

Brunswick Regional Water and Sewer H2GO

Water System
Standards & Specifications

Revised
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Standards and Specifications contained herein are approved only for water main extensions. These Standards and Specifications are not applicable to booster pumps, storage tanks, treatment devices or facilities, and other systems not specifically addressed.

TABLE OF CONTENTS

| | | |
|-----|--|----|
| 1. | SIZING MAINS..... | 4 |
| 2. | RELATION TO SANITARY SEWERS AND STORM WATER PIPES..... | 4 |
| 3. | WATER MAINS..... | 5 |
| 4. | EASEMENTS..... | 6 |
| 5. | VALVES AND APPURTENANCES..... | 6 |
| 6. | HYDRANTS..... | 8 |
| 7. | AUTOMATIC FIRE SPRINKLER SYSTEMS..... | 10 |
| 8. | TRENCHING AND BACKFILL..... | 11 |
| 9. | LAYING PIPE..... | 16 |
| 10. | PIPE FITTINGS..... | 17 |
| 11. | REDUCERS..... | 17 |
| 12. | PLASTIC IDENTIFICATION TAPE AND STRANDED TRACING WIRE..... | 17 |
| 13. | JOINTING..... | 17 |
| 14. | THRUST RESTRAINT..... | 18 |
| 15. | BLOW OFFS..... | 18 |
| 16. | VALVE SETTTINGS..... | 18 |
| 17. | CUTTING DUCTILE IRON PIPE..... | 19 |
| 18. | TAPPING SLEEVES AND VALVES..... | 19 |
| 19. | TAPPING SADDLES..... | 19 |
| 20. | BORING AND JACKING..... | 20 |
| 21. | PAVEMENT AND PROPERTY REPAIR AND REPLACEMENT..... | 20 |
| 22. | WATER SERVICES..... | 20 |
| 23. | IRRIGATION SYSTEMS..... | 23 |
| 24. | BACKFLOW PREVENTION..... | 23 |
| 25. | TESTING..... | 23 |
| 26. | DISINFECTION..... | 24 |
| 27. | REPAIR OF WATER MAINS..... | 27 |
| 28. | MATERIAL SUBMITTALS..... | 27 |
| 29. | ACCESSIBILITY..... | 28 |
| 30. | PLANS AND SPECIFICATIONS..... | 28 |
| 31. | GENERAL WARRANTY..... | 28 |

Brunswick Regional Water and Sewer H2GO Water Distribution Specifications

1. SIZING MAINS:

Major transmission mains shall be sized in accordance with BRWS H2GO master plan or as directed by BRWS H2GO. Six (6) inch mains may be used only when interconnections at 600 foot intervals are provided. The total maximum length of six (6) inch or eight (8) inch lines, without connecting to a larger main, is one-thousand-two-hundred (1200) feet and two-thousand (2000) feet, respectively. Four (4) inch water mains are permitted on residential cul de sacs less than four-hundred (400) feet long. Where needed, lines shall be upsized to provide adequate fire flow as directed by BRWS H2GO. Water mains should be sized to maintain a residual pressure of at least 30 psi during peak domestic demands and at least 20 psi during fire flow demands.

2. RELATION TO SANITARY SEWERS AND STORM WATER PIPES:

When installing a water main, the horizontal separation between water and sewer shall be ten (10) feet. If this separation cannot be maintained due to existing conditions, the only variation allowed is the water main in a separate trench with the elevation of the water main at least eighteen (18) inches above the top of the sewer and must be approved by BRWS H2GO. All distances are measured from outside diameter to outside diameter.

When a water main crosses over a sewer main, there must be eighteen (18) inches of vertical separation. If a water main must cross over a sewer main with less than eighteen (18) inches of vertical separation or cross under a sewer main, both these lines must be constructed of ductile iron for a distance of ten (10) feet on either side of the crossing with a twelve (12) inch minimum vertical separation and be constructed using joints conforming to water main standards with one joint of the water pipe centered at the sewer main. All crossings within these vertical clearances shall be filled with #67 stone. All distances are measured from outside diameter to outside diameter.

When a water line passes over or under a storm sewer, vertical separation of eighteen (18) inches shall be maintained unless both lines are of ductile iron or encased in concrete for a distance of ten (10) feet on each side of the crossing. If not encased in concrete, a concrete pad shall be poured between the two pipes. Distances are measured outside diameter to outside diameter.

All crossings should be as near to ninety (90) degrees as practicable.

3. WATER MAINS:

- A. Distribution system piping shall be ductile iron (DIP), polyvinyl chloride (PVC) plastic, or polyethylene (PE) pipe. All water system piping sixteen (16) inches in diameter and larger shall be ductile iron pipe. All water system piping less than sixteen (16) inches in diameter shall be PVC plastic (conforming to AWWA C900) (DR-18) or ductile iron or polyethylene pipe.
- B. Ductile iron pipe (DIP) shall be cement-mortar lined and enamel lined ductile iron pipe, in accordance with AWWA C104. Joints shall be push on or mechanical joint type conforming to AWWA C111 and ANSI A21.11, latest edition. Fittings shall be cast or ductile iron conforming to ANSI A21.10. All pipe which must be field cut to install fittings and other appurtenances shall be "gauged full length" to assure a uniform circular cross section. Machining, jacking, or other modifications will not be allowed in the field. When using ductile iron pipe, soil shall be tested for corrosivity as prescribed by the Engineer or by BRWS H2GO. If soil is found to be corrosive, the pipe shall be wrapped in polyethylene sheeting as required and in accordance with AWWA C105. Ductile Iron Pipe shall be designed and manufactured in accordance with AWWA C150 and C151(thickness class 50) for a laying condition Type 2 and a working pressure as follows:

| | |
|---------|---------|
| 3"-12" | 350 psi |
| 14"-20" | 250 psi |
| 24" | 200 psi |
| 30"-54: | 150 psi |

- C. Polyvinyl chloride (PVC) pipe shall be two-hundred (200) psi PVC pipe conforming to ASTM D2241 or AWWA C900, NSF approved. Pipe material shall be PVC 1120. Joints shall be rubber ring type conforming to ASTM D3139. Bells shall be formed integrally with the pipe, or may be made using cylindrical PVC couplings with two rubber rings. Fittings shall be molded PVC with joints similar to the pipe. Fabricated fittings using solvent welded joints will not be acceptable. Fittings may be ductile iron specially designed for use with PVC pipe.
- D. Polyethylene (PE) pipe shall be high density polyethylene pipe conforming to AWWA C906. Pipe material shall be PE 3408. Joints shall be heat fused. Pipe shall be two-hundred (200) psi, DR 9.0.

4. EASEMENTS:

Where public water mains are installed outside of public rights-of-way, water main shall be centered within a 20 foot wide easement. No plantings or structures are allowed within public water main easements.

