

## DIVISION 2 - SITE WORK

### SECTION 02660 - WATER DISTRIBUTION SYSTEM

#### 1. SIZING MAINS:

Major transmission mains shall be sized in accordance with the County's master plan or as directed by the County. Six (6) inch mains may be used only when a good grids exists. 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 a good grid does not exist, lines shall be upsized to provide adequate fire flow as directed by the County.

#### 2. RELATION TO SANITARY SEWERS AND STORM WATER PIPES:

Water lines shall be located at least ten (10) feet horizontally from any existing and/or proposed sanitary sewer and/or storm water lines. When local conditions prevent a ten (10) foot lateral separation, the water line shall be laid at eighteen (18) inches above the top of the sewer line or eighteen (18) inches below the bottom of the storm water line. Sanitary sewer lines (or storm water lines) that cross under (or over) water mains shall be installed with eighteen (18) inches vertical separation below the bottom (or top) of the water main. If this vertical separation is not possible, then the sanitary sewer line shall be installed using ductile iron pipe for a minimum distance of ten (10) feet each side of water main and the water main reconstructed with ductile iron pipe for a distance of ten (10) feet from the sanitary sewer line. When a water line must cross under a sanitary sewer line, both the water line and sanitary sewer line shall be constructed of ductile iron pipe with joints equivalent to water line standards, while the storm water line shall be constructed of reinforced concrete pipe, both for a minimum distance of ten (10) feet on each side of the point of crossing.

Water mains should cross sanitary sewer mains at an approximate ninety (90) degree angle. Water mains and storm water mains shall have a minimum vertical separation of twelve (12) inches when horizontal separation is less than three (3) feet, unless other approved by the County.

#### 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. SDR21 PVC pipe will not be acceptable.
- 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 the County. If soil is found to be corrosive, the pipe shall be wrapped in polyethylene sheeting as required. Ductile Iron Pipe shall be designed and manufactured in accordance with AWWA C150 and C151 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 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. 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 as shown in the Details. 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. All valve boxes shall be encased in a trowel finished two (2) foot x two (2) foot x six (6) inch pad of 3000 psi concrete beneath the asphalt or in traffic-bearing areas between the ditch and the edge of pavement (EOP) with the cover flush with the top of the pavement or flush with finished grade. Pre-cast concrete valve box encasements may be used for valve box encasement outside of traffic-bearing areas. 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 one-hundred-seventy-five (175) psi. 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 the County, or by the County'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, American Darling*.

C. BUTTERFLY VALVES (BFV):

Butterfly valves shall be installed in water lines sixteen (16) inches or larger. All shall meet the requirements of AWWA C504 with mechanical joints, two (2) inch open left operating nut. All valves twenty-four (24) inches and larger shall be installed in a manhole as shown in Detail. 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. COMBINATION AIR VALVES:

Combination air valves shall be installed at all high points of water lines sixteen (16) inches in diameter or larger 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. The valve shall be manufactured for a two-hundred (200) psig working pressure, sized by the Engineer and approved by the County.

Air release valves shall be of the single housing style that combines the operation of both an air/vacuum and air release valve. The valve shall meet or exceed the requirements of AWWA C512 and be installed in accordance with the Details.

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):

ADD specification.

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. 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 per Details. Markers 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 the County.

5. 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 five-hundred (500) 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.

- A. Residential. In residential areas the maximum distance between hydrants, measured along street centerlines, shall be eight-hundred (800) feet, unless otherwise approved by the County's fire marshal.
- B. Commercial. 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 pumps. These hydrants shall be at least forty (40) feet away for 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 four and one-half (4.5) 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 yellow *Tnemenc* paint (or approved equal) and shall be touched up after installation and given one (1) field coat of chrome yellow enamel, if hydrant comes from manufacturer painted yellow. If hydrant is painted with a color other than yellow from the manufacturer, there shall be three (3) field coats of chrome yellow 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*", Clow "*Medallion*", American Darling (*MK-73*). Hydrants shall be rodded to the valve or a suitable thrust collar. 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.

## 6. AUTOMATIC FIRE SPRINKLER SYSTEMS:

- A. Approval. All automatic fire sprinkler systems shall be approved by the County's fire marshal.
- 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. These backflow prevention assemblies shall be NFPA approved and UL listed and/or Factory Mutual Research Corporation.
- 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 maintain 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. The County shall maintain up to and including the PIV but not beyond.

E. Fire Department Connection (FDC). Where automatic fire sprinkler systems are used, a fire department connection shall be provided. The FDC shall be located within fifty (50) feet of a fire hydrant. 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.

