

CHAPTER 12

LOW PRESSURE SANITARY SEWERS

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1 **PART 1 - GENERAL**

2 **1.1 SUMMARY**

3 A. Section Includes:

4 1. PVC Pipe and Fittings

5 2. HDPE Pipe and Fittings

6 3. Ductile-iron Pipe and Fittings

7 4. Valves

8 5. Service Boxes and Lids

9 **1.2 RELATED DOCUMENTS**

10 A. Charlotte Water Water and Sewer Design and Construction Standards and Standard
11 Details.

12 **1.3 DEFINITIONS AND ABBREVIATIONS**

13 A. See Sections iii and iv of the Charlotte Water Water and Sewer Design and Construction
14 Standards for common abbreviations and definitions.

15 **1.4 SUBMITTALS**

16 A. Required submittals for product approval include, but are not limited to, the following:

17 1. Product brochures

18 2. Catalog cut sheets

19 3. Shop drawings including dimensions and part/material lists

20 4. Certification of compliance

21 5. Prior product acceptance test reports

22 6. Reference contact data

23 7. Shipping tickets and purchase invoices

24 B. Provide product data for the following:

25 1. PVC Pipe and fittings

26 2. HDPE Pipe and Fittings

27 3. Ductile Iron Pipe and Fittings

28 4. Valves

29 5. Service Boxes and Lids

30 C. Shop Drawings:

31 D. Pre-excavation Photographs or Videotape: Show existing conditions of adjoining
32 construction and site improvements, including finish surfaces that might be misconstrued

1 as damage caused by earth-moving operations. For Donated Projects, these
2 requirements apply to existing road rights-of-way only. Submit before earth moving
3 begins.

- 4 E. Product Certificates: Required for all products.
- 5 F. Qualification Data: For qualified testing agency.
- 6 G. Material Test Reports: For each on-site and borrow soil material proposed for fill and
7 backfill as follows:
 - 8 1. Classification according to ASTM D 2487.
 - 9 2. Laboratory compaction curve according to ASTM D 698.

10 **1.5 DELIVERY, STORAGE, AND HANDLING**

- 11 A. Do not store plastic pipe and fittings in direct sunlight. All pipe must be in brand new
12 factory condition, and no more than one year old from manufacturer date to installation.
13 Pipe manufacturer must provide letter regarding exposure requirements.
- 14 B. Valves must be stored such that they are protected from freezing.
- 15 C. Protect pipe, pipe fittings, and seals from dirt and damage.
- 16 D. All PVC and HDPE pipe will be shipped, stored, and strung at the project in such a
17 manner as to be protected from total accumulated exposure to sunlight and possible
18 ultraviolet radiation of no more than two (2) weeks. Pipe must be installed within one
19 year from the manufacturer date printed on the pipe wall.
- 20 E. The Contractor shall be responsible for the safe storage of materials furnished by or to
21 them, and accepted by them and intended for the work, until they have been incorporated
22 in the completed project. Handling and storage of all project materials are to be in
23 compliance with the manufacturer's recommendations for handling and storage. The
24 interior of all pipe, manholes and other accessories shall be kept free from dirt and foreign
25 materials at all times.
- 26 F. Transportation of Materials and Equipment: The Contractor and their Suppliers are
27 directed to contact the North Carolina Department of Transportation to verify axle load
28 limits on State maintained roads (and bridges) which would be used for hauling of
29 equipment and materials for this project. The Contractor and their Suppliers shall do all
30 that is necessary to satisfy the Department of Transportation requirements and will be
31 responsible for any damage to said roads which may be attributed to this project. All
32 materials required to construct this project shall be furnished by the Contractor and shall
33 be delivered and distributed at the site by the Contractor or their material supplier.
- 34 G. Loading and Unloading Materials: Pipe and pipe accessories shall be loaded and unloaded
35 by lifting with hoists or skidding so as to avoid shock or damage. Pipe and precast manholes
36 will be unloaded with hoists and/or as recommended by the respective manufacturers.
37 Under no circumstances shall such materials be dropped. Pipe handled on skidways shall
38 not be skidded or rolled against pipe already on the ground.
- 39 H. Responsibility for Materials on Site: In distributing the material at the site of the work, each
40 piece shall be unloaded opposite or near the place where it is to be laid in the trench. Each
41 piece shall be redundantly chocked at each end to prevent movement or rolling. Pedestrian
42 or vehicular traffic shall not be unduly inconvenienced in placing of material along the
43 streets or right-of-way, as applicable.

1 The Contractor will string in advance no more than the amount of pipe and material that
2 can be installed within two (2) weeks unless approved by the Engineer. All the materials
3 shall be placed in such a manner as not to hinder access, endanger or impede traffic, create
4 a public nuisance or endanger the public.

5 Materials strung through residential areas (or any area with maintained lawns) shall be
6 placed in such a manner as not to restrict normal lawn maintenance and must either be
7 installed within two (2) weeks or removed to an approved storage yard, as required by the
8 Engineer.

9 I. Material and Equipment Storage Sites: Unless otherwise shown on the plans, the
10 Contractor will be responsible for locating and providing storage areas for construction
11 materials and equipment. Unless prior written consent from the owner of the proposed
12 storage area is received by Charlotte Water, the Contractor will be required to store all
13 equipment and materials within the limits of the project site, or the limits of the sanitary
14 sewer easement and temporary construction easement provided. The materials and
15 equipment storage shall comply with all local and state ordinances throughout the
16 construction period. Material and equipment may only be stored within road right-of-way if
17 approved by the controlling agency. Bulk storage of stacked materials shall not be permitted
18 in or along road rights-of-way.

19 Storage sites shall be fenced with adequate protection to reasonably prevent the public
20 from entering the site. The Contractor shall be responsible for the safeguarding of materials
21 and equipment against fire, theft, and vandalism and in a manner which does not place the
22 public at risk and shall not hold the City responsible in any way for the occurrence of same.

23 J. Care of Coatings and Linings: Pre-cast manholes, pipe and fittings, including frames and
24 covers, steps, straps, etc., shall be so handled such that the coating or lining will not be
25 damaged. If, however, any part of the coating or lining is damaged, the repair shall be
26 made by the Contractor at their expense in a manner satisfactory to the Engineer.

27 **1.6 FIELD CONDITIONS**

28 A. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities
29 occupied by Owner or others unless permitted and then only after arranging to provide
30 temporary service according to written requirements by Charlotte Water.

31 **PART 2 - PRODUCTS**

32 **2.1 PIPE, GENERAL**

33 A. Unless superseded or modified by a Special Provision; all materials, apparatus, supplies,
34 methods of manufacture, or construction shall conform to the specifications for same
35 contained in this Section. National material standards (ASTM, ANSI, etc.) referred to
36 herein shall be considered to be the latest revisions only.

37 B. The Engineer may waive certain requirements of these Material and Installation
38 specifications, provided that the Contractor requests such waiver in writing and provided
39 that the function of the material is not impaired. The Contractor may request to substitute
40 for a material that has been specified. The Engineer, in writing only, may accept or reject
41 such request.

1 C. Unless amended on the Construction Drawings, or approved by Charlotte Water, all
2 piping shall be Poly Vinyl Chloride (PVC) or High-Density Polyethylene (HDPE), as
3 specified herein.

4 D. Unless amended on the Construction Drawings, or approved by Charlotte Water, all
5 piping shall have a maximum diameter of 4-inches, as specified herein.

6 **2.2 PVC SERVICE PIPE AND FITTINGS**

7 A. 4-inch diameter and smaller pipe: All 4-inch diameter and smaller pressure sewer pipe
8 may be manufactured and tested in accordance with ASTM D-2241 for iron pipe size
9 (IPS) dimensions and shall be Pressure Class 315 with an SDR of 13.5 or less (pressure
10 rating equal to 315 psi) and shall be PVC 1120 pipe. PVC pressure pipe shall be made
11 from materials whose Cell Classifications are Class 12454 and shall be furnished in
12 lengths of 20 feet. Lesser lengths will be accepted to allow the proper placement of
13 fittings, valves, etc. Pipe color shall be green unless otherwise approved by the Engineer.

