



Raleigh Water - Public Utility Design Manual

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**Raleigh
Water**

Serving the people of Garner, Knightdale, Raleigh, Rolesville, Wake Forest, Wendell, and Zebulon areas.

TABLE OF CONTENTS

SECTION 1 GENERAL POLICIES AND REGULATIONS	1
1.1 INTRODUCTION	1
1.2 DEFINITIONS	2
1.3 ABBREVIATIONS	7
1.4 PERMITS AND PROCESSES	11
1.5 GENERAL POLICIES AND REGULATIONS	14
1.6 PROJECT SIZE:	20
1.7 USE OF THE WATER, SEWER, AND REUSE SYSTEMS	24
1.8 OTHER POLICIES	28
1.9 WATER, SEWER, AND REUSE FEES	31
1.10 GENERAL ACCEPTANCE	32
1.11 GENERAL CONSTRUCTION STANDARDS	33
SECTION 2 WATER	39
2.1 WATER DESIGN STANDARDS	39
2.2 WATER DESIGN – PUBLIC	40
2.3 WATER DESIGN – PRIVATE	47
2.4 WATER MATERIAL STANDARDS	47
2.5 WATER CONSTRUCTION STANDARDS (Public Systems)	54
SECTION 3 SEWER	70
3.1 SEWER DESIGN STANDARDS	70
3.2 SEWER DESIGN – PUBLIC	70
3.3 SEWER DESIGN – PRIVATE	99
3.4 SEWER MATERIAL STANDARDS	99
3.5 SEWER CONSTRUCTION STANDARDS	110
SECTION 4 REUSE	130
4.1 REUSE DESIGN STANDARDS	130
4.2 REUSE DESIGN – PUBLIC	131
4.3 REUSE DESIGN – PRIVATE	134
4.4 REUSE MATERIAL STANDARDS	135
4.5 REUSE CONSTRUCTION STANDARDS	143
APPENDIX A: GUIDELINES AND REQUIREMENTS FOR THE CROSS CONNECTION AND HYDRANT METER PROGRAMS	
APPENDIX B: STANDARD DETAILS	
APPENDIX C: CHECKLIST FOR RALEIGH WATER PLANS	
APPENDIX D: PLAN NOTES AND PERMIT BLOCKS	
APPENDIX E: RESERVED FOR FUTURE USE	
APPENDIX F: PERMITTING SCENARIOS	
APPENDIX G: APPROVED PRODUCTS LIST	

SECTION 1

GENERAL POLICIES AND REGULATIONS

1.1 INTRODUCTION

1. The Raleigh City Charter gives the Raleigh City Council (the “City Council”) the authority to create a Department of Public Utilities (also known as Raleigh Water) and further states that Raleigh Water will be self-sustaining through its water and sewer rates and other fees. The City of Raleigh Code of Ordinances (“City Code”) details the requirements, duties, functions, and policies of Raleigh Water and the Merger Communities.
2. Raleigh Water has prepared the Raleigh Water Public Utility Design Manual (“Handbook” or “Public Utilities Handbook”) to establish its procedures, policies, standards, and specifications for connection to, the extension of, and modifications to the City of Raleigh’s (the “City” or “Raleigh”), water, sewer, and reuse systems. The Handbook is adopted by City Council pursuant to City Code Section 8-2016. To the extent of any conflict between the City Code and the Handbook, the City Code prevails.
3. The Town Councils of Garner, Wake Forest, Rolesville, Knightdale, Wendell and Zebulon (the “Merger Communities”) agreed to transfer easement rights and merge their respective utility systems with the City’s water, sewer and reuse utility systems. Raleigh owns and operates the water, wastewater, and reuse systems within each Merger Community. The policies listed in this Handbook apply to all persons making connections, modifications, or extensions of Raleigh’s water, sewer, or reuse utility systems regardless of location.
4. This Handbook is designed to facilitate the understanding by property owners, developers, engineers, and contractors, how Raleigh Water does business inside the City limits, in the Merger Communities, and in the City’s and Merger Communities’ extraterritorial jurisdictions.

The organization of this material falls into four primary areas: General Policies and Regulations, Water, Sewer, and Reuse. The Water, Sewer, and Reuse sections will each cover the respective design, materials, construction, and standard details for that utility system. Appendices are attached with additional reference information. The appendices include:

Appendix A: Guidelines and Requirements for the Cross Connection and Hydrant Meter Programs

Appendix B: Standard Details

Appendix C: Checklist for Raleigh Water Plans

Appendix D: Plan Notes and Permit Blocks

Appendix E: RESERVED – NOT IN USE

Appendix F: Permitting Scenarios

Appendix G: Approved Products List

5. Much of the information covered in this Handbook has been adopted from other sources such as State and National Standards and Regulations, “good engineering practice”, and the experience of the staff of Raleigh Water. The standards, policies, and specifications indicated in the Handbook shall be considered final, and exceptions may only be granted by the Raleigh Water Director or their designee upon written request prior to construction.

1.2 DEFINITIONS

Throughout this Handbook, the following terms shall have the meanings indicated below:

Adjacent lot: That parcel of land that shares a common boundary and/or a common right of way with an existing lot seeking sewer service and lies upstream of the existing lot.

Air-gap: An unobstructed vertical distance through the free atmosphere between the lowest opening from any pipe or faucet supplying water to a tank, plumbing fixture, or any other device and the flood level rim of the receptacle. The vertical separation shall be at least the diameter of the supply pipe or fixture opening, but in no case shall the air-gap be less than one (1) inch.

Atmospheric vacuum breaker: A device designed to allow air to enter the downstream water line to prevent backsiphonage as described in AWWA Recommended Practice for Backflow Prevention and Cross-Connection Control Manual M-14.

Auxiliary intake: Any piping connection or other device whereby water may be secured from a source other than the public water supply.

Backflow: Any flow of water into the public water supply from any other source due to a cross-connection, auxiliary intake, interconnection, backpressure, backsiphonage, any combination thereof, or other cause.

Backflow Assembly: A certified assembly or method used to control backflow from occurring in the potable water supply. The type of assembly required shall be based on degree of hazard, existing or potential. An assembly is testable in a line to its utilization and is unaltered from the manufacturer's configuration.

Backpressure: Any pressure on any source of water other than the public water supply which may be greater than the pressure on the public water supply and may result in a backflow.

Backsiphonage: As described in AWWA Recommended Practices for Backflow Prevention and Cross-Connection Control Manual M-14, any circumstance in which the pressure on the public water supply may be reduced to the point that the elevation and atmospheric pressure on a source of water other than the public water supply may result in a pressure to be greater than the pressure on the public water supply and may result in a backflow.

Certified: A written approval by the Raleigh Water Director or their designee that a device or methodology is acceptable for use within the City of Raleigh Utility System.

Certified tester: A person who has proven their competency to test, repair, overhaul and make reports on backflow prevention assemblies as evidenced by certification of successful completion of a training program approved by the Raleigh Water Director or their designee.

Confinement assembly or device: A certified backflow prevention device installed within a private plumbing or distribution system to isolate a localized hazard from the remainder of said system.

Containment assembly: A certified backflow prevention assembly installed at the point of separation between the public water supply and a private service or private distribution system or at the point of metering.

Critical Mains: Water and sewer mains that are critical to the continued safety of the system in Raleigh and the Merger Communities. Critical infrastructure is defined as follows:

City of Raleigh Service Area:

- Sixteen (16) inches or larger water main
- Four (4) inches or larger sewer force main
- Fifteen (15) inches or larger gravity sewer main

Merger Communities' Service Area:

- Eight (8) inches or larger water main
- Four (4) inches or larger sewer force main
- Sixteen (16) inches or larger gravity sewer main

Cross-connection: Any physical connection whereby the public water supply is connected with any other water supply system, whether public or private, either inside or outside of any building or buildings, in such a manner that a flow of water into the public water supply is possible either through the manipulation of valves or because of ineffective check or back-pressure valves, or because of any other arrangement.

Cross connection control coordinator: The official position established and authorized by the City and designated by the Raleigh Water Director or their designee to administer and interpret the cross-connection section of these specifications and who shall also be a certified tester.

Dedicators: The person(s) owning or constructing any private utility system being dedicated to the city.

Developer: A person who makes an application to the City for the City's approval of a site plan or subdivision.

Development: Any person caused change to improved or unimproved real estate including, but not limited to, constructing or changing any building or other structure, clearing, grading, mining, dredging, filling, paving, excavation, drilling operations (except to obtain soil sample) or depositing any waste. Development also means any site plan or subdivision of land.

Double check valve backflow prevention assembly: A certified assembly composed of two (2) single, spring-loaded independently operating check valves, including tightly closing shut-off valves located at each end of the assembly, and having suitable connections for testing the water tightness of each check valve.

Dual check valve: A certified device containing two (2) independently acting check valves in series.

Dwelling Unit: A building or portion of a building providing complete and permanent living facilities, including cooking and bathing facilities.

Existing Lot: Any lot that has been recorded in the register of deeds of the county in which the land resides prior to the application for connection to City utilities.

Fire line: A system of pipes and equipment used to supply water in an emergency for extinguishing fire.

Food Service Establishment (FSE): Any commercial or industrial facility where food or food products are processed, prepared, cooked, or served. Also includes any facility that washes cookware or utensils used in the preparation, cooking, or serving of food. Examples include

restaurants, cafes, cafeterias, snack bars, grills, delis, catering services, bakeries, grocery stores, butcher shops, schools, childcare centers, churches, hospitals, or similar establishments,

Indirect discharge or discharge: The discharge or the introduction from any non-domestic source regulated under §307(b), (c), or (d) of the Act (33 U.S.C. 1317), into the POTW (including holding tank waste discharged into the system).

Interconnection: Any system of piping or other arrangement whereby the public water supply is connected directly with a sewer, drain, conduit, pool, heat exchanger, storage reservoir, or other device which does or may contain sewage or other waste or substance which would be capable of imparting contamination to the public water supply.

Interference: The inhibition or disruption of the POTW collection system, treatment processes, operations, or its sludge process, use, or disposal, which causes or contributes to a violation of any requirement of the *Control Authority's* (and/or the POTW's if different from the *Control Authority's*) NPDES or non-discharge permit or prevents sewage sludge use or disposal in compliance with specified applicable state and Federal statutes, regulations or permits. The term includes prevention of sewage sludge use or disposal by the POTW in accordance with §405 of the Act (33 U.S.C. 1345) or any criteria, guidelines, or regulations developed pursuant to the Solid Waste Disposal Act (SWDA) (42 U.S.C. 6901, *et seq.*), the Clean Air Act, the Toxic Substances Control Act, the Marine Protection Research and Sanctuary Act (MPRSA) or more stringent state criteria (including those contained in any state sludge management plan prepared pursuant to Title IV of SWDA) applicable to the method of disposal or use employed by the POTW.

Major Utility Mains: Those water, reuse water, and/or sewer lines which are twelve (12) inches in diameter or greater.

Minor Utility Mains: Minor utility mains shall mean water, reuse water, and/or sewer lines which are less than twelve (12) inches in diameter.

New Construction: Structures for which the “start of construction” commenced on or after the effective date of this handbook and includes any subsequent improvements to such structures, including demo and rebuilds.

Person: Any individual, partnership, co-partnership, firm, company, corporation, association, joint stock company, trust, estate, governmental entity or any other legal entity, or their legal representatives, agents or assigns. This definition includes all Federal, state, and local government entities.

Publicly Owned Treatment Works (POTW) or municipal wastewater system: A treatment works as defined by §212 of the Act (33 U.S.C. 1292) which is owned in this instance by the City. This definition includes any devices or systems used in the collection, storage, treatment, recycling, and reclamation of municipal sewage or industrial wastes of a liquid nature. It also includes sewers, pipes, and other conveyances only if they convey wastewater to the POTW treatment plant. For the purposes of this Handbook, POTW shall also include any sewers that convey waste waters to the POTW from persons outside the City who are, by contract or agreement with the City, or in any other way, users of the City's POTW.

Pressure vacuum breaker: A certified assembly containing an independently operating spring-loaded check valve and an independently operating loaded air inlet valve located on the discharge side of the check valve. The assembly must be equipped with suitable connections for testing the

proper operation of the device and tightly closing shut-off valves located at each end of the assembly.

Pre-treatment: The reduction of pollutants, the elimination of pollutants, or the alteration of the nature of pollutant properties in wastewater prior to or in lieu of discharging or otherwise introducing such pollution into a POTW. The reduction or alteration can be obtained by physical, chemical or biological processes, or process changes or other means, except by diluting the concentration of the pollutants unless allowed by an applicable pretreatment standard.

Public water supply or system: The water and waterworks system of the City, and its customers outside the corporate limits, for general use and which supply is recognized as the public water supply by the North Carolina Department of Environmental Quality.

Raleigh Director of Public Utilities or Raleigh Water Director: The person designated by the City to supervise the operation of the City's publicly-owned treatment works and who is charged with certain duties and responsibilities by the Charter and the City Code, or their duly authorized representative.

Raleigh Water: The Department in the City responsible for the permitting, maintenance, and expansion of the water and sewer system and its infrastructure and assets in the City of Raleigh and the Merger Communities. Raleigh Water and City can be used interchangeably for the purpose of this document.

Reduced pressure principal zone backflow prevention assembly (RPZ): A certified assembly containing within its structure two (2) spring loaded independently operating check valves, together with an automatically operating pressure differential relief valve located between the two (2) check valves. The first check valve reduces the supply pressure a predetermined amount so that during normal flow and at cessation of normal flow the pressure between the checks shall be less than the supply pressure. In case of leakage of either check valve, the differential relief valve, by discharging to the atmosphere, shall operate to maintain the pressure between the check valves less than the supply pressure. This assembly shall have suitable connections for testing the proper operation of the assembly, including tightly closing shut-off valves located at each end of the assembly.

Reuse water: Wastewater that has been treated to water quality standards as defined by the applicable section of the North Carolina Administrative Code and is intended to be distributed for non-potable uses such as irrigation and/or industrial processes.

Reuse water service stubs: Those portions of the reuse water service pipes that connect to the City's reuse water mains and extend to the boundaries of public easements and rights-of-way.

Right-of Way (ROW) :An interest in land to the City which provides for the perpetual right and privilege of the City, its agents, franchise holders, successors, and assigns to construct, install, improve, reconstruct, remove, replace, inspect, repair, maintain and use a public street, including related and customary uses of street rights-of-way such as sidewalks, bike paths, landscaping, mass transit facilities, traffic control devices signage, sanitary sewer, storm water drainage, water supply, cable vision, electric power, gas and telephone transmission and related purposes in, upon, over, below, and across the rights of way. The City is authorized to remove, and keep removed from the Rights-of-way all trees, vegetation, and other obstructions as is determined to be necessary by the City to maintain, repair, and protect facilities located in the Right-of-way.

Sewer Interceptor/Outfall: Gravity sewer mains equal to or larger than fifteen (15) inches in diameter.

Stormwater: Any flow occurring during or following any form of natural precipitation and resulting therefrom.

Stub Only Install Permit: Stub Only Install permits are required for all new physical connections to a water, sewer, or reuse main that are installed by a licensed utility contractor.

Stub Only Removal Permit: Stub Only Removal permits are required for the removal of the service line in accordance with Raleigh Utility standards.

Structure: Anything constructed, installed, or portable, the use of which requires a location on a parcel of land. This includes a fixed or movable building which can be used for residential, recreational, business, commercial, agricultural, institutional or office purposes, either temporarily or permanently. Structure also includes, but is not limited to fences, decks, garages, swimming pools, hot tubs, children's play sets, barbeque pits, tennis courts, signs, walls, heating, ventilation and air conditioning units, storage tanks, sheds, docks, mooring areas, and other accessory construction.

Tap size: The nominal diameter of the connection of a water service, sewer service, or reuse line installed between a meter assembly and main connected to the water or reuse utility system of Raleigh, without regard to the configuration of that water or reuse assembly, or ownership of the water or reuse meter assembly, service, or water or reuse main.

Utility Connection Permit: Required for all new connections or changes in service size or type. This permit establishes the basis for new or modified water, sewer, and/or reuse services to a parcel.