7. TRENCHING:

Trenches shall conform to the Section 02200, "Earthwork". Trenches shall be not more than two feet wider than the pipe, unless directed otherwise by the Engineer and shall have vertical sides. The bottom of the trench shall be cut flat to the indicated depth true and even so that the barrel of the pipe will have good bearing for its full length. In no case will trench depth be less than that depth required to provide a minimum pipe cover of three (3) feet unless otherwise directed by the Engineer or the County. Recesses in the trench bottom shall be excavated at pipe joints to accommodate bells and jointing of pipes. Bell holes for joint making shall be no more than twelve (12) inch wider than the trench.

8. LAYING PIPE:

Laying pipe and fittings, and the installation of all appurtenances shall be in accordance with "Specifications for Installation of Water Mains" AWWA C600, or ASTM D2774, as applicable, or as specified by the manufacturer. In no case shall there be any rocks, stones, or other hard matter in the trench bottom so as to endanger it from external strains. 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. Any pipe that has grade or joint disturbed after laying shall be taken up and relaid. 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. Brunswick County 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.

9. 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.

10. REDUCERS:

All reducers shall be cast in a bell shape so as to minimize turbulence in the transition. Reducers shall be rodded or "mega-lugged" to another fitting installed with thrust restraint or thrust collar.

11. 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 the County or the County's engineer.

12. JOINTING:

Jointing shall be accomplished in accordance with the pipe manufacturers 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, 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 or 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.

13. 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. The reaction areas are shown in the Details. 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 plastic 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 the Director of Engineering Service or an authorized representative.

14. 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 the County. Where there is not sufficient pressure or fire hydrants to thoroughly flush the system, a larger blow off shall be required.

Blow off assemblies shall be constructed as shown in the Details. 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.

15. 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. All tees and ells shall be wrapped with polyethylene sheeting and have a suitable thrust block or be rodded back to a suitable thrust collar as before described. Hydrant valves shall be installed as near the main line as possible. Blow offs shall remain underground, unless otherwise specified by the County, 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. Welding three-quarter (3/4) inch rods shall be prohibited. Only three-quarter (3/4) inch "DI" (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 and reducers along the line shall be rodded to a sufficient thrust collar as described above.

16. 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.

17. 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.

18. 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 a 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:

<u>Size Pipe to be Tapped</u>	<u>Maximum Size Saddle Outlet</u>
16"	8"
18"	8"
20"	10"
24" and larger	12"

19. BACKFILL:

Backfill shall be accomplished as provided for in Section 02200, "Earthwork" for piping.

20. BORING AND JACKING:

A. At various locations where indicated or directed, the Contractor shall bore or 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 paving with the main threaded through the casing. Casing thickness shall be as follows:

<u>Casing Size (Nominal)</u>	<u>Wall Thickness (Inches)</u>
Under 14"	.188
14" – 24"	.250
30"	.312
36"	.375

Casting material shall be smooth wall API 5L Grade B steel pipe or spiral welded steel pipe in conformance with ASTM A 211.

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, and Section 02930, Establishing Vegetation.

## 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. 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 the County 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 the County 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 ABB Combination Meter or approved equal, by the County in advance, with encoder and pit pad installed, all to be provided to the County by the Owner or the Owner's Contractor.

F. Three-quarter (3/4) inch and one (1) inch meter boxes shall be Ford or approved equal cast iron type, with locking cover and cast iron self closing meter lid. 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 the County in advance. Water meter boxes shall not be placed in streets, driveways, sidewalks, parking areas, or obstructed by fencing or buildings. The County 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 fiberglass according to the Details. Meter vaults for meters four (4) inch and larger shall be pre-cast concrete according to the Details. 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 County specifications.
- H. Service taps to existing water lines shall be made by the County 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. 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 Carolina Building Code, Plumbing, Section 610.1, 1994*)
- K. Water pressure reducing valves or regulators shall be used 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 607.9.1, 1994*). 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. The County 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 two (2) inch tap can be used. Two (2) inch polyethylene pipe (CTS) shall be installed from the tap to a point located adjacent to the back of the right-of-way or easement. At this point a tee shall be placed in the line reducing the lines to one (1) inch minimum. The two (2) lines shall then be run to the appropriate metering facilities for termination (see Details). 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 USC-FCCCHR. Reduced pressure principle backflow assemblies shall be installed above ground in an insulated box.

### 24. BACKFLOW PREVENTION:

All assemblies used to prevent backflow into the County'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 the County's

*Cross-Connection and Backflow Protection Policy* (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 County's *Cross-Connection and Backflow Protection Policy* (AP-98002, latest version) with all test results being submitted to the County.

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. Test shall be made in sections from valve to valve unless otherwise approved by the Engineer. All testing shall be performed only during the presence of County staff or authorized representative(s) thereof. Any testing performance without County staff, or authorized representative, being present shall be considered a failed test and shall be re-tested.

