

SECTION 6000
WATER DISTRIBUTION SYSTEM

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6010 WATER DISTRIBUTION PIPE

A. DESIGN

1. The following Standard Specifications and associated Detail Drawings shall apply to all water system extensions and development of the Cary municipal water system. The Standard Specifications and Detail Drawings included herein shall apply to all aspects of the Cary water system that extend into Morrisville, RTP, Wake County, Chatham County, and any other areas outside the corporate limits in which the water system is otherwise owned, operated, and maintained by Cary. All utility extension permits must be obtained prior to construction. Refer to General Provisions in Section 2000 for further requirements.
2. Location: Water transmission lines shall be located and sized in accordance with the current "Water System Master Plan" or as directed by Cary and shall extend to the adjacent properties to provide an adequate network. All public water mains shall be located under the roadway within dedicated right of way or dedicated easements with a minimum width of 20 feet. Dedicated easements for water mains and appurtenances shall be recorded as "Cary Utility and Pipeline Easement." Cary utility and pipeline easements shall contain only Cary utilities unless otherwise approved by an approved development plan or encroachment agreement. See Section 2100 for allowable landscape plantings within a Cary easement.
3. Easement Areas: No permanent structures, equipment, retaining walls, embankments, impoundments, or other elements that would inhibit maintenance operations shall be constructed within a utility and pipeline easement. Fences may be allowed across easements provided that appropriate access gates have been installed to allow utility maintenance. Fill or cut slopes greater than 5:1 are not allowed to extend into easements
4. Sizing: Major transmission lines shall be sized in accordance with the "Water System Master Plan" or as directed by Cary. Six (6) inch mains may be used on a case-by-case basis when Cary has determined that a good grid exists, and the existing network supports using six (6) inch mains. The total maximum length of 6 inch and 8-inch lines, without connecting to a larger main, is 1200 feet and 2000 feet, respectively. Four (4) inch water mains are permitted on residential cul-de-sacs less than 400 feet long. Where the existing network is lacking connectivity, lines shall be upsized to provide adequate fire flow as directed by the Director of Utilities. The Utilities Department may require a fireflow test, hydraulic modeling and/or a water main loop to provide adequate fireflow and water quality. All lines shall be designed in accordance [with Policy Statement 129, Minimum Water Supply Pressure.](#)

5. Second Connection Required: In support of Cary Standard Operating Procedure 008, a second connection to the distribution system is required for any development proposing 100 or more service connections.
6. No service taps are allowed on a fire hydrant line.
7. In instances where water mains are extended to accommodate a service line installation an auto-flusher shall be installed as required by the Utilities Department.
8. All utility crossings within Cary streets shall be made by trenchless methods. State-maintained streets within the Cary ETJ should also be crossed using trenchless methods. In cases where utility conflicts, rock, or other obstructions prevent trenchless crossings, Cary may consider approving other methods.
9. Construction involving Existing Mains:
 - a) The existing water main must remain active and protected during all phases of construction. The contractor must provide a plan for the structural protection of the existing water main.
 - b) A proposed construction sequence must be submitted for any demolition of a portion of existing water main. The plan must be reviewed and approved by Utilities and Public Works.
10. Restraint: All valves and fittings shall be restrained. Pipe joints shall also be restrained an adequate length away from valves and fittings in accordance with AWWA manual M41 (or the latest edition of Thrust Restraint Design for Ductile Iron Pipe as published by the Ductile Iron Pipe Research Association). The standard joint restraint method shall be to use manufacturer provided restrained joint pipe and fittings. Pipe up to and including 12-inches in diameter may also utilize mechanical joint pipe with approved wedge action retainer glands (for the specified distance).
 - a) 4" to 8" Diameter Pipe: For pipe 4-inches through 8-inches, the following table may be used to determine the required restrained length of pipe for single occurrences of valves or fittings within the pipe system. The table may not be used for combined bends or offsets where a series of fittings occur. In lieu of using the below table, a pipe restraint plan detailing all assumptions and calculations may be provided by the NC Professional Engineer sealing the plan drawings. In either case, the method of restraint to be used and the length of pipe to be restrained (if applicable) shall be clearly identified on the plans at all necessary locations.

**Required Restrained Lengths for Single Fittings and Valves
for Pipe 4-inches to 8-inches in Diameter (in Feet, Both Directions
unless otherwise noted)**

	4"	6"	8"
90° Horizontal	59'	84'	108'
90° Vertical Up	59'	84'	108'
90° Vertical Down	91'	130'	168'
45° Horizontal	24'	35'	45'
45° Vertical Up	24'	35'	45'
45° Vertical Down	38'	54'	70'
22½° Horizontal	12'	17'	21'
22½° Vertical Up	12'	17'	21'
22½° Vertical Down	18'	26'	33'
11¼° Horizontal	6'	8'	11'
11¼° Vertical Up	6'	8'	11'
11¼° Vertical Down	9'	13'	17'
	4"	6"	8"
Tee (Restrained the Branch)	89'	4" branch – 88' 6" branch – 128'	4" branch – 87' 6" branch – 127' 8" branch – 166'
Reducer (Restrained Larger Pipe)	N/A	67'	8" x 4" – 121' 8" x 6" – 70'
Valves, Caps and Plugs (Dead Ends)	91'	130'	168'

- b) All pipe and fittings: **Projects with pipe diameters greater than 8-inches, polywrapped pipe, or combined bends must have a pipe restraint plan with the method of restraint to be used and the length of pipe to be restrained clearly identified on the plans at all necessary locations.** The pipe restraint plan must be calculated in accordance with AWWA manual M41 (or the latest edition of *Thrust Restraint Design for Ductile Iron Pipe* as published by the Ductile Iron Pipe Research Association). The plan must also account for the actual soil types that exist at the project site.
- c) Valves: All valves shall be restrained in a manner consistent with operation as a dead end. This includes restraining the valve to the pipe and restraining a sufficient number of pipe joints on both sides of the valve to accommodate dead end restraint. There shall be no joints between the valve and fitting. Restraint at intersections may be achieved by using stainless steel rods (through 16" diameter) or approved wedge action retainer glands (through 48" diameter).
- d) Dead Ends: All MJ cap and plug fittings, including tapped caps, shall be restrained with approved wedge action retainer glands. The adjacent pipe shall be restrained the distances specified above (or on the sealed pipe restraint plan). Reaction blocking shall not be used to restrain caps and plugs.

Restraining systems not included within this Specification shall require written approval prior to utilization. All joint restraint products that include the means of restraint within the joint gasket shall be prohibited in Cary's water system.

11. Depth of Installation:

All water mains shall have a minimum cover of 4 feet measured from the top of the pipe to the finished grade. When water lines are installed along a roadway they shall be installed at sufficient depth to maintain four (4) feet of cover to the subgrade of any future road improvements including potential vertical alignment changes.

12. Relation to Sanitary, Storm Sewers and Reclaimed Water Lines:

a) Separation between Potable Water Mains and Sanitary Sewer Mains or Storm Sewers.

- **Parallel Installations:** 10-ft lateral separation (pipe edge to pipe edge) or minimum 5-ft lateral separation and water line at least 18-inches above sanitary or storm sewer line measured vertically from top of sewer pipeline to bottom edge of water main. In unique cases where the sanitary sewer and the water main are installed with at least 5-ft of lateral separation but less than 10-ft of horizontal separation, and less than 18-inches of vertical separation, both the water main and sanitary sewer shall be constructed of ductile iron pipe with joints in full compliance with water main standards.
- **Crossings (Water Main over Sanitary or Storm Sewer):** All water main crossings of sanitary sewer lines shall be constructed over the sewer or storm line in conformance with Cary Specifications. At a minimum, 18-inches of clearance shall be maintained between the bottom edge of the water main and the top edge of the sanitary or storm sewer main. If 18-inches of clearance is not maintained, the water main and sanitary sewer main shall both be constructed of ductile iron pipe with joints in conformance with water main construction standards. The sanitary sewer pipe shall be ductile iron the entire run from manhole to manhole. When the separation between pipelines is 18-inches or less, the void space between the pipes shall be filled with minimum 500-psi, quick setting, and non-excavatable flowable fill extending 3-ft on both sides of the crossing. Regardless of pipe material, at least 12-inches of vertical separation is required for both sanitary and/or storm sewer crossings of potable water mains.

	Water	Storm water	Sewer (Gravity and Forcemain)	Reclaimed
Water	18-inches vertical	Parallel Installations: 10-foot horizontal Crossings: 18 inches vertical	Parallel Installations: 10 feet horizontally Crossings: 18-inches vertical separation water main over sewer	Parallel Installations: 10-foot horizontal and water line at least 18-inches above reclaimed Crossings (water main over reclaimed water pipeline): Min. 18-in vertical separation
Storm water	Parallel Installations: 10-foot horizontal Crossings: 18 inches vertical	/	24-inches vertical	Min. 18-inches vertical.
Sewer (Gravity & Forcemain)	Parallel Installations: 10 feet horizontally Crossings: 18-inches vertical separation water main over sewer	24-inches vertical	7-foot horizontal separation, increasing with depth	Parallel Installations: 10-foot horizontal Crossings (reclaimed water pipes over sewer pipes): 18-inches
Reclaimed	Parallel Installations: 10-foot horizontal and water line at least 18-inches above reclaimed Crossings (water main over reclaimed water pipeline): Min. 18-in vertical separation	Min. 18-inches vertical.	Parallel Installations: 10-foot horizontal Crossings (reclaimed water pipes over sewer pipes): 18-inches	18 inches vertical

- Crossings (Water Main under Sanitary Line): Allowed only as approved by Cary, when it is not possible to cross the water main above the sanitary line. At a minimum, 18-inches of separation shall be maintained, (measured from pipe edge to pipe edge) and both the water main and sanitary sewer shall be constructed of ductile iron in conformance with water main construction

- standards. The sanitary sewer pipe shall be ductile iron the entire run from manhole to manhole. If local conditions prevent providing 18-inches of clearance, then at least 12-inches of clearance shall be provided and the void space between the pipes shall be filled with minimum 500-psi, quick setting, and non-excavatable flowable fill extending at least 3-ft on both sides of the crossing.
- Crossings (Water Main under Storm Sewer Line): Allowed only as approved by Cary, when it is not possible to cross the water main above the storm sewer line. At a minimum, 18-inches of separation shall be maintained, (measured from pipe edge to pipe edge) and the water main shall be constructed of ductile iron in conformance with water main construction standards. If local conditions prevent providing 18-inches of clearance, then at least 12-inches of clearance shall be provided and the void space between the pipes shall be filled with minimum 500-psi, quick setting, and non-excavatable flowable fill extending at least 3-ft on both sides of the crossing.

b) Separation between Potable Water Mains and Reclaimed Water Mains

- Parallel Installations: Preferred 10-ft lateral separation (pipe edge to pipe edge) AND water line at least 18-inches above reclaimed water line measured vertically from top of reclaimed water pipeline to bottom edge of water main. Because all reclaimed water mains in Cary's municipal system are required to fully comply with water system testing and integrity standards as described by 15A NCAC 18C, when the 10-ft lateral separation standard cannot be met, a minimum of 5-ft lateral separation, shall be provided.
- Crossings (Water Main over Reclaimed Water Pipeline): All water main crossings of reclaimed water mains shall be constructed over the reclaimed water line in conformance with Cary Specifications. At a minimum, 18-inches of clearance shall be maintained between the bottom edge of the water main and the top edge of the reclaimed water main. When the minimum 18-inch clearance cannot be maintained, the reclaimed main shall be constructed of ductile iron pipe in conformance with water main construction standards extending at least 10-ft on both sides of the crossing. The void space between the pipes shall be filled with minimum 500-psi, quick setting, and non-excavatable flowable fill extending at least 3-ft on both sides of the crossing. Reclaimed water mains crossing more than 18-inches under potable water service lines may be constructed of either C900 or C905 PVC as typically required for reclaimed water pipeline construction.
- Crossings (Water Main under Reclaimed Water Pipeline): Allowed only on a case-by-case basis and design shall be approved by Cary prior to construction. At a minimum, 18-inches of separation shall be maintained and both potable water and reclaimed mains shall be constructed of ductile

iron pipe in conformance with water main construction standards extending at least 10-ft on both sides of the crossing. If local conditions prevent 18-inches of clearance between the pipelines, the void space between the pipes shall be filled with minimum 500-psi, quick setting, and non-excavatable flowable fill extending at least 3-ft on both sides of the crossing.