5. VALVES AND APPURTENANCES:

A. GENERAL:

Valves shall be installed on all branches from feeder mains and hydrants according to the following schedule: three (3) valves at crosses; two (2) valves at tees; and one (1) valve on each hydrant branch. When a loop section of water line is connected back into the feeder main within a distance of two-hundred (200) feet or less, only one (1) valve will be required in the feeder main. Where no water line intersections exist, a main line valve shall be installed at every one-hundred (100) feet per one (1) inch diameter main up to a distance of two-thousand (2000) feet between valves or for transmission lines a main line valve shall be installed at every two-hundred (200) feet per one (1) inch diameter main up to a distance of five-thousand (5000) feet between valves. Place main line valves adjacent to or in close proximity of fire hydrants whenever possible. Valves shall be properly located, operable and at the correct elevation. All valves and reducers shall be rodded to the tee or cross if one (1) is located within ten (10) feet. If reducers cannot be rodded, concrete blocking or other restraining methods, as approved, shall be required. The valve box shall be centered over the wrench nut and seated on compacted backfill without touching the valve assembly. The maximum depth of the valve nut shall be five (5) feet. When valve extension kits are used, they must be manufactured by the same company that manufactured the valve.

B. GATE VALVES (GV):

Valves shall be designed for operation at working water pressure not less than two-hundred (200) psi for three (3) through twelve (12) inch size and one-hundred-fifty (150) psi for sixteen (16) inch. All materials and parts shall meet the requirements of "Resilient Seated Gate Valves for Water Supply Service", AWWA C509. Valves shall be made to open to the left and shall have a two (2) inch square head nut upon the end of the stem with the direction arrow clearly and plainly cast thereon. They shall generally be type known as a Resilient Seat Gate Valves. The materials strength shall be not less than that required by the specifications of AWWA. In every case, they shall be factory tested to three-hundred (300) psi, in such manner as to assure tight fitting gates and shall be so certified by their manufacturer. Valve ends shall be constructed for use with mechanical joints or push on joints. Gate valves, up to and including twelve (12) inches, shall be installed in a

vertical position. Gate valves sixteen (16) inches and larger shall be approved by BRWS H2GO or by BRWS H2GO's engineer prior to installation. They may be installed horizontally and equipped with bevel gears, grease case, rollers, tracks scrapers, and a bypass located on the side of the body (fully revolving disc valves shall not require rollers), or vertically and be equipped with spur gears enclosed in a grease case and with a bypass located on the side of the body. In either case, the roller and scraper operators shall be installed in a manhole. Valves shall be *Mueller, Clow, and American Darling*.

C. BUTTERFLY VALVES (BFV):

Butterfly valves shall be installed in water lines sixteen (16) inches or larger. Butterfly valves shall meet the requirements of AWWA C504 with mechanical joints and two (2) inch open left operating nut. All valves twenty-four (24) inches and larger shall be installed in a manhole. Butterfly valves shall be designed for a working pressure of 250 psi and tested to a hydrostatic pressure equivalent to twice the rated pressure. For transmission lines a main line valve shall be installed at every two-hundred (200) feet per one (1) inch diameter main up to a distance of five-thousand (5000) feet between valves.

D. AIR VALVES:

Air valves shall be installed at all crest locations wherein an elevation change of ten (10) feet or greater is incurred and at other locations as directed by the Engineer. The water main shall be installed at a grade that will allow air to migrate to a high point where the air can be released through an air release valve. A minimum pipe slope of one (1) foot in five-hundred (500) feet should be maintained. Automatic air valves shall be infinitely variable automatic air valves designed to allow escape of air for an operating range starting from pressure range: 0 through 250 psi (0-17.2 bar), close watertight when liquid enters the valve even when the fluid is rising without pressure (no minimum operating pressure required) and soft working behavior as water hammer inhibition realized by roll-on diaphragm and spring mechanism. When the sealing device of the valve is closed an air cushion is trapped between the fluid and sealing area, a mud deflector made of PE allows no contact between fluid and sealing area. The valve body shall be epoxy coated steel. The spindle spring shall be stainless steel grade 316Ti, designed to facilitate disassembly for cleaning and maintenance. The float shall be Delrin (Polyoximethylene, POM); the valve seat and all working parts shall be of corrosion-resistant materials. Valves shall be equipped with the necessary attachments, including ball valve, to permit back flushing after installation without dismantling the valve. Valves shall meet or exceed the requirements of AWWA C512. Air valves shall be manufactured by Hawle or an approved

equal. All air valves shall be located inside an approved five (5) foot diameter flat top manhole as shown in the details. The drainage pipe of the manhole must daylight to a slope and shall not connect directly to any storm drain or sanitary sewer. Air valves shall not be located in flood prone areas or in areas where the drainage pipe cannot daylight to a slope.

E. CHECK VALVES (CV):

1. Single-Check. Spring-checks only, no swing checks allowed.
2. Double-Check.

F. PRESSURE REDUCING VALVES (PRV) AND PRESSURE SUSTAINING VALVES (PSV):

Pressure reducing and/or sustaining stations shall be installed when directed by BRWS H2GO to connect to high and low pressure systems. The pressure reducing valve shall allow enough flow from the high side to maintain a specified pressure on the low side and will not reduce the high side below a certain amount. This type valve will be a piston type globe pressure sustaining/pressure reducing valve.

G. VALVE BOXES:

Valve boxes shall be gray cast iron conforming to ASTM A48-48, Class 30, with twelve (12) inch top section (screw or telescopic) and bottom section length as required for valve bury. Box shall have a five (5) inch opening with "Water" stamped on the cover. Concrete collar two (2) foot x two (2) foot square or two and one-half (2.5)-foot diameter round shall be poured flush with the cover having minimum thickness of six (6) inches as shown in the detail. A pre-fabricated, round "slip" form may be used only outside of traffic bearing areas (i.e., back side of ditches, etc.).

H. VALVE MARKERS:

Valve markers shall be used and shall be constructed of fiberglass (blue) marked with letters, either **MV** (main valve), **AV** (air release valve), or **BO** (blow off) and shall specify a telephone number to contact to report problems or to request water main locates. Valve markers shall be required only for valves on transmission mains or as otherwise designated by BRWS H2GO.

6. HYDRANTS:

All hydrants shall be installed on a minimum six (6) inch water line and should be installed in close proximity to road intersections whenever possible. Only one (1) fire hydrant may be installed when the line is served by a six (6) inch

tap and is not looped to another main. When placed at intersections, hydrants shall be offset from the top of the intersection so as to not allow a vehicle running through said intersection to strike the hydrant. The minimum acceptable flow for fire hydrants is seven-hundred-fifty (750) gpm with twenty (20) psi residual pressure for residential and one-thousand-five-hundred (1500) gpm with twenty (20) psi residual pressure for all other areas, unless otherwise specified by the County's fire marshal. The Engineer shall contact the local fire department(s) and/or County's fire marshal during the design phase to coordinate the proper location of all fire hydrants within the project area.

