooth and uniform invert, with full-length of the barrel resting on the trench bottom or bedding prepared for the pipe. Holes shall be excavated to accommodate pipe bells. The pipe shall be kept thoroughly clean. Each pipe shall be inspected for defects before lowering pipe into trench. Water shall not be allowed to rise around joints until they have been made tight.

2. All gravity sewer shall be bedded in accordance with manufacturer's recommendation for the proposed depth of sewer, and as detailed in the contract drawings.
3. The exposed end of all pipes shall be closed by means of an approved plug to prevent earth or other substances from entering the pipe. The interior of the sewer shall be kept free from all dirt, cement or superfluous materials of every description as the work progresses.

B. FORCE MAINS

1. All pipe for force main sewers shall be laid and jointed in accordance to approved manufacturer's recommendations, contract drawings and as specified herein.
2. Each pipe shall be inspected for defects before lowering pipe into the trench. Any defective pipe shall be immediately removed from the site.
3. Water shall not be allowed to rise around the joints until they have been made tight. The exposed end of all pipe shall be closed by means of an approved plug to prevent earth or other foreign substances from entering the pipe. The interior of the pipe shall be kept clean and free of all dirt, stone or foreign material as work progresses.
4. The force mains shall be properly bedded according to the manufacturer's recommendations, contract drawings and the minimum standards defined below:

All Pipe IN ROCK OR WET TRENCHES: Washed stone bedding from 4-inches below pipe to springline of pipe.

ALL OTHER CONDITIONS: Hand carve trench to shape of lower quadrant of barrel

5. Concrete Blocking: All bends, tees and plugs shall be blocked with 3000 psi concrete from the pipe to undisturbed ground to the dimensions shown on the plans. Plant mix concrete is preferred although field mix concrete (Sacrete or equal) may be used as long as it is properly mixed outside of

the trench in clean containers with potable water. The concrete mix shall be placed and rodded or consolidated by suitable means to minimize voids and shall receive a 24-hour cure before being backfilled. If the ground is soft, restrained joint fittings shall be used as directed by the Engineer.

6. Utility Line Marking Tape: Shall be placed above all PVC pipe used in the force main construction. It shall be placed as

3.03 INSTALLATION OF JOINTS

A. MECHANICAL JOINTS

The socket, gasket or spigot of the pipe shall be cleaned of all foreign matter. The gland shall be slipped on the spigot end, followed by the gasket and the pipe end pushed into the bell. The ring gasket shall be properly seated so that it is totally confined under pressure within the bell. The loose gland shall be moved into position against the face of the gasket and the nuts and bolts loosely assembled with the fingers and then made up tight with a suitable ratchet wrench.

B. PUSH-ON JOINTS

The joint shall be thoroughly cleaned, prepared, lubricated and installed in accordance with the requirements, instructions and recommendations of the manufacturer and Engineer.

C. SOLVENT CEMENTS JOINTS

The joint shall be thoroughly cleaned, prepared and installed in accordance with the requirements, instructions and recommendations of the manufacturer and Engineer.

3.04 TESTING

- A. All pipe installations shall be tested as specified herein. Tests shall be performed by Contractor at his expense in the presence of Engineer or his representative. Testing shall not be performed until such time that all work which may affect the results of the testing has been completed. Where a test section fails to meet test requirements, Contractor shall make corrections as specified herein and retest the section. The correct/retest procedure shall continue until such time as test requirements are met.
- B. All gravity lines will be lamped by the Engineer. The Contractor shall furnish two personnel to assist the Engineer in removing and replacing manhole covers, and in carrying Engineer's tripod, hoist and other equipment necessary to perform this task.

C. AIR TEST: ALL GRAVITY SEWER PIPE.

1. Procedure:

- a. Air test shall be conducted in strict accordance with the testing equipment manufacturer's instructions, including all recommended safety precautions. No one will be allowed in the manholes during testing. Equipment used for air testing shall be equipment specifically designed for this type of test, and is subject to approval of the Engineer.
- b. The test shall be performed only on clean sewer mains after services are installed and the pipe is completely backfilled. Clean sewer mains by propelling snug fitting inflated rubber ball through the pipe with water. After completely cleaned, plug all pipe outlets with suitable test plugs. Brace each plug securely.
- c. For pipe within test sections above the ground water table, add air slowly to the portion of the pipe installation under test until the internal air pressure is raised to the starting pressure of 4 psig. After the starting pressure is obtained, allow at least two minutes for air temperature to stabilize, adding only the amount of air required to maintain pressure. When pressure decreases to 3.5 psig, start stopwatch. Determine the time that is required for the internal air pressure to reach 2.5 psig.
- d. For pipe with test sections below the ground water table, determine the starting pressure for the test section, in psig, as follows:
 1. Determine the maximum depth of pipe within the test section in feet.
 2. Multiply this depth by 0.67 and add 9.3 feet.
 3. Multiply the result in part 2 by 0.43 and round to the nearest 0.5 psig. After this starting pressure is obtained, continue the test in accordance with the procedure in the paragraph above.

2. Requirement: The test section shall be acceptable if the elapsed time for pressure drop of 1.0 psig is greater than the sum of the times shown below for all pipe sizes within the test section.

PIPE DIAMETER (INCHES)

<u>LENGTH</u>	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	"	"
175	0:31	1:09	2:03	3:13	4:37	7:05	"	"	"
200	0:35	1:19	2:21	3:40	5:17	"	"	"	12:06
225	0:40	1:29	2:38	4:08	5:40	"	"	10:25	13:36
250	0:44	1:39	2:56	4:35	"	"	8:31	11:35	15:07
275	0:48	1:49	3:14	4:43	"	"	9:21	12:44	16:38
300	0:53	1:59	3:31	"	"	"	10:12	13:53	18:09
350	1:02	2:19	3:47	"	"	8:16	11:54	16:12	21:10
400	1:10	2:38	"	"	6:03	9:27	13:36	18:31	24:12
450	1:19	2:50	"	"	6:48	10:38	15:19	20:50	27:13
500	1:28	"	"	5:14	7:34	11:49	17:01	23:09	30:14

3. Corrective Measures: If elapsed time is less than the specified amount, Contractor shall locate and repair leaks and repeat the test until elapsed time exceeds the specified amount.

D. INFILTRATION/EXFILTRATION TEST (USE ALL MANHOLES)

1. The use of this method for sewer pipe, in lieu of air tests may be used as an alternate test method.
2. Procedure:
 - a. Infiltration: Immediately following a period of heavy rain a test of work constructed up until the time shall be made. Three measurements shall be made at one (1) hour intervals to compute the amount of the infiltration. Tests for manholes only shall be conducted on individual manholes. Tests for pipe and manholes shall be performed on test sections not exceeding 600 linear feet of collector sewer and shall include both pipe and manholes. The Engineer reserves the right to use his judgement as to

whether the ground is sufficiently saturated and/or whether the fall of rain is adequate to permit making infiltration tests. In the event that sufficient rain does not occur before the date of completion, the Contractor shall be required to conduct the tests at any time during a 30-day period following this date. Should Engineer determine that certain pipe or manholes cannot be tested by infiltration methods, the Engineer may direct the filling of lines and the measurement of exfiltration. The allowable rate of exfiltration shall be the same as for infiltration.

- b. Exfiltration: Determine test sections as outlined for infiltration tests. Install a temporary water plug at the inlet and outlet of the test section. Fill test section with clean water up to the bottom of the lowest manhole frame within the test section. Allow time for saturation of pipe and manholes refilling test section as required. Beginning with a full test section, allow at least eight (8) hours to elapse without adding water. Measure the water level at the beginning and end of the elapsed time above. Compute the volume of water lost in gallons per hour.
3. Test Requirements: The rate of water loss/gain shall be less than the rate, in gallons per hour, calculated for the test section using the following allowances:
 - a. Sewer main and manholes with or without service laterals; 100 gallons per 24 hours per inch of sewer main diameter per mile of sewer main (gpd/in-mi).
 - b. Manholes only; 1 gallon per 24 hours per vertical foot of manhole.
4. Corrective Measures: If actual leakage rate is greater than required leakage rate, Contractor shall locate and repair leaks and repeat the test until actual leakage is less than the required rate.

E. DEFLECTION TEST

1. Use: All gravity sewer, 8-inch diameter through 15-inch diameter except ductile iron.
2. Procedure: Tests shall be performed by the Contractor in the presence of the Engineer no sooner than thirty (30) days after completion of backfill. The Owner, at his option, may require a second test within the guarantee period of the project. A nine (9) arm mandrel and proving ring, as manufactured by Wortco, Inc. or an approved equal, will be provided by the contractor. The mandrel shall be manually pulled, from manhole, through the entire length of mainline pipe. The mandrel and proving ring shall remain the property of the Contractor.

3. Requirement: All pipe shall allow passage of the test mandrel. The mandrel and proving ring shall be sized at 5% less than the ASTM dimension for the pipe in accordance with the following table:

NOM. DIA	L	ASTM D3034 SDR 35 D	ASTM D2680 D
8"	8"	7.28"	7.40"
10"	10"	9.09"	9.31"
12"	12"	10.79"	11.22"
15"	15"	13.20"	14.09"

L = Mandrel Contact Length
D = I.D. of Proving Ring

4. Corrective Measures: All pipe that fails the deflection test shall be removed, replaced and retested at no additional expense to the Owner.

F. FORCE MAIN PRESSURE TEST

1. The pressure/leakage test of water mains shall be in accordance with Standard AWWA C600-82. The allowable leakage shall not exceed that determined by the following formula:

$$L = \frac{SD \sqrt{P}}{133,200}$$

L = Allowable leakage in gallons per hour
S = Length of line tested in feet
D = Nominal diameter of pipe, in inches
P = Average test pressure, in psi - 1.50 average system pressure in the area, but not less than 150 psi.

2. Where practicable, pipe lines shall be tested in lengths of no more than 2,000 feet.
3. Duration of test shall be not less than 2 hours where joints are exposed, and not less than 24 hours where joints are covered, unless directed by the Engineer.
4. All visible leaks at exposed joints, and all leaks evident on the surface where joints are covered, shall be repaired and leakage minimized, regardless of total leakage as shown by test.
5. All pipe, fittings, and other material found to be defective under test shall be removed and replaced at the Contractor's expense.

6. Lines which fail to meet tests shall be repaired and retested as necessary, until test requirements are complied with.

END OF SECTION

SECTION 33 36 00 - PRE-CAST CONCRETE STRUCTURES

PART 1: GENERAL

1.01 SCOPE OF WORK

- A. This section covers the furnishing of all labor, equipment and materials necessary for the number, size, and type of pre-cast concrete structures to be installed as shown on the Contract Drawings.
- B. Installation of pre-cast concrete structures, manholes, and vaults involves, but is not limited to, the following:
 - 1. Preparation of the sub-grade.
 - 2. Installation.
 - 3. Pipe connection and sealing.
 - 4. Waterproofing.
 - 5. Frames, covers, and steps/ladders.
 - 6. Backfilling.
- C. Excavation and backfilling, as it relates to the installation of pre-cast concrete structures, are specified in Section 31 23 00 of these Contract Specifications.

1.02 Related Documents

- A. The general provisions of the Construction Contract, including the General and Supplemental General Conditions and the General Requirements (if any), apply to the work specified in this section
- B. Related work specified elsewhere in these Contract Specifications include:
 - 1. Section 31 23 00 – Excavation for Utilities
 - 2. Section 33 34 00 – Force mains and Gravity Sewers

1.03 SUBMITTALS

- A. Shop Drawings: Submit shop drawings for all pre-cast concrete structures for approval by the Engineer. Details of the underground structures, metal accessories, fittings, and connections shall be included in the submittals.
- B. If dimensions proposed for underground structures differ from those shown on the Contract Drawings, Contractor shall also submit flotation calculations for Engineer's review.

1.04 Quality Assurance

- A. All pre-cast concrete structures used in the work shall be manufactured by a supplier approved by the Engineer and septic and pump tanks shall bear the seal of approval from the Division of Environmental Health of the North Carolina Department of Environment & Natural Resources (NCDENR-DEH).

1.04 WARRANTY

All materials shall be guaranteed to be free from defects in materials and workmanship for a period of one (1) year after final acceptance by the Owner.

PART 2: PRODUCTS

2.01 Pre-Cast Concrete Structures

- A. Concrete Base: Pre-cast with extended footing where shown on the Contract Drawings.
- B. Pre-Cast Concrete Structures: Pre-cast underground structures shall conform to American Society of Testing and Materials (ASTM) C 913-89 with respect to design, materials, and manufacture as well as being capable of withstanding, at a minimum, HS-20 loads.
 - 1. Size shall be as shown on the Contract Drawings. Tanks shall be cast with a positive seal gasket system at all pipe penetrations. For pipe penetrations, use flexible connectors with dual stainless steel pipe clamps meeting ASTM C 923 for all pipe diameters. Rubber gaskets shall conform to ASTM C 433.
 - 2. Minimum acceptable wall thickness of pre-cast concrete structures shall be six (6) inches.
 - 3. All pre-cast concrete structures shall be certified by the manufacturer as sufficient for the service conditions, and as having been fitted at the plant site to assure proper joining and fitting of mating sections for a successful installation at the job site.