Utility system, Utility mains: Water mains, reuse water mains, and sewer mains (individually or collectively as determined by the context), and shall include all pipes, valves, valve boxes, hydrants, water service stubs, sewer service stubs, reuse service stubs, cleanouts, meters and other appurtenant fixtures, equipment, and apparatus connected to and forming a part of the main water, reuse water, or sewer main, pipelines and/or systems, and all appliances necessary and convenient thereto. The utility lines dedicated to the City as public shall include only main transmission and distribution pipes, valves, hydrants and other apparatus, fixtures and equipment forming a part of the lines laid in public streets, roads, highways and alleys or across City utility or sanitary sewer easements on private property, and shall not include services leading from water meter or first sewer cleanout at right-of-way or easement to building connections on private property and shall not include the water, reuse water, or sewer lines within any residences or other privately-owned building or structure.

Vehicle Maintenance Facility (VMF): Any commercial or industrial facility where automobiles, trucks, or equipment are serviced or maintained, including garages, service stations, repair shops, oil and lubrication shops, or similar establishments.

Wastewater: Also referred to as Sewer. The liquid and water-carried industrial or domestic wastes from dwellings, commercial buildings, industrial facilities, mobile sources, treatment facilities and institutions, together with any groundwater, surface water, and stormwater that may be present, whether treated or untreated, which are contributed into or permitted to enter the POTW.

Water service stubs, sewer service stubs, and reuse water service stubs: Those portions of the water service, building sewer, and reuse water pipes which connect to the City's water, sewer, or reuse water mains and extend to the boundaries of public easements and rights-of-way with private property.

1.3 ABBREVIATIONS

Throughout this Handbook, the following abbreviations shall have the meanings indicated below:

AASHTO: American Association of State Highway and Transportation Officials

AC: Alternate Current

ADA: Americans with Disabilities Act

ANSI: American National Standards Institute

ASTM: American Society for Testing Materials

ATS: Automatic Transfer Switch

AWG: American Wire Gauge

AWWA: American Water Works Association

BFP: Back Flow Preventer

CAD: Computer-Aided Design

CCF: Centum Cubic Feet

CCFRPM: Centrifugally Cast Fiberglass Reinforced Polymer Mortar

CCW: Counterclockwise

CD: Compact Disc

CH: Clayey Soil with High Liquid Limit

CI: Cast Iron

CIPP: Cured in Place Pipe Lining

CO: Certificate of Occupancy

CSA: Calcium Sulfoaluminate Cement

CW: Clockwise

DC: Direct Current

DFT: Dry Film Thickness

DI: Ductile Iron

DIP: Ductile Iron Pipe

DIPRA: Ductile Iron Pipe Research Association

DR: Dimension Ratio

EST: Eastern Standard Time

ETJ: Extraterritorial Jurisdiction

F: Fahrenheit

FDC: Fire Department Connection

FEMA: Federal Emergency Management Agency

FM: Force Main

FOG: Fats Oils and Grease

fps: Feet per Second

FSE: Food Service Establishments

ft: feet

gal: gallon

gpapd: Gallons per Acre per Day

gcpd: Gallons per Capita per Day

GPD: Gallons per Day

GPM: Gallons per Minute

HDPE: High Density Polyethylene

HMI: Human Machine Interface

HQW: High Quality Water

HTH: High Test Hypo-chlorite

IEC: international Electrotechnical Commission

lbs.: pounds

MJ: Megajoule

mm: millimeter

MPRSA: Marine Protection Research and Sanctuary Act

MUTCD: Manual of Uniform Traffic Control Devices

N.C.P.E.: North Carolina Professional Engineer

N/A: Not Applicable

NBR: Nitrile Butadiene Rubber

NC: North Carolina

NCAC: North Carolina Administrative Code

NCDENR: North Carolina Department of Environment and Natural Resources

NCDEQ: North Carolina Department of Environmental Quality

NCDOT: North Carolina Department of Transportation

NCGS: North Carolina General Statutes

NEC: National Electric Code

NEMA: National Electrical Manufacturers Association

NPDES: National Pollutant Discharge Elimination System

NPSH: Net Positive Suction Head

NTU: Nephelometric Turbidity Units

O&M: Operation and Maintenance

O/L: Overload

OD: Outer Diameter

ORW: Outstanding Resource Waters

OSHA: Occupational Safety and Health Administration

p.m.: Post meridiem

PACP: Pipeline Assessment Certification Program

PE: Professional Engineer

PEX: Cross-linked polyethylene

POTW: Publicly owned treatment works

ppm: Parts per Million

psi: Pounds per Square Inch

PSM: The term PSM is not an abbreviation but rather an arbitrary designation for a product having certain dimensions.

PVC: Polyvinyl Chloride

RCP: Reinforced Concrete Pipe

ROM: Read Only Memory

ROW: Right of Way

RP: Reduced Pressure

RPZ: Reduced Pressure Zone Backflow Prevention Assembly

RR: Railroad

RTU: Remote Terminal Unit

RW: Raleigh Water

SCADA: Supervisory Control and Data Acquisition

SDR: Standard Dimension Ratio

§: Section, usually in reference to legal code

SOA: Sewer Only Account

SWDA: Soil Waste Disposal Act

T.V.: Television

U.S.C.: United States Code

UDO: Unified Development Ordinance

UL: Underwriters Laboratories

US: United States

USA: United States of America

UV: Ultraviolet

VAC: Volts Alternating Current

VCP: Vitrified Clay Pipe

W/S: Water/Sewer

1.4 PERMITS AND PROCESSES

1. Raleigh Water staff shall review and approve all aspects of proposed connections, modifications, and extensions to the water, wastewater, and reuse systems. This section outlines the various permits that are issued by Raleigh, when such permits are typically required, and the review processes through which these permits are issued. The names and timelines for these review processes vary among the City and each Merger Community, but the required permits and level of detail needed from the applicant remains the same. Other permits issued by other City departments or external agencies may be required. It is the responsibility of the applicant to determine permits which may be necessary and secure them.
2. Utility Connection Permits
 - A. Required for all new connections or changes in service size or type. This permit establishes the basis for new or modified water, sewer, and/or reuse account and services to a parcel. For water and reuse this permit sets up the meter.
 - B. This permit is generally issued as a standalone permit, or in association with a stub, plumbing utility, or building permit.
 - C. The Development Review website for Raleigh Water describes the methods of application for Utility Connection Permits.
3. Stub Permits
 - A. Stub Only Install permits are required for all new physical connections to a water, sewer, or reuse main that are installed by a licensed utility contractor.
 - B. Stub Only Removal permits are required for the removal of the service line in accordance with Raleigh Utility standards.
 - C. This permit is generally issued as a standalone permit, or in association with a utility connection, plumbing utility, or building permit. In developments requiring infrastructure construction drawing approval, this permit can be issued prior to building permit approval with the site infrastructure construction drawings, Site Permitting Review, or Administrative Site Review.
 - D. The Development Review website for Raleigh Water describes the methods of application for Stub Permits.
 - E. City-installed water and sewer stubs (taps) may be requested at time of permit application for any existing single-family residential structure seeking to abandon well and/or septic due to a failure. Existing single-family residential may also request an irrigation stub (tap) be installed by the City. Restrictions on City-installed water and sewer taps are provided in Section 1, paragraph 1.9.2.D of this Handbook. Sufficient lead-time (minimum six (6) weeks) should be provided for all new City-installed service taps and all fees must be paid in full prior to the work order being authorized.
4. Water, Sewer, and Reuse Main Extension Permits
 - A. Raleigh has received delegated authority from the State of North Carolina to issue permits for water, sewer, and reuse main extensions. Permits are required for all extensions, replacements, re-alignments, upgrades, or modifications of the system. This includes any

replacement changing the location, diameter, or material for water and reuse – but excludes any replacement which maintains the same alignment and grade for sewer.

- B. These permits are generally issued as part of the infrastructure construction drawing approval process.
- C. In Raleigh, this permit is applied for through the Raleigh permitting office. In the Merger Communities, these plans are submitted for review through the Merger Community and routed to Raleigh Water staff for review and permit issuance.

5. Industrial Pretreatment Permits

- A. For projects discharging large volumes of wastewater or wastewater with characteristics which could impair the downstream sewer system, Industrial pretreatment permits may be required.
- B. These permits are typically issued in conjunction with building permits and utility connection permits but may be applied for earlier as a standalone review.
- C. For both Raleigh and Merger Communities, application for industrial pretreatment approval can be made by contacting the industrial pretreatment program directly.

6. Cross Connection Approval

- A. Cross connection or Backflow Prevention is required for all new connections to the water system with the exception of non-irrigated single-family residential connections where no well (or a properly abandoned well) is present on the property.
- B. Backflow devices and assemblies are issued plumbing permits; however, in accordance with Chapter 15A NCAC 18C .0406 (b) these devices are reviewed by Raleigh Water to ensure protection of the public water system.
- C. Raleigh Water review of the backflow prevention is generally at building permit application but is also reviewed during site plan and infrastructure construction drawing for projects requiring these submittals. Certified backflow assemblies must be located within fifty (50) linear piping feet from the water meter.
- D. In Raleigh, plumbing permits for backflow assemblies are applied for at the Raleigh permitting office. In the Merger Communities, this permit is applied for via the permitting and inspections department of the Merger Community.

7. Fats, Oils, and Grease (FOG) Approvals

- A. FOG approval is required for all new or modified food service establishments and vehicle maintenance facilities per NC Plumbing Code Chapter 10 – Section 1003.1.
- B. The Raleigh Water review of FOG pretreatment systems is generally triggered at building permit application but is also reviewed during site plan and infrastructure construction drawing for projects requiring these submittals.
- C. The Fats, Oils, and Grease Program Manager is responsible for review and approval of all proposed pretreatment systems. Submittals must be made via electronic mail to include the following:

- 1) Business name of the proposed establishment.
 - 2) Physical location of the proposed establishment.
 - 3) PDF copy of plumbing plans that include a plumbing fixture schedule and details showing installed fixtures connecting to the building grease waste line along with the planned location of the proposed grease interceptor.
 - 4) Completed sizing calculation spreadsheet.
- D. The minimum sizing of a FOG pretreatment system shall be one thousand (1,000) gallons unless otherwise approved by the Fats, Oils, and Grease Program Manager.
- E. For projects requiring new or modified FOG pretreatment systems, pre-approval of the device is required through the pretreatment program. The FOG approval letter must be digitally affixed to the plans at time of building permit submittal.
- F. In Raleigh, plumbing permits for FOG approvals are applied for through the Raleigh permitting office. In the Merger Communities, this permit is applied for via the permitting and inspections department of the Merger Community. Applications and process can be found on the Raleigh Website.
- G. For projects requiring new or modified FOG pretreatment systems, pre-approval of the device is required through the pretreatment program. Applications and process can be found on the Raleigh Water website. The FOG approval letter must be digitally affixed to the plans at time of building permit submittal.
8. In Raleigh, plumbing permits for FOG approvals are applied for through the Raleigh permitting office. In the Merger Communities, this permit is applied for via the permitting and inspections department of the Merger Community. Applications and process can be found on the Raleigh Water Website
9. Water and Sewer Easement Encroachments
- A. Encroachments are required for any structure (building, retaining wall, fence, storm water piping, etc.) that is existing or proposed to be built within an existing or proposed easement belonging to the City.
- B. The timing for these encroachments varies based on the nature of the encroachment. Application for encroachment review can be made at any time and can be requested by staff as part of other review processes.
- C. Encroachment Applications can be made on the Raleigh Website. Questions can be emailed to Public Utilities Code Enforcement.
10. Water Sewer or Reuse Main/Easement Abandonment and Relocation Policy
- A. Encroachments in easements are discouraged. In cases where they are necessary and technically feasible in accordance with Raleigh Water design standards, Raleigh Water will consider requests for relocation of water, sewer, or reuse mains and easements proposed as a remedial action to resolve conflicts such as encroachment of buildings, houses, and other such permanent structures. The property owner shall demonstrate, with concurrence of City staff, that any utility easement to be abandoned no longer serves the public interest. All easement relocations require approval by the City Manager's office after the proposed easement is recorded and any associated infrastructure in the easement is relocated to the new easement alignment. The total cost of relocation of sewer mains and dedication of new easements shall be at the expense of the property owner, including engineering cost, survey cost, recordation of maps, surplus property procedure, etc.

11. Permits from Other Agencies

- A. It is the sole responsibility of the applicant to identify, apply for, and secure approval for any additional permits necessary to facilitate connection to water and sewer. These may include, but are not limited to:
 - 1) Land Disturbance permits;
 - 2) Stormwater permits;
 - 3) Flood permits;
 - 4) Plumbing permits;
 - 5) Right of way permits;
 - 6) Irrigation well permits;
 - 7) Fire permits;
 - 8) Urban forestry permits;
 - 9) Blasting permits;
 - 10) NCDEQ Neuse River Buffer permits;
 - 11) US Army Corps of Engineers Wetland permits;
 - 12) NCDOT or Railroad Encroachments; and
 - 13) Utility Commission Approval

12. Typical Processes

- A. Additional information regarding processes that are typical for different types of development projects and which water, sewer, and reuse permitting steps are required for each of those types of projects is available on the Raleigh Water website.

1.5 GENERAL POLICIES AND REGULATIONS

- 1. The City controls and schedules the availability of the City's water, sewer, and reuse services. Applications for permanent water, sewer, and reuse service connections in Raleigh are available through the Raleigh process. Application for service in the Merger Communities should be made through the appropriate municipalities process. Sufficient lead-time (6 weeks) should be provided for all new City-installed service taps and all fees must be paid in full prior to the work order being authorized.
- 2. Extension and Connection Policy
 - A. Water and reuse service shall be provided on an as-available basis to the customer's meter. All customers shall hold the City not responsible from any and all claims, damages, liabilities, or expenses caused in whole or in part by pressure conditions, water quality variation, or interruptions in service. The customer shall be responsible for installation of booster pumps to increase pressure when necessary.
 - B. All water, sewer, and reuse main extensions and service connections to the City's water, sewer, and reuse systems must be approved by Raleigh Water prior to construction. All water and sewer main extensions outside the corporate limits must also be approved by the City Council either as part of the development approval process, or as an individual City Council approval for projects not part of the development process.
 - C. Property owners of parcels within the Raleigh city limits that were annexed by a City-initiated annexation may request the City extend water and sewer service to the property in

accordance with City Code sections 8-2031 through 8-2039. These extensions may be subject to assessments and fees for City-installed taps in addition to normal connection fees.

D. Developments

- 1) Extension of and connection to water and sewer and reuse facilities are required for all new developments in accordance with Chapter 8 Article 8.7 of the Raleigh UDO. Development is defined in the UDO.
- 2) All standard size mains and services for new developments shall be installed by the developers at no cost to the City. Outside the City limits and not one of the Merger Communities, the developer must have the City Council approval to extend the utility lines to the development, and this extension will be done at no cost to the City.
- 3) If the development is outside the corporate limits of the City or Merger Community and water, sewer, and/or reuse mains are available, or will be available within twelve months after recording the plat, the developer shall connect to the City's utility system.
- 4) For developments outside the corporate limits, but inside the extraterritorial jurisdiction, the extensions of utilities beyond the corporate limits must be in accordance with the utility extension and connection requirements outlined in the UDO and City Code Section 8-2063(b).
- 5) Both scenarios are permitted through the standard development plans review process and do not require separate City Council approval.
- 6) Any utility lines less than twelve (12) inches in size will be paid for by the developer and are not reimbursable.
- 7) It will be the developer's responsibility to acquire any necessary easements for the extensions at the developer's sole cost.
- 8) Offsite utility easements must be recorded by deed (utilizing the City's locked easement forms) prior to construction drawing approval.
- 9) Onsite utility easements may be dedicated on the project final plat. These easements must have functional access to public right of way and be properly recorded.
- 10) Plan and elevation drawings of all access roads shall be shown on the plans prior to approval.
- 11) Water and sewer main extensions outside the Corporate Limits shall be made in accordance with City Code Section 8-2063(b).
- 12) If a lot cannot be served as provided in 8-2063(b) or utility extensions and connections are not required per the chart in Appendix F, wells and/or septic tanks may be installed only if authorized by the Wake County Department of Environmental Services.

E. Non-Development Connections

- 1) Property owners of parcels within the corporate limits of the City or Merger Community that were annexed through an annexation petition or property owners of parcels outside the city limits do not qualify for public extensions of the water and sewer system. At their own cost, owners of these parcels may choose to connect to utilities, if available, or extend utilities to the parcel and connect if they are unavailable.
- 2) When one utility connection is requested for non-development applications not associated with a past development project, the City will require connection to both utilities if they are available immediately adjacent to the property, and a well and septic permit is not issued by Wake County.