In residential areas the maximum distance between hydrants, measured along street centerlines, shall be five-hundred (500) feet, unless otherwise approved by the County's fire marshal.

In commercial, business, office, institutional and industrial zoning the maximum distance between hydrants, measured along street centerlines, shall be five-hundred (500) feet, unless otherwise approved by the County's fire marshal. New buildings, or additions that result in a total building area of ten-thousand (10,000) square feet, require hydrants to be installed at three-hundred (300) foot intervals along sides of the building that are accessible to fire pumpers. These hydrants shall be at least forty (40) feet away from the building. Where sprinkler systems are used, a fire department connection (FDC) shall be within fifty (50) feet of an accessible fire hydrant.

Hydrants shall be the Traffic Type, Dry Barrel, conforming to AWWA Standard C502, latest revision, and with not less than five and one-quarter (5.25) inch valve opening, two – two and one-half (2.5) inch hose nozzles and four and one-half (4.5) inch pumper connection with National Standard threads. Hydrant shall have breakable barrel and operating stem with barrel length for three (3) foot main cover and shall be equipped with six (6) inch bottom hub and with strapping lugs and one and one-half (1.5) inch solid operation nut and "O" ring seals. Main valve seat shall have bronze to bronze threads into the hydrant shoe. Hydrant shall be grease lubricated with a thrust bearing to reduce operating torque or may be oil lubricated. Hydrants shall be left open and be rated at one-hundred fifty (150) psi working pressure and three-hundred (300) psi test pressure. Hydrants shall be shop painted chrome red *Tnemec* paint or approved equal and shall be touched up after installation and given one (1) field coat of chrome red enamel, if hydrant comes from manufacturer painted red. If hydrant is painted with a color other than red from the manufacturer, there shall be three (3) field coats of chrome red paint applied by the Contractor after installation. Hydrant shall be dry bonnet type and be provided with not less than two (2) drain outlets for draining when the valve is closed. Manufacturer shall furnish complete literature with detailed shop drawings of hydrant showing materials, construction and assembly and operating characteristics. This shall include friction loss characteristics at

varying flows through the pumper and both hose connections by an approved National Underwriter's Laboratory. All fire hydrant legs shall be constructed with ductile iron pipe from the water main to the fire hydrant. Hydrants shall be Mueller "Centurion" or American Darling (MK-73-5) or approved equal. Hydrants shall be restrained with stainless steel tie rods extending from the main line tee to the hydrant, or by combination of tie rods and blocking or by Megalug, or approved equal, retainer glands at each joint per manufacturer's requirements. Hydrants shall be installed on a suitable solid foundation, as indicated on the drawings, and with one-fourth (1/4) cubic yard rock or stone as shown on the drawings. There shall be adequate pea gravel for the weep outlets to drain. Hydrants shall be installed plumb one-eighth (1/8) inch per foot, and set so that the pumper nozzle is eighteen (18) inches (+3 inches) (-1 inch) above the surrounding grade.

7. AUTOMATIC FIRE SPRINKLER SYSTEMS:

A. Approval. All automatic fire sprinkler systems shall be approved by the County's fire marshal and or the town fire department.

B. Backflow Prevention. When a fire protection system is proposed, a double check detector valve assembly including two (2) check valves, two (2) OS&Y gate valves and four (4) test cocks shall be installed on the supply side of the sprinkler fire protection line. Only devices approved of manufacture and models approved by the State of North Carolina and the University of Southern California Foundation for Cross-Connection Control and Hydraulic Research shall be used within the BRWS H2GO system.

C. Location. The backflow prevention assembly shall be installed on the back side of the right-of-way on the customer's side of the water service and shall be installed above ground in an insulated box and shall be operated and maintained by the customer at his or her expense.

D. Post Indicator Valve. A post indicator valve (PIV) shall be provided at the right-of-way or edge of easement. The top of PIV shall be thirty-six (36) inches above the finished grade. BRWS H2GO shall maintain up to and including the PIV but not beyond. No shutoff valves shall be installed between the PIV and the sprinkler riser assembly.

E. Fire Department Connection (FDC). Where automatic fire sprinkler systems are used, a fire department connection shall be provided. When a sprinkler system serves only a part of a large structure, the FDC shall be labeled, with minimum two (2) inch letters on a permanent sign, as to which section of the structure that sprinkler riser serves. Where FDC hookups or booster pumps are used, an RPZ is required.

8. TRENCHING AND BACKFILL:

A. General: Use soils free of organic matter, refuse, rocks and lumps greater than 4 inches in diameter and other deleterious matter.

B. Backfilling Materials: Suitable material, when used as backfill in paved areas shall be capable of being compacted as specified in paragraph 3.4.3 of these specifications.

1. Type 1 Material: Excavated material from the trench or materials from other sources which are free from large clods, roots or stones larger than 1 inch may be used as initial backfill in trenches.

2. Type 2 Material: Excavated material from the trench or materials from other sources which are free from large clods, roots or stones larger than 6 inches may be used as final backfill in trenches.

C. Classification: For the purpose of this specification, soils to be used as fill material are grouped into five classes according to soil properties and characteristics.

Class I – Angular, 6 to 40 mm (1/4 to 1-1/2 in.), graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, crushed gravel, and crushed shells. For the purposes of these specifications, Class I material shall be NCDOT #57 or #67 stone.

Class II – Coarse sands and gravels with maximum practical size of 44 mm (1-1/2 in.), including variously graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry. Soil types GW, GP, SW, and SP are included in this class.

Class III – Fine sand and clayey gravels, including fine sands, sand-clay mixtures, and gravel-clay mixtures. Soil types GM, GC, SM, and SC are included in this class.

Class IV – Silt, silty clays, and clays, including inorganic clays and silts of medium to high plasticity and liquid limits. Soil types MH, ML, CH, and CL are included in this class. These materials are not recommended for bedding, haunching or initial backfill.

Class V – This class includes the organic soil, OL, OH, PT as well as soils containing frozen earth, debris, rocks larger than 40 mm (1-1/2 in) in diameter, and other foreign materials. These materials are not recommended for bedding, haunching, or initial backfill.

D. Backfill Zones: Each backfill zone shall extend the full width of the trench bottom.

1. Foundation: Extending down from the bottom of bedding zone as defined below.
2. Pipe Embedment
 - a) Bedding: Extending from 4 inches below the pipe bottom to the pipe bottom for 30-inch diameter and smaller and 6 inches below the pipe for pipes larger than 30 inches in diameter.
 - b) Haunching: Extending from the bedding (bottom of the pipe) to the pipe spring line.
 - c) Initial Backfill: Extending from the haunching (pipe spring line) to 1 foot above the top of the pipe.
3. Final Backfill: Extending from the initial backfill to the finish ground elevation.