A. 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 four (4) 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.
- (6) All leaks shall be repaired and testing procedures described in this section shall be accepted by the County before proceeding with the allowable leakage test described above.

B. Polyethylene (PE) Pipe shall be tested separately from valve to valve. The test procedure consists of initial expansion, and test phases. During the initial expansion phase, the test section is pressurized to the test pressure, and enough make-up liquid is added each hour for three (3) hours to return to test pressure. The test phase follows immediately, and may be one (1), two (2), or three (3) hours. At the end of the test time, the test section is returned to test pressure by adding a measured amount of liquid. If the amount of make-up liquid added does not exceed Table I values below, leakage is not indicated.

**Table 1: Test Phase Make Up Amount**

Nominal PE Size (Inches)	Make-Up Water Allowance (U.S. Gallons/100 Ft. of Pipe)		
	·Hour Test	·Hour Test	·Hour Test
1-1/4	0.06	0.10	0.16
1-1/2	0.07	0.10	0.17
2	0.07	0.11	0.19

	-Hour Test	-Hour Test	-Hour Test
3	0.10	0.15	0.25
4	0.13	0.25	0.40
5	0.19	0.38	0.58
5-3/8	0.21	0.41	0.62
6	0.3	0.6	0.9
7-1/8	0.4	0.7	1.0
8	0.5	1.0	1.5
10	0.8	1.3	2.1
12	1.1	2.3	3.4
13-3/8	1.2	2.5	3.7
14	1.4	2.8	4.2
16	1.7	3.3	5.0
18	2.2	4.3	6.5
20	2.8	5.5	8.0
22	3.5	7.0	10.5
24	4.5	8.9	13.3
26	5.0	10.0	15.0
28	5.5	11.1	16.8
30	6.3	12.7	19.2
32	7.0	14.3	21.5
34	8.0	16.2	24.3
36	9.0	18.0	27.0
42	12.0	23.1	35.3
48	15.0	27.0	43.0
54	18.5	31.4	51.7

C. PVC Pipe (OPTIONAL):

- (1) General: 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.
- (2) Cross-connection control: 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.
- (3) Procedure: The following procedure is based on the assumption that the pressure and leakage tests will be performed at the same time. Separate tests may be made as desired. If separate tests are made, the pressure test shall be performed first. Tests shall be performed only after the pipeline has been properly filled, flushed, and purged of all air. The specified test pressure shall be applied by means of an approved pumping assembly connected to the pipe in a manner satisfactory to the Engineer. The test pressure shall not exceed pipe or thrust-restraint design pressures. If necessary, the test pressure shall be maintained by additional pumping for the specified time during which the system and all exposed pipe, fittings, valves, and hydrants shall be carefully examined for leakage. All visible leaks shall be stopped. All defective elements shall

be repaired or removed and replaced and the test repeated until the allowable leakage requirements have been met.

- (4) **Test Method:** The Contractor may perform simultaneous pressure and leakage tests or perform separate pressure and leakage tests on the installed system at test durations and pressures specified in Table 2. Tests shall be witnessed by the Engineer, or an authorized representative thereof, and the County and the equipment used for the test shall be subject to the approval of the Engineer and/or the County.
- (5) **Allowable Leakage:** The Contractor shall furnish the gauges and measuring device for the leakage test, pump, pipe, connections, and all other necessary apparatus, unless otherwise specified, and shall furnish the necessary assistance to conduct the test. The duration of each leakage test shall be two (2) hours, unless otherwise specified. During the test, the pipeline shall be subjected to the pressure listed in Table 1 below. Leakage shall be defined as the quantity of water that must be supplied into the pipe section being tested to maintain a pressure within five (5) PSI of the specified leakage-test pressure after the pipe has been filled with water and the air in the pipeline has been expelled. No installation will be accepted if the leakage is greater than that determined by the formula:

$$L = \frac{ND\sqrt{P}}{7,400}$$

Where:

- L = allowable leakage, in gallons per hour
- N = number of joints in the length of pipeline tested
- D = nominal diameter of the pipe, in inches
- P = average test pressure during the leakage test, in pounds per square inch (gauge)

**Table 1-B System Test Methods**

Procedure	Pressure	Duration of Test, hours
Simultaneous Pressure and Leakage Tests	150% of working pressure* at point of test, but not less than 125% of normal working pressure at highest elevation.**	2
Separate Pressure Test	150% of working pressure* at point of test, but not less than 125% of normal working pressure at highest elevation.**	1
Separate Leakage Test	150% of working pressure* of segment tested.**	2

\*Working pressure is defined as maximum anticipated sustained operating pressure.

\*\*In no case shall the test pressure be allowed to exceed the design pressure for pipe, appurtenances, or thrust restraints.