14 B. Pipe markings shall meet the following minimum requirements:

15 1. Manufacturer

16 2. Manufacturer Number (identifies factory, location, date manufactured, shift and
17 sequence)

18 3. Nominal diameter

19 4. Beam load

20 5. Laying length

21 6. ASTM designation

22 C. All pipe joints shall be by ELASTOMERIC GASKET JOINTS only, conforming to ASTM
23 standard D-3139. Pipe Bells for all pipes shall be integral to the pipe; sleeve couplings
24 are not allowed.

25 D. Fittings: PVC fittings for pressure sewer pipe 4-inch diameter and smaller shall be
26 Schedule 80 fittings manufactured in accordance with ASTM D-2467 with solvent weld
27 joints installed according to ASTM D-2855. Fitting color shall be grey. Schedule 80 PVC
28 solvent weld by threaded adapters shall be provided to join pipe to 2-inch threaded main
29 line iron bodied plug valves. 3 and 4-inch pipe shall connect to main line iron bodied plug
30 valves with mechanical joint transition gaskets.

31 E. Gaskets: ASTM F 477, elastomeric seals. The lubricant used for assembly shall be as
32 recommended by the manufacturer and shall have no detrimental effect on either the pipe
33 or the rubbergasket.

34 F. Solvent Cement: ASTM F943, low VOC emissions, heavy bodied, medium setting, high-
35 strength PVC solvent cement formulated for PVC sewer piping. Solvent cement shall not
36 be used without prior application of the primer.

37 G. Primer: ASTM F 656; Weld-on 729, or equal.

38 H. Whenever a PVC pressure sewer crosses over or within 1.5 feet below a water main, the
39 PVC pipe shall be installed within a length of 3-inch, 4-inch, or 6-inch diameter Ductile
40 Iron Pipe. The ductile iron pipe shall extend not less than 10 feet on each side of the
41 water main. The ductile iron pipe shall be standard Pressure Class 350 cement lined
42 pipe.

1 I. Manufacturers:

2 1. PVC pipe shall be as furnished by the following or pre-approved equal:

3 a. North American Pipe Corporation, NAPCO

4 b. JM Eagle

5 c. Diamond Plastics

6 d. National Pipe

7 e. Sanderson Pipe

8 f. Jetstream (by Pipelife)

9 2. PVC fittings shall be as furnished by the following or pre-approved equal:

10 a. North American Pipe Corporation, NAPCO

11 b. IPEX

12 J. PVC Solid Wall Sewer Pipe for Service Laterals:

13 1. Solid wall schedule 80 PVC service laterals shall be in accordance with ASTM D-
14 2665, NSF 14, and D-1785. Fittings shall be socket type in accordance with ASTM
15 D-2466. PVC material shall be PVC 1120. Joining shall be through solvent cement
16 and primer in accordance with ASTM D-2564. Pipe color shall be grey unless
17 otherwise approved by the Engineer.

18 2. The pipe shall contain all product markings required by ASTM D-1785, or ASTM
19 D-2665. The minimum pipe markings shall include manufacturer's name or
20 trademark, ASTM designation "ASTM D-1785 or D-2665", nominal pipe size, type
21 of plastic material such as "PVC1120 pipe", Schedule 80 as applicable, and
22 production code including year, month, day, shift, plant and extruder. Markings
23 shall be at intervals of not more than 5 feet.

24 3. The fittings shall contain all product markings required by ASTM D-1785, or ASTM
25 D-2665. The minimum markings on fittings shall include manufacturer's name or
26 trademark, and the pipe material "PVC". Markings shall be on the body or the hub.

27 4. PVC pipe and fittings shall be manufactured within the North American Continent.
28 An officer of the manufacturing company shall certify that all pipe and fittings were
29 manufactured in North America.

30 5. Product shall be manufactured at a facility that has a Registered ISO 9001:2000
31 Quality Management System. Copy of current ISO 9001:2000 registration shall be
32 submitted with product submittals.

33 6. Required submittals for product approval include, but are not limited to, product
34 brochure, catalog cuts or shop drawings including dimensions and part/material
35 list, certification of compliance, prior product acceptance test reports, and
36 reference contact data.

1 **2.3 HIGH DENSITY POLYETHYLENE (HDPE) PIPE AND FITTINGS**

2 A. High Density Polyethylene (HDPE) pipe and fittings shall meet the requirements of
3 AWWA C901 (3-inch diameter and smaller pipe) and AWWA C906 (4-inch diameter
4 pipe).

5 B. HDPE must meet or exceed the minimum wall thickness for HDPE IPS Pressure Pipe
6 PE4710 Dimension Ratio: SDR 9.

7 C. The outside diameter of the pipe shall be based upon the Iron Pipe Size (IPS) sizing
8 system.

9 D. Polyethylene pipe shall be made from HDPE material having a material designation code
10 of PE4710 or higher.

11 E. The material shall meet the requirements of ASTM D 3350 and shall have a minimum
12 cell classification of PE445474C.

13 F. Pressure Pipe shall be approved by the Underwriter's Laboratory (UL) or Factory Mutual
14 (FM).

15 G. Pipe Markings:

16 1. Meet the minimum requirements of AWWA C901 and C906. Minimum pipe
17 markings shall be as follows:

18 a. Manufacturer's Name or Trademark and production record

19 b. Nominal pipe size

20 c. IPS

21 d. Dimension Ratio (SDR 9)

22 e. AWWA C901 or C906

23 f. Seal of testing agency that verified the suitability of the pipe

24 g. Resin type (PE4710)

25 2. Color identification to identify pipe service is required:

26 a. Conform to ASME A13.1.

27 1) Color: Sewer/wastewater – green.

28 2) For pipes 4-inches and larger in diameter: Stripes or colored exterior pipe
29 product shall be green.

30 a. Permanent identification of piping shall be provided by co-extruding
31 multiple equally spaced color stripes into the pipe outside surface or by
32 solid colored pipe shell.

33 b. The striping material shall be the same material as the pipe material
34 except for the color.

35 3) Pipe interior shall be gray for visual inspection.

36 4) Plain Black HDPE Pipe without color code markings may not be used.

37 H. Only smooth wall HDPE will be permitted.

38 I. Fittings: Fittings for HDPE pipe shall be as specified in Charlotte Water's standard
39 specification for High Density Polyethylene (HDPE) Sanitary Sewer Piping.

1. 3 and 4-inch pipe shall connect to main line iron bodied plug valves with HDPE
2. butt fusion mechanical joint adaptor fittings. 2-inch and smaller pipe shall connect
3. to iron bodied main line plug valves and PVC service valves with a SDR 9 HDPE
4. socket fusion stainless steel threaded adaptor, as manufactured by DriscoPlex,
5. Integrity Fusion Products, Georg Fischer Central Plastics, or approved equal.
6. 2. Reducers: For reducers to pipes 2-inches and smaller reducers shall be socket
7. fusion fittings conforming to ASTM 1056 and larger than 2-inches shall be butt
8. fusion conforming to ASTM F 2620.
9. J. Acceptable manufacturers of HDPE piping and fittings shall be as specified in Charlotte
10. Water's standard specification for High Density Polyethylene (HDPE) Sanitary Sewer
11. Piping.
12. K. HDPE Laterals:
 13. 1. HDPE laterals shall be in accordance with ASTM D-2239 and shall meet or exceed
14. the minimum wall thickness for HDPE IPS Pressure Pipe PE4710 SDR 9.
 15. 2. Connections to a new HDPE main shall be performed using electrofusion and or
16. butt fusion. Fittings shall be made of polyethylene pipe compound that meets the
17. requirements of ASTM D1248, Class C and suitable for fusion welding to
18. polyethylene pipe.
 19. 3. New service connections to existing active mains Connections to an existing sewer
20. house connection pipe shall be made using sleeved stainless-steel couplings on
21. each side of a new service cut-in wye.
22. L. Pipe Manufacturers: Performance Pipe, GF Piping Systems, JM Eagle, Driscoplex, WL
23. Plastics or approved equal.
24. M. Butt Fusion Fittings Manufacturers: ISCO, IPEX, Georg Fisher, or approved equal.
25. N. Electrofusion Fittings Manufacturers: Agru America, GF Piping Systems, Integrity Fusion
26. Products, IPEX, MT Deason Company, NUPPI Americas Inc, or approved equal.