E. Topsoil: Natural, friable soil free of subsoil, stumps, rocks larger than 1 inch in diameter, weeds and other material detrimental to plant growth.

F. Granular Fill: Granular fill under floor slabs shall be Class I material.

G. Structural Fill: Fill material placed inside the line of the building foundation or slab shall be Class I or II.

H. Fill Beneath Pavement: Fill material used beneath pavement and for road shoulders shall be Class I, II or III.

I. General Fill: General fill material not otherwise specified shall be Class I, II or III.

J. Trench Backfill: Material used for bedding, haunching and initial backfill shall be as specified hereinafter.

K. Project Safety:

1. Contractor is responsible for Project safety.
2. Perform work in conformance with applicable State and Federal safety regulations including, but not limited to, the following:
 - a) North Carolina Safety and Health Standards for the Construction Industry (29CFR 1926 Subpart P).
 - b) NC OSHA Industry Guide No. 14, Excavations.
 - c) NC OSHA Industry Guide No. 20, Crane Safety.

3. Provide barriers, warning lights, and other protective devices at excavations as necessary for safety of workers and the public.
4. Provide sloping of bank, shoring, sheeting, or other means of maintaining the stability of the trench in accordance with the requirements of the Associated Contractor's Manual of Accident Prevention OSHA, Part 1926.P.

L. Trench Excavation: All excavation shall be in compliance with current OSHA requirements. Trenches for pipe and other utilities shall be excavated true to line and grade. Unless otherwise indicated or specified, trenches shall be of a depth to provide a minimum cover of three (3) feet over the top of pressure lines, two (2) feet over the top of casing piping, three (3) feet over the top of pipe buried in a roadside ditch, and five (5) feet over the top of pipe buried under a channel or stream.

1. Side walls of trenches shall comply with OSHA requirements. Unless otherwise specified, trenches shall be between 12 and 18 inches wider at the top of the pipe than the outside diameter of the pipe, plus sheeting where necessary. Pavement shall be cut 12 inches wider than the required trench width on each side.

2. Where soil conditions preclude vertical walls, the trench width shall be as specified above with the upper part of the trench limited to the least possible width greater than that specified. Where excessive trench widths are necessary, or where directed by the ENGINEER, sheeting shall be used to support trench walls.

3. Pressure Pipelines: For pressure pipelines, trench bottoms shall be prepared as follows:

- a. Trench bottoms shall be graded to provide uniform and continuous bearing for the pipe along its entire length. Bell holes shall be provided for completion of joints. No ridges, sags or undercutting will be allowed.

- b. If approved by the ENGINEER and subject to suitable soil conditions, trenches may be excavated a few inches below the established subgrade and backfilled to subgrade with Class I material, well compacted and graded to provide uniform and continuous bearing for the entire length of pipe. Bell holes shall be provided for completion of joints.

- c. In rock or other unyielding material, excavation shall be made at least 6 inches below the established subgrade and the trench backfilled to subgrade with Class I material. The material shall be

compacted and bell holes provided as specified for ordinary excavation.

d. Where material at subgrade is unstable, soft and incapable of supporting the pipe, trenches shall be excavated below subgrade to a depth as required by soil conditions, and backfilled to subgrade with Class I material. The material shall be compacted and graded to provide a stable foundation and uniform bearing for the pipe. Bell holes shall be provided as specified for other types of foundation.

e. Debris encountered in trench excavation for water and other pipelines shall be removed for the overall width of the trench. It shall be removed to a depth of six inches (6") below the bottom of the pipe for pipes smaller than twenty-four inches (24") in size; eight inches (8") below the bottom of the pipe for pipes twenty-four inches (24") to the thirty-six (36") in size; and twelve inches (12") below the bottom of the pipe for pipes larger than thirty-six inches (36") in size, if debris extends to such depth.

4. Trenches shall be kept free of water during pipe installation. Water shall be removed from trenches and disposed of by the CONTRACTOR to the satisfaction of the ENGINEER.

M. Trench Backfill: Trench Backfill shall progress as rapidly as pipe-laying and testing will permit. Remove shoring, bracing, and sheeting, unless otherwise noted, as the trench is backfilled. Engineer shall have the authority to require that the sheeting be left in place.

1. Backfill in pipe embedment zone (bedding, haunching, and initial backfill).

a) General:

1. Backfill with material as specified below. Select material shall be free from objects larger than 2 inches.
2. Where rock and hard material has been excavated below pipe bottom, backfill and compact bedding with Class I material. Class II or III material may be used for bedding with Engineer's approval.
3. Place backfill material with a shovel to assure placement of material under pipe haunches.
4. Take care during placement and compacting of material to avoid movement of pipe.

b) Place backfill in bedding and haunching zones in 6 inch maximum lifts and compact to 90 percent density. Place initial backfill in one lift, do not compact. Provide backfill material in pipe embedment zone as specified below.

1. Pressure Lines (Flexible and Rigid Pipe)
 - a) Excavation in Class I, Class II, Class III, and stable Class IV soils suitable for bedding, the bedding surface shall provide a firm foundation of uniform density. Backfill with select excavated material.
 - b) Excavation in Class V, unstable Class IV soils, running water, and other unstable soil conditions, excavate a minimum of 4 inches below pipe bottom and provide Class I material for bedding and haunch zone. Backfill with Class I, II, or III material in initial backfill.

2. The remainder of the backfill material shall be placed as specified below. No debris or rocks larger than 6 inches in any dimension shall be used in this portion of the backfill.

a. Under pavement, backfill material shall be placed in layers not more than 6 inches thick and thoroughly compacted to prevent future settlement. Compaction shall be at least 95% of maximum as determined by the Standard Proctor test (ASTM D698). Rolling with rubber tired vehicles or track type equipment will not be allowed. The top of the trench shall be filled with base for pavement as specified in Pavement Repair Detail, well mixed and compacted. Excess material shall be promptly removed from the site, and the pavement surface cleaned of objectionable material. CONTRACTOR shall correct any future settlement within the guarantee period.

b. Backfill under pavement cuts shall be tested for proper compaction at the CONTRACTOR'S expense. At least one test shall be performed for each pavement cut; longitudinal pavement cuts shall be tested at increments of 100 linear feet or fraction thereof. Testing shall be performed by an independent laboratory acceptable to the ENGINEER. If compaction does not meet the specified requirements, the CONTRACTOR shall remove and replace backfill and retest at no additional cost to the OWNER. Testing shall be done until test results are satisfactory to the ENGINEER. Copies of all test results shall be promptly submitted to the ENGINEER.

c. In unpaved roads and shoulders, backfill shall be placed in layers not more than 8 inches thick and thoroughly compacted with mechanical tampers. The top 6 inches of the trench shall be filled with well compacted topsoil.

d. For cross-county lines, outfall lines and at other locations where damage to the system or property will not occur, backfill shall be

placed in 12-inch layers and compacted with mechanical tampers. The upper portion of the backfill, more than 5 feet above the pipe, may be compacted by rolling with wheeled equipment. Excess material may be mounded on the trench as long as it does not interfere with surface drainage.