B. MATERIALS

General: All water main distribution pipe shall be ductile iron and comply with NSF/ANSI/CAN 61 (latest edition) and NSF/ANSI/CAN 600 (latest edition) Drinking water system components-Health Effects and latest revisions. Any newly installed ductile iron water mains (and fittings) larger than 12-inch in diameter shall be zinc-coated ductile iron pipe. The zinc-coated ductile iron pipe shall be sprayed with an arc-sprayed zinc per ISO 8179 zinc coating on the outside of the pipe and covered with an asphaltic topcoat. The mass of the zinc applied shall be 200 g/m² of pipe surface area. A finishing layer topcoat shall be applied to the zinc. The coating system shall conform in every respect to ISO 8179-1 "Ductile iron pipes – External zinc-based coating – Part 1: Metallic zinc with finishing layer. Second edition 2004-06-01.

1. The Utilities Department maintains a list of approved manufacturers for all water distribution products. The zinc coated ductile iron pipe shall be manufactured by a manufacturer listed on Cary's Approved Products List. New manufacturers must submit requests for approval to the Utilities Department in accordance with Standard Procedure 120, Manufacturer Approval Guidelines.
2. Ductile Iron Pipe
 - a) Ductile iron pipe shall be designed and manufactured in accordance with AWWA C150 and C151 and provided in nominal 18-ft or 20-ft lengths. The minimum required pressure ratings for ductile iron pipe and required laying conditions are tabulated below. For all other installations other than specified, the laying condition, bedding requirements or the minimum pressure class rating and/or thickness class shall be increased in accordance with AWWA C151. A pipe thickness design shall be submitted for external loading in all cases where the pipe depth exceeds the specified range of depths outlined in the following table.

Pressure Class, Max. Depth and Laying Condition for DI Water Mains

Pipe Diameter	AWWA C-150, Laying Condition	Pressure Class	Maximum Depth of Cover
4-8 -inch	type 1	350 psi	3-16 feet
4-8 -inch	type 4	350 psi	16-34 feet
10-12 -inch	type 1	350 psi	3-10 feet
10-12 -inch	type 4	350 psi	14-28 feet
10-12 -inch	type 5	350 psi	28-44 feet
14-20 -inch	type 4	250 psi	3-22 feet
14-20 -inch	type 5	250 psi	22-30 feet
14-20 -inch	type 5	350 psi	30-41 feet
24-30 -inch	type 4	250 psi	3-19 feet
24-30 -inch	type 5	300 psi	19-29 feet
24-30 -inch	type 5	350 psi	29-33 feet
36-42 -inch	type 4	300 psi	3-20 feet
36-42 -inch	type 5	350 psi	20-32 feet

Note: For cases not specified, a ductile iron pipe and bedding design certified by a Professional Engineer licensed in the State of North Carolina shall be required in compliance with AWWA C150 and the Ductile Iron Pipe Research Association.

- b) Pipe joints shall be mechanical joint or push-on type as per AWWA C111. Pipe lining shall be cement mortar in accordance with AWWA C104. All buried ductile iron pipe shall have a bituminous exterior coating in accordance with AWWA C151.

3. Ductile Iron Fittings

All ductile iron fittings shall be provided in conformance with AWWA C110 for standard ductile iron fittings and AWWA C153 for compact ductile iron fittings. All fittings shall be pressure rated for a minimum 350-psi through 24-inches in diameter and 250-psi for fittings greater than 24-inches in diameter. In cases where minimum pressure standards are less than the pipe specification, fittings shall always be pressured rated to meet or exceed the pressure ratings for the specified pipe. All fittings for potable water service shall be provided with cement mortar linings and asphaltic seal coats in accordance with AWWA C104. All ductile iron fittings shall have an asphaltic exterior coating in accordance with AWWA C151. All ductile iron fittings shall be provided with mechanical joint end connections or proprietary restrained joints from an approved manufacturer. Gaskets shall be provided in conformance with AWWA C111 with EPDM rubber gaskets preferred over SBR.

4. Restrained Joint Ductile Iron Pipe

All restrained joint ductile iron pipe unless otherwise specified shall be of the boltless restrained joint type. For installations requiring welded locking rings, the rings shall be factory welded. The restrained joints shall provide a minimum of 4-degrees of deflection for pipe sizes, 4-inches through 12-inches in diameter.

All proprietary pipe restraint systems shall be approved by Cary and provided in compliance with all standards for coatings, linings, pressure classes, etc. as required for ductile iron pipe. All restrained joint pipe shall be installed based on laying conditions, pressure class, etc. as required for typical ductile iron pipe.

5. Encasement Pipe

- a) Encasement pipe shall be new and manufactured of grade 'B' steel with minimum yield strength of 35,000-psi in accordance with ASTM A139 and A283.
- b) All casing pipe shall have machine cut, bevel ends that are perpendicular to the longitudinal axis of the casing.
- c) Size and minimum wall thickness of smooth wall or spiral welded steel encasement pipe shall be as shown in the below table. Actual wall thicknesses shall be determined by the casing installer based on their evaluation of the required forces to be exerted on the casing when it is installed.

Minimum Wall Thickness of Steel Encasement Pipe

Encasement Pipe Outside Diameter (<i>inches</i>)	Minimum Wall Thickness (<i>inches</i>)
12- ³ / ₄	0.188
14	0.250
16	0.250
18	0.250
20	0.250
24	0.250
26	0.312
28	0.312
30	0.312
36	0.375
42	0.500
48	0.500
54	0.500
60	0.500
66	0.625

- d) Encasement pipe installed for railroad bores shall meet the requirements of the American Railway Engineering Association (AREA) for boring under railroads.
- e) Encasement pipe shall have the following minimum sizes:

Minimum Allowable Steel Encasement Diameter Per Carrier Size

Carrier Pipe Size Inside Diameter (inches)	Carrier Pipe Outside Bell Diameter Typ. (inches)	Steel Encasement Nominal Diameter (inches)
6	9.19	12 ^{-3/4}
8	11.33	16
10	13.56	18
12	15.74	20
14	19.31	24
16	21.43	26
18	23.70	28
20	25.82	30
24	29.88	36
30	36.34	42
36	42.86	48
42	49.92	60
48	56.36	66

6. Casing Pipe Spacers and End Closures

- a) The carrier pipe shall rest on steel pipe alignment spacers. The spacers shall have either a bituminous or epoxy coating. A minimum of 2 steel spacers per joint shall be required on carrier pipe less than 36-inches. Carrier pipe greater than or equal to 36-inches shall have a third spacer. The steel spacers shall be located evenly along the carrier pipe alignment in such a manner that each spacer supports the same unit weight of carrier main. The spacing interval of the steel spacers shall assure the necessary grade, clearance, and support of the carrier main. The spacers shall be manufactured for the specific carrier pipe and casing pipe diameters being used such that the risers do not allow the pipe to float within the casing.
- b) In cases where the encasement pipe is installed near facilities with stray current, such as gas lines, high voltage power transmission lines, petroleum lines, railroad tracks, etc., the steel spacers shall be provided with composite contacts on the runners such as an EPDM rubber liner or an ultra-high molecular weight polyethylene plastic skid to prevent transmitting the stray current to the carrier pipe.

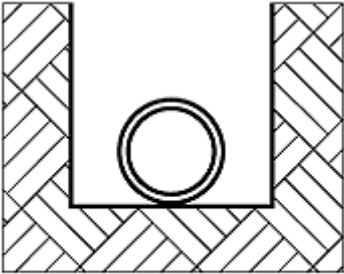
- c) The carrier pipe bells shall not be allowed to contact the interior of the encasement pipe under any circumstances.
- d) No blocks or temporary spacers shall be wedged between the carrier pipe and the top of the encasement pipe.
- e) The ends of the encasement pipe shall be sealed using 8-inch bricks and a non-shrink grout.
- f) A 2-inch galvanized vent pipe shall be provided on the upper end of the casing on all stream and railroad crossings.

C. INSTALLATION

1. Excavation and Preparation

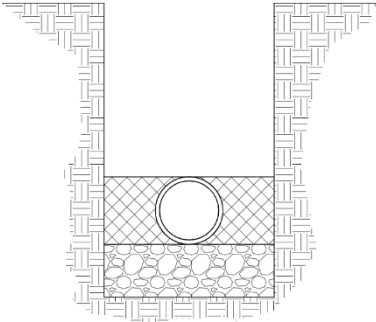
- a) Ductile iron pipe shall be installed in accordance with the requirements of AWWA C600 and the Ductile Iron Pipe Handbook published by the Ductile Iron Pipe Research Association. Materials at all times shall be handled with mechanical equipment or in such a manner to protect them from damage. At no time shall pipe and fittings be dropped or pushed into ditches.
- b) Pipe and fitting interiors shall be protected from foreign matter and shall be inspected for damage and defects prior to installation. In the event foreign matter is present in pipe and fittings, it shall be removed before installation. Open ends of pipe shall be plugged or capped when pipe laying is not in progress.
- c) All pipe shall be constructed with at least 48 inches of cover below the finished surface grade. Pipe shall be laid on true lines as directed by the Engineer. Trenches shall be sufficiently wide to adjust the alignment. Bell holes shall be dug at each joint to permit proper joint assembly. The pipe shall be laid and adjusted so that the alignment with the next succeeding joint will be centered in the joint and the entire pipeline will be in continuous alignment both horizontally and vertically. Pipe joints shall be fitted so that a thoroughly watertight joint will result. All joints will be made in conformance with the manufacturer's recommendations for the type of joint selected. All transition joints between different types of pipe shall be made with transition couplings approved on shop drawings showing the complete assembly to scale.
- d) Pipe shall be installed at laying conditions as specified by the plans. Laying conditions for ductile iron pipe shall be as described in AWWA C151 and the Ductile Iron Pipe Research Association. Laying conditions shall be defined as follows:

Type 1: Flat Bottom Trench with Pipe Resting on Stable Undisturbed Earth. Unstable conditions such as wet trench bottoms, intermediate rock layering, partially weathered rock, and other unsuitable soil conditions shall require utilizing more stringent laying conditions. At a minimum, Type 4 laying condition shall be utilized with a minimum of 4-inches of bedding to overcome unstable conditions. For severe unstable soil conditions, undercut excavation and an engineer designed foundation plan shall be provided prior to pipeline installation.