27 2.4 DUCTILE-IRON PIPE AND FITTINGS

28. A. All materials furnished in accordance with these specifications shall be new and unused,
29. unless otherwise specified in the project Special Provisions. Unless superseded or
30. modified by a Special Provision, all materials, apparatus, supplies, methods of
31. manufacture, or construction shall conform to the specification for same contained in this
32. Section. National material standards (ASTM, ANSI, etc.) referred to herein shall be
33. considered to be the latest revisions only.
34. B. Pipe: At a minimum, all Ductile Iron Pipe shall conform to the requirements of
35. AWWA C151/A21.51, and ASTM A-746, pressure class 350, with Protecto 401 lining or
36. approved equal.
 37. 1. The pipe class selection for all diameters shall be based on the installation
38. conditions and existing or proposed depth of cover. Special thickness class pipe
39. up to and including thickness class 56 shall be required when specified, based on
40. installation conditions and depth of cover.
 41. 2. The pipe shall contain all product markings required by ASTM A-746 and AWWA
42. C-151. The minimum pipe markings shall include the weight, class or nominal
43. thickness, casting date. The manufacturer's mark, the country where cast, the

1 production year, and the letters "DI" or "DUCTILE" shall be cast or metal stamped
2 on the pipe, and on pipe sizes 14-inch and larger shall not be less than $\frac{1}{2}$ -inch in
3 height. All markings shall be clear and legible, and all cast or metal-stamped marks
4 shall be on or near the bell.

5 C. Compact Fittings: AWWA C153/A21.53, with Protecto 401, Themec Perma-Shield PL
6 Series 431, or approved equal lining in accordance with AWWA.

7 1. The fittings shall contain all product markings required by AWWA C-153 as
8 applicable. The minimum markings on each fitting shall include the identity of the
9 AWWA standard, the pressure rating, nominal diameters, manufacturer's
10 identification, the county where cast, the letters "DI" or "DUCTILE", and the angle
11 of all bends. The markings shall be distinctly cast raised or in relief on the outside
12 of the fitting body.

13 D. Gaskets: AWWA C111/A21.11, Styrene Butadiene Rubber (SBR or EPDM), of shape
14 matching pipe and fittings.

15 E. Manufacturers:

16 1. DIP pipe shall be as furnished by the following or pre-approved equal:

- 17 a. American Cast Iron Pipe
- 18 b. McWane Cast Iron Pipe
- 19 c. US Pipe Company

20 2. DIP fittings shall be as furnished by the following or pre-approved equal:

- 21 a. American Cast Iron Pipe
- 22 b. McWane Cast Iron Pipe
- 23 c. Star Pipe Products
- 24 d. Sigma Corporation
- 25 e. SIP Industries
- 26 f. Tyler Union Pipe
- 27 g. US Pipe Company

28 F. HDPE to Ductile Iron Transition Assembly:

29 1. Transition between DIP and HDPE shall be fully restrained joint pipe. Provide a
30 male HDPE MJ adaptor on the outer ends of the pipe such that it is fully restrained.

31 2. 3-inch DIP: Use DI mechanical joint Long Pattern Solid Sleeve with IPS transition
32 Gasket, on each end of the DIP. Use male HDPE MJ adaptor on the outer ends
33 of the LPSS's such that the connection is fully restrained. Alternatively, use EBAA
34 Iron Series 2000PV mechanical joint restraint on the HDPE side of the long pattern
35 solid sleeve. Contractor to follow all installation instructions, including requirement
36 to remove the spacer on each restraint screw, prior to assembly.

37 3. 4-inch and larger DIP: Use DI mechanical joint Long Pattern Solid Sleeve with IPS
38 transition Gasket, on each end of the DIP. Use male HDPE MJ adaptor on the
39 outer ends of the LPSS's such that the connection is fully restrained. Alternatively,
40 use EBAA Iron Series 2000PV mechanical joint restraint on the HDPE side of the

1 long pattern solid sleeve. Contractor to follow all installation instructions, including
2 requirement to remove the spacer on each restraint screw, prior to assembly.

3 G. PVC to Ductile Iron Transition Assembly:

4 1. 3-inch DIP – use DI mechanical joint reducer with IPS transition gasket, on each
5 end of the DIP.

6 2. 4-inch and larger DIP - use DI mechanical joint long pattern solid sleeve with IPS
7 transition gasket on each end of the DIP.

8 **2.5 VALVES**

9 A. All valves on pressure sewer mains shall be plug or ball valves as specified below. Valve
10 operation shall be open left. All direct bury valves shall require valve extension stems.

11 B. Plug Valves: All valves on pressure sewer mains shall be eccentric plug valves and
12 shall confirm to all requirements of AWWA C-517 and as specified below:

13 1. Plug valves shall be non-lubricated, with a plug facing of a material specifically
14 recommended by the valve manufacturer for the indicated service and shall
15 have stainless steel permanently lubricated upper and lower plug stem
16 bearings. Valve seats shall be nickel. Valves shall be designed with adjustable
17 seals which are replaceable without removing the bonnet. The bearing and
18 seal area shall be protected with grit seals. Valve bodies shall be Gray Cast
19 Iron or Ductile Iron.

20 2. Area of port opening for all 3 inch and larger valves shall be no less than 100%
21 of full pipe area. Area of port opening for all 2-inch valves shall be no less than
22 81% of full pipe area.

23 3. All valves shall be rated at 175 psi and shall be Bi-Directional.

24 4. Buried valves 2-inch in diameter and smaller shall have schedule 80 threaded
25 ends and shall be connected to the pressure main by schedule 80 PVC
26 threaded by socket adapters on PVC pipe and with a DR 9 HDPE butt fusion by
27 stainless steel threaded adaptor, as manufactured by DriscoPlex, Integrity Fusion
28 Products, Georg Fischer Central Plastics, or approved equal on HDPE pipe.

29 5. Buried plug valves shall have 2-inch operating nuts within 10- inches to 15-
30 inches below finish grade. Maximum operating torque shall be limited to 150
31 Ft.-Lbs. Enclosed gearing/actuator shall be required as recommended by the
32 manufacturer.

33 6. Extension stems, stem guides, actuators, operating levers, and other
34 miscellaneous items required for a complete installation shall be provided in
35 accordance with the requirements and recommendations of the manufacturer.

36 7. Buried plug valves shall be provided with adjustable valve boxes. Valve boxes
37 shall be cast iron conforming to ASTM A- 48, Class 35. Valve box castings
38 shall be fully bituminous seal coated. Valve box shall be in accordance with
39 the Charlotte Water Standard Detail.

40 8. Buried valves 3-inch and 4-inch and other valves specifically indicated shall
41 have mechanical joint ends conforming to ANSI A21.11.

42 9. MJ valve connections shall be fully restrained to the HDPE pipe using a male MJ
43 SDR 9 HDPE adaptor, with stainless steel pipe inserts.

1 10. Manufacturers:

2 a. Plug valves shall be as manufactured by DeZurik Corporation, Milliken
3 Valve Co., Keystone Valve, or approved equal.

4 C. Thermoplastic ball valves: Thermoplastic ball valves shall be used at each service
5 connection and shall be made of PVC Thermoplastic. The valves shall be furnished
6 with teflon seats and true union ends. The handle shall be capable of being locked
7 in the open and closed positions using a barrel lock or pad lock. Thermoplastic ball
8 valves shall be as manufactured by Heyward, Incorporated or approved equal.

9 D. Thermoplastic ball check valves: Thermoplastic ball check valves shall be used at each
10 service connection and shall be made of PVC Thermoplastic. The valves shall be
11 furnished with elastomeric seats and true union ends. Thermoplastic ball check valves
12 shall be as manufactured by Hayward, Incorporated or approved equal.