3: Tops of trenches shall be flush with existing ground elevation. All ponding areas and settlement below finished grade during the construction period shall be promptly corrected by the CONTRACTOR. Trenches shall be protected against scour due to surface drainage.

4: Backfilling around manholes shall, in general, conform to the requirements for backfilling trenches, except that backfill shall not be placed around manholes until all mortar has properly set.

N. Dry Boring: Where dry boring of pipe under highways or railroads is indicated, the bore diameter shall be essentially the same as the outside diameter of the pipe to prevent settlement or caving. If voids develop or if the bore diameter is greater than the outside diameter of the pipe by more than 1 inch, the voids shall be pressure grouted or other remedial measures as approved by the ENGINEER shall be taken at the CONTRACTOR'S expense.

9. LAYING PIPE:

Laying pipe and fittings, and the installation of all appurtenances shall be in accordance with AWWA C600 or AWWA C605, as applicable, or as specified by the manufacturer. Backfill with materials free of stones and debris larger than 6 inches in dimension. Pipe barrels shall be laid in trenches and jointed without disturbing the pipe bed, jointing and alignment. Laying condition shall be Type 3 as set out in AWWA C600 and C605. Any pipe that has grade or joint disturbed after laying shall be taken up and relayed. The interior of the pipe shall be thoroughly cleaned of all foreign matter before being lowered into the trench and shall be kept clean all during laying operations by means of plugs or other approved methods. The pipe shall not be laid in water or when trench or weather conditions are unsuitable for the work; when work is not in progress open ends of pipes and fittings shall be securely closed so that no trench water, earth, or other foreign substance will enter the parts. All water pipe sixteen (16) inches nominal diameter and larger shall be pigged. BRWS H2GO reserves the right to require new lines less than sixteen (16) inches nominal diameter to be pigged, if deemed necessary. Any section of pipe, or fittings, found to be defective before or after laying shall be replaced with new parts at the Contractor's expense. All bends, fittings, and plugs shall be securely restrained by blocking or by installation of restraining rods and thrust collars. Pipe deflection for twelve (12) inch nominal diameter and larger pipe shall be no more than three (3) degrees or according to manufacturer's specification, whichever is less. Pipe deflection for pipe less

than twelve (12) inch nominal diameter shall be no more than five (5) degrees or according to manufacturer's specifications, whichever is less. Appropriate bends shall be used as required. Depth of cover of pipe shall be as given in 8. TRENCHING AND BACKFILLING – L. TRENCH EXCAVATION.

10. PIPE FITTINGS:

Pipe fittings shall be cast or ductile iron designed and manufactured as per AWWA C110. Sizes of fittings up to and including twelve (12) inches shall be designed for an internal pressure of two-hundred-fifty (250) PSI. Compact ductile iron mechanical joint fittings shall be designed and manufactured as per AWWA C111 are also acceptable. Joints for fittings shall be mechanical and lined with cement mortar with a seal coat of bituminous material, all in accordance with AWWA C104.

11. REDUCERS:

All reducers shall be cast in a bell shape so as to minimize turbulence in the transition. Reducers shall be rodded or Megalugged, or approved equal, to another fitting installed with thrust restraint or thrust collar.

12. PLASTIC IDENTIFICATION TAPE AND STRANDED TRACING WIRE:

Provide plastic identification tape for all new water mains. Tape shall be three (3) inches wide, blue in color, bearing the continuous message "Caution - Water Main Buried Below". Tape shall be buried continuously directly above water main and eighteen (18) inches below finished grade. Twelve (12) gauge stranded copper wire coated in blue insulation shall be used to mark all PVC and PE pipe. The wire shall be affixed to the pipe and tied off on valves and fire hydrant legs. Tracer wire shall be used on each individual service when feasible, as determined by BRWS H2GO or BRWS H2GO's engineer. Any main transmission lines shall have a marker pole placed every 1000 feet with an emergency contact/ call before dig number for BRWS H2GO applied to the pole.

13. JOINTING:

Jointing shall be accomplished in accordance with the pipe manufacturer's recommendations, subject to approval of the Engineer. For mechanical joints the normal range of bolt torque of three-quarter (3/4) inch bolts shall be between sixty (60) and ninety (90) foot pounds. When tightening bolts, it is essential that the gland be brought up toward the pipe flange evenly; maintaining approximately the same distance between the gland and the face of the flange at all points around the socket. This shall be done by partially tightening the bottom bolt first, and then the top bolt, next the bolts at either side, and last the remaining bolts; repeat this cycle until all bolts are within the

above range of torques. If effective sealing is not attained at the maximum torque indicated above, the joint shall be disassembled, cleaned thoroughly and reassembled. Bolts shall not be over stressed to compensate for poor installation. Joints in plastic piping shall be made in conformance with the manufacturer's recommendations. Do not thread plastic pipe, make threaded connections with adapters.

14. THRUST RESTRAINT:

Reaction blocking for all fittings or components subject to hydrostatic thrust shall be securely anchored by the use of concrete thrust blocks poured in place. No concrete shall interfere with the removal of fittings. Material for reaction blocking shall be three thousand (3000) PSI concrete (minimum). A minimum of four (4) mil polyethylene sheeting shall cover the fittings to ensure that no concrete will interfere with removal of the fittings. Alternative restraining methods and mechanical joint restraints may be used upon approval by BRWS H2GO or an authorized representative.

15. BLOW OFFS:

Blow offs shall be a minimum of two (2) inches and installed at the end of all dead-end lines, unless otherwise specified by BRWS H2GO. Where there is not sufficient pressure or fire hydrants to thoroughly flush the system, a larger blow off shall be required. Blow offs shall remain underground, unless otherwise specified by BRWS H2GO, be turned up with a slip female connection and located in a box suitable for installing a temporary blow off pipe at any time and operating same. The valves shall be gate type with a non-rising stem and a two (2) inch operating nut. A full size valve is required on mains that are planned to be extended.