2.01 Accessories

- A. Cast-in vault hatches shall be fiberglass and of the size shown on the Contract Drawings. For submersible pump tanks and tanks with effluent filter installations, Contractor shall coordinate between the pre-caster and the respective equipment

Manufacturer's to ensure the proper location and size of the access hatch frames.

- B. Submersible pump tanks and valve vaults shall be provided with either cast-in manhole-type steps or a permanent aluminum ladder for operator access to the interior of the structure.

- 1. Manhole steps shall be of steel-reinforced, molded polypropylene plastic, designed for a 400-pound maximum vertical load and a 1,000-pound horizontal pull-out load. Steps shall be set 16 inches on center from the top of the cone to the invert shelf, integrally cast into sidewalls, and shall not penetrate through the wall. Unless otherwise indicated, steps shall have at least a 10-inch clear width and shall project at least four (4) inches from the wall into which they are embedded. Do not locate steps over influent or effluent pipe.

- C. All aluminum accessories associated with pre-cast concrete structures shall be coated with bituminous mastic where in contact with concrete.

PART 3: EXECUTION

3.01 Delivery, Storage, and Handling

- A. Upon delivery, the Contractor shall inspect all pre-cast concrete structures and components and arrange, with the manufacturer, for the replacement of any found to be damaged and/or deformed.
- B. The structures shall be stored in a manner to prevent damage as a result of Construction activities, weather, or lack of ventilation.
- C. Extreme care shall be exercised in handling all materials. The Contractor shall use manufacturer-supplied steel lift rings when moving the structures.

3.02 Installation

- A. All pre-cast concrete structures shall be installed in the positions and orientations and to the depths and elevations indicated on the Contract Drawings, in accordance with manufacturer's instructions, and in conformance with the requirements of ASTM C891-90.
 - 1. Each structure shall be installed upon a 12-inch minimum layer of No. 57 washed stone aggregate.
 - 2. Place bell ends of pre-cast sections or the groove end of the concrete facing down. In preparation for making joints, all surfaces of the portion of the section to be jointed and the factory-made jointing materials shall be clean and dry. Each joint, seam, and pipe penetration inside and outside of joints shall receive

liberal applications of non-shrink grout as well as liberal applications of bitumastic waterproof sealant. This will be in addition to the positive seal gasket system of flexible connectors specified in Section 03314-2.01(B).

3. Lifting holes and other penetrations of the pre-cast structure wall shall be sealed with non-shrinking grout. Pipe connections shall be made so that the pipe does not project beyond the inside wall of the structure. Grout connections as necessary to make smooth and uniform surfaces on the inside of the structure.
4. Before placing any tank or vault system into operation, remove any dropped grout, sand, or other imperfections and obstructions from the interior of the structure. Specifically, the inside walls of the installed structure shall be smooth and uniform. Smooth-finish inverts, so that wastewater flow is confined and directed through inlet and outlet pipes with easy transition.
5.
 - a. All access points to the tanks shall be backfilled such that precipitation flows away from the tank entrances.
 - b. Tanks shall be backfilled in accordance with the applicable specifications herein before prescribed.
6. A 24-hour static water test, in accordance with ASTM standards, shall be performed on all pre-cast concrete tanks in order to ensure their water-tightness.
 - a. The testing shall be performed in the presence of the Engineer or his representative.
 - b. Each tank shall be filled with water, and the initial water level shall be accurately measured.
 - c. At the end of a 24-hour test period, the level of the water remaining in the tank shall be measured again.
 - d. The Engineer shall pass the tank, if the difference between the initial and final water levels is less than 0.5 inch or if the total volume of water displaced is less than one (1) percent of the total effective liquid capacity of the tank being tested.
 - e. Each failed tank shall be tested again. In the event that the tank does not pass the second static water test, the Contractor shall remove and replace the tank installation at no additional cost to the Owner.
7. Vacuum testing may be required by the engineer in addition to the 24 hour static water test.

END OF SECTION

PART 1: GENERAL**1.01 SCOPE OF WORK**

This section covers providing and installing the storm drainage and underdrainage collection systems, including pipe culverts, French drains and appurtenant structures. Storm drainage systems shall be constructed as shown on the Contract drawings and as specified herein.

1.02 DELIVERY, STORAGE AND HANDLING**A. UNLOADING AND HANDLING**

All pipe and storm drainage material shall be unloaded and handled with reasonable care. Pipe shall not be rolled or dragged over gravel or rock during handling. When any joint or section of pipe is damaged during unloading or handling, the undamaged portions of the joint or section may be used where partial lengths are needed, or if damaged sufficiently, the Engineer will reject the joint or section as being unfit for installation and the Contractor shall remove such rejected pipe from the project.

1.03 SUBMITTALS

- A. The Contractor shall submit for approval of the Engineer shop drawings, which describe in detail the materials to be utilized before ordering. Six (6) copies of shop drawings shall be submitted. Prior to submittal all shop drawings are to be reviewed by the Contractor, and shall be stamped and signed as to compliance with the referenced specification. Any variance to the specification shall be noted.

The following shop drawings shall be submitted:

1. Drainage Pipe
2. Underdrain Pipe
3. Underdrain or Pipe Bedding
4. Drainage Structure Castings
5. Precast Drainage Structures
6. Frame, grate and hoods

1.04 WARRANTY

All pipe and materials shall be warranted for a period of one (1) year following installation and acceptance by the Owner.

PART 2: PRODUCTS

2.01 REINFORCED CONCRETE PIPE

- A. Reinforced concrete pipe shall conform to ASTM C-76, latest revision. Pipe shall be Table III or Table IV with Wall B, unless otherwise noted. All pipe shall have interior surfaces free from roughness, projection, indentations, offset or irregularities of any kind.
- B. Joints shall be sealed with a plastic cement putty meeting Federal Specification SS-S-00210, such as Ram-Nek or a butyl rubber sealant. Joint material for reinforced concrete pipe shall comply with ASTM C 443 and shall be either "O" ring type joints utilizing a rubber "O" ring, or bell and spigot type utilizing a mastic joint material equal to Ram-Neck.

2.02 CORRUGATED METAL PIPE

- A. All corrugated metal pipe shall be aluminized type 2 corrugated steel conforming to AASHTO M-274 latest revision unless otherwise called out on the design drawings. If called out as bituminous coated, pipe will conform to AASHTO M190, latest revision. Pipe shall be fully bituminous coated with an asphalt paved invert. Bituminous coating, shall consist of asphalt cement having a minimum thickness of 0.04" measured at the crest of the corrugations. Paved inverts in corrugated metal pipe, shall consist of asphalt cement applied on the inside of the pipe for one quarter of its circumference (bottom of pipe when installed). The pavement shall have a minimum thickness of 0.50" tapering to 0.1" at the sides. If pipe is called out as plain, non-coated, it shall conform to AASHTO M-36 latest revision.
- B. Corrugated metal pipe shall have 2-2/3" x 1/2" corrugations and shall be of the following minimum gauges:

18" and smaller pipes	16 gauge
21" - 30" pipes.....	14 gauge
36" - 48" pipes.....	12 gauge
56" and larger pipes	10 gauge

Corrugated Metal Pipe shall have rerolled ends to accommodate corrugated coupling bands. Coupling bands shall conform to NCDOT 932-3(A) installed with a minimum of two corrugations per pipe. Dimple bands shall not be used.

2.03 HIGH DENSITY POLYETHYLENE PIPE

All HDPE shall be water tight type "S" Hancor Blue Seal or approved equivalent and installed according to manufacturers specifications. Pipe manufactured for this specification shall comply with the requirements for test methods, dimensions and markings found in AASHTO Designations M252, M294, and MP7. Pipe and fittings

shall be made from virgin PE compounds which conform with the applicable current edition of the AASHTO Material Specifications for cell classification as defined and described in ASTM F667. Pipe shall have smooth wall interior unless otherwise specified.

The fittings shall not reduce or impair the overall integrity of function of the pipeline. Fittings may be either molded or fabricated. Common corrugated fittings include in-line joint fittings, such as couplers and reducers, and branch or complimentary assembly fittings such as tees, wyes and end caps. These fittings may be installed by various methods such as snap-on, bell and spigot, bell – bell and wrap around couplers. Couplers shall provide sufficient longitudinal strength to preserve pipe alignment and prevent separation of the joints. Only fittings supplied or recommended by the manufacturer shall be used. Where designated on the plans or project specifications, an elastomeric gasket meeting the requirements of ASTM F477 shall be supplied.

Installation of the pipe specified above shall be in accordance with either AASHTO 30 or ASTM D2321 and as recommended by the manufacturer, with the exception that minimum cover in traffic load areas shall be 12” for pipe diameters between 4” and 48” and 18” for pipe diameters 60” and greater.

2.04 CASTINGS

Castings shall be sound and free from warp, holes and other defects that impair their strength or appearance. Exposed surfaces shall have a smooth finish and sharp, well defined lines and arises. Machined joints, where required, shall be milled to a close fit. Provide all necessary lugs and brackets so that work can be assembled in a neat, substantial manner.

2.05 AGGREGATE FOR UNDERDRAINS

Aggregate for underdrains shall be washed stone, standard size number 67 per North Carolina Department of Transportation specifications, Section 905.

PART 3: EXECUTION

3.01 PREPARATION OF PIPE FOUNDATION

A. LINES AND GRADES

The pipe foundation shall be prepared to be uniformly firm and shall be true to the lines and grades as shown on the plans. Any deviation or field adjustments will require the approval of the Engineer. When an Inspector is present on the site and is so requested by the Contractor, he shall check the position of grades and lines; but the Contractor shall be responsible for the finished drain line being laid to exact and proper line and grade.

B. PIPE FOUNDATION

1. Whenever the nature of the ground will permit, the excavation at the bottom of the trench shall have the shape and dimensions of the outside lower third of the circumference of the pipe, care being taken to secure a firm bearing support uniformly throughout the length of the pipe. A space shall be excavated under and around each bell to sufficient depth to relieve it of any load and to allow ample space for filling and finishing the joint. The pipe, when thus bedded firmly, shall be on the exact grade. In case the bed shaped in the bottom of the trench is too low, the pipe shall be completely removed from position, and earth of suitable quality shall be placed and thoroughly tamped to prepare a new foundation for the pipe.
2. In no case shall the pipe be brought to grade by blocking up under the barrel or bell of same, but a new and uniform support must be provided for the full length of the pipe. Where rock or boulders are encountered in the bottom of the trench, the same shall be removed to such depth that no part of the pipe, when laid to grade, will be closer to the rock or boulders than 6". A suitably tamped and shaped foundation of suitable earth shall be placed to bring the bottom of the trench to proper subgrade over rock or boulders.
3. Where the foundation material is found to be of poor supporting value, the Engineer may make minor adjustment in the location of the pipe to provide a more suitable foundation. Where this is not practical, the foundation shall be conditioned by removing the existing foundation material by undercutting to the depth as directed by the Engineer, within the limits established on the plans, and backfilling with either a suitable local material secured from unclassified excavation or borrow excavation at the nearest accessible location along the project, or foundation conditioning material consisting of crushed stone or gravel or a combination of sand and crushed stone or gravel approved by the Engineer as being suitable for the purpose intended. The selection of the type of backfill material to be used for foundation conditioning will be made by the Engineer.

C. WATER IN TRENCHES

The Contractor shall remove all water which may be encountered or which may accumulate in the trenches by pumping or bailing; and no pipes shall be laid until the water has been removed from the trench. The Contractor will not be permitted to drain water through the storm drain within a period of twenty-four (24) hours after the pipe has been laid, and the open end of the pipe in the trench shall be kept closed with a tight fitting plug to prevent washing of dirt or debris into the line. Water so removed from the trench must be disposed of in such manner as not to cause injury to work completed or in progress.

D. SPECIAL FOUNDATIONS

Whenever the bottom of the trench shall be of such nature as to provide unsatisfactory foundation for the pipe, a Geotechnical Materials Testing Engineer will be required to examine the materials and make recommendations for necessary repairs to subgrade.

3.02 LAYING PIPE

A. GENERAL

All piping is to be installed in strict accordance with the manufacturer's recommendations. Installation manuals from various material suppliers shall be furnished to the Engineer for his review and approval prior to installation of any material. The Engineer may augment any manufacturer's installation recommendations, if in his opinion it will best serve the interest of the Owner.

B. LAYING PIPE

1. No pipe shall be laid except in the presence of the Engineer or his inspector, or without special permission from the Engineer. Proper tools, implements, and facilities satisfactory to the Engineer shall be provided and used for the safe and convenient prosecution of pipe laying. All pipe, fittings, valves, and other materials used in the laying of pipe will be lowered into the trench piece by piece by means of suitable equipment in such a manner to prevent damage to the pipe materials, to the protective coating on the pipe materials, and to provide a safe working condition to all personnel in the trench. Each piece of pipe being lowered into the trench shall be carefully given a final inspection to see that it is clean, sound and free of defects. It shall be laid on the prepared foundation to produce a straight line on a uniform grade, each pipe being laid as to form a close abutted joint with a preceding pipe, so as to form a smooth and straight inside flow line. Each pipe will be tested for its exact position after it is in its final position. The pipes shall be fitted together in order to insure sufficient space for joint gaskets, and other jointing material. Pipe shall be removed at any time if broken, injured or displaced in the process of laying same, or of backfilling the trench.
2. When cutting short lengths of pipe, a pipe cutter as approved by the Engineer will be used, and care will be taken to make the cut at right angles to the center line of the pipe, or on the exact skew as shown on the plans. In the case of push-on pipe, the cut ends shall be tapered with a portable grinder, or course file to match the manufactured taper.
3. When coupling bands for annular or helical corrugated metal pipe are used, the pipe sections shall be joined and fully bolted so that the circumferential and longitudinal strength will be sufficient to preserve the

alignment, prevent separation of the sections, and to prevent infiltration of backfill material.