13 E. Iron body plug valves: Iron body plug valves shall be used at air releases and
14 cleanouts.

15 **2.6 SERVICE BOXES AND LIDS**

16 A. All 1.5-inch diameter service connections and air release/clean outs shall be placed in
17 an appropriately sized box, in accordance with the Standard Details, and shall be as
18 manufactured by Hubbell PenCell Plastics, DFW Plastics, or approved equal.

19 1. All service connection boxes shall be made of green plastic with the physical
20 dimensions shown in the Standard Details and constructed of standard
21 thermoplastic materials using the structural foam approach, and shall be as
22 manufactured by Hubbell PenCell Plastics, DFW Plastics, or approved equal. The
23 plastic composition shall be uniform and substantially resistant to moderate acid
24 attack, ultraviolet ray action, and weathering as may be encountered in outdoor
25 application and semi-buried service.

26 2. Plastic lids shall be furnished as needed with "snap lock" tabs and imprinted with
27 the words "CHARLOTTE WATER" or "CLT WATER" and "Pressure Sewer" on the
28 lid.

29 3. Plastic lids shall have a 3/4-inch diameter prick hole.

30 B. All 2-inch through 4-inch diameter service connections shall be installed in precast
31 concrete vaults with steel access doors in accordance with the appropriately sized
32 Standard Details.

33 1. The steel access door shall be imprinted with the words "CHARLOTTE WATER"
34 or "CLT WATER" and "Pressure Sewer" on the cover. The ERT hanger and slots
35 shown on the Standard Water Details shall be removed for the LPSS door.

36 2. The service box and lid shall conform to the requirements of ANSI 77 and shall
37 meet the load requirements of Tier15.

38 C. Identification

39 1. Lid: Premise numbers shall be clearly indicated on lid via an adhesive tag. See
40 the Charlotte Water Water and Sewer Design and Construction Standards for
41 requirements.

42 2. Manifolds: Premise numbers shall be engraved inside the door, on the support rib
43 adjacent to the handle in line with transmitter. Lettering shall be laid out using a 1

1 $\frac{1}{4}$ -inch stencil and engraving shall be with a high-speed rotary tool with a $\frac{1}{4}$ -inch
2 oval or ball bit.

3 **PART 3 - EXECUTION**

4 **3.1 PIPING INSTALLATION GENERAL**

5 A. General Locations and Arrangements: Drawing plans and details to indicate general
6 location and arrangement of underground sanitary sewer piping. Location and
7 arrangement of piping layout take into account design considerations. Install piping as
8 indicated, to extent practical. Where specific installation is not indicated, follow piping
9 manufacturer's written instructions.

10 B. In all instances pipe shall be laid in a workmanlike manner, true to line and grade, with
11 bell ends facing up-grade in the direction of laying. The various pipes referred to herein
12 shall be handled, belled up and laid in accordance with the manufacturer's requirements
13 and good engineering practices as defined in the various publications referenced in this
14 document. The following requirements and/or standards of the Charlotte Water shall
15 govern this construction unless exceeded by other regulatory bodies.

16 C. Install proper size increasers, reducers, wyes, bushings, and couplings where different
17 sizes or materials of pipes and fittings are connected. Reducing size of piping in direction
18 of flow is prohibited.

19 D. When installing pipe under streets or other obstructions that cannot be disturbed, use
20 dry bore with encasement, auger without encasement, dry punch/mole or horizontal
21 directional drilling, as shown on the plans or as approved by the Engineer.

22 E. Pipe Bedding: Unless otherwise specified or noted on the Plans the following bedding
23 classes are commonly required by Charlotte Water. When filter fabric is required to be
24 placed over the granular bedding and pipe, as shown on the Standard Details, the fabric
25 shall be Mirafi 140N or approved equal. When granular material embedment is required,
26 the Contractor will backfill above the granular bedding as specified for Type I bedding to
27 an elevation one (1) foot above the top of pipe bell.

28 1. Type I - Shaped Bottom Bedding: The trench bottom shall be shaped so the
29 pipe bears uniformly upon undisturbed native earth. Soil shall then be placed by
30 around the pipe and completely under the pipe haunches in uniform layers not
31 exceeding six (6) inches in depth up to an elevation one (1) foot above the top
32 of the pipe bell. Each layer shall be placed and then carefully and uniformly
33 compacted, so that the pipe is not damaged, nor the alignment disturbed.

34 2. Type IA – Granular Shaped Bottom Bedding: The trench bottom shall be
35 shaped so the pipe bears uniformly upon undisturbed native earth. The pipe
36 haunches shall be filled with an approved stone to a vertical height of one-fourth
37 the outside diameter of the pipe bell for the pipe's entire length and for the entire
38 width of the ditch. Type IA granular shaped bottom bedding may be used in lieu
39 of Type I shaped bottom bedding. Soil shall then be placed by around the pipe
40 and completely in uniform layers not exceeding six (6) inches in depth up to an
41 elevation one (1) foot above the top of the pipe bell. Each layer shall be placed
42 and then carefully and uniformly compacted, so that the pipe is not damaged,
43 nor the alignment disturbed.

1 3. Type II - Granular Material Embedment: The trench bottom shall be undercut a
2 minimum of six (6) inches below the pipe barrel grade and filled with an approved
3 stone to an elevation such that the pipe will be completely and uniformly bedded to
4 a vertical height of one-third the outside diameter of the pipe bell for the pipe's
5 entire length and for the entire width of the ditch. Depending upon soil and ground
6 water conditions, greater depths (undercut) may be required to create a stable
7 condition. Type II granular material embedment shall be used as directed by the
8 Engineer. When ground water or bedrock is encountered, a minimum bedding of
9 Type II is required.

10 4. Type III - Granular Material Embedment: The trench bottom shall be undercut a
11 minimum of six (6) inches below the pipe barrel grade and filled with an approved
12 stone to an elevation such that the pipe will be completely and uniformly bedded to
13 vertical height of one-half the outside diameter of the pipe bell for the pipe's entire
14 length and for the entire width of the ditch. Depending upon soil and ground water
15 conditions, greater depths (undercut) may be required to create a stable condition.
16 Type III granular material embedment shall be used as directed by the Engineer.

17 5. Type IV – Granular Material Embedment: The trench bottom shall be undercut
18 a minimum of six (6) inches below the pipe barrel grade and filled with an
19 approved stone to an elevation such that the pipe will be completely and
20 uniformly bedded to a vertical height equal to the outside diameter of the pipe
21 bell for the pipe's entire length and for the entire width of the trench. Depending
22 upon soil and ground water conditions, greater depths (undercut) may be
23 required to create a stable condition. Type IV granular material embedment
24 shall be used as directed by the Engineer.

25 6. Type V – Granular Material Embedment: The trench bottom shall be undercut
26 a minimum of six (6) inches below the pipe barrel grade and filled with an
27 approved stone to an elevation such that the pipe will be completely and
28 uniformly bedded to a vertical height of twelve (12) inches above the outside
29 diameter of the pipe bell for the pipe's entire length and for the entire width of
30 the trench. Depending upon soil and ground water conditions, greater depths
31 (undercut) may be required to create a stable condition. Type V granular
32 material embedment shall be used as directed by the Engineer.

33 7. Type VI – Flowable Fill Embedment: The trench bottom shall be undercut a
34 minimum of six (6) inches below the pipe barrel grade and filled up to the spring
35 line with excavatable flowable fill, for use adjacent to lakes and ponds, when
36 the pipe is more than 6 feet below full pond, or when excavation occurs within
37 45-degree line sloping out and down from toe of foundation slab. Depending
38 upon soil and ground water conditions, wider trenches may be required to
39 create a stable condition in poor soils that cannot brace the flowable fill. Type
40 VI flowable fill embedment shall be used as directed by the Engineer.