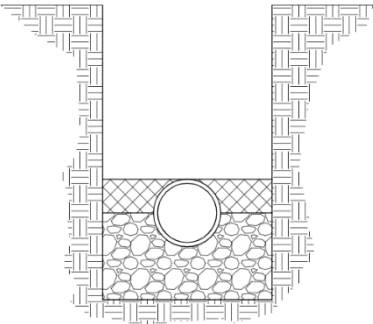
Type 1*

Type 4: Pipe bedded in Class 1 material, No. 67 or No. 78 crushed stone to a depth of 1/8 pipe diameter or a minimum of 4-inches. Embedment material, consisting of Class 1, Class 2 or Class 3 materials, (as defined in Section 7000), shall be compacted greater than 95% Proctor to the top of the pipe. Careful attention must be allocated to compacting embedment material under the bottom edges of the pipe.



Type 4

Type 5: Pipe bedded in Class 1 material, No. 67 or No. 78 crushed stone to the center of the pipe and extending a minimum of 4-inches under the pipe. Granular or select embedment, consisting of Class 1 or Class 2 materials, compacted to greater than 95% Proctor installed to the top of the pipe.



Type 5

- e) For installations below the water table, a single layer of engineering fabric shall be installed between the pipe and trench floor/trench wall. The fabric shall fully encapsulate the waterline, bedding, and embedment material with a minimum of 12-inch overlap at the top of the embedment material.
- f) Prior to beginning construction, the Contractor shall contact local utility companies and verify the location of existing utilities. The Contractor shall be completely and solely responsible for locating all existing buried utilities inside the construction zone before beginning excavation. The Contractor shall be solely responsible for scheduling and coordinating the utility location work. When an existing utility is in conflict with construction, it shall be exposed prior to beginning construction to prevent damage to the existing utility.
- g) All valves that are under the ownership and acceptance of Cary's municipal water system shall be operated only by trained personnel of Cary. Existing valves in Cary's water system will not be operated without a minimum notice of 24 hours to the Engineer and the Public Works Department. Contractor's personnel shall only be responsible for operating valves within new construction areas that are not directly connected with the existing municipal water supply. At such time when the valves in new construction areas are connected with the municipal water supply, the valves shall only be operated by Cary personnel or in limited circumstances by Contractor's personnel after receiving authorization from the Operator in Responsible Charge of the water distribution system. For all other cases, the Contractor shall operate valves only in accordance with Cary Policy Statement No. 49, [Water Valves, Control of Closing and Opening](#).
- h) Trenching for pipelines (water, sewer, pressure, natural gas and liquid petroleum), communication and power lines and drainage and irrigation pipes shall be excavated to the required depth to permit the installation of the pipe (inclusive of pipes, wires, cables, ducts, and conduit) along the lines and grades shown on the construction drawings.
- i) Prior to trenching for the construction of any utility mains or connections, the Contractor shall locate all existing utilities within the construction zone. This may include at a minimum contacting the North Carolina One Call Center at 811 or 1-800-632-4949. Where critical Cary water and sewer utilities cannot be located by traditional means, specialized utility locating, such as vacuum excavation or ground penetrating radar (GPR) may be required to locate existing utilities before excavating.
- j) In all cases where trenchless methods are planned to cross an existing utility corridor with water, sewer, force main, reclaimed water and/or other Cary maintained pipelines, an SUE (subsurface utility exploration) services

firm shall be contracted to verify the depths of existing utilities prior to boring. Where SUE involves survey work, the survey shall be in accordance with the requirements of Section 10050 of these Standard Specifications.

k) The Contractor shall be responsible for implementing all required safety provisions for trenching in compliance with the Occupational Safety and Health Administration (OSHA) regulations and all other applicable safety requirements and procedures.

l) Trench Dimensions

i. The minimum trench width at the top of the pipe shall be at least 24-inches greater than the outside diameter of the pipe. Rock shall be removed to a depth of at least 6-inches below the bottom of the pipe and the trench backfilled with suitable material.

ii. Open trenches shall not exceed 100-feet.

iii. All trenches shall be confined to the limits of the right-of-way or utility easement. Trenches in paved areas shall not be sloped.

iv. All trenches in or along roadways shall be properly backfilled at the end of each working day.

m) Trench Protection

i. Wet trenches shall be stabilized with a base layer of #78 M or #57 stone. The bottom of the trench shall be shaped to provide uniform support along the entire length of the pipeline. Severely unstable trench bottoms requiring undercut excavation shall receive a foundation support system for the pipeline designed by a registered Geotechnical Engineer licensed in the State of NC.

ii. A space shall be excavated at each bell to provide ample space to join the pipes with no misalignment.

iii. The Contractor shall take all necessary measures to prevent water from entering the trench.

2. Pipe laying and backfilling

a) Open ends of pipe shall be plugged when pipe laying is not in progress to prevent trench water, soil, and debris from entering.

- b) All pipe shall be laid in accordance with the manufacturer's recommendations and all applicable Cary Standards, Specifications and Details.
 - c) Pipe laying shall be accomplished in a manner and with the required resources to provide a properly aligned and sealed pipeline and joints.
 - d) Pipe deflection limits shall not be exceeded in accordance with manufacturer requirements.
 - e) All gravity mains shall be installed beginning with the downhill section at the lowest elevation, and advanced upgrade to the terminus of the main. All bell ends shall be oriented facing the uphill direction.
 - f) Backfill material shall be free from construction material, frozen material, organic material, or unstable material. Backfill with a high clay content or high shrink-swell potential that cannot meet compaction requirements shall be deemed unsuitable and replaced as directed by a professionally licensed Geotechnical engineer.
 - g) Backfill materials that have been allowed to become saturated or with moisture contents non-conductive to meeting compaction requirements shall be deemed unsuitable and replaced.
 - h) When original excavated materials have been deemed unsuitable, granular material must be imported to the site to backfill utility trenches and meet compaction requirements. The following materials shall be acceptable forms of granular backfill: aggregate base course, soil type base course, select backfill material, sand or screenings in accordance with NCDOT Specifications.
 - i) In all open utility trenches, backfill shall be compacted to 95% maximum dry density as measured by AASHTO method T99. The Contractor shall be responsible for verifying that compaction requirements have been met or exceeded by providing soils testing data from an approved Geotechnical Firm. The soil test results shall be certified by a licensed Geotechnical Engineer.
 - j) Backfill for utility trenches shall be placed in 8-inch lifts or less of uncompacted soil and compacted with a mechanical tamp before placing additional layers.
3. Pavement repairs
- a) All pavement cuts shall be repaired within a maximum of three (3) days from the date the cut is made. If conditions do not permit a permanent repair

within the given time limit, permission to make a temporary repair must be obtained from the Infrastructure Field Technician.

- b) Pavement repairs shall be made in accordance with Cary Standard Details.
 - c) All asphalt pavement utilized to repair open trenches shall comply with all applicable Cary asphalt pavement material and installation Specifications.
 - d) All pavement patches shall be provided in such a manner that a uniform and smooth driving surface free of depressions and/or bumps is obtained. Pavement patches not meeting this standard shall be milled and replaced.
4. Trenchless pipe installation
- a) The preferred trenchless method shall be auger boring. Alternate trenchless methods including microtunneling, guided boring, conventional tunneling, horizontal directional drilling or hand tunneling may be approved after thorough evaluation by the Utilities Department.
 - b) In addition to meeting or exceeding all Cary requirements, all trenchless crossings shall be approved by and meet the requirements of all controlling legal authorities, such as NCDOT, Norfolk Southern Railway and CSX Corporation.
 - c) Direct bores may be made without a casing pipe on pipelines 6-inches in diameter and smaller.
 - d) Encasement pipe shall be installed with all trenchless construction methods (excluding horizontal directional drilling when it is approved and as noted above). There shall be a minimum cover of 4-ft between the pavement subgrade and the top of the casing pipe. Under no circumstances shall the pavement subgrade be disturbed.
 - e) Permanent easements (UPE) shall be provided at all trenchless pits to allow for future access to casing pipes.
 - f) All carrier pipe shall be manufacturer provided restrained joint ductile iron pipe except for reclaimed water mains in which restrained PVC C900 or C905 pipe in compliance with Section 6500 is utilized.
 - g) As the trenchless operation progresses, each new section of encasement pipe shall be joined using full penetration seal welds prior to installation of the casing. Joints shall be electric-fusion welded by operators qualified in accordance with the American Welding Society's standard procedure for arc welds. The welds shall be capable of transmitting all thrust and other loads across the joints.

- h) If voids are encountered while installing encasement pipe thirty (30) inches and larger, 2-inch or larger grout holes shall be installed at ten (10) foot centers in the top section of the encasement pipe. The grout holes shall be used to fill the void spaces with 1:3 Portland cement grout at sufficient pressure to prevent settlement of the roadway, unless NCDOT approval stipulates otherwise. Other grout mixtures may be submitted for approval.
 - i) In the event that an obstruction is encountered during the trenchless operations, the equipment shall be withdrawn. The pipe shall be cut off, capped, and filled with 1:3 Portland cement grout at a sufficient pressure to fill all voids before moving to another boring site.
 - j) Restrained joint ductile iron carrier pipe shall be pulled into the casing pipe.
 - k) For all trenchless operations of 100-ft or more, the ground surface elevations shall be recorded prior to beginning work.
 - i. At a minimum, survey points shall be identified with a nail or hub located as follows:
 - Road crossings: Centerline and each shoulder/curb
 - Utility and Pipeline Crossings: Directly above and 10-ft each side of the crossing
 - All locations: Points shall not exceed 50-ft spacing.
 - ii. Elevations at each point shall be recorded with an accuracy of 0.01-feet.
 - l) Settlement observations shall be made each day until the pipe/casing is fully installed.
 - m) Readings shall be reported to the Infrastructure Field Technician.
 - n) In the case of observed settlement, the monitoring points and observation frequency shall be increased as determined by Cary.
5. External corrosion protection
- a) External corrosion can occur at an accelerated rate in metallic pipelines such as steel and ductile iron when they are installed in aggressive soils or when they are installed near other structures or utilities that carry impressed currents. Such facilities that typically utilize impressed current cathodic protection are gas pipelines, such as owned by Colonial Pipeline, Cardinal Pipeline and Dixie Pipeline. Other potential sources that may create stray currents that contribute to accelerated pipeline corrosion are high voltage power transmission lines and railroad crossings.

- b) In cases where metallic steel and ductile iron pipelines or encasement pipes are planned for installation in close proximity to any potential sources of stray current or aggressive soils, zinc coated pipe shall be specified and a field analysis consisting of stray current evaluation and soil testing shall be conducted by an experienced technician, as certified by the National Association of Corrosion Engineers, (NACE), to determine the potential for external corrosion and the need for additional protection measures. In cases where stray current conditions and/or aggressive soils are prevalent, a corrosion specialist certified by the NACE or other applicable certification board shall be consulted regarding the design of pipeline protection measures.
- c) At a minimum, all stray current protection systems should include bonded joints and sacrificial anodes with a 50-year or longer design life and test facilities in lieu of polyethylene encasement, unless otherwise approved by Cary. The cathodic protection element of the pipeline design package shall be sealed by Professional Engineer licensed in the State of NC.
- d) Full impressed current cathodic protection shall only be utilized when extreme corrosion potential has been proven and/or as otherwise directed by the Utilities Department and the certified corrosion engineer of record.