3.03 BACKFILLING

- A. The backfill around the pipe shall be placed in layers not to exceed 6" loose and compacted to 95% Standard Proctor test for all areas and 98% for top 24" below subgrade directly beneath subgrade in paved areas. From the bottom of the trench to the centerline of the pipe the backfill material shall be compacted by approved hand tamps. From the centerline of the pipe to the top of the trench other mechanical tamps as approved by the Engineer may be used. The Engineer shall approve all backfill material. Select backfill material shall be used when called for on the plans.
- 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 stones, frozen lumps, roots and limbs, chunks of highly plastic clay, or other objectionable materials.
- C. All pipe backfill areas shall be graded and maintained in such a condition that erosion or saturation will not damage the pipe bed or backfill.
- D. Heavy equipment shall not be operated over any pipe until it has been properly backfilled and has a minimum cover as required by the plans. Where any part of the required cover is above the proposed finish grade, the Contractor shall place, maintain, and finally remove such material at no cost to the Owner. Pipe, which becomes misaligned, shows excessive settlement, or has been otherwise damaged by the Contractor's operations shall be removed and replaced by the Contractor at no cost to the Owner.

3.04 TESTING

- A. Upon completion, installed lines shall show a full circle of light when "Lamped" between catch basins. This test shall be performed by the Engineer.
- B. Other tests may be required by the Engineer, such as exfiltration and compaction of backfill over pipes. In this event the results shall meet the minimum standards that the manufacturer states are obtainable.
- C. One compaction test performed directly above storm pipe placed in areas under pavement shall be conducted every 300 LF of storm pipe placed and shall meet testing requirements noted in section 2220 of the specifications.

END OF SECTION

PART 1: GENERAL**1.01 SCOPE OF WORK**

This section covers providing and installing the storm drainage and underdrainage collection systems, including excavation, drainage layer, adsorption, ground cover, control structure, outfall, filtration material, and design elements. Bioretention systems shall be constructed as shown on the Contract drawings and as specified herein.

1.02 DELIVERY, STORAGE AND HANDLING**A. UNLOADING AND HANDLING**

All pipe and storm drainage material shall be unloaded and handled with reasonable care. Pipe shall not be rolled or dragged over gravel or rock during handling. When any joint or section of pipe is damaged during unloading or handling, the undamaged portions of the joint or section may be used where partial lengths are needed, or if damaged sufficiently, the Engineer will reject the joint or section as being unfit for installation and the Contractor shall remove such rejected pipe from the project.

B. MIX STORAGE AND HANDLING

Pipe, soil media, concrete storm structures, and all other materials shall be delivered to the Project Site properly tagged, bundled, and ready to place. Materials delivered to the Project Site, and not immediately placed, shall be protected from mud, rainfall erosion, oil, grease, and distortion.

1.03 SUBMITTALS

- A. The Contractor shall submit for approval of the Engineer shop drawings, which describe in detail the materials to be utilized before ordering. Six (6) copies of shop drawings shall be submitted. Prior to submittal all shop drawings are to be reviewed by the Contractor, and shall be stamped and signed as to compliance with the referenced specification. Any variance to the specification shall be noted.

The following shop drawings shall be submitted:

1. Drainage Pipe
2. Underdrain Pipe
3. Underdrain or Pipe Bedding
4. Drainage Structure Castings

5. Media Mix
6. Frame, grate and hoods

1.04 WARRANTY

All pipe, materials, and workmanship shall be warranted for a period of one (1) year following installation and acceptance by the Owner.

PART 2: PRODUCTS

2.01 SOIL MEDIA TYPE

- A. The soil mix should be uniform and free of stones, stumps, roots or other similar material greater than 2 inches. It should be a homogenous soil mix of 85-88 percent by volume sand (USDA Soil Textural Classification), 8 to 12 percent fines (silt and clay), and 3 to 5 percent organic matter (such as peat moss) shall be used. In areas where phosphorus is the target pollutant, lower (8 percent) fines should be used. Additionally, the soil mix should have a P-index between 10 and 30.

2.02 PLANTING MATERIALS

- A. Plant Material:
 1. Definition: Trees and shrubs listed in the Plant Schedule in the Drawings.
 2. General:
 - a. Species, sizes, manner in which to be planted, and approximate quantities to complete the planting as indicated are included in the Plant Schedule.
 - b. Scientific and common plant names conform to those given in Hortus Third, or are those generally accepted in the nursery trade.
 3. Quality:
 - a. Conform to the standards set forth in American Standard for Nursery Stock.
 - b. Standard quality and first-class representatives of their species or variety and true to name and type.
 - c. Nursery-grown, unless specified otherwise.
 - d. In compliance with State and Federal laws relating to disease and insect infestation; file certificates with Landscape Architect.
 - e. Having normal, well developed branches and vigorous root systems, free from defects, decay, disfigurements, sun scald, bark abrasions, plant diseases, insect pests or eggs, borers and any and all infestations.

4. Plant material will be rejected for:
 - a. Lack of compactness or proper proportion;
 - b. Weak, thin growth in rows too close together;
 - c. Cut back from larger stock to meet specified requirements;
 - d. Undersized, dry, cracked or broken balls, or plants that are loose in their ball.
 - e. Any balled & burlapped material not root-pruned within the last two years.
 - f. Root bound within container or ball;
 - g. Lacking proper proportion as to height and spread and specified characteristics or plant material;
 - h. Not acceptable to Landscape Architect; or Owner

5. Size:
 - a. Sizes and proportions of all plant materials shall equal those recommended by the American Standard for Nursery Stock for specified grades.
 - b. Measure plants before pruning and with branches in normal position.
 - c. Equal or exceed measurements specified in Plant Schedule, which are the minimum acceptable; provide 50% of plant material maximum size specified.
 - d. Height and spread dimensions: General body mass of plant, not from branch tip to tip.
 - e. Well-proportioned as to height; reject plants which meet specified measurements but do not possess an overall balance.
 - f. Take caliper measurements on trunk 6 inches above natural ground level up to and including 4-inch caliper size; 12 inches above natural ground level for larger sizes.
 - g. B&B plants shall have firm natural balls of a diameter and depth not less than that recommended in American Standard for Nursery Stock.
 - h. Container-grown plants: Conform to standards set forth in American Standard for Nursery Stock for container-grown plants.

6. Quantity: Furnish plants in sufficient quantity to satisfy the intent of the Drawings and Specifications. Locate in sufficient quantity so that time is not lost if some plants are rejected.

2.03 UNDERDRAIN PIPE

- A. Six (6) Inch diameter pipe for underdrain systems. An up-turned elbow may be used. Clean-out pipes must be provided per plan. Clean out pipes must be capped, four (4) inches above finished grade

2.04 HIGH DENSITY POLYETHYLENE PIPE

All HDPE shall be water tight type "S" Hancor Blue Seal or approved equivalent and installed according to manufacturers specifications. Pipe manufactured for this specification shall comply with the requirements for test methods, dimensions and markings found in AASHTO Designations M252, M294, and MP7. Pipe and fittings shall be made from virgin PE compounds which conform to the applicable current edition of the AASHTO Material Specifications for cell classification as defined and described in ASTM F667. Pipe shall have smooth wall interior unless otherwise specified.

The fittings shall not reduce or impair the overall integrity of function of the pipeline. Fittings may be either molded or fabricated. Common corrugated fittings include in-line joint fittings, such as couplers and reducers, and branch or complimentary assembly fittings such as tees, wyes and end caps. These fittings may be installed by various methods such as snap-on, bell and spigot, bell – bell and wrap around couplers. Couplers shall provide sufficient longitudinal strength to preserve pipe alignment and prevent separation of the joints. Only fittings supplied or recommended by the manufacturer shall be used. Where designated on the plans or project specifications, an elastomeric gasket meeting the requirements of ASTM F477 shall be supplied.

Installation of the pipe specified above shall be in accordance with either AASHTO 30 or ASTM D2321 and as recommended by the manufacturer, with the exception that minimum cover in traffic load areas shall be 12” for pipe diameters between 4” and 48” and 18” for pipe diameters 60” and greater.

2.07 CASTINGS

Castings shall be sound and free from warp, holes and other defects that impair their strength or appearance. Exposed surfaces shall have a smooth finish and sharp, well defined lines and arises. Machined joints, where required, shall be milled to a close fit. Provide all necessary lugs and brackets so that work can be assembled in a neat, substantial manner.

2.08 AGGREGATE FOR UNDERDRAINS

Aggregate for underdrains shall be washed stone, standard size number 67 per North Carolina Department of Transportation specifications, Section 905.

2.09 FILTER FABRIC

AASHTO M288 Class 2 Non-woven geotextile Filter Fabric shall be used. Must maintain 125 gpm per sq. ft. flow rate. Note: a 4” pea gravel layer may be substituted for geotextiles meant to separate sand filter layers.

PART 3: EXECUTION

3.01 PREPARATION OF PIPE FOUNDATION AND POND EXCAVATION

A. LINES AND GRADES

The pipe or pond foundation shall be prepared to be uniformly firm and shall be true to the lines and grades as shown on the plans. Any deviation or field adjustments will require the approval of the Engineer. When an Inspector is present on the site and is so requested by the Contractor, he shall check the position of grades and lines; but the Contractor shall be responsible for the finished drain line being laid to exact and proper line and grade.

B. SYSTEM FOUNDATION

1. Whenever the nature of the ground will permit, the excavation at the bottom of the trench shall have the shape and dimensions depicted on the project details, care being taken to secure a firm bearing support uniformly throughout the area of the system. The system shall be on the exact grade. In case the bottom of the excavation is too low, earth of suitable quality shall be placed and compacted per project specifications to prepare a new foundation for the system.
2. In no case shall pipe be brought to grade by blocking up under the barrel or bell of same, but a new and uniform support must be provided for the full length of the pipe. Where rock or boulders are encountered in the bottom of the excavation, the same shall be removed to such depth that no part of the system, when laid to grade, will be closer to the rock or boulders than 6". A suitably tamped and shaped foundation of suitable earth shall be placed to bring the bottom of the excavation to proper subgrade over rock or boulders.
3. Where the foundation material is found to be of poor supporting value, the Engineer may make minor adjustment in the location of the system to provide a more suitable foundation. Where this is not practical, the foundation shall be conditioned by removing the existing foundation material by undercutting to the depth as directed by the project Geotechnical Engineer, within the limits established on the plans, and backfilling with either a suitable local material secured from unclassified excavation or borrow excavation at the nearest accessible location along the project, or foundation conditioning material consisting of crushed stone or gravel or a combination of sand and crushed stone or gravel approved by the project geotechnical Engineer as being suitable for the purpose intended. The selection of the type of backfill material to be used for foundation conditioning will be made by the Engineer.

C. POND EXCAVATION - See Grading Specification.

D. **WATER IN EXCAVATIONS**

The Contractor shall remove all water which may be encountered or which may accumulate in the excavation by pumping or bailing; and no pipes shall be laid until the water has been removed. The Contractor will not be permitted to drain water through the storm drain within a period of twenty-four (24) hours after the pipe has been laid, and the open end of the pipe in the trench shall be kept closed with a tight fitting plug to prevent washing of dirt or debris into the line. Water so removed from the excavation must be disposed of in such manner as not to cause injury to work completed or in progress.

3.06 LAYING PIPE

See Drainage Materials specification

3.07 BACKFILLING

- A. The backfill of 67 stone around the underdrainage shall be placed in layers not to exceed 6" loose. Soil media shall be placed in a manner that does not damage or disturb the drainage layer or filter fabric. The project geotechnical Engineer shall approve soil media material provided by the contractor.
- B. Care shall be taken during soil media backfill and maintain alignment and prevent damage to the drainage layer. The soil media shall be protected from stones, frozen lumps, roots and limbs, chunks of highly plastic clay, or other objectionable materials.
- C. All soil media and surrounding area shall be graded and maintained in such a condition that erosion or siltation will not damage backfill material.
- D. Heavy equipment shall not be operated over any pipe until it has been properly backfilled and has a one (1) foot minimum cover. Where any part of the required cover is above the proposed finish grade, the Contractor shall place, maintain, and finally remove such material at no cost to the Owner. Underdrain, which becomes misaligned, shows excessive settlement, or has been otherwise damaged by the Contractor's operations shall be removed and replaced by the Contractor at no cost to the Owner.

3.08 TESTING

- A. A draw down test per the permit shall be performed by the contractor. Draw down test will be documented by contractor and provided as part of the project closeout requirements.