- 3) When one utility connection is requested for non-development applications not associated with a past development project, the City will require connection to water at a minimum, if utilities are available immediately adjacent to the property. A septic permit must be issued by Wake County.
- 4) Water only connections are allowed where sewer is not immediately adjacent to the property or for non-wastewater generating uses.
- 5) Sewer only connections are prohibited except as described in the “Sewer Only Policy” below.
- 6) All water, sewer, and reuse services in public rights-of-way must be installed by the City, or by a licensed utility contractor.
- 7) Sewer services in easements must either be installed by licensed utility contractors or licensed plumbers.
- 8) All water, sewer, and reuse services in new developments are the responsibility of the developer. To qualify for service, the property must abut a public water main, sewer main, and/or reuse main.
- 9) All potable and reuse water services will be metered, and the meter will be located at the right-of-way or in a two (2) foot dedicated utility placement easement adjacent to the right-of-way.
- 10) All sewer services must have a clean-out located at the right-of-way or easement line.

3. Sewer Only Policy

A. Sewer Only Account Prohibitions and Exceptions

- 1) Sewer Only Accounts (SOAs) are prohibited for all new development, including existing lots where no building or structure exists. SOAs are prohibited for all non-development connections, with the following exceptions:
 - a) Existing buildings served by a failing septic system, where water is not located immediately adjacent to the property.
 - b) Properties with pre-existing assessments or other agreements with the City allowing access to sewer where water is not located immediately adjacent to the property.
 - c) Where a water main is located across the frontage of the property, a property with a failing septic system must also connect to the City’s water supply system.

B. Process for Sewer Only Account Application

- 1) The person seeking sewer service must file an application for service with the Raleigh Water Director or their designee. The application must be in writing, signed under seal by the applicant, and include a showing of necessity for service.
- 2) If the application is approved, the property owner must enter into a written contract for sewer only service in the form and manner required by the City. The contract will be written to survive termination of the SOA to the extent stated within the contract.
- 3) To show “necessity of service”, the applicant must provide a certification from Wake County, or other acceptable information, that the property is in need of sewer service due to a failure of the septic system, or other onsite system, and that the property owner has complied with the public health laws in the treatment and disposal of sewage since the system failed.
- 4) The applicant must provide an engineering report, signed and sealed by a NC licensed professional engineer, and Soil Scientist, depending on the scenario, stating that no

alternative means of treatment is available for the property, including systems eligible for coverage by NPDES General Permit No. NCG550000. The engineering report must consider a system that reduces and removes total nitrogen when the property is located in a water supply watershed.

- 5) The applicant must pay all associated fees from the City, within twelve (12) months of water service located across the frontage of the property, at the property owner's expense.
- 6) The applicant must either vacate the premises or to provide lawful disposal of sewage if the City stops accepting sewage flow from the property for failure of the property owner to stay current in payments for sewer service; and
- 7) The applicant must provide notice of these restrictions to any prospective purchaser, or purchaser, of the terms of the contract with the City for sewer service, including that the contract is not transferrable, and the new owner must separately qualify for service.
- 8) The applicant must pay a deposit, in the form of three (3) years of service charges at the prevailing rate as adopted by City Council, to be refunded upon termination of the account except as the deposit is used to offset any outstanding balance at the time of termination.
- 9) The applicant must pay all applicable fees and the deposit due at the time of permit issuance.

4. Submetering Policy

- A. Sub-metering for purposes of reselling water is not allowed, except as approved by the North Carolina Utilities Commission (NCUC).

5. Assessable Projects Policy

- A. Utility main extensions inside the corporate limits and constructed by the City, or by the City's contractor, will be made by assessment to the property owners who benefit from the improvements in accordance with City Code Sections 8-2031 to 8-2039.
- B. A fee in lieu of assessment will be made when the water, sewer, and/or reuse mains are located outside the corporate limits and were paid for by the City – these charges will be due when the property owner(s) request annexation into the City.

6. Private Utility System Acquisition Policy

- A. Any existing private utility system desiring to make connection to the Raleigh Water system will submit a letter of request to the Raleigh Water Director or their designee and the owner must make a written application to the City Council for permission to make such connections. The application must be accompanied with a map made by a professional engineer or registered land surveyor and sealed plats of the property to be served. Additionally, construction plans shall be accompanied by any necessary federal, state, county and city permits or applications for permits. City Code Section 8-2074.
- B. The plans, maps, and other documents for water, sewer, and reuse lines will be reviewed by Raleigh Water for a recommendation on whether to approve or disapprove the application. Any water and sewer extension recommendations will be sent to the City Council so a final decision concerning the connection may be made. All water, sewer, and reuse lines providing service to adjoining properties shall be properly dedicated to the City prior to the connection of the system and shall be built to City standards, where applicable. The utility lines dedicated to the City shall include main distribution lines, services from mains to meters, valves, hydrants, and other fixtures to form the system, but will not include service lines

leading from the meter to the building connections, the sewer service lines connecting the building to the City's sewer main, or fire lines.

- C. If any easements or right-of-way contracts are needed for the extension of mains over privately-owned lands, the developer shall acquire these easements at no cost to the City. In this case, all easements shall have functional access to public right of way, be properly recorded using the City's locked easement forms, and Raleigh Water Standard Procedure 602-4 (see Appendix E) shall be followed. Plan and elevation drawings of all access roads shall be shown on the plans prior to approval.
 - D. Once a utility system has been accepted, the City shall have complete control over the mains and connections for the purpose of making inspections and turning the water and/or reuse services on and off.
 - E. In times of emergency when the City needs the water to supply the needs of the citizens inside the corporate limits, the service to outside customers will be discontinued and notice of the cut-off will be provided to these users. The City cannot be held responsible to provide a certain water pressure and to furnish fire protection to those customers along these lines installed outside the corporate limits. (Per City Code Section 8- 2073)
 - F. The following policy shall serve as minimum conditions under which the City shall eventually take responsibility for and accept private community utility lines into the public system:
 - 1) The private community utility lines meet the City's minimum design and construction standards for such a system.
 - 2) The system is supplied by a central temporary source from wells, pumps, and tanks and/or a sewage disposal system.
 - 3) The system owner shall provide for the water, sewer, and/or reuse systems in streets and easements to become part of the City's utility system without any cost to the City.
 - 4) The system owner shall properly abandon the wastewater treatment plant pursuant to applicable laws and regulations at no cost to the City. All lots connecting to the utility system shall bear their share of the utility connection fee, which must be paid as a lump sum.
7. Oversized Main Reimbursement Policy
- A. During the rezoning, development plan, or building permit review process, the Raleigh Water Director or their designee may determine that major mains are required to be oversized to provide for future flows within the basin being developed. Developers may be reimbursed for major utility mains if certain conditions are met. The major mains are those water, sewer, and reuse water lines that are twelve (12) inches and larger in diameter.

- 1) The City's policy is to reimburse the developer for the cost differential between the major mains and a six (6) inch water and eight (8) inch sewer, whether inside or outside the corporate limits.
- 2) In order to qualify for the reimbursement, the developer must have properly prepared plans and profiles for the major mains that will have to be approved by the City.
- 3) Where the reimbursement amount is more than two hundred and fifty thousand dollars (\$250,000), the Developer shall utilize State procurement laws (public bidding).
- 4) Should the developer fail to execute the reimbursement contract within one (1) year of the City's acceptance of the utility improvements, the City shall have no further obligation to reimburse the developer for the cost of the main or interceptor facilities.
- 5) Approval of the reimbursement contract must be granted by the City Manager.
- 6) The reimbursement payments may be a one-time payment if the Raleigh Water Director or their designee determines that there are sufficient funds to meet all outstanding obligations and the immediate request for reimbursement.
- 7) Otherwise, reimbursement shall be in annual installment payments over a period up to ten (10) years beginning on January 1 immediately following the execution of the contract. If more than one (1) contract is outstanding, then the reimbursements will be made based on the order that the contracts were signed. The details of this reimbursement are outlined in Raleigh Water Standard Procedure 700-6 (see Appendix E). Code Section 8-2091.

8. Main Replacement Reimbursement Policy

- A. During the rezoning, development plan, or building permit review process, the Raleigh Water Director or their designee may determine that the increase in sewer discharge associated with a project will exceed the available capacity of downstream sewer mains and that replacement of the existing downstream sewer mains is required or that replacement of existing water mains is necessary to facilitate the potable water demands or fire flow requirements for a project.
 - 1) The City's Urban Redevelopment Main Replacement Reimbursement Program will provide reimbursements to developers who are required by the City to replace existing water and sewer mains in association with development projects pursuant to §8-2096. Reimbursements under this program may be for replacing water and/or sewer mains to provide adequate pipe capacity, and/or when the City requires the replacement of existing water and sewer infrastructure adjacent to a proposed project based on the condition of the existing pipes.
 - 2) The available reimbursement amount, as a percentage of estimated construction cost, will vary based on the age, condition, and available capacity of the existing mains that are being replaced in association with the development project.
 - 3) The highest levels of reimbursement will be provided for projects replacing mains which are old, deteriorated, or over capacity in existing conditions, with the intent of distributing the costs of such projects between developers, the existing customer base, and future developments equitably.
 - 4) The Raleigh Water Director or their designee shall adopt an Urban Redevelopment Main Replacement Reimbursement Policy pursuant to the requirements and standards set forth in City Code Section 8-2096 to implement this program, which shall be approved by the

Council and incorporated into this Code by reference.

B. The developer shall identify the proposed increase in sewer capacity associated with the proposed development project.

- 1) The Raleigh Water Director or their designee will determine if there is enough information readily available to ensure that there is adequate downstream capacity for the proposed project. If the City determines there is adequate downstream sewer capacity based on readily available information, no capacity improvements will be required downstream of the project.
- 2) In the event that not enough information is available, the developer shall be required to provide a sewer capacity study, prepared and sealed by a North Carolina licensed professional engineer, evaluating the downstream sewer capacity. The Raleigh Water Director or their designee may require the study to extend to include major interceptors where there is concern that a large project may exceed the capacity of downstream interceptors.

1.6 PROJECT SIZE:

1. Where adequate sewer capacity is a concern, the City process will vary depending on the size of the development project relative to the adequacy of the downstream sewer. For the purposes of this section a Small Project is considered a project which increases sewer flows less than 1% of the capacity of existing downstream pipe flowing full. A Large Project is a project which increases sewer flows more than 1% of the capacity of the existing downstream pipe flowing full.
2. Allowances will be made for demonstrated current sewer discharge based on historical water billing data from the parcel or parcels being redeveloped.

% Pipe is full after construction of proposed project	Small Project (<1% pipe capacity)	Large Project (>1% of pipe capacity)
<65% Full	- Development may proceed with no improvements.	Development may proceed with no improvements.
>=65% full	- Development may proceed with no improvements.	<ul style="list-style-type: none">- The developer must construct improvements for the project to proceed and may apply for reimbursement.- If the developer's project does not proceed and the main is over 65% full without the proposed development, the City will initiate a Capital Improvement Project to construct the improvements. This project will be prioritized along with other Capital Improvement Projects and will not be scheduled to meet a development timeline.

- A. Raleigh Water Director or their designee may determine that existing mains adjacent to a project require replacement as part of the proposed project due to age or deterioration. Replacement of mains adjacent to a project will only be required when the project will be modifying connections to the existing mains or constructing other improvements, such as street or storm drainage improvements in the right of way or easement containing the water and sewer mains. The City will provide one hundred percent (100%) reimbursement based on the unit prices in City Code Section 8-2096(f) below when replacement of the mains is not needed to accommodate additional sewer capacity or water demands or to address conflicts associated with the project.
 - B. Following the identification by the Raleigh Water Director or their designee of mains requiring replacement, the developer shall provide construction drawings for the proposed improvements through the infrastructure construction plan approval process. Prior to construction drawing approval, the developer shall notify the City that an application for reimbursement will be made for the proposed project. The City will determine the applicable reimbursement value based on the criteria described in this section and the Urban Redevelopment Main Replacement Reimbursement Policy.
 - C. Within one year following completion of the project and acceptance of utility improvements by the City, a reimbursement contract shall be prepared pursuant to City Code Section 8-2095 and submitted to Council for approval, and then executed by the City and developer. No reimbursement contract shall be executed by the City until such time as main trunk or interceptor facilities which serve the major mains are operational. Should the developer fail to execute the reimbursement contract within one year of the City's acceptance of the utility improvements, the City shall have no further obligation to reimburse the developer for the cost of the main or interceptor facilities that the developer constructed.
 - D. The reimbursement amount will be calculated based on the unit costs below and the Urban Redevelopment Main Reimbursement Policy. The City will require that the reimbursement be based on the lowest cost alternative which is feasible for the construction being pursued. If the developer chooses to pursue a higher cost construction method or alignment, the City will reimburse based on the lower cost alternative. (i.e. the developer may choose a more expensive alternative to speed schedule). Reimbursement based on unit costs is intended to cover both design and construction. In the event that the developer believes that actual construction cost will significantly exceed the costs below, the developer may request to be reimbursed according to the amounts and procedures established in the Anomaly Process in City Code Section 8-2096(g) below.
3. Policy of the City for participation in the provision of Water and/or Sanitary Sewer Service Extensions Outside the corporate limits (Resolution 2013-837)
- A. In the consideration of requests for City participation in the provision of water and/or sanitary sewer extensions outside the corporate limits ("W/S extension"), the following criteria and requirements shall apply:
 - 1) Generally Applicable Criteria
 - a) The W/S extension is consistent with the City's delineation of its long-range Utility Service Area Plan, and which typically will provide service to more than one parcel.
 - b) If the W/S extension is not in accord with the Utility Service Area Plan, a significant health or environmental condition or concern exists which would be resolved or mitigated by the W/S extension.

- c) The W/S extension will promote the orderly expansion of the City's utility system and realization of cost and engineering efficiencies.
- d) In the case of sanitary sewer service extensions, sewer pump stations will not be allowed or installed, and the integrity of the sewerage basin preserved.
- e) The W/S extension will provide economic benefits to the City and its citizens and serve the interests of the public.
- f) The owner shall exercise maximum good faith efforts to negotiate and successfully acquire from private owners all rights-of-way or easements needed for the W/S extension. Should the owner be unsuccessful in acquiring the needed rights-of-way or easements, the owner shall, through correspondence records or by other means demonstrate to the City that such good faith efforts have been made to acquire needed rights-of-way or easements without the necessity of City participation.

2) Requirements for City W/S Extension Participation

- a) Upon favorable consideration of a request for City participation in a W/S extension, the following requirements shall be incorporated into a Public-Private agreement for Utility Services Extension ("Joint Development Agreement", "Public-Private Agreement", or "Agreement") (which shall represent the mandatory requirements, as additional conditions may be imposed as determined by the City Council) to be entered into between the owner and the City, as follows:
 - i. The owner shall submit to the City a valid petition for the annexation of the property to be served by the W/S extension.
 - ii. The owner shall undertake and be responsible for design of the W/S extension and shall bear all expense of such design work. The owner shall agree to complete all W/S design work within six (6) months from the execution of the Agreement.
 - iii. The owner shall agree to bear all costs of constructing the W/S extension and shall post sufficient security for the full amount of such construction costs.
 - iv. The owner shall agree to bear all costs of acquisition of easements or other property rights ("R/W") necessary for construction of the W/S extension ("R/W costs")
 - v. If the City agrees to undertake the acquisition of needed R/W, then the Public-Private Agreement shall specify a period of time for the City to acquire such right of way, to be no less than six (6) months from the execution of the Agreement.
 - vi. The owner shall, per terms of the Agreement, agree to pay the City for all R/W costs incurred by the City, either by cash reimbursement, or as a credit against the owner's reimbursement entitlement under applicable City policies.
 - vii. A public hearing on all such proposed Public-Private Agreements shall be held, upon ten (10) days published notice.

3) Extensions outside the ETJ (Extraterritorial Jurisdiction)

- a) All utility service connection outside the corporate limits of the City (see City Code Section 8-2063), but in the Service Area shall be subject to the approval of the City Council. After action has been taken by the Raleigh Director of Public Utilities Director or their designee, and recommendations have been made to the Council, the

Council shall consider and act upon the question of approving or disapproving the application, and the action of the Council shall be final.