D. PIPE IDENTIFICATION AND MARKING

1. Marking Tape

- a) Installation: Marking tape shall be installed continuously and longitudinally along all water mains and water services for new construction and for any repair or retrofit construction using open trench methods. For service connections, the marking tape shall extend from the main line to the water meter. Marking tape shall be installed directly above the center of the pipe and at least 24-inches deep from final grade to a maximum depth of 36-inches below final grade.
- b) Specifications: The water main marking tape shall be an approved product identified in Cary's Approved Products List. The marking tape shall be made of polyethylene (or approved equivalent) material, 6-inches wide and a minimum of 6 millimeters thick. The marking tape shall have detectable markers embedded in the tape and spaced adequately to provide continuous detection along the tape from above the buried pipe at final grade. The tape shall be blue in color and shall be marked with words "CAUTION WATER LINE BURIED BELOW" (or an approved equivalent wording). The wording shall be repetitive along the full length of the tape.

2. Marker Balls

- a) Installation: Non-programmable marker balls are required at the ends of all casing pipe, fittings and reducers. Marker balls shall be used in addition to

marking tape within thoroughfares and within 100-ft of a signalized intersection. Through signalized intersections, marker balls shall be spaced at 25-ft intervals. They shall also be installed along and directly above all water mains in conditions where marking tape cannot be installed due to restrictions or conflicts. In these conditions, non-programmable marker balls shall be placed, at all vertical and horizontal deflection points, at all tees and crosses and at a spacing along the main no greater than 100 feet apart. Each marker ball shall be installed directly above the center of the pipe and at least 24-inches deep from final grade to a maximum depth of 36-inches below final grade. Any sections where tape cannot be accurately placed at time of backfilling sufficient survey data shall be collected to reestablish location for tape installation. A table of marker ball locations, with description, must be submitted as part of the record drawing.

- b) Specifications: The Marker Ball is a non-programmable ball and shall be an approved product identified in Cary's Approved Products List. The marker ball shall be blue in color for potable water and conform to APWA standards. It shall have a minimum detectable depth of 5 feet.

6020 FIRE PROTECTION

A. FIRE HYDRANTS

1. Location

- a) All fire hydrants shall be installed on a minimum 6-inch public water line. New fire hydrants are not permitted on private water lines. Only one fire hydrant may be installed when the line is served by a 6-inch tap and is not looped to another main. There shall be at least one fire hydrant at each street intersection. The minimum acceptable flow for fire hydrants is 1000-gpm at minimum 20-psi residual in residential areas and 1500-gpm at minimum 20-psi residual in other districts. Hydrants at intersections shall be located in accordance with the Standard Details. Valves provided on the fire hydrant branch supply line shall be located within 5-ft of the main line. The fire hydrant shall be a minimum of 24-inches from the valve.
- b) In residential districts the maximum distance between hydrants, measured along street centerlines, shall be 500 feet. When residential intersections are less than 700 feet apart, a hydrant is not required between the intersections.
- c) In business, office and institutional, and industrial zoning the maximum distance between hydrants, measured along street centerline, shall be 300 feet. When business, office and institutional, and industrial intersections are less than 450 feet apart, a hydrant is not required between intersections

- d) On thoroughfares and collector streets with access points only at street intersections, hydrants shall be located at each street intersection and at 1000-foot intervals along the street. Where these intersections are less than 1200 feet apart, no hydrant is required between the intersections. Fire hydrants shall be placed in a staggered arrangement on both sides of any roadway classified as a major or minor thoroughfare with the hydrant spacing as referenced above.
 - e) Where sprinkler systems are used, a fire department connection shall be within 50 feet of an accessible fire hydrant except within the *Business Improvement District* where greater lengths may be permitted. See Section 6020 B for other sprinkler system requirements.
2. Specifications: Hydrants shall conform to AWWA C502 with a minimum valve opening of 4 1/2 inches. Hydrants shall be furnished with a 4 1/2-inch steamer* and double 2 1/2 inch hose connections with caps and chains, National Standard Threads, mechanical joint, 1 1/2 inch pentagon operating nut, open left, painted fire hydrant red, bronze to bronze seating, a minimum 4 foot bury depth with a break away ground line flange and break away rod coupling. The hydrant bonnet will be designed with a sealed oil or grease reservoir with O-ring seals and a Teflon thrust bearing. Fire hydrant caps shall be attached to the body of the hydrant with a minimum 2/0 twist link, heavy duty, non-kinking, machine chain. All fire hydrants shall be designed and rated for a working pressure of 250-psi or greater.
- * For hydrants located within the Town of Morrisville only: Where Fire Department Connections are provided to buildings, the hydrant closest to the FDC shall be supplied with a 5-inch Storz connection in lieu of the 4 1/2 inch steamer connection. The Storz connection shall be by the hydrant manufacturer only and come as part of the hydrant assembly. No adapters for the Storz connection are allowed.
3. Installation: Hydrants shall be set plumb, properly located with the pumper nozzle facing the closest curb of a fire lane or street, but not a parking space. The back of the hydrant opposite the pipe connection shall be firmly blocked against the vertical face of the trench with 1/3 cubic yard of concrete. Double bridle rods and collars shall be connected from the tee to the hydrant. All joints between the tee and the hydrant shall be mechanical joints restrained with wedge action retainer glands. Stainless steel rods not less than 3/4 inch diameter may also be used to restrain the assembly. A minimum of 8 cubic feet of stone shall be placed around the drains. The backfill around the hydrants shall be thoroughly compacted and closely match the elevation on the approved plans. Hydrant extensions will not be allowed on new or retrofit installations. Hydrant installation shall be in accordance with Cary Standard Details. Hydrant tees may be used upon approval of the Utilities Department.

4. Depth of Bury:

Typical 90-Degree Hydrant Shoe Installations:

The maximum depth of bury for all new fire hydrants with 90-degree hydrant shoes shall be 5-ft from the breakaway flange connection. The breakaway flange or safety coupling shall be oriented vertically just above finished grading and bolted directly to the fire hydrant in compliance with manufacturer standards. The breakaway flange or safety coupling shall not be buried.

Vertical Shoe Hydrant Installations:

For installations requiring depth of bury greater than 5-ft, the fire hydrant shall be equipped with a vertical shoe arrangement that provides for full extension of the lower valve plate against a stopping mechanism located inside the vertical shoe to maximize hydraulic flow conditions through the hydrant. The vertical shoe shall be equipped with flanged connections. The maximum depth of bury for vertical shoe installations shall not exceed 4-ft measured from the breakaway flange to the bottom of the vertical hydrant shoe. The vertical shoe and all piping included in the hydrant supply line shall be restrained with blocking and rodding or blocking with wedge action retainer glands or standard Aquagrip connections.

In all cases where the vertical shoe is utilized, typical washed stone bedding extending at least 12-inches on all sides of the central axis and extending from the top of the vertical shoe downward to at least 12-inches below the vertical shoe shall be provided surrounding the vertical hydrant shoe assembly to assure positive drainage. In cases where Aqua-grip connections are not utilized, piping below the vertical shoe shall be provided in a flanged by plain end configuration and restrained with wedge action retainer glands to the lower mechanical joint fitting or the lower fitting shall be blocked and rodded to the vertical shoe connection. The entire assembly shall be restrained and support blocking shall be provided under the vertical bend assembly.

5. Hydrant Relocations: For installations where hydrants will be relocated, all hydrants with greater than 10-years of operational service, as indicated by the date of manufacture provided on the hydrant, shall be replaced with new fire hydrants. The existing fire hydrant shall be turned over to Cary's Public Works Department.

For installations where the hydrant to be relocated has less than 10-years of operational service, the existing hydrant may be relocated. The existing hydrant shall still be disinfected, flushed and pressure tested.

B. AUTOMATIC FIRE SPRINKLER SYSTEMS

1. General: Working plans and calculations for all automatic fire sprinkler and standpipe systems shall be submitted to Cary's permitting department through the electronic plan review portal for review and approval before installation. If 20

sprinkler heads or more are modified or added to an existing sprinkler system, if any modifications occur in the hydraulically calculated remote area, or the hazard classification changes, a plan submittal including complete calculations and a permit will be required. All fire sprinkler systems shall be installed with an alarm check valve installed in each riser with all required appurtenances (example: retard chamber, water motor gong, pressure gauges, etc.). Exception: NFPA 13 D and 13 R residential sprinklers when approved by a fire official. All installations, minor repairs, or minor replacements shall be performed by a licensed fire sprinkler contractor. Contact the Inspections and Permits Department for a permit application.

2. Design: Approved working plans shall be in complete compliance with NFPA No. 13, 13D, 13R, 14, 16, 20, 22, 24 and Cary Specifications. An NFPA above ground material and test certificate and NFPA underground material and test certificate are required after completion of designated, approved work.
3. Hydraulic Design: If a system is hydraulically designed, the following design criteria must be followed:
 - a) Safety Margin: In all cases, a fixed minimum safety margin of at least 10-psi shall be applied to the design calculations. (Example: Demand = 70 psi, Supply \geq 80 psi)
 - b) Hose Allowances: Both exterior and interior hose allowances shall comply with NFPA 13 requirements.
 - c) Water Supply Pressure: The sprinkler system designer shall be responsible for verifying system pressure. Refer to [Cary Policy Statement 129I](#) regarding Minimum Water Supply Pressure.
4. Backflow Prevention: When a fire protection system is proposed, with a Fire Dept. connection or as otherwise required by the Cross Connection Ordinance a reduced pressure principle detector assembly (RPDA) shall be installed on the supply side of the sprinkler fire protection line inside the riser room. These backflow prevention devices must be UL listed and/or listed by Factory Mutual Research Corporation. Reduced pressure principle detector assemblies shall not be arranged vertically. For all RPDA's, a relief valve fill cup piped outside the building shall be provided. The relief valve drain may be piped to the main building drain.
5. Post Indicator Valve (PIV): A post indicator valve shall be provided at the right of way or edge of easement no more than 40 feet from the building if space permits. Each connection into the building shall have a post indicator valve. The top of the PIV shall be 30-42 inches above finished grade and 36-inches of unobstructed access perimeter shall be maintained around the PIV. [See Cary's Approved Backflow List](#) at www.CaryNC.gov.

In urban settings, a wall mounted indicator valve may be used where there is no suitable location for a post mounted indicator valve. Wall mounted indicator valves shall be centered 30–42 inches above the finished grade. It shall be greater than 10-ft from any door, window, or other protected opening along the wall.

All indicator valves regardless of type shall have an electronically controlled tamper switch. All PIVs shall be made of ductile iron construction and shall be UL listed and FM approved. The standpipe of all PIV's shall be painted red. Cary shall maintain up to the post indicator valve. Where wall mounted indicator valves are used, Cary shall maintain up to a location 10 feet outside of the building or as designated on the approved plans.