END OF SECTION

SECTION 33 49 00

MINOR DRAINAGE STRUCTURES

PART 1: GENERAL

1.01 SCOPE OF WORK

The work covered by this section consists of the installation of drainage catch basins, together with all necessary metal grates, covers, frames, and other hardware, in accordance with the requirements shown on the plans and the provisions of these specifications.

1.02 QUALITY ASSURANCE

All plastic surface drainage structures and other fabricated materials shall be manufactured by suppliers with at least five (5) years of experience in the manufacture of similar materials.

1.03 SUBMITTALS

SHOP DRAWINGS

The Contractor shall submit at least six (6) copies of shop drawings to the Engineer, including dimensional drawings, materials of construction; catalogue cut sheets, and other pertinent information.

1.04 DELIVERY, STORAGE AND HANDLING

All materials shall be delivered, stored and handled in strict accordance with the manufacturer's recommendations, and in a manner, which preserves the structural integrity of the materials.

1.05 WARRANTY

All materials and equipment shall be warranted to be free from defects in workmanship and materials for one (1) year after final acceptance.

PART 2: PRODUCTS

2.01 MATERIALS

A. Storm Inlet Structures

1. Concrete and masonry shall meet the requirements of the appropriate section of NCDOT Standard Specifications for Roads and Structures (latest Edition). All concrete shall be Class A or B 4000 psi minimum unless otherwise indicated on the plans, meeting the requirements of Section 700 and constructed in accordance with Section 825. Masonry

shall meet the requirements of Section 700 and construction in accordance with Section 830 and/or 834.

2. Where necessary to fit field conditions, the dimensions of the structure and footings shall be varied as directed by the Engineer.
3. Plastic (PVC) surface drainage structures shall conform to the dimensions and depth referenced on the Construction drawings. The required ductile iron frame shall be provided from the manufacturer as an integral part of the surface drainage structure. All pipe junctions internal to the box shall be made by means of thermal molding and shall be water tight. Connections to stormwater conveyance pipe shall be water tight and shall conform to ASTM D3212 for joints for drain and sewer plastic pipe using flexible elastomeric seals. The flexible seals shall conform to ASTM F477. The pipe bell spigot shall be joined to the main structure of the catch basin. The Ductile Iron frame and grate shall be manufactured in a way that allows them to rest securely on the rim of the Plastic catch basin and shall conform to ASTM A536 grade 70-50-05 for Ductile Iron.

B. FITTINGS AND CONNECTIONS

1. Where fittings enter the masonry, they shall be placed as the work is built up, thoroughly bonded, and accurately spaced and aligned.
2. Pipe connections shall be made using manufacturer provided bell and spigot type joints. Any sump that exists in the structure shall be filled with an approved material to ensure that there is no standing water in the surface drainage structure.
3. Metal frames for grates and covers shall be set elastomeric rings on the plastic surface drainage structure. The surrounding concrete shall be set at line and grade per the construction plans to allow proper drainage into the structure while allowing the top of the structure to be removed for maintenance if necessary.

C. BACKFILL

After the structure has been completed, and all forms, falsework, sheeting, and bracing have been removed, the excavation shall be backfilled with approved material compacted to a density of 95% standard proctor for areas unpaved and 98% for the last 24" under subgrade in paved areas. Backfilling shall not be done until the concrete or brick masonry has cured for at least seven (7) curing days, unless otherwise permitted by the Engineer. Please refer to the project grading specifications for allowable soil types and compaction procedures.

D. PIPE COLLARS AND PIPE PLUGS

Pipe collars and pipe plugs shall be constructed in accordance with the details shown on the plans or as directed by the Engineer.

PART 3: EXECUTION

3.01 INSTALLATION

- A. Drainage structures shall be built to the lines, grades and dimensions as shown on the plans. The Contractor shall adjust the final grades in the field as necessary to provide positive drainage to the structures or to match final pavement or grade elevation.
- B. Excavations for drainage structures shall be made with care so as not to disturb the surrounding areas more than necessary. All excavations shall be maintained water free until completion of the drainage structure, including backfilling. The Contractor shall provide adequate pumping capacity as required.
- C. Place 6" of #57 washed stone under structures. Where the foundation material is found to be of poor supporting value, the existing foundation material shall be removed by undercutting to the depth directed by the Engineer and backfilled with suitable material secured from locations along the project or from a borrow pit. The backfill placed in the undercut area shall be compacted to a degree satisfactory to the Engineer.

3.02 QUALITY CONTROL AND FIELD TESTING

The Contractor shall demonstrate to the Owner and Engineer that all drainage structures operate as intended and designed. All drainage structures shall be field tested by the Contractor in the presence of the Engineer prior to final acceptance. All drainage structures will be cleaned of debris and sediment before being turned over to the Owner.

END OF SECTION

PART 1: GENERAL**1.01 SCOPE OF WORK**

The work covered by this section consists of the construction of storm detention structures together with all necessary metal grates, frames, standpipes, weirs and other hardware, in accordance with the requirements shown on the plans and the provisions of these specifications.

1.02 QUALITY ASSURANCE

All precast concrete structures and other fabricated materials shall be manufactured by suppliers with at least five (5) years of experience in the manufacture of similar materials.

1.03 SUBMITTALS**SHOP DRAWINGS**

The Contractor shall submit at least six (6) copies of shop drawings to the Engineer, including dimensional drawings, materials of construction, and other pertinent information.

1.04 DELIVERY, STORAGE AND HANDLING

All materials shall be delivered, stored and handled in strict accordance with the manufacturer's recommendations, and in a manner which preserves the structural integrity of the materials.

1.05 WARRANTY

All materials and equipment shall be warranted to be free from defects in workmanship and materials for one (1) year after final acceptance.

PART 2: PRODUCTS**2.01 MATERIALS****A. CONCRETE AND MASONRY**

1. Concrete and masonry shall meet the requirements of appropriate section of NCDOT standard specifications for road and structures (latest edition).

Concrete shall be class B, 4000psi minimum, meeting the requirements of section 700.

2. Where necessary to fit field conditions, the dimensions of the structure shall be varied as directed by the Engineer.

B. FITTINGS AND CONNECTIONS

1. Where fittings enter the masonry, they shall be placed as the work is built up, thoroughly bonded, and accurately spaced and aligned.
2. Pipe connections shall be cut off flush with the inside wall of the drainage structure and grouted as necessary to make smooth and uniform surfaces on the inside of the structure. Each drainage structure shall have a shaped invert constructed from concrete, and a bench with a maximum 5:1 slope. The bench shall begin at a height of one-half the pipe diameter for 15 to 24 inch pipe, and one-third the pipe diameter for 30 to 48 inch pipe, and one-fourth the diameter for pipe greater than 48 inches in diameter.
3. Metal frames for grates and covers shall be set in full mortar beds or secured by methods approved by the Engineer.
4. Standpipes shall be adequately secured to the inside wall of detention structures with two (2) stainless steel straps with stainless steel fasteners.
5. Stairs shall be provided directly under all the metal frame and grate to provide access to the detention structure and shall be spaced 1'-4" apart. Stairs shall be constructed per OSHA standards and specifications with access per OSHA standards.

C. BACKFILL

After the structure has been completed, and all forms, falsework, sheeting, and bracing have been removed, the excavation shall be backfilled with approved material compacted to a density of 95% standard proctor. Backfilling shall not be done until the concrete or brick masonry has cured for at least seven (7) curing days, unless otherwise permitted by the Engineer.

D. STANDPIPES

Interior Standpipes, where specified on plans and details, shall be made of high density polyethylene (HDPE) corrugated Type "S" Hancor Blue Seal or equivalent. Pipe material shall meet the product specifications of ASTM F667.

PART 3: EXECUTION

3.01 INSTALLATION

- A. Detention structures shall be built to the lines, grades and dimensions as shown on the plans. The Contractor shall adjust the final grades in the field as necessary to provide positive drainage to the structures or to match final pavement or grade elevation.
- B. Excavations for detention structures shall be made with care so as not to disturb the surrounding areas more than necessary. All excavations shall be maintained water free until completion of the drainage structure, including backfilling. The Contractor shall provide adequate pumping capacity as required.
- C. Where the foundation material is found to be of poor supporting value, the existing foundation material shall be removed by undercutting to the depth directed by the Engineer and backfilled with suitable material secured from locations along the project or from a borrow pit. The backfill placed in the undercut area shall be compacted to a degree satisfactory to the Engineer.
- D. Contractor is required to tie-in to an existing structure. The existing structure should be brought into compliance with current municipality standards.

3.02 QUALITY CONTROL

The Contractor shall demonstrate to the Owner and Engineer that storm detention structures are constructed as designed. Detention structures will be inspected by the Engineer to be complete with metal frame and grate, steps, grouting, secured standpipe with stainless steel straps and fasteners, and correct standpipe height, orifice diameter and weir dimensions prior to final acceptance.

3.03 CLEANING

Clean interior of structure of dirt and superfluous materials.

END OF SECTION

SECTION 33 49 24 STORMWATER CHAMBER DRAINAGE SYSTEMS

PART 1: GENERAL

1.01 SCOPE OF WORK

- A. The work covered by this section shall consist of furnishing all labor, equipment, and materials to complete the installation of the StormTech, Triton, or approved equivalent chamber drainage system.
- B. Related work includes the installation of drainage inlet structures, manholes and outlet structures.

1.02 RELATED SECTIONS

- A. Section 31 00 00 Earthwork
- B. Section 31 23 00 Excavation and Backfill
- C. Section 33 41 00 Drainage Materials
- D. Section 33 49 00 Minor Drainage Structures
- E. Section 33 49 23 Storm Detention Structures

1.03 ABBREVIATIONS

- A. HDPE: High Density Polyethylene
- B. PE: Polyethylene
- C. ASTM – American Society for Testing and Materials
- D. AASHTO – American Association of State Highway and Transportation Officials

1.04 DEFINITIONS

- A. Stormwater Chamber System: All products associated with the drainage system including but not limited to chambers, end caps, pipe, fittings, stone, geotextile, and drainage structures.
- B. Subsurface Drainage System: Refers to the StormTech, Triton, or approved equivalent subsurface stormwater chamber system.
- C. Manifolds and manifold piping refer to the piping system to inlet and outlet rows of chambers.

- D. Stormtech, Triton, or approved equivalent brand names will be referred to as CHAMBER MANUFACTURER hereafter.

1.05 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM F 2418 Standard Specification for Polypropylene (PP) Corrugated Wall Stormwater Collection Chambers

1.06 ADMINISTRATIVE REQUIREMENTS

A. PREINSTALLATION MEETINGS

Contact chamber manufacturer representative and Engineer at least one week prior system installation for any pre-installation consultation.

B. SEQUENCING

- 1. Contractor is responsible for coordinating the installation of the subsurface stormwater chamber system with the installation of permanent structures on site.
 - a. Construction loads for permanent structures may require the subsurface chamber system to be installed after the permanent structure(s) on site.
- 2. Coordinate stormwater chamber system connections to off site storm sewer with the appropriate agency having jurisdiction.
- 3. Coordinate stormwater chamber system connections to existing on-site storm sewer appropriately to not allow sediment to enter into system.

1.07 SUBMITTALS

The Contractor shall provide to the Engineer six (6) copies of shop drawings or submittals for each of the following:

A. PRODUCT SPECIFICATIONS AND INSTALLATION INSTRUCTIONS

- 1. Chambers and end caps
- 2. PE and HDPE pipe

B. INSPECTION AND MAINTENANCE INSTRUCTIONS

- 1. StormTech Isolator™ Row (or equal)

1.08 QUALITY ASSURANCE

A. QUALIFICATIONS

All chamber and end cap products must be produced in an ISO 9001 certified manufacturing facility or shall demonstrate at least 5 years of experience in the production of similar products.

1.09 DELIVERY, STORAGE AND HANDLING

- A. Contractor shall check all materials upon delivery to assure that the proper chamber size and plastic pipe and pipe fittings have been received.
- B. Contractor shall check the chambers for shipping damage prior to installation. Units that have been damaged must not be installed. Contractor shall contact chamber manufacturer immediately upon discovery of any damage. Chambers may be left palletized until the units are ready to be installed.
- C. All chambers, PE pipe and PE pipe fittings shall be delivered to the site and unloaded with handling that conforms to the manufacturer's instructions for reasonable care.
- D. Protect chamber and chamber fittings from dirt and damage.
- E. All pipe and chambers shall be protected against impact, shock and free fall, and only equipment of sufficient capacity and proper design shall be used in the handling of the pipe. Storage of the pipe on the job shall be in accordance with the pipe manufacturer's recommendations.
- F. Contractor shall refer to the fabric manufacturer's guidance handling and storage of fabric products on site.

PART 2: PRODUCTS

2.01 STORMWATER CHAMBER SYSTEM

A. MATERIALS

1. Chamber

- a. Chambers shall be injection molded from virgin polypropylene resin and produced in accordance with ASTM F 2418.
- b. Chamber rows shall provide continuous, unobstructed internal space with no internal support panels in order to provide ease of access for inspection and maintenance functions.