16. VALVE SETTING:

Valves shall be set with stems vertical. Valves shall be set in two-section cast iron valve boxes as specified hereinbefore. Valves installed on two (2) legs of a tee or three (3) legs of a cross shall be rodded or "mega-lugged" to the fitting with a minimum of two three-quarter (3/4) inch galvanized "all thread" rods. Valves installed at the end of the line shall be rodded back to a suitable thrust collar with a minimum of two three-quarter (3/4) inch galvanized all thread rods or mega-lugged. A minimum of one (1) joint of ductile iron pipe is required between valve and thrust collar. Hydrant valves shall be installed as near the main line as possible. Welding three-quarter (3/4) inch rods shall be prohibited. Only three-quarter (3/4) inch ductile iron or Black Iron threaded couplings shall be used. All bolts and nuts shall be hardened steel with black oxide finish. Sufficient suitable rock or stone shall be placed around all buried valves and valve boxes in such a manner that sand will not infiltrate the valve

box. Plugs installed at the end of the line shall be rodded to a sufficient thrust collar as described above.

17. CUTTING DUCTILE IRON PIPE:

Where necessary to cut a length of ductile iron pipe, such cutting must be done with a three-wheel pipe cutter or as directed by the Engineers. In any case, pipe broken or cracked or otherwise made unfit for use by the cutting shall be replaced by the Contractor. After the pipe has been cut, it shall not be installed until the Engineer, or authorized representative, has given his approval of the cut piece of pipe proposed for use. It will not be necessary (except where directed by the Engineer because of peculiar circumstances) to band the cut ends of the pipe as called for in the AWWA specifications.

18. TAPPING SLEEVES AND VALVES:

Tapping sleeves (Romac, Ford, or Mueller) approved for specific composite shall be used. For ductile iron, a tapping sleeve or approved tapping saddle shall be used. Tapping valves shall be No. 125 class, have one (1) flanged and one (1) MJ (mechanical joint) end, and shall allow a drilling machine to be attached directly to the valve. Two (2) inch through twelve (12) inch valves to be two-hundred (200) psi working pressure and four-hundred (400) psi test pressure. Fourteen (14) inch to twenty-four (24) inch valves to be one-hundred-fifty (150) psi working pressure and three-hundred (300) psi test pressure. Valves shall have a two (2) inch operating nut. All tapping sleeves and valves shall be air tested at 1.5 times the working pressure for a minimum of five (5) minutes.

Tapping sleeves shall not be used when connecting pipes of equal diameter. They shall be installed in accordance with the manufacturer's instructions and only on clean, defect free pipe. Tapping sleeves shall be installed no closer than four (4) feet from any other fitting, valve or joint along the main to be tapped.

19. TAPPING SADDLES:

Tapping Saddles shall be used on mains 16 inches and larger. Saddles shall be made of ductile iron providing a factor of safety of 2.5 with a working pressure of 250 psi. Saddles shall be equipped with an AWWA C110 flange connection on the branch. Sealing gaskets shall be O-ring type, high quality molded rubber having an approximate 70 durometer hardness, placed into a groove on the curved surface of the saddles. Straps shall be alloy steel. The maximum size saddle outlet for each size of pipe to be tapped shall be as follows:

| Size Pipe to be Tapped | Maximum Size Saddle Outlet |
|------------------------|----------------------------|
| 16" | 8" |
| 18" | 8" |
| 20" | 10" |
| 24" and larger | 12" |

20. BORING AND JACKING:

A: At various locations where indicated or directed, the Contractor shall bore and jack water services under paved roads in lieu of cutting pavement. This generally will apply to mains under railroads and State highway roads and all services under paved roads. Mains two (2) inches and larger shall be installed in steel casings bored under the pavement with the main threaded through the casing. Steel casing pipe under roadways to be installed by boring and jacking shall be constructed to the required standards of the NCDOT. A minimum of two (2) spider-type supports shall be used per joint of carrier pipe. For railroad crossings, the construction requirements shall conform to the requirements of the affected railway company.

Casing material shall be uncoated spiral welded steel or smooth wall seamless steel conforming to ASTM A-139 and ASTM A-283, Grade B, with minimum yield strength of 35,000 psi.

B. Services shall be jacked under paved roadways.

21. PAVEMENT AND PROPERTY REPAIR AND REPLACEMENT:

The Contractor shall restore all pavement, driveway, sidewalks, curbing and gutters, storm drains, as a part of the work to a condition equal to that before the work began. No permanent pavement shall be restored unless and until in the opinion of the Engineer; the condition of the backfill is such as to properly support the pavement. Pavement repair for State Highway pavements shall conform to NCDOT requirements. Pavement repair for all other streets shall include six (6) inches ABC base course and one and one-half (1.5) inches bituminous concrete surface course unless otherwise required by the NCDOT. Existing unpaved drives, roadways, etc., shall be stabilized where directed after backfilling by use of crushed stone. All grassed shoulders of NCDOT Roadways, shall be repaired and re-grassed in accordance with NCDOT requirements.

22. WATER SERVICES:

A. Water services shall be installed where directed by the Engineer in accordance with the detail on the plans. All connections shall be made by wet taps except in new development construction in which case these

connections will be made dry. Services shall be wired from main line connection to meter box with 12 gauge blue insulated wire. Each service to be installed shall be shown on the construction drawings and then on the record drawing, as installed. There shall be one (1) tap for each service and the tap shall be made perpendicular to the main and shall run straight to the meter, unless approved by BRWS H2GO in advance.

B. Corporation stop shall be made with AWWA inlet threads. Provide saddles with PVC pipe and ductile iron pipe, unless otherwise approved by BRWS H2GO in advance. Corporations shall be ball type, made of brass and complete with compression connections with set screw for use with polyethylene pipe or flared coupling and AWWA Standard threads as per AWWA C800. Taps shall be located at 10:00 or 2:00 o'clock on the circumference of the pipe. Service taps shall be staggered from one side of the water main to the other and at least eighteen (18) inches apart. The taps must be a minimum of twenty-four (24) inches apart if they are on the same side of the pipe. No burned taps will be allowed and each corporation stop will be wrapped with Teflon tape for ductile iron pipe water mains. No taps are allowed on a fire hydrant leg. No tapping shall be made where rodding is placed.

C. Service saddles shall be bronze body (85-5-5 waterworks brass) and double strap for taps over one (1) inch with silicon bronze nuts conforming to ASTM A98 and factory installed grade 60 rubber gaskets.

D. Service pipe shall be polyethylene plastic pipe (CTS) SDR-PR, conforming to ASTM D-2239, as applicable to PE 3408, Class 200 psi, NSF approved.

E. Meters two (2) inches and larger shall be of the compound type with magnetic driven and bronze body conforming to AWWA Standard C701, latest revision and shall be Sensus Combination Meter or approved equal, by BRWS H2GO in advance, with encoder and pit pad installed, all to be provided to BRWS H2GO by the Owner or the Owner's Contractor.