6. Fire Department Connection: Where standpipe systems or combination sprinkler/standpipe systems are used, a fire department connection with 5-inch Storz connections shall be provided within 50-ft of an approved fire hydrant. All 5-inch Storz FDC's shall be installed in accordance with Cary Standard Detail 6000.35 or 6000.36.
 - a) Except, where buildings are only protected by automatic fire sprinkler systems, a 2.5-inch Siamese fire department connection with National Standard threads shall be provided within 50-ft of an approved fire hydrant, except for townhomes, apartment buildings, and within urban settings where greater lengths may be permitted. All 2.5" Siamese FDC's shall be installed in accordance with Cary Standard Detail 6000.28.
 - b) When a sprinkler system serves only part of a large structure, the fire department connection shall be labeled, with minimum 2-inch letters on a permanent sign, as to which section of the structure that sprinkler riser serves.
 - c) Automatic sprinkler systems and/or standpipe systems that require 150 psi and above, shall have a sign indicating the pressure required at the inlets to deliver the system demand at all Fire Department Connections.
7. Dedicated Riser Room: A dedicated sprinkler riser room is required providing an entry door to the room from the exterior of the building. All dedicated riser rooms shall be equipped with a floor drain sized appropriately to prevent flooding. The floor drain shall be piped to storm system or main building drain. The floor drain shall be provided with a circular raised ring/hub around the floor drain to prevent debris and/or chemicals from entering the drain during an emergency spill. The hub shall be fabricated of cast iron or other corrosion resistant material and extend at least 3-inches above floor elevation.
8. Alarm Communication: All sprinkler systems are to have alarm communication equipment to fully comply with NFPA 72. Equipment must be fully functional and

reporting to a UL listed central receiving station before a Certificate of Occupancy is issued for the facility.

9. Access: All buildings which have an elevator, a fire alarm system monitored by a central receiving station, or a fire sprinkler protection system shall provide a "Knox Box" key entry system (Knox Co.). This "Knox Box" shall be mounted on the exterior entrance to the dedicated riser room or at the normal fire department entrance when no fire sprinkler system is provided and there is no dedicated riser room. Mount "Knox Box" on wall at 5 feet A.F.F. on door handle side of dedicated riser room door or entrance door. This "Knox Box" shall be ordered through the Cary Fire Department and shall be in place before a Certificate of Occupancy is issued. Keys to access the facility shall be provided to the Fire Department by the owner/manager.
10. Identification: The exterior door leading to the dedicated sprinkler riser room shall be labeled with minimum 2-inch lettering designating "SPRINKLER RISER ROOM" in a contrasting color. Durable vinyl lettering is suggested.
11. Fire Alarm Panel Location: When a building is protected by an automatic sprinkler system and has a fire alarm system, the fire alarm control panel or a remote annunciation of the fire alarm control panel shall be placed in the sprinkler riser room. This control panel shall have the capacity of silencing and resetting. Adjacent to the fire alarm control panel shall be a framed zone map. Nomenclature shall correspond with the zone map. All plans and specifications must be submitted to Cary's permitting department through the electronic plan review portal for approval prior to installation of equipment or wiring. When there is no sprinkler system in a building, the fire alarm control panel or remote annunciator shall be located at the normal fire department entrance.

C. FIRE PROTECTION DURING CONSTRUCTION

The fire protection water supply system, including fire hydrants, shall be installed and be in at least the functional status prior to placing combustible materials on the project site. In addition, functional status includes adequately installed and maintained access to the construction project, with the first layer of asphalt installed. If phased construction is planned, coordinated installation of the fire protection water system is permitted. Coordination of the water system will be done through the Utilities Department. Functional status would include meeting all standards set forth in Section 6060 "Testing and Inspections".

6030 VALVES AND APPURTENANCES

A. VALVES

1. General

- a) Valves shall be installed on all branches from feeder mains and hydrants according to the following schedule: 4 valves at crosses; 3 valves at tees; one valve on each hydrant branch and elsewhere as directed by the Director of Utilities. When a loop section of water line is connected back into the feeder main within a distance of 200 feet or less, only one valve will be required in the feeder main. In all cases where new water mains are connected to an existing water distribution line, valves shall be located at all end points and at intermediate points throughout the new system extension to assure testing requirements can be met without interfering with the operation of the existing system.
- b) Where no water line intersections are existing, a main line valve shall be installed at every 100 feet per 1 inch diameter main up to a maximum distance of 2000 feet between valves.
- c) Valves shall be properly located, operable and at the correct elevation. The maximum depth of the valve nut shall be 6 feet without an extension kit. When valve extension kits are used, they must be manufactured by the same company which manufactured the valve.

2. Combination Air Valves

- a) Combination air valves shall be provided to purge air from the system at startup, vent small pockets of air while the system is being pressurized and running, and prevent critical vacuum conditions during draining. Combination air valves rated for potable water use shall be installed at all high points of water lines 8 inches in diameter or larger and at other locations such as major changes in grade as directed by Cary. A high point shall be determined as any high location where the difference between the high elevation and adjacent low elevation exceeds 10-ft, unless otherwise determined by the Director of Utilities based on special circumstances.

All combination air valves shall be provided in conformance with AWWA C-512. The water main shall be installed at a grade which will allow the air to migrate to a high point where the air can be released through an air valve. A minimum pipe slope of 1 foot in 500 feet should be maintained.

- b) The combination air valve shall be sized by the Engineer and approved by Cary. Combination air valves shall be of the single housing style with Type 304 or 316 stainless steel body that combines the operation of both an air/vacuum and air release valve. The valve shall be rated for minimum 230 PSI working

pressure. The combination air valve shall be provided with cylindrical shaped floats and anti-shock orifice made of high-density polyethylene. Combination air valves with spherical floats shall not be accepted. All combination air valves shall be installed in accordance with Cary Standard Details.

- c) 2-inch combination air valves shall be installed in a standard 4-foot diameter eccentric manhole. The 2-inch valve shall have a 2-inch male NPT inlet. Connection to the main shall be with a saddle tap in the same sizing as the combination air valve assembly and isolated with a gate valve also of the same size. The isolation gate valve shall be provided with NPT threads and connected with “no lead” brass (meeting UNS C89833 as per ASTM B584) or bronze piping. Brass or bronze ball valves may be used in lieu of gate valves for 2-inch installations. The isolation valve shall be rated for 200-psi service or greater.
- d) Combination air valves 3-inches and greater shall be installed in a flat top manhole sized according to the water main diameter. Mains less than or equal to 20” shall utilize a 5-foot diameter manhole and larger mains shall utilize a minimum 6-foot diameter manhole. All connections shall be by flange joints. Connection to the main shall be by an MJ x FLG tee with the branch diameter equal to at least half of the main diameter. If needed due to larger diameters, a flanged reducer shall be provided prior to the flanged gate valve sized equally to the flanged combination air valve.
- e) Precast concrete manholes shall meet the requirements of section 7020. Manholes shall be provided without steps.

3. Gate Valves, less than 4-inches for Blowoff Assemblies

Gate valves for blowoff installations sized smaller than 4-inches, shall be resilient seated wedge type with a non-rising stem and a 2-inch operating nut in compliance with AWWA C509. The smaller diameter gate valves shall be provided with triple O-ring seals and threaded end connections in compliance with ANSI B2.1. Gate valves smaller than 2-inches shall be identified “no lead” and consist of brass components designated under UNS C89833 as per ASTM B584. The small diameter gate valves shall be rated for a minimum pressure rating of 200-psi.

4. Gate Valves, 4-inches to 12-inches

All valves for potable water applications, 12-inches in diameter and smaller shall be resilient seated wedge gate valves in conformance with the requirements of AWWA C509, (grey or ductile iron body) or AWWA C515, (reduced wall ductile iron body). All coating materials used in the construction of gate valves for potable water applications must comply with NSF 61 to assure lead free construction and meet the requirements for extractables. All gate valves shall be designed for a working pressure of 250-psi with a minimum UL listing and FM approval rating of

200-psi. Gate valves shall be fusion bonded epoxy (FBE) coated both interior and exterior at a nominal thickness of 6-8-mils and the FBE coating shall be provided in conformance with AWWA C550. All gate valves shall be assembled with stainless steel bolts.

All gate valves 12-inches in diameter and smaller shall be installed in the vertical position and shall be provided with mechanical joint fittings. Gate valves shall be restrained by wedge action retainer glands or other approved manufacturer provided restraining systems. All gate valves shall open left with a non-rising stem (NRS) and be provided with a 2-inch square operating nut. All gate valves shall be constructed with triple O-ring seals in which 2 O-rings are located above the thrust collar and 1 O-ring is located below the thrust collar. The two upper O-rings shall be replaceable with the valve fully open and subjected to full rated working pressure.

The gate valve wedge shall be fully encapsulated in rubber. All valves shall be rated for bi-directional flow. All sealing gaskets shall be made of EPDM rubber materials.

5. Gate Valves, 14-inches through 48-inches

Gate valves 14-inches through 48-inches shall be resilient seated wedge gate valves in conformance with the requirements of AWWA C515, (reduced wall ductile iron body) and shall comply with all Specifications outlined for gate valves 4 through 12 inches. Gate valves installed vertically shall be provided with a minimum of 2-ft of overhead clearance between the top of the operator nut and the finished grade. All gate valves 18-inches and greater shall be provided with a geared actuator. Vertical gate valve installations shall have spur gear actuators and horizontal installations shall have bevel gears.

Gate valves 18 inches in diameter shall be provided with a gear operator at a minimum 2:1 ratio and larger valves through 24-inches shall be provided with a gear operator at a minimum 3:1 ratio.

Gate valves installed in a horizontal position shall only be provided as permitted by the Director of Utilities for special circumstances where vertical alignment is not possible. All horizontal gate valves shall meet or exceed the Specifications outlined herein for vertical gate valves including the 250-psi pressure rating. All horizontal gate valves shall be equipped with bevel gears resulting in a minimum 4:1 turn ratio for valves 30 through 48-inches in diameter.

6. Insertion Valves, 12-inches and under: Insertion valves shall only be used as permitted by the Utilities Department. Insertion valves shall meet the requirements of AWWA C515, seat on the valve body and be rated for a working pressure of 250-psi or greater. All insertion valves shall be made of ductile iron in conformance with ASTM A-536 Grade 65-45-12 and epoxy coated at a minimum of 10-mils.

Insertion valves under this section are available for pipe sizes through 12-inches in diameter. Larger insertion valves shall meet requirements for Insertion Valves, 16-inches through 24-inches, below. In cases where insertion valves are being installed to shut down water to a work zone area, the insertion valve shall be located a minimum of 100-ft from the work zone or greater as determined by the Engineer of Record to assure the insertion valve can safely operate as a dead end without dislodging from the pipeline or otherwise causing the existing pipeline to shift.

Disinfection – During installation of any insertion valve, positive pressure in the distribution system shall be maintained at all times. Once the water main is exposed and the trench is adequately dewatered, the exterior of the main and all insertion valves and equipment, including the cutter head and valve gate shall be cleaned and disinfected pursuant to AWWA C651-14 by spraying or swabbing with a minimum 1% chlorine solution.

Insertion Valves shall be Resilient Wedge Gate Valves, designed for use in potable water systems and be listed on Cary's Approved Products List. The body, bonnet and wedge shall be ductile iron meeting or exceeding AWWA C515. Insert Valves shall be ductile iron construction meeting ASTM A536 Grade 65-45-12. The pressure rating markings must be cast into the body of the insert valve.

Chemical and modularity tests shall be performed as recommended by the Ductile iron Society, on a per ladle basis. Testing for tensile, yield and elongation shall be done in accordance with ASTM E8.