- c. Chambers shall incorporate an optional 4-inch cut-out to allow for the installation of inspection ports. Inspection ports shall be installed and constructed per plans and details. Inspection ports shall only be installed along the Isolator™ Row (or equal).
 - d. The chambers shall be open-bottomed.
 - e. The chamber shall incorporate an overlapping corrugation joint system to allow chamber rows of almost any length to be built. The chambers may be cut at 6.5” increments at the job site to improve site optimization and reduce product waste.
2. End Caps
- a. End caps shall be injection molded from polyethylene resin to allow prefabricated pipe connections with polyethylene pipe.
 - b. All chamber rows shall be terminated with an end cap specifically designed to fit any corrugation of the stormwater chamber. End caps shall have a curved face capable of resisting typical horizontal and vertical loads.
3. Manifold Piping
- b. Manifold piping shall be of HDPE.
4. Stone
- a. The foundation, embedment and cover stone shall be in accordance with the chamber manufacturer’s installation instructions.
5. Fabric
- a. Fabric between the chamber bottom and the stone foundation located along the entire length of the Isolator™ Row (or equal) shall be AASHTO M288 Class 1 Woven.
 - b. Fabric between the top of the Isolator™ Row (or equal) chambers and the embedment stone and surrounding the entire chamber system shall be AASHTO M288 Class 2 Non-Woven

2.02 ACCESSORIES

Pipe plugs can be used during construction on all inlet pipes to the stormwater chamber system to prevent construction sediment from entering the Isolator™ Row system. Pipe plugs to be removed once construction of the system is complete and no further construction sediment loading is expected.

PART 3: EXECUTION

3.01 PREPARATION

A. GENERAL

1. The Contractor shall install all drainage structures, pipe and chambers in the locations shown on the drawings. Pipe shall be of the type and sizes specified on the drawings and shall be laid accurately to line and grade. Structures shall be accurately located and properly oriented.
2. Chambers, pipe and drainage structures shall be inspected prior to installation and any defective or damaged product shall be replaced accordingly.
3. Contact local underground utility companies prior to construction.
4. All erosion and sediment control measures as shown on the drawings must be installed before construction of subsurface drainage system ensues.
5. Contractor must contact Engineer 48 hours of prior to construction of subsurface drainage system to allow Engineer to inspect layout of chambers before any backfill begins.

B. SITE PREPARATION

1. Excavation must be free of standing water. When groundwater is present in the work area, dewater to maintain stability of in-situ and imported materials. Maintain water level below pipe bedding and foundation to provide a stable trench bottom.
2. Prepare the chamber bed's subgrade soil as shown on the drawings or in the specifications. Requirement for subgrade soil bearing capacity should meet or exceed the chamber manufacturer's allowable subgrade soil bearing capacity. The contractor must report any discrepancies with subgrade soil's bearing capacity to the design engineer.

3.02 CHAMBER INSTALLATION AND BACKFILLING

- A. Install chamber system flat or at constant slope between points an elevations indicated.
- B. Construct fabric and stone foundation per chamber manufacturer's installation instructions.
- C. Construct the chamber bed by joining the chambers lengthwise in rows. Attach chambers by overlapping the end corrugation of one chamber onto the end corrugation of the last chamber in the row.

- D. See pipe manufacturer's installation instructions for pipe assembly.
- E. Stone placement between chamber rows and around perimeter must following instructions as indicated in the most current version of the chamber manufacturer's installation instructions.
- F. The contractor must refer to the chamber manufacturer's installation instructions for a table of acceptable vehicle loads at various depths of cover. The contractor is responsible for preventing vehicles that exceed the chamber manufacturer's requirements from traveling across or parking over the chamber system.
- G. Refer to the chamber manufacturer's installation instructions for minimum requirements for backfill material above the subsurface drainage system.
- H. See pipe manufacturer's installation instructions for guidance on installing the plastic pipe fittings to the chamber system.

3.03 PROTECTION

- A. Protect all inlets and outlets to the stormwater chamber system during construction. As noted in Section 2.02, pipe plugs may be used in the inlet manhole pipes to prevent construction sediments from clogging the system. Once construction has ceased, the pipe plugs are removed to allow normal system functionality.

3.04 INSPECTION AND MAINTENANCE

- A. If the Contractor fails to provide adequate measures to prevent sediment from entering subsurface drainage system, the Contractor will be responsible for cleaning out prior to final acceptance by the Engineer at no additional cost to the Owner. Maintenance of the Isolator™ Row (or equal) shall utilize a JetVac process to remove sediment. Sediment will also be removed from both the inlet and outlet control structures.

END OF SECTION

PART 1: GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

Refer to other applicable portions of these specifications for work indicated, but not specifically outlined in this section.

A. DESCRIPTION

Furnish and install a complete simplex submersible grinder pumping system as indicated on the Plans and as described herein.

The Pump Station shall include one (1) submersible grinder pump with a factory-built prefabricated fiberglass wet-well with dual guide rail system, pump mounting base elbows, PVC discharge piping, valves, and stainless steel guide rails with support brackets, pump control panel and appurtenances.

B. SUBMITTALS

The Contractor shall furnish six (6) copies of shop drawings to the Engineer in accordance with the General Conditions.

PART 2: GRINDER PUMPS

2.01 GENERAL

A. Furnish and install one submersible grinder pumps in a factory-built simplex pump station as shown on the plans. Each pump shall be equipped with a submersible electric motor connected for operation at 230 volts, 1 phase, 60 hertz service, with a minimum of 20 feet jacketed cable suitable for submersible pump applications. The pump shall be supplied with a mating cast iron discharge elbow and capable of delivering the stated flows. Each unit shall be fitted with 10 feet of stainless steel lifting chain of adequate strength to permit raising and lowering the pump.

B. Pump shall be **RGS200** as manufactured by Goulds.

2.02 PERFORMANCE REQUIREMENTS

Pump Model Number.....	<u>RGS200</u>
Number of required units	<u>One (1)</u>

Rated Design Condition

Capacity (Flow).....	<u>GPM</u>
Head.....	<u>Feet (TDH)</u>
Minimum motor horsepower required.....	<u>2-HP</u>
Electrical Characteristics Required.....	<u>230V / 1PH / 60Hz</u>
Maximum pump operating speed.....	<u>3450 RPM</u>
Minimum Discharge Size	<u>1-1/4 inches</u>

2.03 PUMP DESIGN

- A. The pump’s design shall allow for removal and reinstallation of the pump without the need for personnel to enter the confined space of the wet well and without the removal of bolts, nuts or other fasteners. The pump shall connect to a permanently mounted discharge connection by simple downward motion, without rotation, guided by at least two non-load bearing guides. Final connection shall insure zero leakage between the pump and its discharge connection flange by means of an O-ring seal. No part of the pump shall bear directly on the floor of the wet well. Stainless steel lifting chains are to be supplied with sufficient length to properly and safely lift the pumps from the wet well.

2.04 PUMP CONSTRUCTION

- A. Major components (pump casing, impeller, intermediate housing and motor housing) shall be of at minimum ASTM A48 Class 30 cast iron with smooth surfaces devoid of blow- holes and other irregularities. All exposed fasteners shall be ASTM A-276 Type 316Ti stainless steel. The pump shall be coated with a two-component epoxy finish. This coating shall be approved for external coating on submerged wastewater applications
- B. Mating surfaces between components where watertight integrity is critical shall be machined and fitted with Nitrile Rubber O-rings. Because these are critical passages and flame paths, no secondary sealing compounds, greases, or other devices shall be used.

2.05 BEARINGS

- A. The pump shall have an upper radial bearing and lower thrust bearing with a sleeve bearing for axial forces. These shall be heavy-duty single row ball bearings which are permanently lubricated by the dielectric oil which fills the motor housing. The upper radial bearing and the lower thrust bearing shall have at a minimum 50,000 hours B-10 life. Bearings shall be locally available.

2.06 SHAFT

- A. Provide a common pump/motor shaft of sufficient size to transmit full driver output with a maximum deflection of 0.002 inches measured at the lower mechanical seal. The one-piece motor/pump shaft shall be constructed of at minimum ASTM A 276 Type 416 stainless steel and shall be precision machined to ensure proper tolerances at all contact points. The entire rotating assembly shall be designed with sufficient rigidity and balanced for minimal shaft deflection at extreme pump operating conditions.

2.07 ELECTRIC MOTOR

- A. The motor shall be a squirrel-cage, induction type rated 2-HP at 3450 RPM, 60 Hertz. The stator windings shall have Class F insulation, (180°C or 386°F), and a dielectric oil filled motor, NEMA B design. The motor shall be constructed with open windings operating in a sealed housing which contains clean dielectric oil for heat dissipation from the windings and for lubrication of the bearings and seals. This allow the motor to run continuously in submerged or partially submerged conditions without the need for cooling jackets, which circulate the pumped media up inside the motor shell. Further, the motor's design shall allow it to be capable of running for extended periods in a dry mode without damage to the motor or seals. Air-filled motors which do not have the superior heat dissipating capabilities of oil-filled motors shall not be considered equal
- B. The stator windings shall be the open type with Class F insulation rated for 180 degrees Celsius (386 degrees F) maximum operating temperature. To protect against motor damage due to liquid entry into the motor, an inner moisture sensor is provided to protect the motor windings from damage. The motor shall also be supplied with an outer sensor in the motor's stator cavity that indicates any leakage into the motor stator chamber. Should liquid enter the leakage chamber, the contact will open, and cause the motor to shut down.
- C. Protection against excessive temperature for motors shall be provided by a heat sensor thermostat attached to the stator windings and connected in series with the contactor coil in the control panel. The heat sensor shall stop the motor if the motor winding temperature reaches 120 degrees Celsius (248 degrees F).

2.08 MECHANICAL SEAL

- A. Motors shall be equipped with a rotary mechanical shaft seal to prevent leakage between the motor and pump. The seal assemblies shall consist of a Type 21 John Crane oil-lubricated rotary shaft seals in an oil-filled chamber. The materials of construction shall be carbon for the rotating faces and ceramic for the stationary faces, lapped and polished to a tolerance of one light band, with 300 stainless steel hardware, with all elastomer parts of Buna-N.

2.09 POWER / CONTROL CORDS

- A. Power cord and control cord shall be double sealed. Insulation of power and control cords shall be SOW/SOWA type. Each cable shall be provided with a green ground wire to be accordance with local and national electric codes.

2.10 CABLE ENTRY SYSTEM

- A. The top of the pump shall contain a waterproof junction box which will provide space to connect the power cord to the motor leads. The motor leads shall seal between the motor housing and junction box by means of a rubber compression fitting around each wire. Power cord shall have a green carrier ground conductor that attaches to motor frame. Cords shall be able to withstand a pull of 300 pounds to meet UL and FM code requirements.

2.11 PUMP CASING

- A. The casing shall be of the end suction volute type having sufficient strength and thickness to withstand all stress and strain from service at full operating pressure and loads. The casing shall be of the vertical discharge type. A rail system to allow easy installation and removal of the pump shall be available. The design shall be such that the pumps will be automatically connected to the discharge piping when lowered into position with the guide rails.

2.12 PUMP IMPELLER

- A. The pump impeller shall be of the semi-enclosed type to provide an open unobstructed passage through the volute for the ground solids. Impeller shall be of 85-5-5-5 bronze and shall be threaded onto the stainless steel shaft. Enclosed or semi-open pump impellers which might become obstructed during grinding or and excessive radial loads shall not be considered equal.

2.13 GRINDER CONSTRUCTION

- A. The grinder assembly shall consist of a grinder impeller and shredding ring and shall be mounted directly below the volute passage. Grinder impeller to be threaded onto a stainless steel shaft and shall be locked with a screw and washer. The shredding ring shall be pressed into an iron holding flange for easy removal. The flange shall be provided with tapped back-off holes so that screws can be used to push the shredding ring from the housing. All grinding of solids shall be from action of the impeller against the shredding ring. Both grinder impellers and shredding ring shall be of 440F stainless steel hardened to 58-60 Rockwell C.

2.14 CORROSION PROTECTION

- A. All iron castings shall be pre-treated with phosphate and chromic rinse and to be painted before machining and all machined surfaces exposed to sewage media to be repainted. The pump shall be painted after assembly, and testing, with a dark green water reducible air dry enamel. The paint shall be applied in one coat covering all exterior surfaces to prohibit corrosion from the sewage environment.

PART 3: CONTROLS

3.01 CONTROL PANEL

- A. A NEMA 4X fiberglass control panel shall be furnished with each pumping unit to be installed, as shown on the plans.
- B. The control panel enclosure shall be molded of glass reinforced polyester resins which are chemically resistant to corrosive atmospheres. The resin system shall be pigmented to impart a gray color to the enclosure and be resistant to ultraviolet light.
- C. The resin system also shall include a flame retardant to obtain a flammability rating which meets U.L. 94V-O. Heat distortion temperature shall be 350 degrees Fahrenheit.
- D. The enclosure shall be of one-piece, weatherproof construction with smooth, rounded corners and shall be constructed to have a smooth exterior and interior. The enclosure shall be fitted with a closed cell neoprene gasketed cover. The enclosure shall be provided with back panel mounting provisions.
- E. The cover shall be hinged with a heavy duty corrosion resistant stainless steel piano hinge. The cover shall be lockable by means of two (2) high quality combination stainless steel latches and padlock hasps.
- F. The enclosure shall be provided with external mounting feet on the top and bottom of the enclosure. These mounting feet shall be of fiberglass and molded as an integral part of the enclosure.
- G. The back panel shall be a minimum of .080" aluminum and held in place by four (4) #10 screws, which will mate to the four (4) threaded standoffs, which are molded into the enclosure.
- H. The panel shall include pump circuit breaker, alarm circuit fuse, control circuit fuse, I.E.C. rated motor starter with ambient compensated bimetal overload relay, pump hand-off-auto switch (momentary in the hand position), pump run light, terminal blocks, two (2) ground lugs and all necessary wiring and brackets.