- i. This applies to all extensions outside the corporate limits of the City, except failing septic systems.
4. The owner shall agree to bear all costs of constructing the Water connection.
5. Pump Station Reimbursement Policy
 - A. The City policy is to utilize gravity flow sewers unless it has been determined to be economically infeasible or physically impossible by the City to provide sewer service without relying on a pump station or multiple pump stations. In situations where the City has offered participation in gravity sewer extension to serve the property, a pump station may not be used. In situations where gravity sewer is not available and a pump station could be put in to just serve a single fee simple property, the City may consider the installation of a privately owned and maintained pump station and force main.
 - B. When pump stations are approved, they shall be appropriately sized and sited to serve future upstream development. Where possible, the pump station shall be sized to serve the full drainage basin, however the City may choose to approve a smaller interim pump station when the size of the basin greatly exceeds initial flows.
 - C. If the City requires that the pump station be sized to serve an area larger than the development, the developer's engineer shall prepare estimates to quantify what, if any, additional cost is incurred due to oversizing of the pump station. These cost estimates will be the basis of a City percentage of participation in pump station costs. If the City approves this reimbursement agreement (see City Code Section 6-5001), the City shall execute a reimbursement agreement at a dollar value of the actual bid, not to exceed twenty-five percent (25%) higher than the calculated City participation based on the engineer's estimate.
 - D. The developer shall bid the pump station, in accordance with all applicable City ordinances and policies and NC laws for expenditure of municipal funds. If the actual costs exceed the thresholds set in the contract, the City shall review the costs and choose whether to allow a smaller pump station or amend the agreement to reflect actual costs.
 - E. Following acceptance of the pump station, the City will provide reimbursement to the developer as stipulated in the agreement.
6. Downstream Sewer Capacity Analysis Policy
 - A. As indicated in the Reimbursement Policy every subdivision plan and site plan creating a new average daily sewer demand of two thousand five hundred (2,500) gpd or more shall be subject to a determination of the sufficiency of infrastructure as defined in section 8.2.1(B) and 8.2.1(C) of the Raleigh Unified Development Ordinance. Building permits exceeding this threshold may also require downstream sewer capacity analysis if not already accounted for through a site or subdivision plan review.
 - 1) The engineer shall provide certification that the proposed project or site shall not create conditions in existing downstream pipes that exceed fifty percent (50%) pipe capacity during periods of peak flow.
 - 2) The limits of the analysis are to be from the project site to the nearest fifteen (15) inches or greater gravity main, and may include analysis of pump stations, as well. The City may determine that the study extend further than the nearest fifteen (15) inch gravity main on a case-by-case basis.

- 3) The developer's engineer shall provide a delineated drainage basin and based on this drainage basin the City will provide aggregated billing data to serve as the basis for existing flows. The City will provide information on pipe sizing and slope if available.
- 4) In areas where the City agrees it is appropriate, the developer's engineer may base the study on paper flows and minimum slopes to simplify calculations.
- 5) If the developer chooses, they may install gravity sewer flow meters to better refine the average daily and peak flow rates. If flow meters are used, they must capture enough wet weather events to establish a peak flow rate.

7. Capacity Allocation and Management Policy

- A. Raleigh Water shall manage the capacity of the water and sewer systems to ensure an adequate potable water supply and sewer capacity. This includes the tracking of available, permitted, and allocated capacity for the City's potable water distribution and sewer collection system.
- B. It shall be the policy of Raleigh Water to allocate sewer service capacity for a development at the time the application for an extension of water or sewer system permit ("Extension Permit") is issued.
- C. Allocated flows will not be considered tributary to the system until a certificate of occupancy (CO) for that development has been issued. When the CO is issued or a water meter is installed for a specific building within or outside the development, the flow will be assumed to be tributary to the water and sewer system.
- D. Existing customers or new developments not requiring an Extension Permit will be allocated capacity after the water and/or sewer service is installed and to the set of the water meter or start of sewer service.
- E. Raleigh Water shall comply with any and all federal and state regulations for reporting and tracking of allocated service capacities and distribution and conveyance required.
- F. The City may rescind any service allocation under the following conditions:
 - 1) The proposed development has not made continual and significant progress within a two (2) year period from date of approved construction drawings. "Continual and significant progress" is defined as the substantial completion of site development work over at least fifty percent (50%) of the permitted tract, coupled with the installation of any streets, utilities, or other infrastructure, within the prescribed period. Such determination shall be made by the Raleigh Water Director or their designee after consultation with staff and providing at least thirty (30) days written notice to the developer and or permit holder.
 - 2) The proposed development has not paid the required fees and obtained building permits for the property or lot within a five (5) year period from date of approved construction drawings, notwithstanding whether or not continual and significant progress has been made in the meantime.
 - 3) The developer and/or permit holder requests in writing that the service allocation be rescinded; or
 - 4) A mutual agreement is reached between the Authority and the developer and/or permit holder.

1.7 USE OF THE WATER, SEWER, AND REUSE SYSTEMS

1. Use of the Water System

A. Unmetered Water

- 1) All water used from the Raleigh Water system must be metered except in the case of fire emergencies.
- 2) Hydrant meters must be obtained from the Meters Division (see contact sheet). Hydrant meters are issued as temporary water service and may be recalled at any time and for any reason by the Raleigh Water Director or their designee.
- 3) Water used from the City's water system without metering is a violation of the City Code. The violator may be subject to a fine of five hundred dollars (\$500.00) per violation plus water usage, a one hundred dollar (\$100.00) tampering fee and even criminal charges.
- 4) See the Construction Standards for Water included in this Handbook and Appendix A: Guidelines and Requirements of the Cross Connection and Hydrant Meter Program.

B. Water Backflow/Cross Connection

- 1) All existing and proposed water services (except for single family dwellings with either no well or a properly abandoned well on the property), dedicated fire and irrigation lines, and private distribution systems must be provided with a certified backflow assembly as determined by the Raleigh Water Director or their designee. For projects having any combination of these lines, suitable certified assemblies must be provided to control each level through containment. Questions concerning Raleigh Water's Backflow/Cross-Connection Program should be directed to the Raleigh Water Cross Connection Coordinator. A list of certified assemblies is provided on the Raleigh Water website.

C. Water System and Reuse System Connections

- 1) In no case shall a connection be made between the potable and reuse water systems.
- 2) Where both reuse and potable water are supplied, a reduced pressure principal assembly shall be installed on the potable water service.
- 3) If it is necessary to use potable water to supplement the reuse system, an approved air gap separation must be provided in addition to the reduced pressure principal assembly to protect the potable water system.
- 4) The air gap shall be at least double the diameter of the supply pipe, measured vertically above the overflow level of the container.

D. Irrigation System Policy

- 1) All new permanent in-ground irrigation systems shall be individually metered.
- 2) The irrigation service line can be directly tapped into the main or split off of the domestic service prior to the meter (see Detail W-35). Either method of connection shall be performed by Raleigh Water or a licensed utility contractor.
- 3) All permanent in-ground irrigation systems shall be equipped with an approved reduced pressure zone principle (RPZ) backflow assembly.
- 4) A functional rainfall sensor shall be installed on all permanent in ground irrigation systems and shall be set at one-quarter (1/4) inch. The rain sensor shall be installed per the manufacturer's recommendation in a location that will allow for proper operation and be at least five (5) feet from a house or building. Specifications for rain sensors can be found in the "Water Materials Standards" section.
- 5) Information on tap fees for either connection method can be obtained by calling the City Inspections Department. See the Water, Sewer and Reuse Fees section below.

E. Fire Pump Flow Metering System

- 1) All commercial and/or industrial facilities required to have an on-site pump system(s) for fire protection shall be equipped with an appropriately sized around the pump flow metering system (UL listed) in order to conserve water. If an existing fire pump system is not equipped with an around the pump flow meter and the fire suppression system is modified, an around the pump flow meter shall be installed in concurrence with the system modification. Raleigh Water reserves the right to require modifications to the approved detail as it deems necessary to comply with individual site conditions.

F. Construction Water and Hydrant Meter Requirements

- 1) Raleigh Water does not provide free or otherwise unmetered construction water for any construction project.
- 2) Contractors are responsible for adequate construction water for their job sites in one of the following approved manners:
 - a) Apply for permanent water service connection at Planning and Development Department. Sufficient lead-time (six (6) weeks) should be provided for all new service taps and all fees must be paid in full prior to the work order being authorized. Service taps for new construction and private development projects are not eligible for City installed taps and must be installed by a licensed utility contractor.
- 3) Apply online with the Raleigh Water Meters Division Office for rental of a hydrant meter. Hydrant meters are issued as temporary water service and may be recalled at any time and for any reason by the Raleigh Water Director or their designee. A deposit is required along with a rental fee per account. Additionally, there will be a charge for the cost of the water used, at the outside City rate. Hydrant meters are read in one hundred (100) centum cubic feet (ccf). Please refer to Appendix A: Guidelines and Requirements for the Cross Connection and Hydrant Meter Program for further details.

2. Use of the Sanitary Sewer System

- A. The use of the sanitary sewer system in the Raleigh Water service area is fully described in the City Code Part 8, Article C. A brief summary of the City Code that is applicable to the sewage treatment system is listed below:
- 1) City Code Section 8-2013 makes it unlawful to destroy or interfere in any way with any part of the sewer system.
 - 2) City Code Section 8-2196 makes it unlawful to deposit any solid or liquid substances directly into any manhole.
 - 3) City Code Section 8-2113 sets a limit on certain amounts of biological and toxic wastes that can be discharged into the sewage system. Failure to comply with any of these can result in civil penalties. These limits are necessary so that the biological treatment process can be maintained at acceptable levels.
 - 4) City Code Section 8-2114 develops a procedure so that persons generating waste over the prescribed limits may pre-treat it, apply to Raleigh Water for permission to regulate the rate of discharge so that it is at an acceptable level, or apply to Raleigh Water for permission to discharge certain wastes, but to pay a surcharge equal to the extra treatment cost.
 - 5) City Code Section 8-2127 outlines the Industrial Pretreatment Program. The City Code details discharges exceeding the defined waste limits must submit an industrial

pretreatment application, in addition to the surcharges. The application must be approved by Raleigh Water prior to connection and discharge into the public sewer system.

- 6) City Code Section 8-2119 states: “All food preparation or serving facilities and all vehicle maintenance facilities connected to the City’s sanitary sewer system shall install, maintain, and keep in continuous operation a grease trap interceptor or oil/ water separator. The interceptor shall be sized in accordance with standards established by the Raleigh Public Utilities Department”. See Details S-40 and S-41. The facilities where grease trap interceptors are located must have records on-site and available for staff review, indicating the history of their grease trap maintenance. Failure to comply with the requirements of this section of the Code, will result in the issuance of a Notice of Violation, Civil Penalty assessment, and, if necessary, temporary or permanent interruption of water, sewer, and/or reuse service from Raleigh Water.

B. Sewage Backflow Policy (New Development and Existing Service)

- 1) N.C. Plumbing Code Section 715.1 requires where the flood level rims of plumbing fixtures are below the elevation of the manhole cover of the next upstream manhole in the public sewer, such fixtures shall be protected by a backwater valve installed in the building drain, branch of the building drain or horizontal branch serving such fixtures. Plumbing fixtures having flood level rims above the elevation of the manhole cover of the next upstream manhole in the public sewer shall not discharge through a backwater valve. City Code section 10-6084 deals with fixtures and drains subject to sewage backflow. This section requires that the all-plumbing traps shall be installed with an elevation at least one (1) foot higher than the elevation of the top of the next manhole upstream from the property connection.

3. Use of the Reuse System

- A. The use of the reuse system in the Raleigh Water service area is fully described in the City Code Part 8, Chapter 2, Article F. Raleigh Water encourages the beneficial use of the State’s water resources concurrent with the protection of public health and the environment. As such, the City encourages the use of reuse water for any approved purpose when economically and technically feasible. Utilization of reuse water for non-potable purposes alleviates demand on our limited potable water resources and helps protect the environment by reducing discharges to our rivers.
- B. Raleigh Water has developed a master plan for a reuse distribution system. Development projects may be required to install reuse distribution systems in accordance with the master plan. Please contact Raleigh Water to determine if reuse water is available to a development site.
- C. Reuse water is not intended for consumption. All North Carolina State requirements for reclaimed water must be met as specified by NCDEQ. Public protection is ensured through State Laws (North Carolina Administrative Code Title 15A, Subchapter 2T or 02U.0100), identification of reuse water through signage and the use of purple-colored piping and equipment, and continuous monitoring of water quality. All buffers and runoff requirements specified in City Code Section 8-2187 must be met for irrigation with reuse water.
- D. Reuse Backflow/Cross Connection
 - 1) The Raleigh Water Director or their designee may require an approved backflow assembly for any existing or proposed reuse services, dedicated irrigation lines, or private distribution systems.

- 2) In no case shall a connection be made between the potable and reuse water systems. Where both reuse and potable water are supplied, a reduced pressure zone assembly shall be installed on the potable water service.
- 3) If it is necessary to use potable water to supplement the reuse system, an approved air gap separation must be provided in addition to the reduced pressure principal assembly to protect the potable water system.
- 4) The air gap shall be at least double the diameter of the supply pipe, measured vertically above the overflow level of the container.
- 5) Questions for Reuse applications must be directed to Resource Recovery. Questions about Backflow devices can be found on the City of Raleigh's website.

E. Schedule Reuse Services

Raleigh Water will control and schedule the delivery of reuse water to residences and businesses based upon being able to maintain an acceptable working pressure and safeguarding public health.

1.8 OTHER POLICIES

1. Requirement of Performance Bond 8.1.3 in UDO

- A. If all utility development-related improvements and installations are not completed and accepted by the City prior to a request to record all or a part of any development or issuance of a building permit for any site plan, whichever first occurs, a security instrument shall be posted, in lieu of completion of the utility work, providing for and securing to the City the actual construction and installation of those utility improvements.
- B. For projects within the City, the developer should follow the process outlined by the Infrastructure Surety Process on the City of Raleigh Website.
- C. Pump Stations are not eligible for bonding prior to plat recordation and/or building permit issuance. If a client does request bonding due to extenuating circumstances outside of the standard process, a variance must be approved by the Public Utilities Director.
- D. For projects within the Merger Communities, the developer should contact the respective Town's planning/development departments and obtain their bonding requirements. Bonding for Water and Sewer Infrastructure can be prepared when the Utilities are in the ground, stone on the road, and the line has been scheduled for CCTV.

2. Flood Damage Prevention Policy

- A. All water, sewer, and reuse system components built within a mapped FEMA 100-year floodplain shall be constructed in accordance with City Code Section 8-2009 as well as Article 9.3 of the City's UDO.

3. Well Policy for Irrigation Systems

- A. There shall be no interconnection between the City's water system and the well installed for irrigation. The separation between the well and domestic shall be accomplished via an airgap.
- B. Irrigation wells will not be permitted where reuse water is available.
- C. See Cross Connection Appendix A or Domestic RP requirements when a well is present on the property.

4. Groundwater Reclamation Well Policy

- A. Groundwater reclamation wells are prohibited from discharging into the City sewer system.

5. Existing Materials Policy

- A. Any existing water, reuse water, or sewer main materials (i.e. fire hydrants, valves, etc.) that are to be relocated or removed during a specific project shall not be reused in the City's utility system.

6. Watershed Protection Policy

- A. Raleigh Water is responsible for the water supply watersheds from which the City takes its supply of water (City Code Section 6.26c). For connections and extensions of water, sewer, and reuse within the three (3) water supply watersheds – Falls Lake, Little River, and Swift Creek. The rules for allowing water and sewer connections within these watersheds are as follows:

1) Falls Lake Primary Watershed Protection Area

- a) In the Falls Lake Primary Watershed Protection Area, no extensions of public utilities are allowed, with the exception of emergency extensions deemed necessary to protect the public health, safety and welfare and to protect Raleigh's drinking water supply.
- b) Public utilities may be extended outside Raleigh's jurisdiction in either the Primary or Secondary Watershed Protection Area when a finding is made by City Council that there is a threat to public health, safety and welfare or to Raleigh's drinking water supply. Such extensions would be considered on a case-by-case basis and would require concurrence from the Wake County Commissioners prior to approval when the land is subject to Wake County development regulations. Properties connecting to these facilities would be expected to bear the full cost of any capital facilities needed to provide the utility services and agree to the operating and maintenance fees normally applied to properties outside the City limits. Emergency service to properties would also be subject to the following:
 - i. Only existing development posing a specific threat to the public health, safety and welfare or to Raleigh's drinking water supply would be allowed to connect to emergency utility extensions.
 - ii. Owners of existing development seeking to connect to emergency utility extensions shall file a petition of annexation to be considered by the City Council on a case-by-case basis.
 - iii. No increase in the density of development will be allowed beyond that already approved by the governing jurisdiction at the time of the provision of the utility service.