F. Three-quarter (3/4) inch and one (1) inch meter boxes shall be Ford Double Gulf cast iron type or approved equal, with locking cover and cast iron self closing meter lid placed on two 8"x16"x2" concrete blocks. All meter boxes and vaults shall be located at the edge of the serviced lot's right-of-way or easement, unless otherwise approved by BRWS H2GO in advance. Water meter boxes shall not be placed in streets, driveways, sidewalks, parking areas, or obstructed by fencing or buildings. BRWS H2GO reserves the right to remove, or have removed, fencing, buildings or other obstructions after proper notification has been issued to the proper owner asking them to do the same.

G. Meter vaults for two (2) inch and three (3) inch meters shall be constructed of cast iron. Meter vaults for meters four (4) inch and larger shall be pre-cast concrete. All meter vaults and access doors within the road rights-of-way shall meet HS-20 loading requirements and shall be aluminum (4" meters and larger) with a flush drop lift handle, stainless steel hinges and bolts, a stainless steel slam lock, an automatic hold open arm, and compression springs to allow for easy opening. To ensure positive drainage, the vault shall be tied into the existing storm drainage system, if available. If positive drainage is unobtainable, a sump pump shall be located and operated in the vault. The associated electrical service shall be provided by the Owner or the Owner's Contractor according to BRWS H2GO specifications.

H. Service taps to existing water lines shall be made by BRWS H2GO or by a North Carolina licensed utility contractor. Service taps to new water lines shall be made by the Contractor in accordance with the specifications.

I. Service taps larger than two (2) inches shall be made by a North Carolina licensed utility contractor in the presence of a BRWS H2GO representative. A strainer shall be provided upstream of the meter for meters two (2) inches and larger.

J. An accessible shutoff valve shall be provided on the customer's side of the service ahead of the first outlet or branch connection to the service or distribution pipe of each dwelling, dwelling unit and buildings other than dwellings and dwelling units. When such shutoff valve is located in the service line outside the building, it shall be located and accessible in a manufactured, approved valve box with a readily removable access cover that extends to grade level. When drain valves are provided for the distribution lines or other portion of the water supply system, such drains shall be above grade or otherwise located to prevent the possibility of backflow into the piping system after the system has been drained. (*NC Building Code, Plumbing, Section 608.13, 2009*)

K. Water pressure reducing valves or regulators are required where water pressure within a building exceeds eighty (80) psi static, an approved water pressure regulator conforming to ASSE 1003 with strainer shall be installed to reduce pressure in the building water distribution piping system to eighty (80) psi static or less, whichever is consistent with good engineering practice. (*NC Building Code, Plumbing, Section 604.8, 2009*). All pressure reducing valves and regulators shall be placed on the customer's side of the water service (downstream from the meter) and shall be operated and maintained by the customer at his or her expense. BRWS H2GO reserves the right to permanently remove any existing pressure reducing regulator, located on the utility side of the water service, at the time of its failure.

23. IRRIGATION SYSTEMS:

If an irrigation service is being installed simultaneously with the installation of a potable water service, both of which will serve the same single-family, residential property a Ford Double Gulf Box or approved equal shall be used. All irrigation systems shall be provided with privately maintained reduced pressure principle backflow prevention assemblies (RP) installed in accordance with the NC Plumbing Code and the USCFCCCHR. Reduced pressure principle backflow assemblies shall be installed above ground in an insulated box.

24. BACKFLOW PREVENTION:

All assemblies used to prevent backflow into BRWS H2GO's public water supply system shall be USC approved (University of Southern California Foundation of Cross-Connection Control and Hydraulic Research or USC-FCCCHR). All irrigation, commercial, institutional, and industrial facilities shall be required to install an USC-approved backflow prevention assembly in accordance with BRWS H2GO's *Cross-Connection Control Program* (AP-98002, latest version). All backflow prevention assemblies shall be placed on the customer's side of the water service just behind the right-of-way or easement and shall be installed above ground in an insulated box. These assemblies shall be operated and maintained by the customer at his or her expense. All backflow prevention assemblies shall be tested in accordance with the BRWS H2GO's *Cross-Connection and Control Program*, (latest version) with all test results being submitted to BRWS H2GO.

25. TESTING:

After pipe has been laid and all connections jointed, the system shall be pressure tested for leakage. Any discrepancy in the system which does not conform to the specifications shall be remedied in an approved way and retested until the system is acceptable. Care shall be taken in tightening of joints insofar that no parts of the system are damaged. Any damage occurring shall be remedied by replacing the damaged part with an approved new part. Tests shall be made in sections from valve to valve unless otherwise approved by the Engineer. Furnish suitable test plugs where line ends in "free flow." All testing shall be performed only during the presence of BRWS H2GO staff or authorized representative(s) thereof. The contractor must call the Operations and Maintenance office at **371-9949** 24 hours before the day of testing to schedule a time for BRWS H2GO's staff to be onsite. Any testing performance without BRWS H2GO staff, or authorized representative, being present shall be considered a failed test and shall be re-tested.

To prevent pipe movement, sufficient backfill shall be placed prior to filling the pipe with water and field testing. When local conditions require that the trenches be backfilled immediately after the pipe has been laid, the testing may be carried out after backfilling has been completed but before placement of the permanent surfacing. The Contractor shall ensure that thrust blocking or other types of restraining systems will provide adequate restraint prior to pressurizing the pipeline.

When existing water mains are used to supply test water, they should be protected from backflow contamination by temporarily installing a double check-valve assembly between the test and supply main or by other means approved by the Engineer. Prior to pressure and leakage testing, the temporary backflow protection should be removed and the main under test isolated from the supply main.

Hydrostatic Testing on water mains prior to installation of services shall be successfully completed by the Contractor as described below:

- (1) Each section of pipe line shall be subjected to and successfully meet a pressure of one-hundred-fifty (150) psi (minimum).
- (2) The line shall be slowly filled with water and all air expelled through air valves or other suitable means.
- (3) A suitable test pump shall be connected to the line by means of a tap in the line, or by other suitable and approved means, and the proper test pressure slowly applied to the line.
- (4) A minimum line pressure of one-hundred-fifty (150) psi shall be maintained for a minimum of two (2) consecutive hours. During this testing period there shall be no loss of pressure.
- (5) If pressure loss is realized, the test is failed and the Contractor shall locate and repair all leaks and reschedule testing.

26. DISINFECTION:

A. After pipes are laid and tested, all water piping shall be disinfected in accordance with AWWA Standard C651, continuous-feed method, as modified hereinafter. The entire system shall be flushed thoroughly to remove all algae, deposits, and other foreign substances, and the system shall deliver clear water at all outlets. The water lines shall be tapped on top at the far end and air cock installed of sufficient size to release any air that may be entrapped in the line when filled. The valve at the end of the line should then be closed and the valve between the new pipeline and the

supply opened slightly to allow water to enter the new pipe slowly. Owner shall operate valves connected to the existing water system. Chlorine is then applied under pressure by ejector pump or equal to the water entering the pipeline through the tap located in the pipe at the influent valve in a concentration that will give an overall chlorine residual to the water of at least seventy (70) ppm (parts per million or milligrams per liter).