All pressure and leakage tests shall be witnessed by the County or an authorized representative for approval. If the County is not notified of these proceedings, the County reserves the right to require additional testing, at the Owner/Developer's expense.

D. **Ductile Iron Pipe (OPTIONAL):**

- (1) Flushing: Foreign material left in pipelines during installation often results in valve- or hydrant-seat leakage during pressure tests. Every effort shall be made to keep lines clean during installation. Thorough flushing is recommended prior to a pressure test. Flushing should be accomplished by partially opening or closing valves and hydrants several times under expected line pressure, with flow velocities adequate to flush foreign material out of the valves and hydrants.

***WARNING:*** The testing methods described in this section are specific for water-pressure testing. These procedures should not be applied for air-pressure testing because of the serious safety hazards involved.

- (2) Test Restrictions: Test pressure shall not be less than 1.25 times the working pressure at the highest point along the test section. Test pressure shall not exceed pipe or thrust-restraint design pressures. The hydrostatic test shall be of at least a two (2) hour duration. Test pressure shall not vary by more than plus or minus five (5)PSI for the duration of the test.

Valves shall not be operated in either direction at a directional pressure exceeding the rated valve working pressure. Use of a test pressure greater than the rated valve pressure can result in trapped test pressure between the gates of a double-disc gate valve. For tests at these pressures, the test setup should include a provision, independent of the valve, to reduce the line pressure to the rated valve pressure on completion of the test. The valve can then be opened enough to equalize the trapped pressure with the line pressure, or fully opened if desired.

The test pressure shall not exceed the rated pressure of the valves when the pressure boundary of the test section includes closed, resilient-seated gate valves or butterfly valves.

- (3) Pressurization: After the pipe has been laid, all newly laid pipe or any valved section thereof shall be subjected to a hydrostatic pressure of at least 1.5 times the working pressure at the point of testing. Each valved section of pipe shall be slowly filled with water, and the specified test pressure (based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge) shall be applied by means of a pump connected to the pipe. Valves shall not be operated in either the opening or closing direction at differential pressures above the rated pressure. It is good practice to allow the system to stabilize at the test pressure before conducting the leakage test.
- (4) Air Removal: Before applying the specified test pressure, air shall be expelled completely from the section of piping under test. If permanent air vents are not located at all high points, corporation cocks shall be installed at such high points so that air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure applied. At the conclusion of the pressure test, the corporation cocks shall be removed and plugged or left in place as required by the specifications.
- (5) Examination: All exposed pipe, fittings, valves, hydrants, and joints shall be examined carefully during the test. Any damage or defective pipe, fittings, valves, hydrants, or joints that are discovered following the pressure test shall be repaired or replaced with sound material, and the test shall be repeated until satisfactory results are obtained.
- (6) Leakage Defined: Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe or any valved section thereof to maintain pressure within five (5) psi for the specified test pressure after the pipe has been filled with water and the air has been expelled. Leakage shall not be measured by a drop in pressure in a test section over a period of time.
- (7) Allowable Leakage: No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

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

Where:

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

## 26. DISINFECTION:

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. 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 one-hundred (100) ppm (parts per million or milligrams per liter). The chart below shows the required quantity of seventy (70) percent *HTH* compound to be contained in solution in each one-thousand (1000) foot section of line to produce the desired concentration of one-hundred (100) ppm.

Pipe Size, (inches)	Pounds High Test Hypochlorite (70%) per 1000 Feet of Main	Pipe Size, (inches)	Pounds High Test Hypochlorite (70%) per 1000 Feet of Main
6	1.76	14	9.52
8	3.12	16	12.44
10	4.84	20	19.52
12	7.00	24	28.00

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. Several samples of water should be collected from various points along the line and forwarded to an approved laboratory for bacteriological analysis. Testing laboratory shall send all original lab results directly to Brunswick County. If satisfactory results are obtained, the line or lines may then be placed in service. 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 other approved material.
- 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) PVC (Polyvinyl Chloride) Pipe - Rockwell 411 cast coupling or other approved equal.  
For A.C. Pipe to PVC or Ductile Iron Pipe use a cast pipe coupling with different end diameters sized specifically for the pipe materials and pipe outside diameter at each end.

D. Service Line Repairs:

- (1) A water service line severed between the water main and the water meter shall be repaired using new CTS polyethylene piping (SDR 9.0) and bronze or brass compression fittings.
- (2) A corporation stop pulled out of a PVC pipe water main shall have a new service saddle and a new corporation stop installed on the water main.
- (3) A corporation stop pulled out of a ductile iron pipe shall have a full circle repair clamp placed over the old tap hole. A new tap shall be made and a new corporation stop installed on the water main.

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**END OF SECTION 02660**