2) Falls Lake Secondary Watershed Protection Area

- a) In the Secondary Watershed Protection Area, public utility extensions are allowed only when all of the following conditions are met:
 - i. The capacity of water and sewer facilities is adequate for an extension;
 - ii. An extension is deemed appropriate to promote the orderly provision of public services and facilities in the Raleigh area;
 - iii. There will be no reduction in water quality or degradation of the watershed as a result of public utility extension or the more intense development which may result;

- iv. It is determined that annexation of a proposed development would be in the best interest of the City of Raleigh.
- 3) Little River Watershed
 - a) No extensions of water and/or sewer mains are allowed in both the critical and non-critical areas of the Little River Watershed, except as necessary to protect the public health and safety. Extensions that meet this threshold are also for existing developed properties only.
 - i. The need to protect the public health and safety for the Little River Watershed shall be a determination of the Wake County Environmental Services Director and their determination may be reviewed pursuant to the Wake County Environmental Services Rules of Appeal.
 - b) Extension into or through the Little River Watershed may also be allowed when the NC Department of Environmental Quality (NCDEQ) requests the extension due to environmental contamination of the water and/or sewer service to an existing developed property.
 - c) Any extension that meets the requirements set forth in a) and b) of this section shall also require consent from the City of Raleigh, Town of Rolesville, Town of Wake Forest, Town of Wendell, and Town of Zebulon per the Interlocal Agreement dated November 25, 2008.
- 4) Swift Creek Watershed
 - a) The Swift Creek Land Management Plan defines areas within the Swift Creek Watershed as Existing Urban Compliance, Existing Urban Non-Compliance, New Suburban, New Urban, Rural, Open Space, and Vegetation.
 - b) Extension of public utilities may be allowed in areas designated as Existing Urban Compliance, Existing Urban Non-Compliance, New Suburban, and New Urban under the following conditions:
 - i. The capacity of water and sewer facilities is adequate for an extension.
 - ii. An extension is deemed appropriate to promote the orderly provision of public services and facilities in the Raleigh Water service area.
 - iii. There will be no reduction in water quality or degradation of the watershed as a result of public utility extension or the more intense development that may result.
 - iv. It is determined that annexation of a proposed development would be in the best interest of the City of Raleigh.
 - c) No extensions of water and/or sewer mains are allowed in areas designated as Rural, Open Space, or Vegetation, except when a finding is made by Raleigh City Council and Wake County Board of Commissioners that there is a threat to public health, safety, and welfare or to Raleigh's drinking water supply. Such extensions would be considered on a case-by-case basis and would be subject to the following conditions:
 - i. Only existing development could qualify – no new development would be allowed to extend/connect to water or sewer.

- ii. No increase in the density of development will be allowed beyond that already approved by the governing jurisdiction at the time of the provision of the utility service.

1.9 WATER, SEWER, AND REUSE FEES

1. The City has fees, which are related to its water, sewer, and reuse systems. Fees are normally adjusted at the beginning of each fiscal year on July 1. Refer to the current Development Fee Schedule regarding Raleigh Water fees. A current Development Fee Schedule can be found on the City of Raleigh website.
2. Fee Definitions and Descriptions
 - A. Assessment Fee – The minimum size mains are six (6) inch and eight (8) inches for water and sewer mains, respectively. For corner and dual frontage lots, the property owner may receive a one hundred fifty (150) foot exemption. When utility mains are installed inside the corporate limits by the City, the adjoining property owners are charged an assessment fee for the improvements. These fees are based on the cost of installing a six (6) inch water main and an eight-inch sewer main. This fee is a lien on the property and can be paid over a ten (10) year period at six percent (6%) interest. Each fiscal year these fees are revised to reflect changes in the cost of installation.
 - B. Capital Facility Fee – Fee charged for connecting to the water and sewer system of the city, either within or outside the corporate limits of the City or Merger Communities. These fees are calculated based upon the water meter size or sewer-only fee for the property being served by the connection. Scenarios for the applicability of Capital Facility Fees can be found in Appendix F – Permitting Scenarios.
 - C. Fee in Lieu of Assessment – Properties outside the City corporate limits are unable to be assessed, resulting in a “fee in lieu of assessment.” The “fee in lieu of assessment” is due at the time of connection onto the water and/or sewer system or at the time of annexation into the City.
 - D. Service Installation (“Tap”) Fee – A fee is charged to cover the cost of installation by Raleigh Water of water, sewer, and reuse service lines extending from the main to the edge of the right-of-way or private property.
 - 1) The City has set fees for three-fourths (3/4) inch through one (1) inch water services, four (4) inch sewer service, and three-fourths (3/4) inch through one (1) inch reuse service, or a service tap may be installed by a licensed utility contractor.
 - 2) For sewer taps within a sanitary sewer easement, a licensed plumber may make sewer service taps.
 - 3) Taps for water services larger than one (1) inch and sewer services larger than four (4) inches shall be installed by a private licensed utility contractor retained by the applicant.
 - 4) Tap fees for owner-occupied residential structures may be financed by the City for a term of five (5) years at eight percent (8%) interest upon the request of the homeowner. Water and sewer tap fees relating to public extension projects are subject to a one (1) year freeze following service availability. This freeze shall apply only to owners of developed properties within the project area upon which a tap was installed as part of the public extension project. During the one (1) year freeze period, the eligible property owners may connect to the City system(s) and pay the tap fees which were in effect on the date the City Council directed construction of the project. All other property owners

in the project area shall pay the prevailing tap fee(s) in effect on the date service connection is requested.

- 5) Raleigh Water will not install taps in the following situations:
 - a) On divided streets or where the roadway width exceeds forty-five (45) feet measured edge-of-pavement to edge-of-pavement or back-of-curb to back-of-curb;
 - b) On twenty-four (24) inch and larger mains;
 - c) Taps requiring after hours work;
 - d) For new construction or development projects;
 - e) In NCDOT rights of way, when the service must be installed by boring;
 - f) Water taps larger than one (1) inch;
 - g) Sewer taps larger than four (4) inches; or
 - h) Taps within easements.
- E. Meter Installation Fee – Raleigh Water installs all water and reuse meters connected to the City system. Charges for such installation, based upon meter size, have been adopted and are periodically updated. A Not Ready Fee is charged when the City has attempted to initially install the water meter and determined that the water service stub was either not installed to the property or the water service stub was not installed in accordance with City standards. In a scenario when the meter is either downsized or upsized, no credit is given for the meter installation fee.
- F. Sewer Permit Fees – The City issues sewer extension permits on behalf of the North Carolina Department of Environmental Quality Division of Water Resources. These fees are due at the time of submittal of engineering drawings. There is a permit application processing fee charged by the City.
- G. Water Permit Fees – The City issues water extension permits on behalf of the North Carolina Department of Environmental Quality Division of Water Resources – Public Water Supply Section. These fees are due at the time of submittal of engineering drawings.
- H. Reuse Permit Fees – The City issues reuse extension permits on behalf of the North Carolina Department of Environmental Quality Division of Water Resources. Where applicable, these fees are due at the time of submittal of engineering drawings. There is a permit application processing fee for reuse water charged by the City if no other utilities are being submitted for review.

1.10 GENERAL ACCEPTANCE

1. General Acceptance occurs when the project has met City standards and City specifications. For projects within the City and its ETJ, the developer or their representative must notify the City Planning and Development Department's Engineering Inspector, in writing, before installation and for scheduling inspection. In the Merger Communities and their ETJs, the developer or their representative must notify the Raleigh Water inspector.
2. The boundaries for acceptance are defined by the limits identified in approved utility plans. Phased projects are accepted based on the boundaries defined in approved phasing plans.
3. A phasing plan must be provided if the construction requires a phase approach. Each phase must require all utilities needed to support the phase. Once the project or phase is completed, an inspection shall be scheduled, and a punch list created noting any deficient items.

4. Upon the repair and/or replacement of the deficient items, the developer or their representative shall submit the following items to the Infrastructure Inspector for Raleigh Projects or Raleigh Water Inspector for Merger Communities for issuance of a Letter of Acceptance:
 - A. A professional engineer's certified statement of the cost and quantities of the public utilities installed.
 - B. A professional engineer's certified statement indicating that the work has been built in accordance with the City approved set of construction plans.
 - C. A Release of Liens document signed and notarized from the developer stating that all materials and workmanship associated with the water, reuse water, or sewer mains have been paid in full
 - D. The developer is responsible for ensuring a one (1) year written operational warranty to the City prior to issuance of the Letter of Acceptance
 - E. The developer and/or engineer shall provide a recorded map to the City showing all public rights-of-way and easements and,
 - F. "As-Built" plans and profile requirements are listed in each Section for Water, Sewer, or Reuse.
 - G. The engineer shall keep a preserved copy of the "As-Built" plans on file indefinitely.
5. "As-built" plans shall be submitted prior to acceptance of the project.

1.11 GENERAL CONSTRUCTION STANDARDS

1. Handling and Storage of Materials
 - A. The contractor is responsible for shipping and storing of all materials. The contractor shall replace any material which is damaged or defective prior to installation.
 - B. The loading and unloading of all pipes, valves, hydrants, and other accessories shall be in accordance with the manufacturer's recommended practices.
 - C. The contractor shall locate and provide the necessary storage areas for materials and equipment.
 - 1) If private property is being used for storage areas, then the contractor must have the written consent from the property owner.
 - 2) Without written consent, all material and equipment shall be stored within the existing rights-of-way and easements of the project.
 - 3) Pipe may not be laid out along job site and must be delivered to and removed from job site each day.
 - 4) If there are extenuating circumstances, the inspector shall authorize the pipe to remain on the project from one day to the next, as long as the ends of the pipes are sealed.
 - D. All materials on the job site, shall be stored in accordance with the manufacturer's recommendations.
 - E. All pipes shall be kept free of dirt and other debris. Any damage relating to the coating of the various materials for mains shall be inspected and repaired in accordance with the manufacturer's requirements.
 - F. The contractor shall be responsible for safeguarding and protecting all material and equipment stored on the job site.

- G. The contractor shall be responsible for the storage of materials in accordance with the manufacturer's requirements throughout the project duration.
- 2. Right-of-Way provisions for Traffic and Pedestrian control measures during construction activity
 - A. All Traffic Control Signage and practices shall adhere to the Manual on Uniform Traffic Control, and the latest edition of the NCDOT "Standard Specification for Roadway Structures", NCDOT "Roadway Standard Drawing Manual", and the NCDOT supplement to the MUTCD.
 - B. All public sidewalks must be accessible to pedestrians who are visually impaired and/or people with mobility concerns. Existing and alternative pedestrian routes during construction shall be required to be compliant with the Public Rights of Way Accessibility Guidelines (PROWAG), the ADA Standards for Accessible Design and the Manual on Uniform Traffic Control Devices (MUTCD)
 - C. The contractor shall hold the City harmless for any damages or injuries caused by the construction of mains.
 - D. Detours shall be set up and maintained by the contractor under the direction of the City Department of Transportation and North Carolina Department of Transportation. Notice must be given one (1) week in advance of the detour so that necessary notification of the traveling public may be made.
 - E. The contractor shall provide all safety devices for the entire project. The contractor is in no way relieved of liability for providing this pro34action because the detour is approved by others.
- 3. Property Protection
 - A. Trees, fences, poles and all other property shall be protected unless their removal is authorized, and any property not authorized for removal, but damaged by the contractor, shall be restored by the contractor to the owner's satisfaction.
- 4. General Construction Safety
 - A. The contractor and any subcontractors shall be responsible for the total compliance with all federal, state and local ordinances, laws and regulations as related to safe construction practices and to protecting the employees and the public's health and safety.
 - B. The contractor shall ensure that all Occupational Safety and Health Administration (OSHA) regulations and standards are followed during all phases of the construction project.
 - C. The City shall not be responsible for the contractor's adherence to OSHA regulations and standards. The City may report known violations or unsafe practices to the appropriate enforcement agency.
 - D. The contractor shall be required to furnish safety equipment necessary to inspect the work including, but not limited to ladders, gas detectors/oxygen sensors, blowers, etc.
- 5. Encroachment Contracts and Permits
 - A. Prior to actual construction, the contractor shall acquire the necessary encroachments from NCDOT when working within the rights-of-way of state system roads or highways. The encroachment permit shall be kept on the job site at all times.
 - B. The contractor shall be responsible for securing all other local, state, and federal permits required for the utility construction.
 - C. The contractor must have an approved set of permitted construction plans on site at all times.

- D. For projects which require construction plan approval, all environmental permits and NCDOT encroachments must be provided prior to plan approval.
6. Pavement Removal and Replacement
- A. Any pavement that must be removed shall be cut along straight lines with the appropriate saw cut machine. The removal and replacement of the pavement shall conform to the information shown in the standard details.
 - B. All cuts of City streets must be patched the same day with a temporary or permanent patch. Once work has been completed, all temporary patches shall be replaced with permanent ones. All work from patching shall be cleaned up at the same time of patching.
 - C. The City shall perform density tests as needed to determine contractor's compaction efforts. See Notes 2 and 3 of the relevant detail (W-2, S-3, R-2).
 - D. Pavement cuts shall be confined to a maximum trench bottom width as shown in the relevant Detail (W-1 thru W-3, S-4, S-5, R-1 thru R-3b) plus twelve (12) inches on either side.
 - E. Asphalt compaction shall be done with a gasoline or diesel-powered smooth drum asphaltic roller.
 - F. Pavement cuts within NCDOT Right of Way shall not be performed without the proper encroachment permits on site. All patching of NCDOT pavements shall conform to the approved on-site encroachment permit.
7. Excavation
- A. Prior to any excavation or construction, the contractor shall locate all existing utilities in the field. A locate ticket must be called in through the North Carolina 8-1-1 system three (3) business days prior to excavation on the project. If help is needed in locating utilities operated by Raleigh Water, the contractor should contact the Operations Division.
 - B. Trench width shall be a minimum of twelve (12) inches plus outside diameter of pipe and a maximum of twenty-four (24) inches plus outside diameter of pipe unless additional trench width is required by OSHA. Trench width shall be measured between the faces of the cut at the top elevation of the pipe bell as shown in the standard details.
 - C. Trench bottom conformation, where no special bed-ding is required, may be that referred to herein as flat bottom where the trench bottom is excavated slightly above grade and cut down to pipe grade by hand in the fine-grading operation. Where the trench bottom is inadvertently cut below grade, it shall be filled to grade with an approved material and thoroughly compacted to ninety-five percent (95%) or use #67 stone to bring to grade.
 - D. The maximum length of open trench shall be no more than three hundred (300) feet unless approval is obtained from the Raleigh Water Director or their designee.
 - E. The contractor shall at their expense, keep all trenches free from water during the excavation for construction of sewer mains. The water shall be pumped out of the trench or build check dams to keep it out of the ditch in such a manner as not to cause injury to the public health, private property or the work in progress. Erosion control measures shall be taken during this pumping operation.
 - F. In trenches where water is present or dewatering is required, the trench shall be stabilized with #67 stone. When the contractor encounters material during trench excavation that is considered unsuitable soil. The existing material shall be dug up in its entirety and replaced with #67 stone from the out bottom of the pipe. In this case, construction fabrics may be required to prevent the migration of side support away from the pipe.