- I. The control panel shall be fitted with a red lexan (polycarbonate) alarm light. The light shall be approximately 3" high by 3-1/2" diameter. The globe shall be mounted on top of the enclosure with a neoprene gasket. The lens cannot be removed from the exterior of the enclosure. The lens may be removed by entering the interior of the enclosure and removing four (4) #8 screws. The bulb shall be 40 watt minimum high intensity-medium base type. The bulb shall be easily replaced by removing a thumb screw from the support bracket on the interior of the panel.
- J. The alarm shall have a bright glow and flash during high water conditions. The alarm light will go out when the water level drops.
- K. All internal wiring shall be neat and color coded. Each wire shall be a different color or stripe (except for ground), and all incoming wires shall terminate into a box clamp type terminal block (except incoming power). All wires shall be 14GA. Type TEW rated for 105 degrees Celsius.
- L. A schematic diagram (showing wire color) shall be permanently fastened to the inside of the enclosure. An installation and service manual shall also be included with each control panel.
- M. The control panel shall be U.L. listed as an assembly.

3.02 LEVEL CONTROLS

- A. Pump on, off and alarm levels shall be controlled by three (3) mercury tube float switches. Switches shall consist of a mercury tube switch sealed in a corrosion-resistant polypropylene housing with a minimum of 18 gauge, 2-wire, SJOW/A jacketed cable. The cable shall be of sufficient length to reach the junction box with no splices. The level controls shall be suspended from a stainless steel bracket so that adjustment or replacement may be done without the use of any tools. Level controls shall be UL/CSA listed.

PART 4: FIBERGLASS WET-WELL

4.01 GENERAL

- A. Furnish and install one (1) factory built, below ground sewage pumping station. The pump station will be installed in a factory assembled fiberglass basin with all necessary piping, pump guide rail system, valves and appurtenances pre-plumbed and complete for installation by the contractor.

4.02 FIBERGLASS BASIN

- A. Unless otherwise indicated, the plastic terminology used in this specification shall be in accordance with the definitions given in American Society for Testing and Materials (ASTM) designations D3299-81. This specification is for the hand lay-up; chopped spray technique and filament wound methods for manufacturing of vertical underground fiberglass basins. Other methods of manufacturing shall not be acceptable.
- B. The resin used shall be of a commercial grade and shall be evaluated as a laminate by test or determined by previous service to be acceptable for the environment. The resins used may contain the minimum amount of fillers or additives required to improve handling properties. Up to 5% by weight of thixotropic agent, which will not interfere with visual inspection, may be added to the resin for viscosity control. Resins may contain pigments and dyes by agreement between fabricator and engineer, recognizing that such additions may interfere with visual inspection of laminate quality.
- C. The reinforcing material shall be a commercial grade of glass fiber having a coupling agent, which will provide a suitable bond between the glass reinforcement and the resin.
- D. The laminate shall consist of an inner surface, an interior layer, and a filament-wound structural exterior layer of laminate body.
- E. The inner surface shall be free of cracks and crazing with a smooth finish and with an average of not over two pits per square foot. Any pits found shall be less than 1/8" in diameter with not over 1/32" deep. Pits are to be covered with sufficient resin to avoid exposure of inner surface fabric. Some waviness shall be permissible as long as the surface is smooth and free of pits. Between 0.100 and 0.020 inches of resin-rich surface shall be provided.
- F. Minimum of 0.100 inch of the laminate next to the inner surface shall be reinforced with 30% by weight of chopped-strand fiber having fiber lengths from 0.5 to 2.0 inches.
- G. Subsequent reinforcement shall be continuous-strand roving fiberglass. The thickness of the filament-wound portion of the tank shell shall vary with the tank height to provide the aggregate strength necessary to meet the tensile and flexural requirements. If additional longitudinal strength is required, the use of other reinforcement, such a woven fabric, chopped-strand mat, or chopped strands shall be interspersed in the winding to provide additional strength. Glass content of this filament-wound structural layer shall be 50 to 80% by weight. The exterior surface shall be relatively smooth with no exposed fibers or sharp projections. Handwork finish shall be present to prevent fiber exposure.

- H. The tank wall must be designed to withstand wall collapse based on the assumption of hydrostatic type loading by backfill with a density of 120 lb./ft.³. The tank wall laminate must be constructed to withstand or exceed two times the assumed loading for any depth of basin.
- I. For the tank bottom, subsequent reinforcement shall be of 1.5 oz./ft. 2 chopped strand fiber or woven roving to a thickness to withstand applicable hydrostatic uplift pressure, with a safety factor of 2. In saturated conditions, the center deflection of any empty tank bottom shall be less than 3/8" (elastic deflection) and will not interfere with bottom pump mounting requirements nor rail system.
- J. The width of the first layer of joint overlay shall be 3" minimum. Successive layers shall uniformly increase in width to form a smooth contour laminate that is centered on the joint $\pm 1/2$ ". A highly filled resin paste may be placed in the crevices between joined pieces leaving a smooth surface for lay-up. The cured resin surface of the parts to be joined shall be roughened to expose glass fiber. This roughened area shall extend beyond the lay-up areas so that no reinforcement is applied to an unprepared surface. Surfaces shall be clean and dry before lay-up. The entire roughened area shall be coated with resin after joint overlay is made.
- K. The finished laminate shall be as free as commercially practicable from visual defect such as foreign inclusions, dry spots, air bubbles, pinhole, pimples, and delamination.
- L. The surfaces shall be relatively smooth; hand finish is acceptable, with no exposed fibers or sharp projections.
- M. The tank bottom shall extend past the tank walls so that the O.D. is approximately 4" larger in diameter than the O.D. of the sidewalls. This larger diameter shall serve as an anti-flotation flange. Contractor shall place the tank on a concrete pad and either fill with grout covering the anti-flotation flange or secure with steel clips catching the anti-flotation flange and anchored to the concrete pad. Anti-flotation flange shall not require bolt holes to secure the tank to the concrete pad.
- N. Tank shall include 1-1/4" NPT stainless steel discharge fitting. A 4" cast iron influent hub shall be provided for mounting in the field. (hub shipped loose)
- O. Non-corroding stainless steel heli-coils shall be inserted in all bolt holes of the top flange and shall be positively locked with threads and resin to prevent stripping. A 10-hole pattern shall accommodate the mounting of a one-piece aluminum access cover and door.

4.03 PIPING

- A. Piping shall include Schedule 80 PVC discharge piping; cast iron ball check valve; PVC isolation ball valve; straight pipe, elbows, tees, and unions fabricated from Schedule 80 PVC. Where piping passes through a wall, an enviro-boot seal shall be used to make a watertight seal.

4.04 ACCESS COVER AND DOOR

- A. An access door and frame assembly shall be supplied with a hinged door for removal of each pump. The cover shall be one piece and extend over the entire wet-well and valve vault. An access door shall be centered over the pumps in the wet-well and the valves in the valve vault. The frame assembly and door shall be steel having stainless steel hinges and hardware. Load rating shall be a minimum of 300 PSF in steel. A recessed handle shall be provided with each door, as well as a safety latch to hold the door in an open position.

4.05 GUIDE RAIL SYSTEM

- A. The lift-out rail system shall permit easy removal and installation of the pump without the necessity of personnel entering the wet well. Each lift-out system shall consist of: a cast iron discharge base/elbow, cast iron pump carrier and sealing plate. All exposed hardware shall be 300 series stainless steel.
- B. Discharge elbow shall be 1 ¼" X 2" NPT and shall be integral to the base assembly.
- C. Sealing plate/elbow has a female mating end and shall be bolted to the pump. A simple downward sliding motion of the pump and guide plate on the guide rails shall cause the unit to be automatically connected and sealed to the base. The open face of the sealing plate shall have dove-tailed groove machined into the face to hold a sealing O-ring. The O-ring shall provide a redundant leak-proof seal at all operating pressures.
- D. Two stainless steel guide rail pipes shall be used to guide the pump from the surface to the discharge base connection. The guide rails shall be 1-inch 304 stainless steel schedule 40 pipe. The weight of the pump shall bear solely on the discharge base and not on the guide rails. Rail systems which require the pump to be supported by legs which might interfere with the flow of solids into the pump suction will not be considered equal. The guide rail shall be firmly attached to the access hatch frame.

4.06 VERIFICATION OF PERFORMANCE

- A. All pumps shall be site tested after installation to demonstrate satisfactory operation without excessive noise, vibration, cavitation or over-heating. The manufacturer along with the authorized representative shall conduct site tests. Tests shall include checking for correct rotation, maximum motor amperage draws within nameplate

specifications, balanced voltages on each power leg with the pump operating to within manufacturers tolerances, and demonstrated compatibility of the pump/motor with the controls supplied. Test results shall be in printed form and signed by the Representative and supplied to the owner.

PART 5: WARRANTY

5.01 STANDARD WARRANTY

- A. The pump unit or any part thereof shall be warranted against defects in material or workmanship within one year from date of installation or 18 months from date of manufacture, whichever comes first, and shall be replaced at no charge with a new or manufactured part, F.O.B. factory or authorized warranty service station. The warranty shall not assume responsibility for removal, reinstallation or freight, nor shall it assume responsibility of incidental damages resulting from the failure of the pump to perform. The warranty shall not apply to damage resulting from accident, alteration, design, misuse or abuse.

5.02 INSTALLATION

All materials and equipment shall be installed in accordance with the current edition of the National Electric Code and the North Carolina State Building Code.

5.03 QUALITY CONTROL AND FIELD TESTING

- A. The Contractor shall employ and pay for services of equipment manufacturer's field service representatives fully commissioned and authorized by manufacturer's factory to:
1. Inspect equipment covered by these specifications.
 2. Supervise adjustment, calibrations and installation checks and full commissioning.
 3. Conduct initial start up of equipment and perform basic operational checks. Verify system operation in accordance with Quality Standards of this specification.
 4. Provide Owner with a written statement that manufacturer's equipment has been installed properly, commissioned, and calibrated and is ready for operation by the Owner. Secure manufacturer's certification that each control loop functions as required.
 5. After receipt of written statement and approval by Owner, provide authorized factory training and maintenance service representatives for not less than one

(1) day at job site to train Owner's personnel. Include training for operations.

B. SUPERVISION

The Contractor shall have in charge of the work at all times during construction a thoroughly competent foreman with extensive experience in the work to be performed under this contract. Anyone deemed not capable by the Engineer shall be replaced immediately upon request.

END OF SECTION

PART 1: GENERAL

1.01 SCOPE OF WORK

- A. The work under this section consists of furnishing all materials, labor, equipment and services required for the complete installation of encasement pipe and carrier pipes under highways and railroads by boring and jacking as shown on the drawings and specified herein.

All work in connection with constructing encasement pipes under highways and railroads shall comply with all current requirements of governing highway and railroad agencies. The Contractor shall be familiar with these requirements.

The Contractor shall inspect the locations at the proposed crossings and shall familiarize himself with the conditions under which the work will be performed, and with all necessary details and the suitability of his equipment and methods for the work required.

PART 2: PRODUCTS

2.01 MATERIALS

- A. Encasement pipe shall be smooth wall welded steel conforming to ASTM Designation A139, Grade B. The outside of the pipe shall be coated in accordance with AWWA Standard C203. Minimum pipe wall thickness shall be as follows:

Pipe - Nominal Diameter Inches	Wall Thickness Inches
16	.250
20	.250
24	.250
30	.312
36	.500

PART 3: EXECUTION

3.01 INSTALLATION

- A. Encasements shall be installed by boring and jacking unless field conditions require otherwise. It shall be the Contractor's responsibility to notify the Engineer immediately if conditions do not permit a jack and bore installation.
- B. The encasement pipe shall be of the diameter indicated for the carrier pipe as shown on the drawing.
- C. Installation of encasement pipe shall include all related work and services such as mobilization of equipment, constructing and maintaining working pits, right-of-way maintenance and restoration, traffic maintenance, mining, excavations, dewatering, sheeting, shoring and bracing for embankments, operating pits, and as elsewhere required shall be placed and maintained in order that work may proceed safely and expeditiously.
- D. Installation of the casing pipe shall be carried out without disturbance of the embankment, pavement, tracks, or other railroad or highway facilities and without obstructing the passage of traffic at any time.
- E. The driven portions of the casing shall be advanced from the lower end of the casing unless specific permission to do otherwise is obtained by the Contractor from the Engineer.
- F. The alignment and grade shall be carefully maintained and the encasement pipe installed in a straight line.
- G. The space outside the encasement and the ground shall be filled with grout, sand or pea gravel, as directed by the Engineer. The Engineer will direct that this space be filled if the space is large enough to cause any earth settling.
- H. Before the pipe is installed in the casing, bolt-on metal skids painted with bitumastic paint shall be rigidly fastened to the barrel of the pipe. After completion of the casing, the Contractor shall insert the pipeline in pre-jointed segments. No contact will be permitted between the casing and the carrier pipeline.