Sizes 12" and smaller must be capable of working on Cast/Grey Iron or Ductile Iron Class A, B, C and D, IPS PVC, C900 and C909 PVC, Steel, AC pipe diameters without changing either top or bottom portion of split valve body.

After the installation of the insert valve body on to the existing pipe a pressure test of 1.1 times that of the contents shall sustained for 15 minutes. Once the pressure test is effectively achieved the insert valve body must not be moved in accordance with AWWA Standards. If the insert valve is moved the pressure test must be completed again. The insert valve must not be moved or repositioned once the pressure test is achieved.

The construction of the Resilient Wedge shall comply with AWWA C509 requirements. The ductile iron wedge shall be fully encapsulated with EPDM rubber by a high pressure and high temperature compression or injection mold process. The ductile gate shall be fully coated with molded rubber with no exposed iron.

The resilient wedge shall seat on the valve body and not the pipe to obtain the optimum seating and flow control results. The resilient wedge shall be totally independent of the carrier pipe. The resilient wedge shall not meet the carrier pipe

or depend on the carrier pipe to create a seal. Pressure equalization on the down or upstream side of the closed wedge shall not be necessary to open the valve. The wedge shall be symmetrical and seal equally well with flow in either direction.

The Resilient wedge must ride inside the body channels to maintain wedge alignment throughout its travel to achieve maximum fluid control regardless of high or low flow pressure or velocity. Insertion valve shall provide an unobstructed flow way.

The insert valve shall be fully epoxy coated with minimum of 8 mils of epoxy on the interior and the exterior, including bolt holes and body-to-bonnet flange surfaces, prior to assembly, in compliance with AWWA C550 and certified to ANSI/NSF-61.

The insert valve shall include triple O-Ring stem seals with two O-Rings located above, and one O-Ring below the thrust collar. Side flange seals shall be of the O-Ring type of either round, oval, or rectangular cross-sectional shape.

The gate valve stem and wedge nut shall be copper alloy in accordance with Section 4.4.5.1 of the AWWA C515 Standard. The stem shall be NRS with AWWA standard turns and must have an integral thrust collar in accordance with Section 4.4.5.3 of AWWA C515 Standard. Two-piece stem collars are not acceptable. Operated by 2" square wrench nut according to ASTM A126 CL.B and open left.

The wedge nut shall be independent of the wedge and held in place on three sides by the wedge to prevent possible misalignment. Two thrust washers are required. One shall be located above, and one located below the stem thrust collar.

All parts and components to be exclusively and completely assembled, manufactured, machined, and coated in the USA. All physical and chemical test results shall be recorded such that they can be accessed via the identification number on the casting. These Material Traceability Records (MTR's) are to be made available to the purchaser that requests such documentation. All components shall be manufactured and assembled in the United States. The purchaser shall, with reasonable notice, have the right to plant visitation at his/her expense.

Bolting materials shall meet the requirements of ASTM A307 with dimensions conforming to ANSI B18.2.1.

The stuffing box, operating stem, and resilient wedge (complete bonnet and all moving parts) shall be removable, repairable and or replaceable under pressure without additional pipe penetration taps or foreign methods. While the valve is fully pressurized in the system all moving components shall be fully removable under pressure. In the event the valve stem is broken or damaged the bonnet shall be removable under pressure.

Restraint devices shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA C110/A21.10. Restraint devices shall have a working water pressure rating of 350 psi for 4-12 inch and must include a minimum safety factor of 2 to 1 in all size and be approved by Cary. Gland body wedges and wedge actuating components shall be cast from grade 65-45-12 ductile iron material in accordance with ASTM A536. Mechanical joint restraint shall require conventional tools and installation procedures per AWWA C600, while retaining full mechanical joint deflection during assembly as well as allowing joint deflection after assembly. Proper actuation of the gripping wedges shall be ensured with torque limiting twist off nuts. Set screw pressure point type hardware shall not be used. Restraint devices shall be listed by Underwriters Laboratories and Approved by Factory Mutual (3" through 12" inch size).

Manufacturer's installation procedures shall be strictly adhered to, including the installation of vacuum flange, checking, removing and confirmation of removal of shavings in the valve body. Installation procedures shall be approved by Cary prior to installation of insertion valve.

Prior to installation, the operating pressure shall be confirmed with Cary Utilities Department. Valve pressure testing procedures shall be approved by Cary Utilities Department, Cary Inspection Department and Manufacturer prior to installing.

Contractor shall confirm existing pipe outside diameter prior to purchasing insertion valve.

7. Insertion Valves, 16-inches through 24-inches: Insertion valves shall only be used as permitted by the Utilities Department. Disinfection procedures listed in item 6 above shall be required.
8. Valve boxes
 - a) Valve Boxes shall be cast iron, screw type, with a 5-inch opening, and "water" stamped on the cover. The cover shall be 6-inches in depth. All valve box assemblies and covers shall be cast from Class 35 gray iron and domestically made and manufactured in the USA.
 - b) Valve box ring adjustments will not be allowed. The valve box shall be centered over the wrench nut and seated on compacted backfill without touching the valve assembly. All valve boxes in pavement shall be flush with the top of the pavement or flush with the finished grade. Outside of paved areas precast concrete valve box encasements or a trowel finished 2' x 2' x 6" pad of 3000-psi concrete may be used for valve box encasement provided the assembly is buried flush with the surface grade and compacted properly to prevent movement of the precast encasement.

9. Actuators: All valves shall be provided with standard 2-inch operating nuts. Unless otherwise specified, the direction of rotation to open the valves shall be to the left, (counterclockwise), when viewed from the top. Each valve body or actuator shall have cast thereon the word "OPEN" and an arrow indicating the direction to open.

B. APPURTENANCES

1. Blowoffs:
- a) Blowoffs shall be a minimum of 2 inches and installed at the end of all dead-end water lines. Where there is not sufficient pressure or fire hydrants to thoroughly flush the system, a larger blowoff shall be required.
 - b) Blowoff Assemblies shall be constructed as shown in Cary Standard Details. The valves shall be gate type with a non-rising stem and a 2-inch operating nut, O-ring seals and screwed ends. A full-size gate valve is required on water mains that are planned to be extended.
2. Reaction Blocking: Material for reaction blocking shall be 3000 psi concrete, poured in place. The reaction areas are shown in Cary Standard Details. A minimum 4 mil plastic shall cover the fitting to ensure that no concrete will interfere with removal of the fitting.
3. Rodding: All rodding shall be constructed with type 304 stainless steel rods at the number and sizing specified in the following table. Rod coupling shall not be allowed. All hardware shall also be stainless steel type 304.

Stainless Steel Rod Requirements are as follows:

4-inch branch	2, 3/4-inch stainless steel rods
6-inch branch	2, 3/4-inch stainless steel rods
8-inch branch	4, 3/4-inch stainless steel rods
12-inch branch	6, 3/4-inch stainless steel rods
16-inch branch	8, 3/4-inch stainless steel rods

4. Wedge Action Retainer Glands:
 All wedge action retainer glands shall be manufactured as a one-piece retainer gland for use with mechanical joints and shall be rated to provide restraint up to 350-psi pressure rating for sizes through 16-inches. For sizing above 16-inches, the wedge action retainer gland shall be rated to provide restraint up to 250-psi. Approved wedge action retainer glands shall be made of ductile iron, coated with a manufacturer applied epoxy coating or polyester powder coating.

In cases where wedge action retainer glands are approved for pipe restraint of fire hydrant supply lines or other applications, the entire hydrant supply line shall be restrained.

Wedge action retainer gland connections to push on pipe are not approved.

5. Sampling Stations:

Sampling Stations shall be provided at all new residential and commercial development areas at the rate of 1 sampling station per development complex consisting of at least 200-homes or 1- per 10 acre or greater commercial complex or 1 per institutional facility with more than 100,000 square feet or as otherwise required by the Director of Utilities. Padlocks for sampling stations shall be provided by Cary's Public Works Dept. The sampling station requirement may be waived in cases where area sampling is already deemed sufficient by the Water System Operator.

Sampling stations shall be provided as a self-contained manufactured assembly with locking aluminum housing, stainless steel tube and unthreaded spigot. Sampling stations shall not be connected to a service line.

6040 WATERMAIN TAPS AND SERVICES

A. DESIGN

1. Individual water services shall be provided from the main to each water meter for single family residences in accordance with the Details. All connections shall be made by wet taps. Service connections shall be made perpendicular to the main and shall run straight to the meter.
2. Individual taps to the main shall be provided for the domestic service, fireline service and hydrant lateral in accordance with the Standard Details.
3. All water service lines shall be installed with a minimum depth of cover of 24-inches or greater.
4. All water service lines shall be installed with a minimum distance to adjacent infrastructure of 5 feet on either side of the service. This shall include both domestic and fire service lines.
5. All water meter boxes and vaults shall be located at the edge of the serviced lot's right of way or easement. Water meter boxes shall not be placed in streets, sidewalks, parking areas or obstructed by fencing or buildings. A 10-foot clear zone shall be maintained behind meter boxes and vaults. In addition, within townhouse developments, water services shall be located within 4-feet of driveways in order to minimize conflicts between service lines and trees.
6. All meter boxes shall be protected during construction by installation of tree protection fencing or some other acceptable material. Material will be adequately maintained throughout the construction period to prevent damage and contamination of the sewer system.

7. Provisions for backflow prevention shall be in accordance with existing Cary policies and the NC Plumbing Code.
8. The water meter shall be sized based on water demand. All water service lines shall be minimum 1 inch diameter. Multiple branches up to a maximum of 2 potable water services per multiple branch assembly for a single residential use shall be sized by the Engineer of Record in accordance with AWWA M22 but shall not be less than 1.5-inches in diameter. Gang Service Boxes are prohibited.
9. Service taps 2 inches or less to existing water lines shall be made by Cary except if approved on development plans. Service taps greater than 2 inches to existing water lines shall be made by a Contractor of the Developer after obtaining applicable permits and paying applicable fees.
10. Service taps to new water lines shall be made by the Contractor in accordance with the Specifications after obtaining applicable permits and paying applicable fees.
11. All taps shall be in accordance with [Policy Statement 95](#).
12. No taps shall be made within 3-feet of the bell or spigot end of the pipe.

B. MATERIALS

1. Disinfection – During installation of any tapping sleeve or saddles, positive pressure in the distribution system shall be maintained at all times. Once the water main is exposed and the trench is adequately dewatered, the exterior of the main, all materials and equipment, including tapping sleeves and tapping valves, shall be cleaned and disinfected pursuant to AWWA C651-14 by spraying or swabbing with a minimum 1% chlorine solution.
2. Full Body Tapping Sleeves: Mechanical Joint tapping sleeves shall be fabricated of ductile iron construction in a two-piece assembly with mechanical joint connections to the main line and flanged connection to the tapping valve. All MJ tapping sleeves shall be rated for a working pressure of 200-psi or greater and provided with a ¾-inch test plug for testing. All tapping sleeves shall be hydrostatically tested up to 200-psi before a tap is made. Tapping sleeves shall not be air tested.

All mechanical joint tapping sleeves shall be manufacturer fabricated and approved for installation on the specific main line pipe material, whether ductile iron, plastic, cast iron or asbestos cement.