- G. Safety and convenience of the public necessitate that all work, including excavation, be done in such a manner as to cause minimum vehicular and pedestrian interruption. Utilities such as fire hydrants, valves, etc., shall be accessible at all times. Gutters and drains shall be left open and clear at all times. The contractor shall be responsible for all drainage around their work.
 - H. Sheeting or bracing shall be used to prevent failure of the trench banks. All sheeting shall conform to AASHTO and OSHA safety standard 29 CFR 1926 Subpart P. The Raleigh Water Director or their designee or the Engineer shall have the authority to approve the necessary bracing for the protection of property of the City. The removal of sheeting shall be done in such a manner as to minimize the loss of friction between the backfill and trench walls.
8. Rock Excavation
- A. Rock shall be defined as that solid material that cannot be excavated, in the opinion of the Raleigh Water Director or their designee or Engineer, by any means other than drilling and blasting, drilling and wedging, or boulders and broken concrete exceeding one-half (1/2) cubic yard in volume.
 - 1) Rock shall be excavated to the same limits as earth excavation except that the trench shall be made six (6) inches lower than the outer bottom of the pipe. This six (6) inches shall be refilled with six (6) inches of #67 stone and thoroughly compacted to the sub-grade level.
 - 2) All blasting shall be done under the supervision of the City Inspector or Engineer and subject to all applicable regulations.
 - 3) The City reserves the right to require the removal of rock by means other than blasting where any pipe or conduit is either too close to or so situated with respect to the blasting as to make blasting hazardous.
 - 4) Rock taken from the ditch shall immediately be hauled away and disposed of by the contractor.
 - B. Blasting procedures shall conform to all applicable local, state and federal laws and ordinances.
 - 1) A blasting permit shall be obtained from the City Fire Marshal's Office, prior to any blasting. The application shall be obtained seventy-two (72) hours before any blasting takes place, and the Fire Marshal may specify the hours of blasting.
 - 2) The contractor shall take all necessary precautions to protect life and property, including the use of an approved blasting mat where there exists the danger of throwing rock or overburden.
 - 3) The contractor shall keep explosive materials that are on the job site in special constructed boxes provided with locks. Failure to comply with this specification shall be grounds for suspension of blasting operations until full compliance is made.
 - 4) No blasting shall be allowed unless a galvanometer is employed to check cap circuits.
 - 5) Where blasting takes place within five hundred (500) feet of a utility, structure or property which could be damaged by vibration, concussion, or falling rock, the

contractor shall be required to take seismograph readings and to keep a blasting log containing the following information for each and every shot:

- a) Date of shot;
 - b) Time of shot;
 - c) Crew Supervisor;
 - d) Number and depth of holes;
 - e) Approximate depth of overburden;
 - f) Amount and type of explosive used in each hole;
 - g) Type of caps used (instant or delay);
 - h) The weather; and
 - i) Seismograph instrument and readings.
- C. This blasting log shall be made available to the Raleigh Water Director or their designee or Engineer upon request and shall be kept in an orderly manner.
- D. It shall be the contractor's responsibility to have adequate insurance to cover any damages resulting from blasting so to hold the City harmless from any claims.
9. Surface Restoration
- A. All disturbed surfaces and property thereon, shall be restored to a condition equal to or better to that existing condition before construction begins.
 - B. The contractor shall maintain and be responsible for all ditches in paved streets, curbs, gutters or sidewalks until the contractor repaves the trench cuts.
 - C. The contractor may place temporary or permanent asphaltic material in the cut with permission of the inspector. Asphalt compaction shall be done with a gasoline or diesel-powered smooth drum asphaltic roller.
 - D. All easements will be seeded with grass and left so they can be mowed by conventional mowers, unless approved by Raleigh Water for rip-rap or other specified material.
 - 1) In remote areas, easements will be seeded with a quality fescue grass.
 - 2) In residential areas, easements will be seeded with either falcon or rebel fescue, or leaf mulch at the request of property owner.
 - 3) The contractor shall guarantee a good uniform stand of grass and shall reseed any bare or thin spots.
 - 4) The contractor will be responsible for a one (1) year warranty on materials and work.
10. Erosion Control
- A. Erosion control measures shall be performed by the contractor, conforming to the requirements of, and in accordance with plans approved by the State of North Carolina Department of Environmental Quality, North Carolina Sedimentation Control Commission, City Inspections Department Erosion Control Division, and as per the erosion control plan portion of the construction drawings and these specifications.
 - B. The sedimentation and erosion control plan and permit shall remain on site at all times.
 - C. The contractor shall not allow mud and debris to accumulate in the streets. Should the contractor pump water from trenches during construction, appropriate siltation preventative

measures shall be taken prior to the entry into any storm drain or stream. All measures must be taken so that stormwater runoff does not go to the pipes or manholes of the utility system.

- D. All materials used for erosion control shall be approved by the Engineer prior to installation by the contractor.
- E. Temporary and permanent erosion control measures shall be shown on the plans. Temporary and permanent erosion control work shall be coordinated throughout the project to provide effective and continuous erosion control throughout construction and post construction, which minimizes siltation of streams, lakes, reservoirs, other water impoundments, ground surface, or other property. Seeding and mulching shall be carried out immediately behind construction.
- F. Temporary erosion control measures shall include but not be limited to swales in the easements, silt fences, crushed stone check dam devices, silt basins (sedimentation traps), mulching, earth berms, and rip-rap.
- G. Permanent erosion control measures shall include but not be limited to swales in the easements, rip rap and seeding of disturbed areas.
- H. Erosion and silt shall be controlled on projects by using swales to control run-off and convey run-off to controlled discharge points, by silt fences, rip-rap, crushed stone, and earth berms to contain silt, with pipe culverts where major access or haul roads cross drainage ditches or streams, silt basins where pipe lines cross drainage ditches or streams, and seeding and mulching will be performed as soon after pipe installation as possible. When temporary measures are removed after completion of the project the disturbed area must be stabilized, if necessary.

11. Guarantee

- A. The contractor shall guarantee all material, equipment and work for a period of at least one (1) year after final acceptance by the City. The Infrastructure Inspections division is responsible for the issuance of final acceptance letters in the City of Raleigh jurisdiction.
- B. For projects in Merger Communities, the Raleigh Water Construction Inspection Division is responsible for issuance of final acceptance letters.

12. Wetland/ Stream Buffers

- A. Conditions of 401/404 permits shall be strictly followed to the satisfaction of Corp of Engineers. All Neuse Riparian buffers shall be maintained as required by NCDWQ.

END OF SECTION 1

SECTION 2

WATER

DESIGN, MATERIAL, AND CONSTRUCTION STANDARDS

2.1 WATER DESIGN STANDARDS

1. Unless otherwise indicated, all standards apply to both the public and private water systems. Described in this section are the general design standards, which are to be followed by all parties in preparing development, utility extension, and utility replacement plans for the City. These design standards will ensure that the citizens of Raleigh and Merger Communities will continue to have quality water facilities along with an adequate fire protection system.
 - A. Refer to Appendix C – Checklists for Raleigh Water Plans for the minimum intake standards.
 - B. All engineering plans for public and private water systems must meet State and City minimum design standards as indicated in the most recent amended Rules Governing Public Water Supplies by the N.C. Department of Environmental Quality, Division of Water Resources, Public Water Supply Section and/or the Raleigh Water Departmental Handbook, whichever is the more stringent. All projects must be certified by the engineer of record or the City Engineer.
 - C. The engineer shall be responsible for determining the water pressure at the point of connection and adequacy for services at the highest point of the project. Water pressure zone information is available from the Raleigh Water Administrative office.
 - D. Plan and profile drawings shall be prepared by a registered professional engineer signed, sealed, and dated showing the various elements of the utility mains and shall include overall utility plan layout on a single sheet with scale no smaller than one (1) inch = two hundred (200) feet.
 - E. The design of improvements must be based upon actual field verification by the engineer of existing utilities.
 - F. A phasing plan shall be included to show the extents of the utility construction in each phase.
 - G. The utility drawings shall be on separate sheets, free of landscaping and other details not pertinent to the utility plans.
 - H. A separate landscaping plan must be submitted with the utility plan showing any proposed landscaping and all water and sewer utilities or easement.
 - I. All adjacent tracts and topographic information must be shown on the landscaping plan. The water drawings and sewer drawings may be on the same sheets.
 - J. Landscaping plans shall show all utility engineering drawings and shall be on paper twenty-four inches by thirty-six inches (24x36 inches).
 - K. Plan view must be oriented north with north shown at the top of the page, whenever possible.
 - L. Stationing must be performed in order of increasing station left to right and from downstream manhole to upstream.
 - M. Plan and Profile must be shown on one sheet with the plan view on the top of the sheet and the profile sheet on the bottom of the sheet.
 - N. Water, sewer, storm and any other utilities must be shown on the plan sheet and profile sheet and must not be shown on separate sheets.

2. Once installed, certified surveyed “as built” plans shall be provided to the City showing the utilities. “As built” drawings for the utilities shall be submitted to Raleigh Water prior to acceptance of the project by the City.

2.2 WATER DESIGN – PUBLIC

1. Location Conditions for Design

- A. All mains are to be within dedicated street rights-of-way except major transmission mains not affording direct service connection. Mains within the street right-of-way shall be a minimum of five (5) feet from the outside of the pipe to the edge of the right-of-way. Greater separation may be required for greater depth. Water mains as specified by the City will be marked as indicated on Detail W-13.
- B. Water mains shall be located either in the north or east side of the street pavement.
- C. No person shall construct permanent structures or impoundments, plant trees, shrubs or other vegetation (except shallow rooted ground cover) on water mains, water transmission mains or within water easements without prior written approval through an encroachment agreement from the Raleigh Water Director or their designee.
- D. When a section of existing water line is replaced with new water pipe, all existing water services along this section must be replaced from the main line to the R/W line. The new water meter assembly shall be connected to the existing service line on the customer side of the R/W.
- E. All public infrastructure must have three (3) feet of clearance on all sides. RW reserves the right to cut, clear, and remove all obstructions on public right of ways to maintain this clearance.

2. Size

- A. Major mains are to be sized according to Raleigh Water.
- B. The minimum size water main is six (6) inches for single family residential areas; however four (4) inch water mains will be allowed under certain conditions. All other land uses shall have an eight (8) inch main as the minimum size for water.
 - 1) When the main is less than three hundred (300) feet long and a fire hydrant is not required, special consideration will be made for copper or PEXa piping. No water main shall be less than two (2) inches as required by law.
 - 2) In all residential districts, mains shall be six (6) inch and eight (8) inch, six (6) inch to be used only where it completes a good gridiron, but in no case in blocks of more than six hundred (600) feet in length. Maximum length of six (6) inch and eight (8) inch lines, without connection to a larger main are one thousand two hundred (1200) feet and two thousand (2000) feet, respectively. The maximum length of dead end six (6) inch and eight (8) inch lines are six hundred (600) feet and one thousand two hundred (1200) feet, respectively, except as provided for cul-de-sacs in paragraph 2.2.2.B.4 below.
 - 3) In all other zoning classifications, mains shall be eight (8) inch and twelve (12) inch, eight (8) inch used only where it completes a good gridiron. The maximum length of eight (8) inch lines without connection to a larger main is one thousand two hundred (1200) feet.
 - 4) Within residential cul-de-sacs, eight hundred (800) feet and less (measured along the cul-de-sac centerline from the street centerline to the cul-de-sac radius point) in length serving densities of R-1 or R-4 a six (6) inch water main is permissible and must end with a fire hydrant. If the cul-de-sac is serving a R-6 or greater density development,

then a minimum of eight (8) inch main is required. Water main sizes shall not be reduced except at street intersections or at fire hydrant locations on cul-de-sacs.

- 5) When the proposed project or development is confined by natural topographic features or existing developments, and it is determined that the streets will not be extended to serve adjacent properties, then the mains shall be sized to provide adequate domestic and fire flows. In this case, the minimum main size for single-family residential zoning districts shall be six (6) inch and for all other zoning districts shall be eight (8) inch.
- 6) Raleigh Water is required to provide a minimum pressure of twenty (20) pounds per square inch (psi). If an individual needs greater pressure, then it is their responsibility to incorporate the necessary booster pumping facilities.
- 7) Private fire lines serving hydrants for all land uses shall be a minimum of six (6) inches in diameter and shall be provided with either an approved double detector check assembly or an approved reduced pressure detector assembly, whichever is applicable and built to City standards.

C. Critical mains

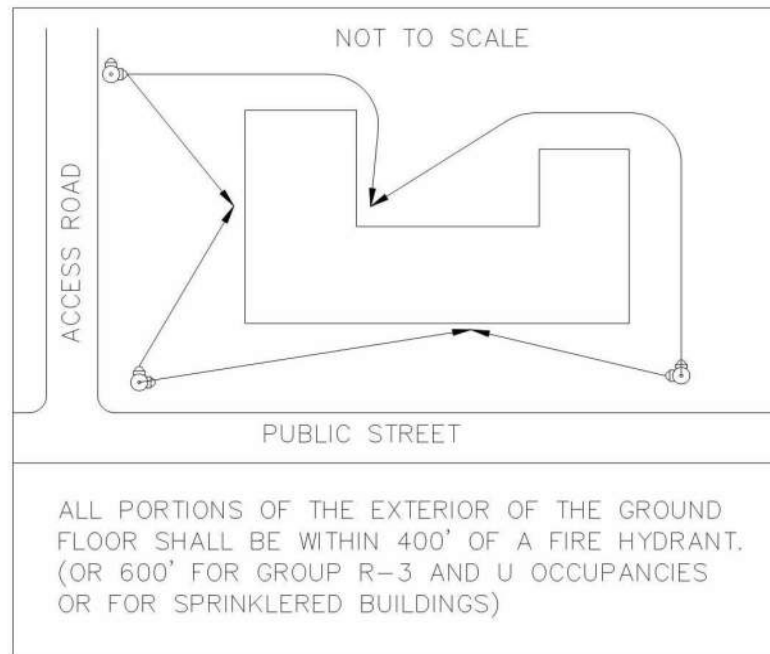
- 1) Critical infrastructure is defined as the following in the City of Raleigh Service area:
 - a) Sixteen (16) inches or larger water main
 - b) Four (4) inches or larger sewer force main
 - c) Fifteen (15) inches or larger gravity sewer main
- 2) Critical infrastructure is defined as the following in Merger Communities' Service Area: (Garner, Knightdale, Wendell, Zebulon, Wake Forest, and Rolesville)
 - a) Eight (8) inches or larger water main
 - b) Four (4) inches or larger sewer force main
 - c) Sixteen (16) or larger gravity sewer main
- 3) In coordination with the Underground Utility Safety and Damage Prevention Act requirements for working within a tolerance zone, Raleigh Water requires that all contractors and utility companies provide notification when they intend to spot any critical infrastructure.
- 4) A seventy-two (72) hour advance notification must be given when considering any type of blasting excavation and/or boring within the regulated distances of critical infrastructure.
- 5) The City of Raleigh cannot locate non-public water and sewer mains/services within private property. It is the contractor's responsibility to notify the property owner when excavating, boring and/or blasting.

3. Fire Hydrants

- A. All fire hydrants shall be installed on a six (6) inch branch with a hydrant branch valve on each branch. All hydrants are to be located at the right-of-way line or in a three (3) foot easement (from all sides of hydrant) adjacent to the right-of-way and installed as per Detail W-4.
- B. Fire hydrants on private property greater than ten (10) feet from the public right of way shall be private with the appropriate backflow assemblies. Fire hydrants on private property less

than ten (10) feet from the public right of way shall be installed in recorded City water easements.

- C. The branch valve shall be no greater than one (1) foot from the main and inside the pavement (when possible. The valve shall be mechanically restrained to the main.
- D. There shall be a fire hydrant located at each street intersection.
- E. From NC Fire Code Section 508.5.1: “All parts of all buildings shall be located within four hundred (400) feet of a fire hydrant as measured by Pull-the-Hose Method or within six hundred (600) feet of a fire hydrant for buildings with an approved automatic sprinkler system, or for Group R-3 and Group U occupancies.” Please reference Section 508.5.1 of the current edition NC Fire Code for rule updates.



- F. In all residential districts, the maximum distance between fire hydrants, measuring along public street centerlines and/or other private travel ways, shall be four hundred (400) feet.
- G. Fire hydrants shall be spaced three hundred (300) feet measuring along public street centerlines, and/or other private travel ways if any non-single-family residential uses exist on either side of a public street. There shall be a fire hydrant located within one hundred and fifty (150) feet of all supply connections for stand pipe and sprinkled buildings. Fire trucks must be able to get within forty (40) feet of the FDC connection.
- H. On divided roads, fire hydrants shall be spaced three hundred (300) feet measuring along public street centerlines on alternating sides of the roadway.
- I. When hydrant legs cross any street to the opposite side of the road, two (2) valves are required. Place one near the main and one on the opposite side near the hydrant.
- J. When the relocation of an existing fire hydrant is approved by Raleigh Water, the existing hydrant branch will be plugged at the tee or tapping valve with a mechanical plug with no bends. If the existing main or tee is lead joint, the tap or tee will need to be cut out and a new section of pipe (nipple) installed with a ductile iron repair joint.