41 8. Stone Stabilization: When the bottom of the trench is not sufficiently stable to prevent
42 vertical or lateral displacement of the pipe after installation with Type II or Type III
43 bedding, stone stabilization will be required to develop a non- yielding foundation for
44 the bedding and pipe. When such conditions are encountered, the trench will be
45 excavated to a depth as great as 2.5 feet below the pipe bell, or as determined by
46 the Engineer, and #467 or #357 crushed stone, ballast stone or rip rap will be placed
47 to an elevation six (6) inches below the bottom of the pipe. The pipe will then be

laid with Type II or Type III bedding as directed by the Engineer. Stabilization techniques utilizing a geotextile fabric may also be permitted or required by the Engineer.

9. **Stone Foundation:** When the bottom of the trench is not sufficiently stable to prevent vertical or lateral displacement of the pipe after installation of feet of stabilization stone material, stone foundation materials will be required to develop a non-yielding foundation for the stone stabilization, bedding and pipe. When such conditions are encountered, the trench will be excavated to a depth, as determined by the Engineer. Class A, B, 1, or 2 stone foundation materials will be placed to an elevation determined by the Engineer. Layering of several classes of stone foundation materials may be required by the Engineer. Stabilization stone shall be used between the stone foundation materials and the bedding stone as determined by the Engineer. The pipe will then be laid with Type II through Type VI (6) bedding as directed by the Engineer. Should the Engineer determine that the stone foundation material is not capable of providing a non-yielding foundation, then concrete cradles or piers shall be required as specified below. Excavation and disposal of undercut materials necessary for installation of stone foundation material is included as part of stone foundation.

10. **Concrete Encasement and Cradles:** Shall be as designed for each individual case and will be noted on the Plans and in the Special Provisions when applicable.

3.2 INSTALLATION OF PVC LOW PRESSURE SEWER PIPE AND FITTINGS

- A. Clear interior of piping of dirt and superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place watertight plug-in end of incomplete piping at end of day and when work stops.
- B. PVC Pipe: PVC pressure sewer main shall be installed substantially in accordance with the Standard Recommended Practices for UNDERGROUND INSTALLATION OF FLEXIBLE THERMOPLASTIC SEWER PIPE, ASTM D-2321.
- C. Valves and Fittings: Valves and fittings shall be installed in the manner specified for cleaning, laying and jointing pipe. Valves shall be installed at locations shown on the Plans and/or as directed by the Engineer.
- D. Valve Boxes: A valve box shall be installed at every buried plug valve. The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the operating nut, with the box cover flush with the pavement or other existing surface. Where the box is not in pavement or sidewalk, the top section shall be anchored by an 24" diameter pre-cast concrete pad, or cast in place concrete pad, set flush with the existing terrain. The top section of the valve box will be grouted into the pre-cast concrete pad, with the full annular space filled with grout. The location of the valve will be identified by the letter "PSV" imprinted onto the curb adjacent to the pressure sewer valve, with the "PSV" pointing at the valve location.
- E. Blocking Fittings: All plugs, caps, tees, wyes, bends, and valves on pressure mains shall be provided with thrust blocking, placed as shown on the plans, standard details, and/or as directed by the Engineer, and consisting of ready-mix concrete having a compressive strength of not less than 3,600 LBS per square inches at 28 days. Bagged mix concrete may be used for blocking, anchorage, etc. on sewer mains and valves. Blocking shall be placed between solid ground and the fittings to be anchored. The area of bearing on the pipe and on the ground in each instance shall be that shown or directed by the Engineer.

1 The valve, fitting, etc. shall be wrapped with 2 layers of polyethene wrap to prevent
2 bonding between the concrete and the fitting. The blocking shall be so placed that the
3 pipe and fittings will be accessible for repair.

4 F. Alignment and Grade: The curb must be in place and backfilled, and the area between
5 curb and street right-of-way line graded smooth and to finished grade before the
6 pressure sewer mains are installed. The pressure sewer mains shall be installed on the
7 opposite side of the road from the water main and typically five feet behind the curb
8 except as shown on the approved plans or as directed by the Engineer. The pressure
9 sewer shall be laid and maintained at the required lines and grades with fittings and
10 valves at the required locations, spigots centered in bells, and all valve stems plumb.

11 G. The location and depth of the pressure sewer main and valves, etc., will be checked for
12 conformance to Charlotte Water standards. Any deficiencies will be corrected to the
13 satisfaction of the Engineer prior to testing and activation of the mains.

14 H. Depth of Pipe Installation: Unless otherwise indicated on the Plans, or required by
15 existing utility location, all pipes shall be installed with the top of the pipe at least 5.0'
16 below the edge of the adjacent roadway pavement or 5.0' below the ground, whichever
17 requires the lower pipe elevation. The Contractor is instructed to check construction
18 plans and blow-up views for additional requirements.

19 I. The Contractor may be required to vary the depth of the pipe to achieve minimum
20 clearance from existing utilities while maintaining the minimum cover specified whether
21 or not the existing pipelines, conduits, cables, mains, etc., are shown on the plans. PVC
22 pressure sewer shall be installed with 18-inches clearance above other utilities or 18-
23 inches clearance below other utilities.

24 **3.3 INSTALLATION OF HIGH DENSITY POLYETHYLENE (HDPE) LOW PRESSURE
25 SEWER PIPE AND FITTINGS**

26 A. Clear interior of piping of dirt and superfluous material as work progresses. Maintain
27 swab or drag in piping and pull past each joint as it is completed. Place watertight plug
28 in end of incomplete piping at end of day and when work stops.

29 B. Installers

30 1. Only formally trained and certified fusion technicians may conduct fusions.
31 Qualification of the fusion technician shall be demonstrated by certification in fusion
32 training within the past year for the type of fusion, and size of the pipe, and on the
33 specific equipment to be used on this project. Provide documentation showing
34 current and up-to-date qualification of training obtained to fuse PE pipe in the
35 appropriate sizes.

36 2. Training in accordance with ASTM 2620 for butt fusion.

37 3. Training in accordance with ASTM F 1055 and F1290 for electrofusion.

38 4. Fusion joints shall be made by qualified technicians per PPI TN-42.

39 5. Qualified technician has documented prior experience in performing HDPE pipe
40 installations, head fusion procedures, and testing methods.

41 C. Joining Methods

1. Butt Fusion: Butt fusion shall be done in accordance with ASTM F 2620, Plastic
2. Pipe Institute (PPI) TR-33 and PPI TN-13. All fusion joints shall be made in
3. compliance with the pipe or fitting manufacturer's recommendations.
4. Saddle fusion: Saddle fusion shall be done in accordance with ASTM F 2620 PPI
5. TR-41 and PPI TN-13. All saddle fusion joints shall be made in compliance with
6. the pipe or fitting manufacturer's recommendations.
7. Electrofusion: Electrofusion joining shall be done in accordance with the
8. manufacturers recommended procedure. Other sources of electrofusion joining
9. information are ASTM F 1290 and PPI TN 34. The process of electrofusion
10. requires an electric source, a transformer, commonly called an electrofusion box
11. that has wire leads, a method to read electronically (by laser) or otherwise input
12. the barcode of the fitting, and a fitting that is compatible with the type of
13. electrofusion box used. The electrofusion box must be capable of reading and
14. storing the input parameters and the fusion results for later download to a record
15. file.
16. 4. Socket Fusion: Socket fusion shall be done in accordance with ASTM 1056 and
17. PPI TN-13. All socket fusion joints shall be made in compliance with the pipe or
18. fitting manufacturer's recommendations. Socket fusion made be used for pipes
19. smaller than 2-inches in diameter.

20. D. Mechanical

21. 1. Mechanical connection of HDPE to auxiliary equipment such as valves, and fittings
22. shall use restrained joint mechanical joint HDPE adapters and other devices in
23. conformance with the PPI Handbook of Polyethylene Pipe, Chapter 9 and AWWA
24. Manual of Practice M55, Chapter 6.
25. 2. Unless specified by the fitting manufacturer, a restraint harness or concrete anchor
26. is recommended with mechanical couplings to prevent pullout.
27. 3. Mechanical coupling shall be made by qualified technicians.