END OF SECTION

PART 1: GENERAL**1.01 SCOPE OF WORK**

- A. This section covers the furnishing of all labor, equipment and materials necessary for the establishment of vegetation of all areas of the site disturbed by construction operations and all earth surfaces of embankments including rough and fine grading, topsoil if required, fertilizer, lime, seeding and mulching. The Contractor shall adapt his operations to variations in weather or soil conditions as necessary for the successful establishment and growth of the grasses and legumes.

PART 2: PRODUCTS**2.01 MATERIALS****A. FERTILIZER**

1. The quality of fertilizer and all operations in connection with the furnishing of this material shall comply with the requirements of the North Carolina Fertilizer Law and regulations adopted by the North Carolina Board of Agriculture.
2. Fertilizer shall be 10-10-10 grade. Upon written approval of the Engineer a different grade of fertilizer may be used, provided the rate of application is adjusted to provide the same amounts of plant food.
3. During handling and storing, the fertilizer shall be cared for in such a manner that it will be protected against hardening, caking, or loss of plant food values. Any hardened or caked fertilizer shall be pulverized to its original conditions before being used.

B. LIME

1. The quality of lime and all operations in connection with the furnishing of this material shall comply with the requirements of the North Carolina Lime Law and regulations adopted by the North Carolina Board of Agriculture.
2. During the handling and storing, the lime shall be cared for in such a manner that it will be protected against hardening and caking. Any hardened or caked lime shall be pulverized to its original conditions before being used.
3. Lime shall be agriculture grade ground dolomitic limestone. It shall contain not less than 85% of the calcium and magnesium carbonates and

shall be of such fineness that at least 90% will pass a No. 10 sieve and at least 50% will pass a No. 100 sieve.

C. SEED

1. The quality of seed and all operations in connection with the furnishing of this material shall comply with the requirements of the North Carolina Seed Law and regulations adopted by the North Carolina Board of Agriculture. Seed shall have been approved by the North Carolina Department of Agriculture or any agency approved by the Engineer before being sown, and no seed will be accepted with a date of test more than 9 months prior to the date of sowing. Such testing however, will not relieve the Contractor from responsibility for furnishing and sowing seed that meets these specifications at the time of sowing. When a low percentage of germination causes the quality of the seed to fall below the minimum pure live seed specified, the Contractor may elect, subject to the approval of the Engineer, to increase the rate of seeding sufficiently to obtain the minimum pure live seed contents specified, provided that such an increase in seeding does not cause the quantity of noxious weed seed per square yard to exceed the quantity that would be allowable at the regular rate of seed.
2. During handling and storing, the seed shall be cared for in such a manner that it will be protected from damage by heat, moisture, rodents or other causes.
3. Seed shall be entirely free from bulblets or seed of Johnson Grass, Nutgrass, Sandbur, Wild Onion, Wild Garlic, and Bermuda Grass. The specifications for restricted noxious weed seed refers to the number per pound, singly or collectively, of Blessed Thistle, Wild Radish, Canada Thistle, Corncockle, Field Bindweed, Quackgrass, Dodders, Dock, Horsenettle, Bracted Plantain, Buckhorn or Wild Mustard; but in no case shall the number of Blessed Thistle or Wild Radish exceed 27 seeds of each per pound. No tolerance on weed seed will be allowed.

D. MULCH

Straw Mulch shall be threshed straw of oats, rye or wheat free from matured seed of obnoxious weeds or other species which would grow and be detrimental to the specified grass.

E. TACKIFIER

Emulsified asphalt or organic tackifier such as Reclamare R2400 shall be sprayed uniformly on mulch as it is ejected from blower or immediately thereafter. Tackifier shall be applied evenly over area creating uniform appearance. Rates of

application will vary with conditions. Asphalt shall not be used in freezing weather.

PART 3: EXECUTION

3.01 PREPARATION

A. PROTECTION OF EXISTING TREES AND VEGETATION

1. Protect existing trees and other vegetation indicated to remain in place against cutting, breaking or skinning of roots, skinning and bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line. Provide wood or metal stakes set on 8 to 10 foot centers and connected at a 4'-0" height by 2" minimum brightly colored flagging tape to protect trees and vegetation to remain. Set perimeter of protection at the drip line of trees to remain unless approved otherwise by the Engineer.
2. Provide protection for roots over 1-1/2" diameter cut during construction operations. Cleanly cut off end of damaged root and coat cut faces with an emulsified asphalt, or other acceptable coating, formulated for use on damaged plant tissues. Temporarily cover exposed roots with wet burlap to prevent roots from drying out and cover with earth as soon as possible.
3. The Contractor shall not remove or damage trees and shrubs which are outside the Clearing Limits established by the Owner or those within the Clearing Limits designated to remain.
4. Repair trees scheduled to remain and damaged by construction operations in a manner acceptable to the Engineer. Repair damaged trees promptly to prevent progressive deterioration caused by damage.
5. Replace trees scheduled to remain and damaged beyond repair by construction operations, as determined by the Engineer with trees of similar size and species. Repair and replacement of trees scheduled to remain and damaged by construction operations or lack of adequate protection during construction operations shall be at the Contractor's expense.

B. GRADING

1. Rough grading shall be done as soon as all excavation required in the area has been backfilled. The necessary earthwork shall be accomplished to

bring the existing ground to the desired finish elevations as shown on the Contract Drawings or otherwise directed.

2. Fine grading shall consist of shaping the final contours for drainage and removing all large rock, clumps of earth, roots and waste construction material. It shall also include thorough loosening of the soil to a depth of 6" by plowing, discing, harrowing or other approved methods until the area is acceptable as suitable for subsequent landscaping operations. The work of establishing vegetation shall be performed on a section by section basis immediately upon completion of earthwork or pipeline installation.
3. Upon failure or neglect on the part of the Contractor to coordinate his grading with seeding and mulching operations and diligently pursue the control of erosion and siltation, the Engineer may suspend the Contractor's grading operations until such time as the work is coordinated in a manner acceptable to the Engineer.

C. SEEDBED PREPARATION

1. The Contractor shall cut and satisfactorily dispose of weeds or other unacceptable growth on the areas to be seeded. Uneven and rough areas outside the graded section, such as crop rows, farm contours, ditches and ditch spoil banks, fence line and hedgerow soil accumulations, and other minor irregularities which cannot be obliterated by normal seedbed preparation operations, shall be shaped and smoothed as directed by the Engineer to provide for more effective seeding and for ease of subsequent mowing operations.
2. The soil shall then be scarified or otherwise loosened to a depth of not less than 6" except as otherwise provided below or otherwise directed by the Engineer. Clods shall be broken and the top 2" to 3" of soil shall be worked into an acceptable seedbed by the use of soil pulverizers, drags, or harrows; or by other methods approved by the Engineer.
3. On 2:1 slopes a seedbed preparation will be required that is the same depth as that required on flatter areas, although the degree of smoothness may be reduced from that required on the flatter areas if so permitted by the Engineer.
4. On cut slopes that are steeper than 2:1, both the depth of preparation and the degree of smoothness of the seedbed may be reduced as permitted by the Engineer, but in all cases the slope surface shall be scarified, grooved, trenched, or punctured so as to provide pockets, ridges, or trenches in which the seeding materials can lodge.

5. On cut slopes that are either 2:1 or steeper, the Engineer may permit the preparation of a partial or complete seedbed during the grading of the slope. If at the time of seeding and mulching operations such preparation is still in condition acceptable to the Engineer, additional seedbed preparation may be reduced or eliminated.
6. The preparation of seedbeds shall not be done when the soil is frozen, extremely wet, or when the Engineer determines that it is in an otherwise unfavorable working condition.

3.02 APPLICATION

- A. Seed shall be applied by means of a hydro-seeder or other approved methods. The rates of application of seed, fertilizer and limestone shall be as stated in Table I.
- B. Equipment to be used for the application, covering or compaction of limestone, fertilizer, and seed shall have been approved by the Engineer before being used on the project. Approval may be revoked at any time if equipment is not maintained in satisfactory working condition, or if the equipment operation damages the seed.
- C. Limestone, fertilizer, and seed shall be applied within 24 hours after completion of seedbed preparation unless otherwise permitted by the Engineer, but no limestone or fertilizer shall be distributed and no seed shall be sown when the Engineer determines that weather and soil conditions are unfavorable for such operations.
- D. Limestone may be applied as a part of the seedbed preparation, provided it is immediately worked into the soil. If not so applied, limestone and fertilizer shall be distributed uniformly over the prepared seedbed at the specified rate of application and then harrowed, raked, or otherwise thoroughly worked or mixed into the seedbed. Seed shall be distributed uniformly over the seedbed at the required rate of application, and immediately harrowed, dragged, raked, or otherwise worked so as to cover the seed with a layer of soil. The depth of covering shall be as directed by the Engineer. If two kinds of seed are to be used which require different depths of covering, they shall be sown separately.
- E. When a combination seed and fertilizer drill is used, fertilizer may be drilled in with the seed after limestone has been applied and worked into the soil. If two kinds of seed are being used which require different depths of covering, the seed requiring the lighter covering may be sown broadcast or with a special attachment to the drill, or drilled lightly following the initial drilling operation.
- F. When a hydraulic seeder is used for application of seed and fertilizer, the seed shall not remain in water containing fertilizer for more than 30 minutes prior to application unless otherwise permitted by the Engineer.

- G. Immediately after seed has been properly covered the seedbed shall be compacted in the manner and degree approved by the Engineer.
- H. When adverse seeding conditions are encountered due to steepness of slope, height of slope, or soil conditions, the Engineer may direct or permit that modifications be made in the above requirements which pertain to incorporating limestone into the seedbed; covering limestone, seed, and fertilizer; and compaction of the seedbed.

Such modifications may include but not be limited to the following:

- 1. The incorporation of limestone into the seedbed may be omitted on (a) cut slopes steeper than 2:1; (b) on 2:1 cut slopes when a seedbed has been prepared during the excavation of the cut and is still in an acceptable condition; or (c) on areas of slopes where the surface of the area is too rocky to permit the incorporation of the limestone.
- 2. The rates of application of limestone, fertilizer, and seed on slopes 2:1 or steeper or on rocky surfaces may be reduced or eliminated.
- 3. Compaction after seeding may be reduced or eliminated on slopes 2:1 or steeper, on rocky surfaces, or on other areas where soil conditions would make compaction undesirable.

I. MULCHING

- 1. All seeded areas shall be mulched unless otherwise indicated in the special provisions or directed by the Engineer.
- 2. It shall be spread uniformly at a rate of two tons per acre in a continuous blanket over the areas specified.
- 3. Before mulch is applied on cut or fill slopes which are 3:1 or flatter, and ditch slopes, the Contractor shall remove and dispose of all exposed stones in excess of 3" in diameter and all roots or other debris which will prevent proper contact of the mulch with the soil. Mulch shall be applied within 24 hours after the completion of seeding unless otherwise permitted by the Engineer. Care shall be exercised to prevent displacement of soil or seed or other damage to the seeded area during the mulching operation.
- 4. Mulch shall be uniformly spread by hand or by approved mechanical spreaders or blowers which will provide an acceptable application. An acceptable application will be that which will allow some sunlight to penetrate and air to circulate but also partially shade the ground, reduce erosion, and conserve soil moisture.
- 5. Mulch shall be held in place by applying a sufficient amount of asphalt or other approved binding material to assure that the mulch is properly held in

place. The rate and method of application of binding material shall meet the approval of the Engineer. Where the binding material is not applied directly with the mulch it shall be applied immediately following the mulch application.

6. The Contractor shall take sufficient precautions to prevent mulch from entering drainage structures through displacement by wind, water, or other causes and shall promptly remove any blockage to drainage facilities which may occur.

3.03 MAINTENANCE

- A. The Contractor shall keep all seeded areas in good condition, reseeding if and when necessary, until an acceptable stand of grass is established over the entire area seeded and shall maintain these areas in an approved condition until final acceptance of the Contract. Any of these additional efforts will be at no additional cost to the Owner.
- B. Grassed areas will be accepted when a 95% cover by permanent grasses is obtained and weeds are not dominant. On slopes, the Contractor shall provide against washouts by an approved method. Any washouts which occur shall be regraded and reseeded until a good sod is established.
- C. Areas of damage or failure due to any cause shall be corrected by being repaired or by being completely redone as may be directed by the Engineer. Areas of damage or failure resulting either from negligence on the part of the Contractor in performing subsequent construction operations or from not taking adequate precautions to control erosion and siltation as required throughout the various sections of the specifications, shall be repaired by the Contractor as directed by the Engineer at no cost to the Owner.

TABLE I - APPLICATION RATES

A. LIME AND FERTILIZER

In the absence of a soil test, the following rates of application of limestone and fertilizer shall be:

1. 4,000 pounds limestone per acre
2. 1000 pounds 10-10-10 (N-P₂O₅-K₂O) fertilizer per acre and the remaining quantity applied when vegetation is three inches in height or 45 days after seeding, whichever comes first.