- K. When hydrant extensions are used, they must be manufactured by the same manufacturer as the hydrant on which they are being used and installed in accordance with the manufacturer's instructions. Any proposed hydrant that is at a depth greater than five (5) feet from the finish grade level to boot flanges, or installed on an existing water main that exceeds a depth greater than eight (8) feet shall be installed with a vertical hydrant assembly that meets or exceeds the current AWWA standards. In installations where multiple barrel extensions are required the fire hydrant stems shall be a single one-piece unit.
 - L. No services are permitted on any public fire hydrant branch or blow-off assembly.
 - M. Additional fire hydrants may be required by the Fire Departments.
 - N. Access to hydrants and meters shall not be obstructed within the right-of-way (ROW). Additionally, there shall be a three (3) foot minimum clear distance around all fire hydrants and water meters. This means that nothing shall be within a three (3) foot radius of all hydrants and water meters including but not limited to: trees, shrubs, fencing, guardrail, signs, light and utility poles, etc. Obstructions within ROW or a dedicated easement(s) must be removed by the property owner within thirty (30) days of notice. Obstructions not removed within the specified time frame may be removed by the City at the property owner's expense.
 - O. Fire hydrants that are out of service shall be bagged or covered with the appropriate color listed below:
 - 1) Public: yellow;
 - 2) Private: red; and
 - 3) Construction project: orange.
4. Valves
- A. Each proposed new intersection shall have a main line valve for every leg i.e., a four-way intersection shall have four (4) main line valves, a T-intersection shall have three (3) main line valves. All valves shall be rodded to a tee or cross in accordance with detail W-15.
 - B. Each fire hydrant shall have a hydrant branch valve and shall be installed as per Detail W-4. In some cases where the hydrant branch is long enough a second branch valve may be required.
 - C. Main line valves on straight runs between street intersections shall be spaced no greater than the distances given below and shall be located within fifty (50) feet of the nearest hydrant to their location.

Maximum Valve Spacing by Main Size	
Main Size (inches)	Maximum Spacing (feet)
6	600
8	900
12	1,000
16	1,000
24	1,500

- D. The high and low-pressure water distribution systems may be connected with specific approval of the Raleigh Water Director or their designee. Such connections shall be made with approved check valves positioned with direction of flow from low to high pressure, and a fire hydrant shall be installed on the high-pressure side of the check valve. The check valve shall be installed in a standard manhole. A four (4) foot manhole shall be used for six (6) and eight (8) inch valves and a five (5) foot manhole for twelve (12) inch valves. Larger size check valves shall be housed in a vault, and the size of the vault shall be approved by the Raleigh Water Director or their designee.
 - E. Mains twelve (12) inches and larger in diameter which have a change in elevation of fifteen (15) feet or greater shall have an air release valve installed at the highest elevation of such change, as per Detail W-18. Additional air release valves may be required by the Raleigh Water Director or their designee on mains less than twelve (12) inches based on elevation changes of fifteen (15) feet or greater.
 - F. Any water service customer which has a water static pressure greater than eighty (80) psi is required by North Carolina State Building Code to install and maintain a pressure reducing valve. The pressure reducing valve will be installed on the building service line after the meter. Such a device must be installed before the City will allow the actual water connection. This installation is covered by the Plumbing Code and is not maintained by Raleigh Water.
 - G. Pressure reducing and/or sustaining stations shall be installed when directed by the Raleigh Water Director or their designee to connect high and low pressure systems. The pressure reducing valve shall allow enough flow from the high side to maintain a specified pressure on the low side and will not reduce the high side below a certain amount. This type valve will be a pressure sustaining/ pressure reducing valve.
 - H. Valves over ten (10) feet in depth must have a valve stem extension to bring operating nut to a depth of no more than five (5) feet. Valve stem extensions in these situations must be a minimum of one (1) inch square stock for water mains twelve (12) inches and larger.
 - I. Insertion valves are only to be installed on a case-by-case basis as approved by the Raleigh Water Director or their designee.
 - J. No valves shall be installed in wetland areas. Valves installed in low areas shall be installed with debris caps.
5. Meters
- A. Each house, building or structure that connects to the City's utility system shall have a separate and independent water meter and water and sewer connection. The property owner will be responsible for connection to both.
 - B. Private distributions systems shall have a master meter and a master backflow assembly.
 - C. Looped private distribution systems will be discouraged and only allowed to meet fire flow requirements. If looped systems are approved, there must be a water meter and a backflow assembly at every point of connection to the public main.
 - D. All water services will be metered, and the meter will be located in the right-of-way or in an easement adjacent to the right-of-way.
 - 1) 5/8" and 1" meters (2) foot easement adjacent to the right-of-way.
 - 2) 2" meter size and up - one (1) from the edge of the box or vault.
 - E. Meters sizes shall be five-eighths of an inch, three-quarters of an inch, one inch, one and a half inches, two inches, four inches, six inches, eight inches, or ten inches (5/8", 3/4", 1", 1 1/2", 2", 4", 6", 8", or 10") with no exceptions.

- F. Any single water service that is to be used for combined domestic and fire service usage will have a minimum pipe size of six (6) inch in diameter, pressure class 350 ductile iron pipe in the right-of-way before the meter.
 - G. All single water services that are used for combined domestic and fire service usage will be required to have a Fire Service Meter with a by-pass meter.
 - H. Meters will be the same size in diameter as the service. The only exceptions are a ten (10) inch Fire Service Meter with a by-pass on a twelve (12) inch water service line and a five-eighth (5/8) inch residential meter on a three-quarter (3/4) inch water service line.
 - I. If a property is subdivided or recombined or a building is sold from the complex, then it will require a separate water service, with an individual meter with those services originating from a City maintained water main. All domestic services, fire lines, and private mains must be installed entirely on the lot for which it serves. Services and fire lines and private mains will not be allowed to cross property lines or to be placed in a private utility easement.
 - J. The City will maintain all water connections within the street right-of-way at no charge to the property owner. Repairs on private property shall be the responsibility of the property owner or customer.
 - K. All meters will be furnished and set by the Meters Division once all fees are paid and accounts have been set up. Meter installation and spacing shall be in accordance with details W-23 thru W-35.
 - L. All costs related to a repair to correct any unapproved connections to a meter or meter assembly will be at the property owner's expense.
6. Installation Restrictions for Design
- A. All water mains shall be installed with a minimum cover of three (3) feet from the top of finished ground or surface grade to pipe crown and shall be in accordance with all applicable City Standards. If minimum cover cannot be maintained due to other agency/development infrastructure projects existing water lines shall be relocated or protected with casings or concrete. In no case shall sub grade construction excavations come within less than two (2) feet of the existing pipe crown.
 - B. When mains are to be installed to a dead end or mains are stubbed for future extension, at least one eighteen (18) foot joint of pipe, or more when required, shall be designed with a thrust collar and blow-off in accordance with Details W-7 thru W-12, of these specifications.
 - C. All mains up to twelve (12) inches in size shall be designed with a blow-off assembly the same size as the diameter of the pipe.
 - D. The blow-off for sixteen (16) inch mains shall be twelve (12) inches. The blow-off for twenty-four (24) inch and larger mains shall require approval by the Raleigh Water Director or their designee.
 - E. Blow-off assemblies shall be in accordance with Details W-21 and 22 of these specifications. Mains which are determined to be extended in the future must also terminate with a full-size main line gate valve prior to the last joint of pipe.
 - F. Hydrants can be used as blow-offs on 6-inch mains but must be rodded back to welded thrust collars or mechanical joint restraint rings as shown in Details W-7 and W-8.
 - G. Direct service connections shall be allowed on mains sixteen (16) inch and smaller installed in dedicated street rights-of-way. No taps or services shall be made on twenty-four (24) inch or larger transmission mains unless approved by the Raleigh Water Director or their designee.

- H. All service connections will be made perpendicular to the main. When there are two (2) existing water mains in the street right-of-way, the main which provides the best flow and pressure for that parcel shall be tapped. This determination shall be made Raleigh Water.
 - I. No service connections are to be made off fire hydrant branches or on fire lines except approved split services in accordance with Detail W-34.
 - J. All service connections will be installed by either the City or a licensed utility contractor in accordance with the requirements included in section 1.7-2E of this Handbook.
 - K. Irrigation services on mains with pressure less than fifty (50) psi shall be direct tapped to the main and shall not be split off the domestic service line. A one (1) inch irrigation service cannot be split off of a three-quarter (3/4) inch domestic service line
 - L. Forty-five-degree (45°) and ninety-degree (90°) bends shall be allowed in the water distribution system for all line sizes when required.
 - M. Meter installations shall be in accordance with the applicable Details W-23 thru W-35. All meters must be installed in the right-of-way or in approved easements adjoining the right-of-way. Meters must be installed adjoining the property they are serving and located on the same street as property address. All meters will be installed by Raleigh Water. Fees for such installation are adopted periodically by the City Council.
 - N. When multi-family developments and non-residential land uses are using gang meter installation, then the construction plans shall show the unit and meter numbering sequence for each building. Gang meter assemblies shall be located in front of the building. If the building number is odd, then the unit and meter letter sequence shall be read from left to right when facing the building. If the building number is even, then the unit and meter letter shall read from right to left when facing the building. See Details W-27 and W-28.
 - O. All service lines shall be connected to the correct meter based on sequential number or letter assignment. The unit and meter letter identification must be shown on the construction plans for installation approval. The correction of errors in the proper meter/unit pairing, detected later, will be the responsibility of the original installer or subsequent owners. The gang meter installation shall be in accordance with Detail W-26. Upon completion of the installation, tests will be conducted to prove order of connections is correct.
 - P. In the case of installation of a gang meter assembly the irrigation meter shall be the last meter in the sequence.
 - Q. Gang meter assemblies shall be centered on the service line coming from the main as shown in Detail W-26.
 - R. In no case shall an irrigation service be installed under or in any part of a building. Please see Cross Connection Section.
 - S. Each irrigation service shall serve either an underground automatic sprinkler system, or a yard hydrant behind the backflow preventer.
7. Easement Map Requirements
- A. The City is standardizing the format for plat information. For a complete list of all information required, refer to the Planning and Development Customer Service Center tab at the City website. The following items must be included:
 - 1) Minimum scale established – 1 inch = 50 feet;
 - 2) Project title – consistent with council authorization;
 - 3) Vicinity map;

- 4) Identify map number of total (example: map #9 of 14);
- 5) Street number on each parcel;
- 6) Owner name on each parcel;
- 7) Successive lot numbers on each parcel – beginning with Lot #1;
- 8) Locate footprint of structure on parcel;
- 9) Reference any recorded easements on each parcel;
- 10) “Line” legend somewhere on map;
- 11) Owner/parcel/take data table somewhere on map to include: Owner’s name, street address, Wake county Tax ID # (7 digit #), Lot #, each take listed, Parcel Deed Book and page number;
- 12) No easements labeled “utility”; and
- 13) No overlapping easements.

2.3 WATER DESIGN – PRIVATE

1. Private Water Permitting

- A. The City does not provide permitting for private water distribution systems. If the proposed system requires permitting, it must be obtained from NCDEQ Public Water Supply Section as a private distribution system.
- B. Private water distribution systems located within the Raleigh Utility Service Area and proposed for connection to the City’s public system now or in the future shall conform to all the public system standards listed within this document with the following conditions:
 - 1) Private water distribution lines shall not be required to be located within public right-of-way or publicly dedicated easements.
 - 2) Private domestic and fire services should adhere to W-34. In order to allow a deviation from W-34 (connection to a permitted private distribution system internal to the site), the private distribution must serve a minimum of two domestic services.
 - 3) Four (4) inch water mains may be installed in private water distribution systems, provided that all parts of all buildings shall be within three hundred (300) feet of a public fire hydrant.
 - 4) Private fire hydrants shall be served by distribution systems six (6) inches and larger.
 - 5) Private fire hydrant nozzles shall have National Standard Threads on the side nozzles. The front nozzle shall be STORZ.
 - 6) Private distributions systems shall have a master meter and a master backflow assembly.
 - 7) Looped private distribution systems will be discouraged and only allowed to meet fire flow requirements. If looped systems are approved, there must be a water meter and a backflow assembly at every point of connection to the public main.
- C. See Appendix F for private water main permitting scenarios.

2.4 WATER MATERIAL STANDARDS

1. General Material Requirements

- A. Current specifications of the American Society for Testing Materials (ASTM), American Water Works Association (AWWA), Ductile Iron Pipe Research Association (DIPRA), American Association of State Highway and Transportation Officials (AASHTO), and the

American National Standards Institute (ANSI) shall apply in all cases where material is covered by an item in these specifications. All material used shall conform fully to these current standards or be removed from the job at the direction of the Raleigh Water Director or their designee.

- B. Pipe specimens shall be subjected to tests by an independent testing laboratory at such time as Raleigh Water may direct or as specified herein. Pipe not meeting these specifications will be ordered removed by the inspector, and such pipe shall be immediately removed from the job site and not transported to any portion of the project being constructed.
- C. Detail or shop drawings of fire hydrants, valves, air release valves, tapping sleeves and tapping saddles must be approved by Raleigh Water prior to installation.
- D. These specifications are not to be considered as proprietary in any way. When a particular brand is listed, it is only used as an aid in describing the type of material being requested.

2. Water Mains

- A. All water mains shall be pressure class or thickness class ductile iron pipe designed in accordance with AWWA Standard C-150. Design shall be done for external and internal pressures separately, using the larger of the two for the next design thickness. An additional allowance shall be made for corrosion and casting tolerances. The thickness design for external and internal pressures shall use the following conditions:
 - 1) Three (3) feet minimum cover or as shown on the plans;
 - 2) Laying condition - Type 1 per ANSI Standards;
 - 3) A minimum working pressure of one hundred and fifty (150) psi for pipes sixteen (16) inches and smaller in diameter, and for twenty-four (24) inches and larger pipe, the design working pressure shall be as determined by the Raleigh Water Director or their designee, and
 - 4) A surge pressure of three hundred (100) psi.
- B. All calculations for thickness shall be in accordance with AWWA Standard C-150, and the calculations shall be submitted to the Raleigh Water Director or their designee for approval prior to shipping any pipe. The minimum thickness shall be pressure class 350 for pipes six (6) inches through twelve (12) inches and pressure class 250 for pipes sixteen (16) inches and larger in diameter.
- C. The ductile iron pipe shall be manufactured in accordance with all applicable requirements of AWWA Standard C-151. The ductile iron pipe shall be supplied in nominal lengths of eighteen (18) or twenty (20) feet.
- D. All pipes shall be domestically manufactured and so indicated with either "USA" stamped or painted on the pipe or by providing a certification to the inspector.
- E. The ductile iron pipe shall be cement-mortar lined with a sealcoat in accordance with AWWA Standard C-104. Ductile iron pipe shall be externally bituminous coated in accordance with AWWA C-151.
- F. Pipe joints shall be mechanical or "push-on" manufactured in accordance with AWWA Standard C-111.
- G. Each joint of ductile iron pipe shall be hydrostatically tested before the outside coating and inside lining are applied at the point of manufacture to five hundred (500) psi. Testing may be performed prior to machining bell and spigot. Failure of ductile iron pipe shall be defined as any rupture or leakage of the pipe wall.