28. E. Joint Recording

29. 1. Butt Fusion: The butt fusion equipment must be capable of reading and storing the
30. input parameters and the fusion results for later download to a record file.
31. 2. Saddle Fusion: The saddle fusion equipment must be capable of reading and
32. storing the input parameters and the fusion results for later download to a record
33. file.
34. 3. Electrofusion: The electrofusion equipment must be capable of reading and storing
35. the input parameters and the fusion results for later download to a record file.
36. 4. Socket fusion: The socket fusion equipment must be capable of reading and
37. storing the input parameters and the fusion results for later download to a record
38. file.
39. 5. The critical parameters of each fusion joint, as required by the manufacturer and
40. these specifications, shall be recorded by an electronic data logging device. All
41. fusion joint data shall be included in the fusion technician's joint report.

42. F. Installation

43. 1. HDPE pipe shall be installed with a minimum of 5.0 feet of cover and a maximum
44. of 25 feet of cover. HDPE pipe and fittings shall be installed in accordance with

ASTM D2321 or ASTM D2774 for pressure systems and AWWA Manual of Practice M55 Chapter 7.

2. Trenching:

- a. Trench Length: The length of open trench required for fused pipe sections should be such that bending and lowering the pipe into the ditch does not exceed the manufacturer's minimum recommended bending radius and result in kinking.
- b. Trench Width: The trench width at pipe grades for pipes less than 24-inches diameter shall be equal to the pipe outer diameter plus 12-inches.

Lay pipe with green stripe within 45-degrees either side of crown, if pipe has green stripe.

Pipe embedment - Embedment material shall be fine aggregate defined as:

- a. Granular and free flowing
- b. Generally meets or exceeds the limits on deleterious substances per Table 1 for fine aggregate according to ASTM C 33.
- c. Reasonably free of organic material.
- d. Gradation:

Embedment Material	
Sieve Size	Percent Retained
1 inch	0
3/8 inch	0-10
#40	20-60
#100	95

5. Compact backfill per ASTM D 698 and AASHTO T-99 as modified by NCDOT to 85% of maximum density or 95% maximum density within a road right-of-way. Compact the top 12-inches below the road sub-grade to 100% of maximum density within a road right-of-way.
6. Valves and Fittings: Valves and fittings shall be installed in the manner specified for cleaning, laying and jointing pipe. Valves shall be installed at locations shown on the Plans and/or as directed by the Engineer.
7. Valve Boxes: A valve box shall be installed at every buried plug valve. The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the operating nut, with the box cover flush with the pavement or other existing surface. Where the box is not in pavement, the top section shall be anchored by an 24" diameter precast concrete pad, set flush with the existing terrain. The top section will be grouted into the precast concrete pad. The location of pressure sewer valves will be identified by the letters "P.S.V." imprinted onto the curb adjacent to the pressure sewer valve.

1 8. Alignment and Grade: The curb must be in place and backfilled, and the area
2 between curb and street right-of-way line graded smooth and to finished grade
3 before the pressure sewer mains are installed. The pressure sewer mains shall be
4 installed on the opposite side of the road from the water main and five feet behind
5 the curb except as shown on the approved plans or as directed by the Engineer.
6 The pressure sewer shall be laid and maintained at the required lines and grades
7 with fittings and valves at the required locations, spigots centered in bells, and all
8 valve stems plumb.

9 **3.4 CONNECTIONS TO EXISTING SEWERS**

10 A. Tie-ins to existing activated sewer lines will be allowed when proper precautions are taken
11 to protect the existing main. Tie-ins to existing unactivated sewer lines not installed under
12 the same contract will not be allowed without written approval from all parties involved
13 (Charlotte Water, contractors, contract holders, etc.). If the proposed sewer does not begin
14 at an existing manhole, a straddle type manhole as shown on the Standard Details will be
15 constructed over (and around) the undisturbed existing pipeline. The existing pipeline will
16 not be cut out and the new invert formed until all testing has been successfully completed.

17 1. Pre-Cast Manhole Tie-In: Any connection at an existing precast manhole will
18 require the Contractor to core the necessary opening through the manhole wall.
19 Connections to existing pre-cast manholes shall require rehabilitation with coating
20 per Charlotte Water standard specifications. Jackhammer or sledgehammer
21 break-in to the manhole is not permitted.

22 2. Brick Manhole Tie-In: Connections to existing brick manholes may be cored or
23 sawed for all pipe diameters. Depending on the condition of the existing manhole,
24 Charlotte Water may require replacement of the manhole. Connections to existing
25 brick manholes shall require rehabilitation with coating per Charlotte Water
26 standard specifications.

27 3. Temporary Watertight Plugs: The Contractor shall install temporary watertight plugs
28 in the proposed sewer line, at the open end of the pipeline prior to leaving the job
29 site daily, during lunch breaks, and elsewhere as dictated by good engineering and
30 construction practices. All installed pipe shall be backfilled or otherwise securely tied
31 down to prevent flotation in the event water enters or rises in the trench. The pipe
32 system shall be watertight during any absence of the Contractor from the project site.
33 The plugs as installed shall prevent infiltration or the introduction of any foreign
34 material into either the existing or proposed systems. The City will not accept any
35 pipeline or manhole which contains any silt, sedimentation or other foreign material,
36 within. The Contractor shall at their own expense flush, or otherwise cause the line
37 to be cleaned out without any discharge into the existing system. Upon completion
38 of all construction, the Contractor will be responsible for the complete removal of all
39 watertight plugs, in the sequence necessary to allow testing and subsequent
40 activation, all under the review of the Engineer.

41 4. Scheduling: When the flow of an existing sewer must be interrupted and/or
42 bypassed, the Contractor shall, before beginning any construction, submit a work
43 schedule which will minimize the interruption and/or bypassing of wastewater flow
44 during construction. This schedule must be approved by the appropriate controlling
45 agencies and Engineer and may require night, holiday, and/or weekend work.
46 Existing low pressure sewer customers impacted by the interruption of service must
47 be notified when the private pump stations must be turned off and must also be

1 notified when the work is complete and the private pump stations can be turned back
2 on. Advance notifications shall be made in writing using door hangers or US mail or
3 in person hand delivery. Advance notifications must be completed a minimum of 48
4 hours prior to the scheduled tie-ins. Notification that private pump stations may be
5 returned to service shall be made in writing by in person delivery, or by doorhangers
6 when the customer does not come to the door.

7 5. 1.5-inch Service Connections to PVC Mains: On 4-inch and smaller mains, the 1.5"
8 laterals shall be connected to the street main with schedule 80 PVC solvent weld
9 wyes. The 1.5" service lateral shall be completed to the property line using
10 Schedule 80 solvent weld PVC pipe and fittings as detailed in the Standard Details.
11 The service connection meter box shall be installed one foot outside the road right
12 of way, and shall not be located in a driveway, or sidewalk. The service box shall
13 include a true union ball valve, a $\frac{3}{4}$ inch brass hose bib/air release, true union ball
14 check valve, and true union property lineball valve. All fittings shall connect to the
15 schedule 80 pipe with solvent welds. The service connection shall be in
16 accordance with the Standard Details. An "S" shall be cut into the top of the curb
17 in line with the service box.

18 6. 1.5-inch through 4-inch Service Connections to HDPE Mains: On 4-inch and
19 smaller mains, the 1.5" laterals shall be connected to the existing low pressure
20 sewer main with SDR 9 HDPE fused wyes. The 1.5" service lateral shall be
21 completed to the first true union ball valve in the service connection vault using
22 SDR 9 HDPE fused pipe adaptor with stainless steel threaded end. The buried
23 true union ball valve on the roadside of the service connection vault shall connect
24 to the HDPE pipe with union by female threaded ends. The pipe shall be SDR 9
25 HDPE by stainless steel male threaded adaptor. The pipe between the buried ball
26 valve and the first ball valve in the service connection vault shall be SDR 9 HDPE
27 pipe. All remaining pipe from the ball valve to the property line cap shall be
28 schedule 80 PVC pipe with solvent welds/flanges, as detailed in the Standard
29 Details. The service connection vault/box shall be installed one foot outside the
30 road right of way, and shall not be located in a driveway, pavement, or sidewalk.
31 The service vault/box shall include a true union ball valve, a $\frac{3}{4}$ inch brass ball
32 valve, hose bib/air release, true union ball check valve, and true union property
33 lineball valve. All 1.5-inch diameter fittings shall connect to the schedule 80 PVC
34 pipe with solvent welds. All 2-inch and larger diameter fittings shall connect to the
35 schedule 80 PVC pipe with flanges as shown on the standard details. The service
36 connection shall be in accordance with the Standard Details. An "S" shall be cut
37 into the top of the curb in line with the service box.