Full body tapping sleeves must be used when the main line is greater than 24-inches. Tapping sleeves fabricated of carbon steel in a two-piece assembly with

mechanical joint connections to the main line and flanged connection to the tapping valve will be considered for approval on a case-by-case basis for mains that are greater than 24-inches. Carbon steel sleeves should be rated for a working pressure of 250-psi or greater and be provided with a ¾-inch test plug. A fusion bonded epoxy coating shall be applied to all carbon steel sleeves.

3. Stainless Steel Tapping Sleeves, 6-inch through 12-inch main lines:

Stainless steel tapping sleeves may be used in lieu of mechanical joint tapping sleeves for ductile iron or asbestos cement water mains through 12-inches in diameter with branch sizing as shown in the following table. All stainless-steel tapping sleeves shall be manufactured in conformance with AWWA C223. All stainless-steel tapping sleeves shall have a stainless-steel flange and be provided in a two-piece assembly with a full circumferential gasket with tabbed gasket holding assembly and ¾-inch test plug. The back band shall be a minimum 14-gauge stainless steel and the front band (where the outlet is located) shall be a minimum 12-gauge stainless steel. The bolt bars shall be a minimum 7-gauge stainless steel. All stainless-steel tapping sleeves shall be manufacturer rated for a working pressure of 200-psi or greater and hydrostatically tested to 200-psi before a tap is made. Stainless steel tapping sleeves shall not be air tested.

Stainless Steel Tapping Sleeve Sizes Allowed

Nominal Main Size (inches)	Nominal Branch Size (inches)
6	4
8	4
10	4
10	6
12	4
12	6
12	8

4. Stainless Steel Tapping Sleeves, 14-inch through 24-inch main lines:

For larger diameter water mains, stainless steel tapping sleeves approved by Cary may be used in lieu of a mechanical joint tapping sleeve for cases where the branch line is 50% or less in diameter than the main line diameter. All the previous Specifications described for tapping sleeves from 6 to 12 inches shall be met for stainless steel tapping sleeves for larger diameter water mains. Additionally, the outlet band for stainless steel tapping sleeves 14-inches through 24-inches shall be a minimum 7-gauge stainless steel. The back half of the sleeve shall be a minimum 12-gauge stainless steel.

5. Tapping Saddles, 14-inch through 24-inch main lines:

Tapping Saddles may be used in lieu of mechanical joint tapping sleeves to tap mains 14 inches through 24-inches when the branch line is 50% or less in diameter than the main line diameter. 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 minimum strap count for branch sizing from 4-12 inches is shown below.

Strap Requirements for Tapping Saddles

Nominal Saddle Outlet (inches)	Number of Straps
4	3
6	3
8	4
12	7

6. Service Line Taps: The maximum size of direct taps for ductile iron water mains 6-inches to 12-inches without a fitting, tapping sleeve or saddle shall be 1-inch. Any taps larger than 1-inch or any size tap on mains larger than 12-inches shall be provided with a saddle tap.

7. Corporation Stops:
 - a) Corporation Stops shall be ball type, made of “no lead” brass (meeting UNS C89833 as per ASTM B584). Corp stops shall be complete with a compression 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 alternating from one side of the water main to the other and at least 12 inches apart. The taps must be a minimum of 24 inches apart if they are on the same side of the pipe. All corporation stops shall be rated for a working pressure of 300-psi.

 - b) 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 line. No tapping shall be made where rodding is placed.

8. Service Saddles: Service Saddles shall be used for service taps larger than 1-inch on all ductile iron water mains 14-inches and greater, or when direct taps cannot be made. Service saddles shall also be used for all taps on existing water mains other than ductile iron, such as asbestos cement, PVC, etc. Service Saddles shall be provided with brass body and fasteners (85-5-5-5 waterworks brass or “no lead” brass meeting UNS C89833 as per ASTM B584) conforming to AWWA C800 and double straps made of silicon bronze (single strap for PVC mains) conforming to ASTM A98 and factory installed grade 60 rubber gaskets. Service saddles shall be provided with AWWA standard threads per AWWA C800.

9. Copper Service Tubing: Copper service tubing shall be type K soft copper tubing per ASTM B88. No union shall be used in the installation of the service connection of 100-feet or less. Service lines more than 100 feet shall use a three (3) piece compression coupling. Only one (1) compression coupling shall be used for each 100 feet or fraction thereof.
10. Meter boxes for 1-inch services: 1-inch meter boxes shall be cast iron per ASTM A48 Class 25 or ASTM A126 Class B. Meter boxes for 1-inch water services shall provide a cover opening of 8 X 18 1/8 inches and boxes shall measure at least 12.5 inches in depth. Lids shall also be cast iron and have the words "Water Meter" cast into them. They shall also be lockable. Lids shall be provided with a 2 inch (maximum) diameter hole to accommodate a transmitter. All meter boxes and lids shall be installed as shown in the Details and have a black E-coating.

Meter boxes shall have 45-degree compression connections outside the box on the inlet side. There shall be a lockable ball valve inside the box on both the inlet and outlet which shall be permanently affixed to ensure proper spacing and alignment for the meter. Meter boxes shall also be provided with an ASSE 1024 approved inline, dual check valve located behind the meter. All fittings and connections shall be "no lead" brass conforming to UNS C89833 as per ASTM B584.

A "no lead" brass curb stop with compression connections shall be installed within 2 feet of the inlet connection. The curb stop may be buried without a box above it.

One 2 inch or 6-inch grade adjuster may be used when needed to meet final grade, however, no grade adjusters are permitted on new construction projects. Grade adjusters shall be cast iron. Grade adjuster and box shall be by the same manufacturer.

In isolated cases and when approved by the Director of Utilities, meter boxes may be located in driveways, alleys and/or parking areas. In these cases, a street rated box capable of withstanding a 40,000-lbs proof load shall be specified.

11. 1 1/2 and 2-inch Water Services: 1 1/2" and 2" meter boxes shall be light weight polymer concrete as indicated in the Standard Details. Meter boxes for 1 1/2 and 2-inch water services shall provide a cover opening of 24 X 36 inches and boxes shall measure at least 30-inches in depth and provided in straight wall arrangement. Standard meter box covers shall bolt down to the box, and all polymer cement covers shall be provided in solid configuration with a 2-inch diameter transmitter hole, and with the words, "Water Meter" cast into the lid. The meter box covers shall be provided with 2 stainless steel bolts in penta head configuration for security. To ensure positive discharge, the box should be tied into the existing storm drain system or shall have an open bottom to allow drainage through a 12-inch stone base. All meter box covers for potable water service shall be provided in standard concrete gray or black color.

Custom setter piping and fittings for 1 ½ and 2-inch water meters shall be constructed from “no lead” brass (meeting UNS C89833 as per ASTM B584) and copper tubing and shall be equipped with a lockable by-pass flanged ball valve and flanged angle meter ball valves. All applications shall have a separate above ground backflow preventer.

12. Water services greater than 2-inches: Water services greater than 2-inches shall have the meter and bypass line located within a precast concrete vault. All piping and valves shall have flanged connections. There shall be isolation gate valves on both sides of the meter as well as one on the bypass line. Gate valves within the vault shall meet the above requirements of AWWA C509 for non-rising stem gate valves but shall be provided with hand wheel operators. A standard buried gate valve with 2-inch nut shall be provided between the main and the vault. Link seals shall be used where the pipe enters and exits the vault.
13. Meter Vaults: Meter vaults and access doors shall meet HS-20 loading requirements and shall be located outside of travel areas. Pedestrian-rated covers shall not be used regardless of where they are located. The access double doors shall be aluminum 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. Vaults for 3- and 4-inch meters shall be approximately 8-feet by 10-feet in size. Six-inch meter vaults shall be approximately 9-feet by 12-feet. To ensure positive drainage, the vault shall be tied into the existing storm drainage system. If positive drainage is unobtainable, a sump pump shall be located and operated in the vault.

6050 IRRIGATION SYSTEMS

- A. All irrigation systems shall be provided with privately maintained reduced pressure principle backflow prevention installed in accordance with the NC Plumbing Code and the Foundation for Cross Connection Control and Hydraulic Research. Reduced pressure zone backflow preventers shall be installed above ground in an insulated box as shown by the details.
- B. All irrigation systems within public street right of way require an encroachment agreement from Cary or NCDOT prior to installation. Plans designating the location, size, material, and depth shall be submitted with the agreement application to the Inspection & Permits Department. If there is an approved development plan, it shall be referenced with the encroachment submittal to Cary.
- C. Pipe material for the mainline proposed to be used within the public right of way shall be Schedule 40 PVC or greater. A distance of at least 3-feet shall be provided from the back of curb or edge of asphalt in a ditch section. A minimum depth of 2-feet of cover shall be provided and all heads shall spray away from the street.

- D. All street crossings of irrigation systems shall be encased in ductile iron or steel conduit. Irrigation systems installed in the medians of Cary maintained roadways must also have French drains installed behind the curb and gutter which are piped to a storm system.

6060 TESTING AND INSPECTIONS

A. GENERAL

1. All materials must be approved by the Infrastructure Field Technician prior to installation. Materials rejected by the Infrastructure Field Technician shall be immediately removed from the job site.
2. The Contractor shall furnish all materials, labor, and equipment to perform all testing and inspections to the satisfaction of the Infrastructure Field Technician or Water Quality representative. Cary shall provide water for testing purposes on water mains in accordance with Cary Standard Procedure 4, Control and Monitoring of Water System Flow Activity.

B. TESTING

1. Hydrostatic Testing
 - a) No valve in the Cary water system shall be operated without authorization in accordance with [Cary Policy Statement 49 "Water Valves, Control of Closing and Opening"](#) A section of line that is to be hydrostatically tested, shall be slowly filled with water at a rate which will allow complete evacuation of air from the line. Hand pumps shall not be used for the pressure testing of water mains. Taps used for testing purposes shall be removed after testing and repaired using a "no lead" brass plug.
 - b) When filling the pipeline, it is very important to fill the line slowly to avoid undue impacts associated with surge and to allow air to evacuate the pipeline. After all air has been expelled from the water main, the line shall be tested to a pressure of 200 psi as measured at the lowest elevation of the line for a duration of 2 hours. The testing period shall not commence until all air has been evacuated and the pressure has stabilized. The pressure gauge used in the hydrostatic test shall be calibrated in increments of 10-psi or less. The pressure gauge shall be liquid-filled and indexed for an operating range of 300-psi or less with a minimum dial size of 4 inches. At the end of the test period, the leakage shall be measured with an accurate water meter.
 - c) Any measured leakage not within the allowable limits as specified in the following table shall require repair of the water main and additional testing until the standards are met. For pipe sizes other than those shown, the Contractor

shall test within the allowable leakage amounts as specified by AWWA C600-99. All visible leaks shall be repaired regardless of the amount of leakage.