B. After the chlorine has been applied to the water, the pipeline is to be valved off and the chlorinated water allowed to remain in the line for twenty-four (24) hours; at the end of this period, the chlorine residual should be at least ten (10) ppm. The line should then be thoroughly flushed until there is only a normal chlorine residual present, as determined by the orthotolidine test. If there is any question that the chlorinated discharge will cause damage to the environment, a reducing agent shall be applied to the water to neutralize the residual chlorine. Open and close valves on the mains being disinfected a minimum of three (3) times during the chlorine contact period and a minimum of three (3) times during flushing. Fire hydrants and other appurtenances should receive special attention to insure proper disinfection.

C. For Cut-In Construction: Use the following procedures for disinfecting of the new installation and the existing main at the cut-in point in accordance with AWWA C651, Section 9:

1. Apply liberal quantities of hypochlorite, in the form of tablets, to the open trench.
2. Interior of new pipe and fittings and the ends of the existing mains shall be swabbed or sprayed with a one percent hypochlorite solution before installation.
3. Install a 2-inch tap downstream of the work area. Tap shall be used for blowing off the main, or use the next fire hydrant downstream of the work area for blowing off the main.
4. Install a 2-inch tap just upstream of the new installation. Control Water from the existing system so as to flow slowly into the work area during the application of chlorine. After the line is thoroughly flushed, add chlorine solution at a concentration of 70 ppm by the continuous feed method and hold in the main for one (1) hour.

D. Several samples of water should be collected from various points along the line and forwarded to an approved laboratory for bacteriological analysis according to the procedure below. Testing laboratory shall send all original lab results directly to BRWS H2GO.

1. Required location for obtaining water samples:
 - a. Every 2,000 lf
 - b. End of each main.
 - c. A minimum of one from each branch.
 - d. Mains at cut-in locations: Each side of work area. Time between samples to be determined by Engineer in field.

2. A laboratory, certified for the required testing by the State of North Carolina, shall collect the sample and perform the testing. The laboratory shall be the same for both sampling and testing.
3. Obtain two water samples at each specified location for the bacteriological testing. Take the first sample immediately after flushing of the chlorinated water and again in 24-hours.
4. Recommended additional samples. During the required sampling of water from the new system, it is recommended that samples be taken from the existing potable water source to determine if coliforms are present.
5. Care in sampling. No hose or fire hydrant shall be used for the collection of samples. Take samples from an approved sample tap consisting of a corporation stop installed in the main with a copper tube gooseneck assembly. Operation shall be such as to ensure that the sample collected is actually from water that has been in the new system. Copper tube gooseneck assembly shall be removed and sample tap corporation stop shut off upon completion of testing bacteriological testing is requirements.
6. Test samples for the presence of coliform organisms in accordance with the latest edition of Standard Methods for the Examination of Water and Wastewater. Testing method used shall be the multiple-tube fermentation technique, the membrane-filter technique, or presence/absence.
7. Test for odor. The water in the new system should also be tested to assure that no offensive odor exists due to chlorine reactions or excess chlorine residual.
8. If samples show the presence of coliform, procedure 1 or 2 described below shall be followed, with the approval of the Owner, before placing the unit or facility in service.
 1. Take repeat samples at least 24 hours apart until consecutive samples do not show the presence of coliform.
 2. Again subject the system to chlorination and sampling as described in this section.
9. If samples are free of coliform, and with the approval of the Owner, the potable water system may be placed in service.
10. Contamination: If, in the opinion of the Engineer, possible contaminants have entered the existing water system, or water

samples show the water in the existing system to be unsafe on completion of the work, the existing water system shall be disinfected as specified herein and shall include all contaminated components. Disinfection of the existing system shall be coordinated with the Owner.

E. If satisfactory results are obtained, the line or lines may then be placed in service upon meeting all satisfactory requirements by BRWS H2GO. All water for flushing, testing, and disinfecting shall be furnished by the Contractor from approved sources, such as existing public systems.

27. REPAIR OF WATER MAINS:

A. Joint Leaks of Ductile Iron Pipe and PVC pipe shall be repaired by use a bell joint leak repair clamp as manufactured by Rockwell or other approved equal.

B. Line Breaks or Punctures shall be repaired by a full circle repair clamp as manufactured by Rockwell, Mueller, or approved equal.

C. Line Splits or Blow Outs shall be repaired by replacing the damaged section with ductile iron pipe with a cast iron coupling at each end. The following cast pipe couplings shall be used for each pipe material indicated:

(1) Asbestos-Cement (AC) - Pipe-Rockwell 441 cast coupling or other approved equal.

(2) Ductile Iron Pipe (DIP) - Pipe-Rockwell 431 cast coupling or other approved equal.

(3) Polyvinyl Chloride (PVC) - Mechanical Joint coupling, PVC Knock-On coupling and/or full circle repair clamps or other approved equal.

28. MATERIAL SUBMITTALS:

A copy of all material submittals marked 'Approved by the Engineer' shall be submitted to Brunswick Regional Water and Sewer H2GO clearly indicating the project for which they are to be used. BRWS H2GO shall have a period of ten (10) days to accept or reject the submittals after receipt of same. After the 10 day period no comment shall be deemed approval.

29. ACCESSIBILITY:

All water lines and appurtenances shall be readily accessible to Brunswick Regional Water and Sewer H2GO personnel by two (2) wheel drive pick up truck for future operation and maintenance.

Where public water mains are installed outside of public rights-of-way, waterline shall be centered within a minimum twenty (20) foot wide easement. BRWS H2GO may require larger easements for large transmission mains. No planting or structures are allowed within water easements. Easements shall be coordinated with BRWS H2GO.

30. PLANS AND SPECIFICATIONS:

The above specifications do not cover all criteria or water line installations. The Design Engineer shall issue detailed Specifications and the uses of the above are guidelines and/or minimum. Brunswick Regional Water and Sewer H2GO shall be furnished one (1) full set of the construction plans and a full set of specifications for review. If changes are required one (1) full set and two (2) half sets of the revised plans marked for construction shall be submitted. If no changes are required two (2) half sets marked 'For Construction' are required. Upon completion of the project Brunswick Regional Water and Sewer H2GO shall be furnished one (1) full set, two (2) half sets and a CD Rom in AutoCad or .DXF AutoCad file format of the 'As Built' plans. Replaced with a CD Rom in Arc View 10.0 or .DWG AutoCad on the NC Grid Horizontal 83 file format of the 'AsBuilt' plans.

31. GENERAL WARRANTY

The General warranty of workmanship and material shall be signed and returned to BRWS H2GO upon completion of final as-builts and deeds of dedication. Once this has been submitted and accepted the one year period of warranty begins.