38 7. Buried Valve Magnet: A PVC encapsulated magnet shall be attached near all the
39 buried service valves on the front side of the meter box, and at the property line
40 service tailpiece cap for magnetic locating purposes.

41 **3.5 TRACER WIRE, PIPE MARKING, AND IDENTIFICATION**

42 A. The installation of tracer wire is required on all underground pipe installed. Tracer wire
43 shall be installed on all wastewater pipe regardless of pipe material. The wire shall begin
44 at the connections to the existing public mains and shall extend along the entire length
45 of new pipe installed.

46 B. Tracer Wire System: A single conductor AWG No. 12 (12-gauge) solid copper wire with
47 30 mils green HDPE insulation shall be laid on top of the pipe to aid in locating the pipe

1 for maintenance purposes. The wire shall extend along the entire length of the new pipe
2 installed. The copper conductor wire shall conform to ASTM B-3.

- 3 1. The wire shall be secured to the pipe with zip ties or duct tape (2-inches in width)
4 near every bell and at the midpoint of each pipe joint, or at a minimum, every 10
5 feet. The wire shall be a single continuous conductor from valve/service box or
6 vault to valve/service box or vault. When the distance between valve/service box
7 or vault exceeds 500 feet, splices will be permitted at 500 feet (or greater) intervals,
8 if needed. The splice shall be made watertight as indicated in the standard detail
9 as approved by the Engineer. Splices shall be isolated from direct tension on the
10 wires in accordance with the Standard Details.
- 11 2. When wire splices are required, the splices shall be securely bonded together with
12 an approved industrial connector to provide electrical continuity. Connector shall
13 be copper, and insulation shall be repaired as detailed to seal out moisture and
14 corrosion and shall be installed so as to prevent any uninsulated wire exposure.
15 See Standard Details.
- 16 3. At valve/service boxes, vaults or tracer wire termination valve boxes, the wire shall
17 be installed along the outside of the box/vault assembly from the pipe to the top
18 section of the box/vault. The wire shall enter the box/vault assembly, directly below
19 the top section of the box/vault. The wire shall extend through the top section and
20 shall terminate 24 inches above the top section. This excess wire shall be coiled
21 and stored in the top section, directly below the box/vault cover.
- 22 4. Contractor shall perform post installation testing of the tracer wire system to
23 confirm conductivity from valve/service box/vault to valve/service box/vault on a
24 daily basis during construction. Immediately prior to, or during the final inspection,
25 the Contractor shall perform post installation testing of the tracer wire system to
26 confirm conductivity from box/vault to box/vault. The test shall consist of applying
27 an alternating High/Low tone voltage to the conductor at one valve box and testing
28 the conductor at the next box/vault with Fluke Networks PRO3000 Tone Generator
29 and Probe Kit or approved equal. Every service line pipe segment shall be tested
30 in addition to all main line pipe segments. Alternate testing methods will be subject
31 to approval by the Engineer. The testing shall be witnessed by the Engineer. The
32 repair or replacement of any defective or improperly installed systems shall be the
33 responsibility of the Contractor. Any and all repairs or replacement of defective or
34 improperly installed tracer wire systems shall be performed by the Contractor and
35 at no cost to the Engineer. Method of repairs or replacement shall be subject to
36 approval of the Engineer. Upon acceptance by the Engineer, the wires in each
37 valve box shall be connected together with a wire-nut wire connector, coiled and
38 stored in the top section, directly below the valve box cover. The official Tracer
39 Wire Conductivity test shall be performed by the contractor at the time of the Final
40 inspection.

41 C. Detectable Warning Tape: 6-inch wide green sewer warning tape will be installed 12
42 inches above the top of the pipe and 24 inches below finish grade.

43 **3.6 HYDROSTATIC TESTING**

44 A. General

- 45 1. Hydrostatic and Makeup Water Tests: On completion of the line or sections of the
46 lines, connections and appurtenances, the line shall be filled and hydrostatically

1 tested. The water for this purpose can be taken from existing lines under the
2 supervision of the Engineer's Inspector and makeup water will be measured by the
3 Inspector with an ultrasonic water meter furnished by Charlotte Water. The Owner
4 will provide water for the first two makeup water tests. If additional tests are
5 needed, the Contractor is responsible for the cost of the water after the initial two
6 tests and for any subsequent tests. All leaks and any defective material shall be
7 repaired or replaced to the satisfaction of the Engineer and the tests repeated until
8 the requirements of this specification are met. Any special equipment, pumps, etc.
9 required to make the test shall be furnished and operated by the contractor as
10 directed by the Inspector.

11 2. The Contractor shall use great care to be sure that all air is expelled from each
12 section under test. If openings are not available for the purpose of expelling air,
13 the Contractor shall provide air releases of sufficient size (as determined by the
14 Engineer) in accordance with Charlotte Water Standard Drawings, at their
15 expense.

16 3. The water for testing purposes can be taken from the nearest available Charlotte
17 Water water main, public fire hydrant, air release, or blow off, under the supervision
18 of the Engineer's Inspector and leakage will be measured by the Inspector with an
19 ultrasonic water meter furnished by Charlotte Water

20 B. Testing of PVC Low Pressure Sewer Piping

21 1. The test pressure will be 1.5 times the new system operating pressure or 150 PSI,
22 whichever is greater, at the low point of the section under test.

23 2. Testing requirements and allowable makeup water shall be as specified in Section
24 9.3, Hydrostatic Testing, of AWWA C-605. See Table 4a of AWWA C-605 for
25 Makeup Water Allowance.

26 3. Required testing of pipelines and valves shall be done under the direct supervision
27 of the Project Inspector. Field testing shall not negate the requirements for material
28 certifications as contained in the material specification section of this contract.
29 Unless otherwise directed by the Engineer, all testing will be completed prior to
30 connection to any existing line. The Contractor shall provide open ventilation of
31 confined spaces. The Contractor shall be responsible for providing all equipment
32 and personnel necessary to comply with OSHA confined spaces regulations.

33 4. On completion of the line or sections of the lines, connections and appurtenances,
34 the line shall be filled and hydrostatically tested. All leaks and any defective
35 material shall be repaired or replaced to the satisfaction of the Engineer and the
36 tests repeated until the requirements of this specification are met. Any special
37 equipment, pumps, etc. required to make the test shall be furnished and operated
38 by the contractor as directed by the Inspector.

39 5. Specific procedures for testing mains are as follows:

40 a. Pressure and leakage tests will be run concurrently and for a duration of two
41 hours except as modified below.

42 b. The Contractor will pressurize the line and complete a pre-test to verify that
43 it is within allowable makeup water before the official test is started. All
44 makeup water shall be measured by a 5/8-inch ultrasonic water meter,
45 furnished by Charlotte Water. Pressure gauges shall be furnished by the
46 Contractor. The official test gauge shall be 4.5-inch dial with accuracy of

1 $\pm 0.5\%$ of span per ASME B40.100, Grade 2A with liquid fill, throttle screw
2 and pulsation damper, or 3-inch digital gauge with accuracy of $\pm 0.25\%$ of
3 span. The gauge shall be 300 PSI or as approved by the Engineer. The
4 gauge shall be calibrated within 90 days of the pressure test. Proof of
5 calibration by a third party testing/lab company shall be provided prior to the
6 testing. Other observation gauges may be 2.5-inch dials with accuracy of $\pm 3\%$ -
7 2-3% of span (ASME B40.100, Grade B)

8 c. During the official test, the Contractor is to maintain the pressure within +/- 5
9 PSI for the duration of the test period. The contractor will pump the line to
10 full test pressure at the end of each hour AND when the test pressure drops
11 5 PSI. The contractor will record the time, meter reading and pressure
12 reading before and after each pumping occurrence.