Maximum Leakage Allowed with Hydrostatic Testing

Pipe Size (Inches)	Allowable Leakage at 200-psi (Gal./Hr. per 1000 feet of pipe)
4	0.38
6	0.57
8	0.76
10	0.96
12	1.15
16	1.53
20	1.91
24	2.29
30	2.87
36	3.44
42	4.01

2. Disinfection

- a) All additions or replacements to the water system shall be disinfected with chlorine in conformance with AWWA C651 before being placed in service under the supervision of the Cary's Infrastructure Field Technician in the following manner:
 - i. Taps shall be made at the control valve at the upstream end of the line and at all extremities of the line including valves.
 - ii. A solution of water containing 70% High Test Hypochlorite (HTH) available chlorine shall be introduced into the line by regulated pumping at the control-valve tap. The solution shall be of such a concentration that the line shall have a uniform concentration of not less than 50-ppm and not more than 100-ppm total chlorine immediately after chlorination. The chart below shows the required quantity of 70% HTH compound to be contained in solution in each 1000 feet section of line to produce the desired concentration from 50-ppm to 100 ppm.

Required Hypochlorite Concentration

Pipe Size (inches)	Pounds of High Test Hypochlorite (70%) to reach 50-ppm <i>per 1,000 feet of line</i>	Pounds High Test Hypochlorite (70%) to reach 100-ppm <i>per 1000 feet of line</i>
6	0.88	1.76
8	1.56	3.12
10	2.42	4.84
12	3.50	7.00
14	4.76	9.52
16	6.22	12.44
20	9.76	19.52
24	14.00	28.00
30	21.86	43.72
36	31.47	62.94
42	42.85	85.70

- iii. The HTH Solution shall be circulated in the main by opening the control valve and systematically manipulating hydrants and taps at the line extremities. The HTH solution must be pumped in at a constant rate for each discharge rate so a uniform concentration will be produced in mains.
- iv. HTH solution shall remain in lines for no less than 24 hours or as directed by Cary's Infrastructure Field Technician.
- v. Extreme care shall be exercised at all times to prevent the HTH solution from entering existing mains.
- vi. Free residual chlorine after 24 hours shall be at least 10 ppm or the Infrastructure Field Technician will require that the lines be re-chlorinated.

3. Flushing

- a) Flushing of lines may only proceed after 24 hours of disinfection contact time and as directed by Cary staff, provided the free residual chlorine analysis is satisfactory.
- b)
- c) At the completion of disinfection, chlorinated water flushed from the water main shall be disposed of in conformance with all Federal, State and local regulations.

- d) In accordance with all applicable regulations, a neutralizing chemical shall be applied to minimize chlorine residual in the flushing water before discharging from the water main, unless an alternate plan is submitted in writing and approved by Cary.
- e) Water used for disinfection shall be flushed from the water main until the chlorine residual concentration is below 5-ppm before initiating sampling.

4. Bacteriological and Turbidity Sampling

- a) Bacteriological sampling shall be utilized to verify disinfection prior to placing a newly constructed water main in operational service. Bacteriological sampling shall consist of 2 consecutive sets of acceptable samples taken at least 24-hours apart and collected from each 1,200-ft section of water main and all dead ends and branches as outlined by ANSI/AWWA C651.
- b) For the first round of sampling, the requested laboratory analysis shall be specified as follows: "Bacteriological Test and Turbidity." For the second round of testing, the laboratory analysis shall be specified as, "Bacteriological Test Only."
- c) Samples for laboratory analysis shall be witnessed by Cary's Infrastructure Field Technician after flushing is completed. The Contractor shall furnish the sample bottles, the testing agency and shall secure these samples. The Contractor shall make arrangements with the laboratory that all test results be submitted directly to the Cary's Infrastructure Field Technician or other designee approved by the Utilities Department. All costs for laboratory testing shall be borne by the Contractor.
- d) The laboratory secured for testing shall be certified by the State Laboratory of Public Health. All sample bottles for bacteriological sampling provided by the laboratory shall be sterilized and treated with a dechlorinating agent, such as sodium thiosulfate. Samples for turbidity shall be taken in plain sterilized bottles from the lab, which are separate from the bottles provided for bacteriological testing. The sample bottles shall be provided with tamper proof seals that will be adhered to the bottles by the Cary's Infrastructure Field Technician. The Infrastructure Field Technician shall provide a sample identification number, job title and an identification of Phase 1 or Phase 2 sampling that will be provided on the tamper proof custody seal. The bottles and tamper proof custody seals shall be accompanied by a chain of custody form provided by the certified laboratory conducting the testing. All sample identification numbers, job titles, and Phase 1 or Phase 2 testing identification from the custody seal shall be recorded on the chain of custody forms by the Infrastructure Field Technician.

- e) All samples shall be collected in compliance with the sampling protocols provided by the certified laboratory. The samples shall be kept in a cooler provided by the Contractor at approximately 40-degrees Fahrenheit or 4-degrees Celsius and delivered to the certified lab for testing as soon as possible. The time at which the sample is taken shall be recorded on the chain of custody form by the Infrastructure Field Technician. Any samples processed at the laboratory more than 30 hours following collection shall be declared invalid, i.e. samples shall be submitted to the lab within 24-hours of collecting them.
- f) All first-round samples shall be tested for bacteriological quality and turbidity in accordance with standards established by NCDENR and AWWA. If turbidity exceeds 1.0 NTU, the sample shall fail and the system shall be re-flushed before initiating a new round of testing.
- g) If the phase 1 sample results for bacteriological quality and turbidity are acceptable, then a second set of samples can be collected at least 24-hours following the first sample collection. No additional flushing other than required to obtain a representative sample will be allowed prior to collecting the second set of samples.
- h) The second set of samples shall be tested for bacteriological quality only. All custody seals and chain of custody forms shall identify the second-round samples as "Phase 2" testing to notify the lab that the first set of samples have already been evaluated and received a satisfactory laboratory analysis.
- i) At the completion of sampling, the total chlorine concentration shall be at least 2-mg/L and no higher than 4-mg/L before the system can be made operational.
- j) If test results are unsatisfactory, the Contractor shall immediately re-chlorinate lines and proceed with such measures as are necessary to properly disinfect the lines.
- k) The new water system shall be valved off from the existing system until a satisfactory bacteriological laboratory analysis has been obtained and the Infrastructure Field Technician has authorized the use of the new water system.

5. Marker Ball and Marker Tape Testing

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

6070 REPAIR,REHABILITATION AND ABANDONMENT

- A. Joint leaks of Ductile Iron Pipe shall be repaired by using a bell joint leak repair clamp approved by Cary or otherwise replacing the damaged pipe and reconnecting with a mechanical joint sleeve connection.
- B. Line Breaks or Punctures shall be repaired by a full circle repair clamp as approved by Cary or otherwise replacing the damaged pipe and reconnecting with a mechanical joint sleeve connection.
- C. Line Splits or Blow Outs shall be repaired by replacing the damaged section with ductile iron pipe with a restrained sleeve connection at each end.
- D. Asbestos Cement Pipe to PVC or Ductile Iron Pipe transitions shall use coupling listed on Cary's Approved Products List with different end diameters sized specifically for the pipe materials and pipe outside diameter at each end.
- E. All water main point repairs shall be replaced with DIP in accordance with these Specifications and backfilled with crush and run stone compacted to 95% maximum dry density as specified elsewhere in the Standard Specifications.
- F. Water Service Line Repairs
 - 1. A water service line severed between the water main and the water meter shall be repaired using new type K copper tubing and bronze or "no lead" brass 3 piece compression unions.
 - 2. A corporation stop pulled out of a PVC pipe water main shall have a new service saddle and a new "no lead" brass 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 "no lead" brass corporation stop installed on the water main.
- G. Water Main Abandonment
 - 1. General
 - a) Water distribution pipe abandonment involves removing the pipe and any related appurtenances from service and leaving them in such a manner that no risk is posed to public health and safety. Pipe and appurtenances that are to be removed because they present a conflict with the proposed work shall be drained of all contents, removed and disposed of as part of the excavation process.
 - b) If the pipe or appurtenances to be abandoned are related to water distribution pipe replacement the abandonment shall commence once the replacement

water distribution pipe has been installed, tested, and all water services have been transferred to the new pipe.

- c) The Contractor shall notify the Fire Marshall prior to any fire hydrant abandonment.
- d) The Contractor shall note the exact location of abandoned water distribution pipe, fire hydrants, and valves on the as-built drawings.

2. Abandonment

- a) Water Distribution Pipe Removal: Water distribution pipe specified for removal shall be physically disconnected and the active water distribution pipe capped and thrust restrained. Once separated from the active pipe, the pipe specified for abandonment shall be drained, removed, and disposed of.
- b) Water Distribution Pipe Abandonment: Water distribution pipe specified for abandonment shall be physically disconnected and the active water distribution pipe capped and thrust restrained. Once separated from the active pipe, the pipe specified for abandonment shall be drained and pumped entirely full with cement grout. The cement grout shall have a compressive strength of 500-psi and shall be of an appropriate consistency to completely fill the water distribution pipe.
- c) Gate Valve Assembly Abandonment: The gate valve specified for abandonment shall be completely closed, the valve box removed and disposed of, the resultant void space backfilled with a minimum 500-psi compressive strength, quick setting, non-excavatable flowable fill, and a standard asphalt repair patch installed.
- d) Fire Hydrant Assembly Abandonment: The fire hydrant assembly specified for abandonment shall have the associated gate valve completely closed, the valve box removed and disposed of, the resultant void space backfilled with a minimum 500-psi compressive strength, quick setting, non-excavatable flowable fill, and a standard asphalt repair patch installed. The hydrant shall then be removed, salvaged and returned to the Public Works Department and the existing water main capped and thrust blocked. The void space shall be backfilled with flowable fill and the final 2-ft below ground level backfilled with topsoil and restored.
- e) Blowoff Assembly Abandonment: The blowoff assembly specified for abandonment shall have the associated gate valve completely closed, the blowoff assembly removed and disposed of, the resultant void space backfilled with a minimum 500-psi compressive strength, quick setting, non-excavatable flowable fill, and a standard asphalt repair patch installed.

f) Combination Air Valve Abandonment

- i. Paved Area: The air valve specified for abandonment in a paved area or within 5-ft of a roadway shall have the valve completely closed and the associated manhole ring, cover, and chimney removed and disposed of. The barrel of the manhole shall then be filled with non-excavatable flowable fill from the bottom of the manhole to within 8-inches of the surface of the roadway. The pavement shall be replaced as specified elsewhere in the Contract Documents.
- ii. Unpaved Area: The air valve specified for abandonment in an unpaved area more than 5-ft from a roadway shall have the valve completely closed and the associated manhole ring, cover, and chimney removed and disposed of. The uppermost barrel sections of the manhole shall be removed up to a depth of at least 6-ft from the ground surface. The manhole barrel shall be filled with aggregate base course to within 12-inches of the ground surface. The manhole barrel shall be filled and tamped in 8-inch lifts with aggregate base course and compacted to a minimum of ninety percent (90%) Standard Proctor density. The upper 12-inches shall be filled with screened topsoil and graded uniformly with the surrounding area. The area shall be seeded and mulched as specified elsewhere in the Standards.

H. Water Service Abandonment: Water service laterals shall be completely abandoned, including the corporation stop, by removing the corporation stop at the main after locating the service connection and turning off the water main. An approved repair band shall be used to repair the water main after removal of corporation stop. All service abandonments shall be coordinated with Cary Utilities and Public Works Departments a minimum of 14 days in advance of anticipated removal. A plan for the isolation of the required section of water main shall be approved by Cary prior to work proceeding. Contractor is responsible for any applicable regulatory approvals necessary to perform the water service abandonment and repair the road to regulatory standards, if applicable.

END OF SECTION 6000