B. MULCH

Mulch shall be applied at the following rates per acre:

1. 3,000-4,000 pounds straw mulch, or
2. 1,500-2,000 pounds wood cellulose fiber.
3. 35-40 cubic yards of shredded or hammermilled hardwood bark
4. 1,200-1,400 pounds of fiberglass roving

C. TEMPORARY SEED

The kinds of seed and the rates of application shall be as contained in this table. All rates are in pounds per acre. See Notes 1 and 2.

1. Fall and Winter (Normally August 1 to June 1)
80 pounds of Ky-31 tall fescue and 15 pounds of rye grain
2. Summer (Normally May 1 to September 1)
100 pounds of Ky-31 tall fescue

NOTES

1. On cut and fill slopes having 2:1 or steeper slopes, add 40 pounds of sericea lespedeza per acre to the planned seeding (hulled in spring and summer unhulled in fall and winter) plus 15 pounds of sudangrass in summer seeding or 25 pounds of rye cereal per acre in fall and winter seeding, if seeded September to February.
2. These seeding rates are prescribed for all sites with less than 50% ground cover and for sites with more than 50% ground cover where complete seeding is necessary to establish effective erosion control vegetative cover. On sites having 50% to 80% ground cover where complete seeding is not necessary to establish vegetative cover, reduce the seeding rate at least one-half the normal rate.

END OF SECTION

1. DESCRIPTION:

- 1.1 Erosion and sedimentation control shall be provided by the Contractor for all areas of the site denuded or otherwise disturbed during construction. The Contractor shall be responsible for all installation, materials, labor, and maintenance of erosion and sediment control devices, as well as removal of temporary erosion and sediment control devices shown on the plans or required to protect all downstream properties, natural waterways, streams, lakes, ponds, catch basins, drainage ditches, roads, gutters, natural buffer zones, and man-made structures.
- 1.2 Erosion and sediment control procedures and facilities shall conform to the "Erosion and Sediment Control Planning and Design Manual" as published by the North Carolina Sedimentation Control Commission, Sections 1607 and 1610 of the "Standard Specifications for Roads and Structures" dated January 1, 2018, as published by the North Carolina Department of Transportation and to all applicable local codes or ordinances, whichever is more stringent.
- 1.3 Related Work: See the following sections for related work.
 1. 31 32 00 Site Stabilization

2. MATERIALS:

- 2.1 Washed stone to be used in temporary sediment basins shall be of strong, durable nature, resistant to weathering and shall be graded to conform to Standard Size Number 57 per Section 1008 of the "Standard Specifications for Road and Structures" dated January 1, 2018, as published by the North Carolina Department of Transportation.
- 2.2 Refer to other sections within these specifications as listed in Item 1.3 above for other material specification required in the installation of erosion and sediment control facilities.

3. INSTALLATION:

3.1 General Requirements:

- 3.1.1 The Contractor shall follow the erosion control construction sequence schedule as shown on the contract drawings, except that should circumstances dictate that extra precaution be taken to prohibit erosion and sedimentation on the project, the Contractor will, at his own expense, take preventative measures as needed.
- 3.1.2 The Contractor is required to maintain all erosion and sediment control facilities to insure proper performance throughout the construction phase and until such time all disturbed areas are permanently stabilized.
- 3.1.3 Upon completion of construction or successful permanent stabilization of all areas which were disturbed before or during construction operations or as indicated on the construction drawings, whichever occurs last, the Contractor shall remove all temporary erosion and sediment control devices and facilities from the project site. The Contractor shall retain these items for future use or properly dispose of these items offsite.
- 3.1.4 The Contractor shall provide temporary or permanent ground cover as called for on the construction plans.

END OF SECTION

PART 1: GENERAL**1.01 SCOPE OF WORK**

This section covers the repairs of pavement for all asphalt surfaces.

1.02 PERFORMANCE

Construction of the subgrade, base course and paving shall be undertaken immediately after completion of all underground piping and structures, all curbs and gutters, all yard piping, conduits and other facilities passing beneath paved areas, and all structural slabs and foundations required within or adjacent to the paved areas.

1.03 REFERENCES

All work and materials required under this section of the specifications shall conform to the applicable sections of the North Carolina Department of Transportation, Division of Highways, Standard Specifications for Roads and Structures - Latest Edition.

PART 2: NOT USED**PART 3: EXECUTION****3.01 INSTALLATION****A. PREPARATION OF SUBGRADE**

The work covered under this section of this specification shall be performed in strict accordance with Section 500 or Section 505 whichever is applicable, of the Standard Specifications for Road and Structures - Latest Edition, of the North Carolina Department of Transportation, Division of Highways.

B. APPLICATION OF AGGREGATE BASE COURSE

The work covered under this section of this specification shall be performed in strict accordance with Section 520 of the Standard Specification for Road Structures - Latest Edition, of the North Carolina Department of Transportation, Division of Highways.

C. ASPHALT PLANT MIX - GENERAL

The work covered under this section of this specification shall be performed in strict accordance with Section 610 and Section 620 of the Standard Specifications

for Roads and Structures - Latest Edition, of the North Carolina Department of Transportation, Division of Highways.

D. TACK COAT

1. Materials used as a tack coat shall meet the requirements for the grades indicated below unless otherwise indicated in the contract. Any of the grades of tack coat material noted in this specification may be used:
 - Asphalt Binder, Grade PG 64-22
 - Emulsified Asphalt, Grade RS-1H, CRS-1H, CRS-1, HFMS-1, CRS-2
2. Do not dilute or mix the tack coat with water, solvents, or other materials prior to application.
3. When tack coat is required beneath an open-graded asphalt friction course, the asphalt grade and rate of application to be used will be specified on the job mix formula.
4. Surface Preparation
 - a. The surface to which the tack coat is to be applied shall be cleaned of dust, dirt, clay, and any other deleterious matter prior to placing the tack coat.
 - b. The Contractor shall remove grass, dirt and other materials from the edge of the existing pavement prior to the placement of tack coat.
5. Weather Limitations
 - a. Tack shall be applied only when the surface to be treated is sufficiently dry and the atmospheric temperature in the shade away from artificial heat is 35° F or above.
 - b. Tack coat shall not be applied when the weather is foggy or rainy.
6. Application Rates and Temperatures
 - a. Tack coat shall be uniformly applied at a rate from 0.04 to 0.08 gallons per square yard. The exact rate of application will be established by the Engineer and will be based on the volume of material at the actual application temperature. When tack coat is required beneath an open-graded asphalt friction course, an asphalt binder Grade PG 64-22 material shall be used. The exact rate of

application will be specified on the job mix formula and will be within the range of 0.06 to 0.08 gallons per square yard.

- b. The temperature of the material at the time of application shall be within the ranges shown in the table below:

Application Temperatures for Tack Coat

Asphalt Material	Temperature Range
Asphalt Binder, Grade PG 64-22	375 - 425°F
Emulsified Asphalt, Grade RS-1H, CRS-1, CRS-1H	90 - 150°F
Emulsified Asphalt, Grade HFMS-1	90 - 160°F
Emulsified Asphalt, Grade CRS-2	125 - 185°F

7. Application

- a. No more tack coat material shall be applied than can be covered with base, intermediate, or surface course during the following day's paving operations.
- b. Tack coat material shall be uniformly applied to the entire surface utilizing an adjustable spray bar. Areas of tack coat application should be uniformly and completely covered.
- c. Tack coat shall be applied only in the presence of and as directed by the Engineer. No base or surface mixture shall be deposited onto the tacked pavement until the tack coat has sufficiently cured.
- d. Contact surfaces of headers, curbs, gutters, manholes, vertical faces of old pavements, and all exposed transverse and longitudinal edges of each course shall be painted or sprayed with tack coat before new asphalt mixture is placed adjacent to such surfaces.
- e. Bridge floors, curbs and handrails of structures, and all other appurtenances shall be covered to prevent tack coat from being tracked or splattered on the structures or appurtenances.

8. Protection

- a. Protect the tack coat after application until it has cured for a sufficient length of time to prevent it from being picked up by traffic.
- b. Contractor shall take the necessary precautions to minimize tracking and/or accumulation of tack coat material on existing or newly constructed pavements. Corrective measures may be required in areas where an excessive accumulation of tack has occurred.

E. BASE COURSE (B 25.0X); INTERMEDIATE COURSE (I 19.0X); SURFACE COURSES (S 12.5X, S AND SF 9.5X)

1. Weather and Temperature Limitations

- a. Asphalt mixtures shall not be produced or placed during rainy weather, when the subgrade or base course is frozen, or when the moisture on the surface to be paved would prevent proper bond. Asphalt material shall not be placed when the air temperature, measured in the shade away from artificial heat at the location of the paving operations, is less than the temperatures noted in the table on the following page.
- b. Where the surface course is to be placed on the intermediate course, the surface course shall be placed as soon as possible after the intermediate course has been placed, and in all cases during the same paving season.

Minimum Paving Temperatures

Asphalt Mixture	Minimum Air Temperature (°F)	Minimum Road Surface Temperature (°F)
B 25.0B B 25.0C	35	35
I 19.0B I 19.0C	35	35
S 9.5C, S 9.5D, S 12.5C, S 12.5D	50	50
SF 9.5A S 9.5B	40	50

2. Spreading and Finishing

- a. Coat surface of manhole frames and inlet frames with oil to prevent bonding with asphalt pavement. Do not tack or prime coat these surfaces.
- b. Tack coat shall be applied to the existing pavement, when necessary, in accordance with the provisions of these specifications.
- c. The asphalt mixture shall be spread and struck off to the required grades, cross sections, and thicknesses.
- d. Should unevenness of texture, tearing, segregation, or shoving occur during the paving operation due to unsatisfactory methods or equipment, the Contractor shall immediately take such action as may be necessary to correct such unsatisfactory work. Excessively throwing back material will not be permitted.

3. Compaction

- a. Immediately after the asphalt mixture has been spread, struck off, shaped to the required width, depth, cross-section, and surface and edge irregularities adjusted, it shall be thoroughly and uniformly compacted. Compaction must be obtained in a manner that provides uniform density over the pavement and meets the required degree of compaction for the type of mixture being placed. Compaction rolling shall be complete before material temperature drops below 185°F.
- b. Compaction rolling should be performed at the maximum temperature at which the mix will support the rollers without moving horizontally. The number and weight of rollers shall be sufficient to compact the mixture to the required density while it is still in a workable condition. Adjustments to the compaction equipment may be required where uniform density is not being obtained throughout the depth of the layer being tested.
- c. All final wearing surfaces, except open-graded asphalt friction course, shall be compacted using a minimum of 2 steel wheel tandem rollers. Pneumatic-tired rollers with smooth tread tires may be used after the breakdown roller and prior to finish rolling. Vibratory rollers must not be operated in vibratory mode during finish rolling on any mix type or pavement layer.

- d. Rollers used to compact the mixture shall be in good condition and capable of reversing without backlash. The rollers shall be operated with the drive wheels nearest the paver and at uniform speeds slow enough to avoid displacement of the mixture. Steel wheel rollers shall be equipped with wetting devices to prevent the mixture from sticking to the roller wheels. Fuel oil shall not be used to moisten roller wheels.
- e. All asphalt mixtures, except open-graded asphalt friction course and type SF 9.5A, shall be compacted to at least 92 percent of the mixtures maximum specific gravity. An SF 9.5A mixture shall be compacted to at least 90 percent of the mixtures maximum specific gravity.
- f. Rolling for open-graded asphalt friction course shall consist of one coverage with a tandem steel wheel roller weighing a maximum of 10 tons, with additional rolling limited to one coverage with the roller where necessary to improve riding surface.
- g. The use of rolling equipment that results in excessive crushing of the aggregate or excessive displacement of the mixture will not be permitted.
- h. In areas inaccessible to standard rolling equipment, the mixture shall be thoroughly compacted by the use of hand tampers, hand operated mechanical tampers, or other approved equipment.
- i. The tolerance of the final compacted pavement shall be within 1/4" of the typical cross-sections shown on the plans.

4. Joints

- a. Placement of surface course material as the final layer of pavement should not be placed between November 15 and April 1 of the next year unless otherwise approved by the Engineer. In addition, open-graded asphalt friction course shall not be placed between October 31 and April 1, unless otherwise approved.
- b. As an exception to the above, when in any day's operations the placement of a layer of asphalt base course material or intermediate course material 2 inches or greater in thickness has started, it may continue until the temperature drops to 32° F.

F. TRAFFIC MARKINGS

The Contractor shall repair and restripe any traffic markings that were damaged, removed or covered during construction. All work shall be done in accordance with NCDOT requirements and specifications. The cost of this work shall be included in the unit bid prices for other related work and no additional payment shall be made.

G. EXISTING UTILITIES

All existing manhole and valve covers shall be raised by the Contractor as necessary prior to paving so that the tops of the covers are flush with the final surface. The cost of this work shall be included in the unit bid prices for other related work and no additional payment shall be made.

3.02 TESTING

All of the above work will be subject to thickness and compaction tests as deemed necessary by the Engineer. Such tests will be at the Expense of the Owner.

END OF SECTION