13 d. The Inspector will begin the test and remain at the job for the first hour,
14 making sure that the test pressure is maintained within +/- 5 PSI. At the end
15 of the first hour, with the line pumped to full test pressure, they will read the
16 meter and record the first hour leakage. If the first hour leakage is within
17 allowable, they will return at the end of the second hour and again read the
18 meter. If the total leakage for the two hour period does not exceed two times
19 the first hour leakage, the test will be terminated. If the total leakage exceeds
20 two times the first hour leakage, but is still within allowable, the test will be
21 held an additional hour. If the third hour leakage does not exceed the
22 average hourly leakage for the first two hours, the test will be terminated at
23 the end of the third hour. Otherwise, the test will be held until the leakage is
24 non-increasing and within allowable for two consecutive hours.

25 e. The maximum length of pipe tested in one test shall be 5,000 feet or as close
26 to 5,000 feet as possible depending on valve spacing.

27 f. During the last stages of the test and without any reduction in pressure,
28 progressing in an orderly manner from the end opposite the test pump, each
29 main line valve, cleanout/manual air release valve, buried service valves
30 between the main and the service vault/box will be closed, and pressure
31 released to determine if it is holding test pressure (minimum 10 minutes per
32 valve closing). No measurable pressure drop is permitted during each valve
33 test.

34 C. Testing of High Density Polyethylene (HDPE) Low Pressure Sewer Piping:

35 1. Hydrostatic leakage testing is recommended and shall comply with ASTM F 2164
36 and AWWA Manual of Practice M55 Chapter 9, and PPI Handbook of Polyethylene
37 Pipe Chapter 2 (2nd Edition). If the test section fails this test, the Contractor shall
38 repair or replace all defective materials and/or workmanship at no additional cost
39 to the Owner.

40 2. Prior to scheduling a test with the inspector, preform a pre-test to confirm
41 compliance. The contractor shall provide a copy of the pretest results to the project
42 inspector before the official test is scheduled.

43 3. Contractor shall perform hydrostatic and leakage tests in accordance with North
44 Carolina state requirements.

45 4. Leak tests of HDPE water system shall be conducted in accordance with ASTM
46 F2164. The pipeline should be slowly filled with potable water and all trapped air

1 bled off. The main should undergo a hydrostatic pressure test using pressure at
2 the lowest elevation in the system at 1.5 times the system design pressure, or 150
3 psi, whichever is greater. The pressure shall be maintained constant for 4-hour
4 period. After 4-hour period is completed, the pressure is then dropped by 10 psi.
5 The pressure shall remain steady within 5% of target test pressure for one hour. If
6 the pressure drops more than 5% during the one hour test, then the pipe has failed
7 the test. Proceed with the depressurization required in Item 5 below. If the
8 pressure drops less than 5% during the one hour test, then the pipe has passed
9 the test. Proceed with testing all the valves as required in item 8 below.

10 5. The total test time should not exceed 8 hours. If the pipeline has to be retested –
11 the pipe must be depressurized and allowed to “relax” for at least 8 hours before
12 the next testing sequence.

13 6. In fused polyethylene water piping system, no leakage shall be present. If leakage
14 is observed at a fusion joint, complete rupture may be imminent. The Contractor
15 shall move all personnel away from the joint and depressurize the main. Leaks,
16 failure, or defective construction shall be promptly repaired by the Contractor at
17 the Contractor’s sole expense. Repair methods shall be approved by the Engineer
18 and shall be witnessed by the Charlotte Water Inspector.

19 7. The maximum length of pipe tested in one test shall be 3,000 feet or as close to
20 3,000 feet as possible depending on valve spacing.

21 8. During the last stages of the test and without any reduction in pressure,
22 progressing in an orderly manner from the end opposite the test pump, each main
23 line valve, hydrant guard valves, air release valves, blow off valves, and all service
24 valves, between the main and service vault/box, will be closed and pressure
25 released to determine if it is holding test pressure (minimum 10 minutes per valve
26 closing). No measurable pressure drop is permitted during each valve test.

27 9. Any visible leakage shall invalidate and stop the test. The pipe shall be repaired
28 in a manor approved by the Engineer. Once repairs have been completed, the line
29 shall be refilled, and the testing process will restart from the beginning of the
30 specified process.

31 **3.7 RECORD DRAWINGS**

32 A. The Engineer shall provide the Contractor PDFs to use as the Contractor Record
33 Drawings. The Record Drawings shall be annotated using Bluebeam, by the Contractor,
34 to show all changes encountered or made during the construction of proposed facilities.
35 Record Drawings should be submitted to the Engineer upon completion of construction
36 of facilities required by each sheet, but no less often than once a month. Record
37 Drawings shall be subject to approval pending review by the Engineer and Charlotte
38 Water Inspector. Review and approval shall consist of a review for accuracy and
39 completeness, based on the Inspector’s knowledge of the project, and based on the
40 minimum requirements indicated below. Record Drawings which are not approved by
41 the Engineer shall be returned to the Contractor for explanation, revision, or correction
42 as deemed necessary by the Engineer.

43 B. Record Drawings shall meet the following minimum requirements and standards:
44 1. General to all projects:
45 a. Annotations shall be in red ink only.

- 1 b. Annotations shall be neatly printed and legible.
- 2 c. Add existing facilities encountered but not shown on plans.
- 3 d. Revise existing facilities encountered differently from plans.
- 4 e. Traffic control, erosion control and other temporary facilities shall not be
5 recorded.
- 6 f. Mark through changed stations, bearings, distances, slopes, etc., and print
7 actual station, bearing, distance, slopes, etc.
- 8 g. Mark through "proposed" for items that were actually installed.
- 9 h. Mark completely through items that were proposed but were not installed.
- 10 i. Correct notes, sizes, diameters, dimensions, classes, types, etc. to actual as
11 installed.
- 12 j. Revise profile of proposed facilities to within 0.1 feet of actual vertical and
13 within 1.0 feet of actual horizontal, based on contractor field survey of each
14 pipe joint.
- 15 k. Revise plan view of proposed facilities to within 1.0 feet of actual.
- 16 l. The following sheets are excluded, and do not require updating by the
17 Contractor:
 - 18 m. Cover Sheet, Permit Sheet, Vicinity/Location Map Sheets
 - 19 n. Traffic Control Sheets, Erosion Control Sheets
 - 20 o. Standard Detail Sheets
- 21 2. General to all new force main projects:
 - 22 a. Indicate pipe manufacturer, type and class of pipe.
 - 23 b. Indicate station for transition in pipe materials.
 - 24 c. Indicate restraint type, manufacturer, and beginning and ending stations in
25 profile, or on plan views without profiles.
 - 26 d. Indicate bedding type and location in profile, or on plan views without
27 profiles.
 - 28 e. Indicate solid ledge rock in profile to within 0.1 feet of actual vertical and
29 within 1.0 feet of actual horizontal, or on plan views without profiles.
 - 30 f. All fittings, valves, air releases, casings, tunnels, etc. shall be stationed.
 - 31 g. Indicate survey grade northing and easting coordinates for all appurtenances
32 and provide GPS locations along the main.
 - 33 h. At air releases, indicate station for tee or plug, control valve and standpipe.
34 Detail required, if not directly adjacent to the main.
 - 35 i. At ALL valves, indicate valve manufacturer, model, and actual number of
36 turns to operate.
 - 37 j. At ALL valves, indicate if valve extension stem was installed, and actual
38 height of extension stem (valve nut to operating nut length, measured to
39 closest 0.1 feet.

1 k. Indicate Survey grade northing and easting coordinates for all valve box
2 tracer wire terminal points.

3 END OF SECTION