- H. All materials used in the production of the pipe are to be tested in accordance with AWWA Standard C-151 for their adequacy within the design of the pipe, and certified test results are to be provided to the City upon request. All certified tests, hydrostatic and material are to be performed by an independent testing laboratory at the expense of the pipe manufacturer.
 - I. Push-on and mechanical joint pipe shall be as manufactured by the American Cast Iron Pipe Company, United States Pipe and Foundry Company, Griffin Pipe Products Company, McWane Cast Iron Pipe Company or approved equal.
 - J. Restrained joints shall be TR Flex or HP LOK as manufactured by U.S. Pipe, Lok-Ring or Flex-Ring as manufactured by American Pipe, Super-Lock as manufactured by Clow, Bolt-Lok or Snap-Lok as manufactured by Griffin or approved equal.
 - K. Upon approval by Raleigh Water, copper or PEXa piping is allowed when the main is less than three hundred (300) feet long and a fire hydrant is not required. PEX piping shall meet AWWA C904 requirements. No water main shall be less than two (2) inches as required by law.
3. Fittings
- A. All fittings shall be manufactured in accordance with AWWA C-110 or C-153 for ductile iron compact fittings. The fittings shall be tested and the manufacturer shall provide certified test results when requested by the City. This testing shall include hydrostatic proof testing of the fittings.
 - B. All fittings shall be mechanical joint with the exception of certain above ground piping which may require flange fittings. Mechanical joints shall be manufactured in accordance with AWWA Standard C-111.
 - C. All fittings shall be cast iron or ductile iron and shall have a minimum working pressure rating of two hundred and fifty (250) psi and minimum iron strength of thirty thousand (30,000) psi.
 - D. All fitting interiors shall be cement-mortar lined with a sealcoat in accordance with AWWA Standard C-104, and the outside shall be bituminous coated.
 - E. Restrained mechanical glands may be used where restraint is needed except when welded restraining rings are required. Restrained mechanical glands provide additional restraint, but do not take the place of required concrete blocking.
 - F. Forty-five-degree (45°) and ninety-degree (90°) bends shall be allowed in the water distribution system for all line sizes when required.
 - G. Exterior bolts, nuts, and rods shall be 316 stamped stainless steel.
4. Gate Valves
- A. Cast iron or ductile iron resilient wedge style vertical or horizontal gate valves and tapping valves shall be used for all main line and hydrant branch valves in sizes from six (6) inches through twenty-four (24) inches. American, Mueller, Kennedy, AVK, Clow, M&H, and Waterous valves in accordance with AWWA C-509-94, C-515, or the appropriate AWWA standard as applicable, shall be used. All resilient wedge valves shall have internal and external epoxy coating, O-ring seals at the stuffing box and bonnet to body and dual O-rings at the stem seal above the thrust collar.
 - B. Tapping valves shall be the same valves as gate valves listed above, subject to the standards, providing that tapping valves shall have the tapping ring.
 - C. Gate valves twelve (12) inches in diameter and smaller, shall be mechanical joint or hub-end all-bell. They shall be "O" ring, open-left valves of the non-rising stem type. These valves

shall be designed for a minimum of one hundred and seventy-five (175) psi working pressure and three hundred (300) psi hydrostatic test pressure with a two (2) inch operating nut. Valves shall be cast iron or ductile iron.

- D. Valves sixteen (16) inches in diameter or greater may be the horizontal gate type or butterfly type, as specified on construction plans, or gate valves as specified above.
 - E. Gate valves, horizontal gate valves or butterfly valves shall be used for all main line and hydrant branch valves in sizes sixteen (16) inches through twenty-four (24) inches.
 - F. Exterior bolts, nuts, and rods shall be 316 stamped stainless steel.
5. Valve Boxes
- A. Adjustable valve boxes shall be class 35 gray cast iron and manufactured in accordance with ASTM A48 and be of the dimensions specified in Detail W-17 of these specifications. Lids shall have the word "Water" cast into the lid. See Detail W-18. All castings must be domestically cast and so indicated by the manufacturers name and "USA" cast into all sections of the valve box. All castings must meet or exceed AASHTO H-20 load rating.
 - B. Total valve box weight shall be a minimum of eighty-five (85) lbs. and have a minimum lid weight of twenty-five (25) lbs., Mueller Model AJBV 5 adjustable are permissible.
6. Butterfly Valves
- A. Butterfly valves with a diameter of sixteen inches or greater shall be Class 150B and shall conform to the latest AWWA Standards C-504, as manufactured by Mueller, Kennedy, Pratt, DeZURIK, or Val-Matic for rubber sealed butterfly valves and valve operating assemblies. "O" ring seals shall also be used exclusively with worm gear.
 - B. All valve end connections shall be mechanical joint or Victaulic, as required by the detail drawings. Valve seats shall be stainless steel, bronze mating or resilient material. Resilient seat shall be mechanically attached to the valve disc, or mechanically retained in the valve body. Resilient seat shall be fully field adjustable by mechanical means. The valve disc shaft shall be stainless steel or either stub or thru-shaft design. Shafts shall be provided with two-way disc thrusters that are fully adjustable from the outside. Valve shaft bearings shall be heavy duty bronze, properly fitted into hubs integrally cast in the body of the valves.
 - C. All butterfly valve gear actuators shall be according to AWWA C-504. The valve operator shall be furnished with a two (2) inch square operating nut and be so mounted that the valve will open-left (counter-clockwise). The butterfly valve operator shall have AWWA stops, be suitable for submersible service and be sized in accordance with AWWA torque requirements for a full 150 lb. rated valve.
 - D. The manufacturer of the butterfly valve shall be fully responsible for the satisfactory performance of the assembled valve and operator unit. The specified operators shall be factory mounted by the valve manufacturer and shipped to the job site as an operating unit. External painting, hydrostatic testing, travel stop adjustments and crating for shipment shall be in complete compliance with the latest AWWA specification for butterfly valves.
 - E. All butterfly valves shall be installed in a standard eccentric precast manhole (diameter appropriate with size valve). Standard Detail W-16.
 - F. Exterior bolts, nuts, and rods shall be 316 stamped stainless steel.
7. Fire Hydrants
- A. Fire hydrants shall comply with AWWA C-502-94 as manufactured for the City by Kennedy, Mueller, Clow, American Darling.

- B. City and all Merger Community fire hydrant nozzles shall have National Standard Threads.
 - C. Private fire hydrant nozzles shall have National Standard Threads on the side nozzles. The front nozzle shall be STORZ.
 - D. The City may require fire hydrants to resist accidental and deliberate contaminations of the water supply.
 - E. All fire hydrants shall have two (2) two-and-a-half (2.5) inch nozzles, and one (1) five (5) inch Storz connection nozzle. The nozzles shall be an integral part of the fire hydrant and must be furnished by the manufacturer or authorized distributor designated by the manufacturer. Storz connector shall have the following characteristics: brass hydrant nozzle connection; have hard anodized aluminum Storz ramps and lugs (hydrant and cap side); and require a high-torque Storz spanner wrench in order for the cap to be removed.
 - F. The hydrant valve opening shall be five-and-a-quarter (5.25) inches with no exceptions. Bronze to bronze threads shall be provided between the hydrant seat or seat ring and the seating attaching assembly. All hydrants must include cast or ductile epoxy lined shoe, rubber drain seals and positive, protective valve stop device.
 - G. Hydrants shall be open-left type and shall have a six (6) inch hub-end or mechanical joint elbow. The hydrant barrel shall be of sufficient length to provide a minimum of three-and-one-half (3.5) feet of bury and be of the break-away impact type.
 - H. Colors
 - 1) Public: public fire hydrants shall be painted chrome yellow with high reflective aluminum silver caps, bonnets, and operating nuts.
 - 2) Private: private fire hydrants shall be painted red.
 - I. Exterior bolts, nuts, and rods shall be 316 stamped stainless steel.
8. Air Release Valves
- A. Water Air release valves shall be two (2) inch Crispin Pressure Air Valves, Model P 20, with a vacuum check unit, or two (2) inch Val-Matic, Model VM-45, with a vacuum check unit or equal as approved by the Raleigh Water Director or their designee. These valves shall be suitable for one hundred and fifty (150) psi working pressure and designed to allow air to escape automatically while the main is in service and under pressure. The valve shall be housed in a City approved eccentric manhole and shall be installed in accordance with Detail W-19 of these specifications. Air release valve locations shall be approved by Raleigh Water, or as shown on the plans. The engineer must field stake the air release location.
9. Tapping Sleeves and Tapping Saddles
- A. Tapping sleeves shall be Mueller mechanical joint, Mueller Outlet Seal, American Uniseal, or Kennedy Square Seal,. One hundred percent (100%) stainless steel sleeves may also be used, as manufactured by Smith-Blair, Romac, Ford, or JCM provided that all metallic parts of the sleeves shall be one hundred percent (100%) stainless steel including bolts. Ductile iron flanges may be included on sleeves or saddles. Test assembly seals with water according to AWWA C-223. All sleeves shall have a minimum of one hundred and fifty (150) psi working pressure. All taps shall be machine drilled – no burned taps will be allowed.
 - B. Saddles shall be equipped with a standard AWWA C-110-98 flange connection. Sealing gaskets shall be "O" ring type, high quality molded rubber having an approximate seventy (70) durometer hardness, placed into a groove on the curved surface of the tapping saddle. Straps shall be of alloy steel. Saddles may be used for taps one-half the size of the main or less (i.e., six (6) inch tapping saddle for use on a twelve (12) inch main).

- C. Exterior bolts, nuts, and rods shall be 316 stamped stainless steel.
- D. Taps on sixteen (16) inch and larger mains shall use stainless steel, full circumferential tapping sleeves.

10. Water Service Connections

- A. Water service pipe for three-quarter (3/4) inch to two (2) inch connections shall be type "K" soft copper with no joints or couplings in the right-of-way. On these water services, the fittings shall be flared copper type brass fittings or compression type fittings.
- B. One-and-a-half (1 1/2) inch and two (2) inch taps may only be made with use of a stainless steel, full circumferential saddle.
- C. For any size tap, a stainless steel, full circumferential saddle shall be used on non-ductile iron pipe.
- D. Corporation cocks for direct three-quarter (3/4) inch and one (1) inch taps may be used on ductile iron pipe and shall have AWWA Standard tapered threads. Unions shall be three-piece copper to copper.
- E. Curb stops used on gang meter assemblies shall be as manufactured by Mueller, Oniseal, Hayes NuSeal, Ford, A.Y. McDonald ball valve. All corporation stops and curb stops shall be bronze ball valves and shall be appropriate material to material corporation and curb stops as manufactured by Mueller, Ford, and A.Y. McDonald and must have a complete ball and installed in a valve box.
- F. Curb stops are required for three-quarter (3/4) inch through two (2) inch meters and shall be located one (1) foot from the meter box on the street side. Curb stops shall be installed in a curb stop box as manufactured by Ford, A. Y. McDonald, or Trumbull.
- G. Water meter gang assemblies of three-quarter (3/4) inch and one (1) inch meters may be allowed on three-quarter (3/4) inch to two (2) inch service connections and shall conform to the requirements shown in Detail W-26. A deviation from this standard may be warranted in some circumstances. Calculations will be required to support the deviation.
- H. All service saddle materials shall be all 304 stainless steel. Saddles shall be full circumferential, 2-bolt, with a nitrile butadiene rubber (NBR) "O" ring gasket attached to the body. The saddle shall have corporation cock threads. These saddles shall be Romac 306 Service Saddle or approved equal.
- I. For services greater than two (2) inches, the water service pipe shall be four (4), six (6), eight (8), or twelve (12) inches in diameter and shall be of ductile iron pipe. Cast iron or ductile iron fittings shall be used on these services. All taps will be made by using the appropriate size tapping sleeve and valve. See Detail W-14. On a "dry line", the connection may be made with a "TEE and Valve" as shown in Detail W-15.
- J. Copper setters or copper meter yokes shall be five-eighths (5/8) inch and twelve (12) inches in height as manufactured by Ford or approved equal. All copper setters shall have locking wings on the angle valve and be of the Ford angle check type.
- K. Curb stops on gang meter assemblies shall be as manufactured by Mueller, Oniseal, Hayes Nuseal, Ford, and A.Y. McDonald. All corporation stops and curb stops shall be bronze ball valves and shall be appropriate material to material as manufactured by Mueller, Ford, and A.Y. McDonald.

11. Meters

- A. All water meters shall be provided and installed by the Raleigh Water Meters Division.

12. Meter Boxes and Vaults

- A. All meter boxes and vaults shall be constructed of cast iron, precast concrete, concrete block, high-density polyethylene, or cast-in-place concrete as on details W-23 thru W-35. Meter vault access doors shall be aluminum slam lock type as manufactured by Halliday, U.S.F. Fabrication, or approved equal.
- B. Meter boxes and vaults shall not be placed within sidewalks or driveways unless no other alternatives are available, and approval is obtained by the Raleigh Water Director or their designee. Traffic rated lids and vaults shall be installed for all meters one-and-a-half (1 1/2) inch and larger.
- C. The meter box must be set to grade. If for some reason, the grade is altered, then the meter box must be adjusted to match the new grade. This includes the addition of topsoil by a landscape contractor or homeowner, flower gardens, etc.

13. Steel Encasement Pipe

- A. Steel pipe for boring installations shall be high strength steel, welded or smooth-wall seamless manufactured in accordance with ASTM A252 and consisting of grade 2 steel with a minimum yield strength of thirty-five thousand (35,000) psi. The minimum casing pipe wall thickness shall be three hundred seventy-five thousandths (0.375) inch for bored encasement.
- B. No coatings required for buried or bored encasements but must conform to the noted wall thickness in the table below. All encasement pipes must be approved by the appropriate controlling agency (i.e., NCDOT, RR, etc.) prior to ordering the material.
- C. All carrier piping shall be restrained joint ductile iron. One (1) joint of restrained pipe must extend beyond the ends of the encasement pipe. The minimum inside diameter of steel encasements shall be eight (8) inches greater than the inside dimension of the carrier pipe. See the following table for encasement diameter and thickness:

Encasement Diameter and Thickness by Nominal Pipe Diameter		
Carrier Pipe Nominal Diameter (inches)	Encasement Minimum Inside Diameter (inches)	Encasement Nominal Wall Thickness (inches)
6	14	0.375
8	16	0.375
10	18	0.375
12	20	0.375
14	24	0.375
16	26	0.500
18	30	0.500
20	32	0.500
24	36	0.625
30	42	0.625
36	48	0.750
42	56	0.875

- D. Both ends of the casing shall be mortared. Metal "spider" pipe alignment devices shall be installed in all casings with a minimum of two (2) "spiders" per pipe joint one-quarter (1/4) of the pipe joint length in from both the bell and spigot ends. See Detail W-40.

14. Irrigation Rain Sensors

- A. Irrigation rain sensors are devices mounted in an open outdoor area at least five (5) feet from any structure and wired to the common wire of all permanent in ground irrigation systems. Rain sensors shall be capable of overriding the irrigation controller when one-quarter (1/4) inch of rainfall has occurred to keep the system from watering in the rain. Rain sensors shall also be UL listed and installed per the manufacturer's recommendations.

15. Irrigation Programmable Controllers

- A. Irrigation programmable controllers are devices installed on all permanent in ground irrigation systems that operate the watering cycle of an irrigation system. Controllers shall be programmable by day of the week and UL listed.

2.5 WATER CONSTRUCTION STANDARDS (Public Systems)

1. As part of the requirement to obtain construction approval for water main extensions, the engineer shall affix the appropriate permit sticker to the original drawings. The various permit stickers are included in Appendix D.
2. The requirements contained in this section shall apply to water main installations constructed for Raleigh Water or for private developers who may or may not dedicate the water improvements to the City. All necessary construction permits must be obtained before construction may begin in accordance with North Carolina State Law.
3. Any Contractor performing work within the City or Merger Communities shall have a copy of these specifications on each jobsite.
4. Scope of work
 - A. The contractor shall furnish all materials, equipment, and labor for excavation, installation, and backfilling of water mains and any related appurtenances as shown on the plans.
 - B. The City of Raleigh Public Infrastructure Inspectors and/or Raleigh Water shall conduct all City inspections on main extension projects.
 - C. It shall be the contractor's responsibility to schedule a pre-construction meeting in Raleigh and the Merger Communities prior to the start of any work.
 - D. On main replacement or upgrade projects that affect existing streets or established neighborhoods, it shall be the contractor's responsibility to provide notice to adjacent property owners fifteen (15) days before beginning any construction work on the project in accordance with NCGS Chapter 160A-499.4.
 - E. The Raleigh Water "Water and Sewer Project Inspection and Acceptance Requirements" website is the primary source of inspection information. See city of Raleigh Webpage for all inspection information.
 - F. Contractor shall contact the Planning and Development Department by 4:00 p.m. EST each day to notify where and what will be done the following day. For any work conducted in Merger Communities or outside the City Service Area the contractor shall contact Raleigh Water by 4:00 p.m. EST to notify where and what will be done the following day. Any work requiring inspector observation outside of the normal business hours will be charged to the contractor at the current inspector hourly rate.

- G. If a developer, engineer, or contractor proceeds with the main installation prior to permit issuance the City may require the work to be reinstalled and the developer, engineer or contractor shall be fully liable for all actions and costs, including prosecution by the City and/or the State for proceeding with installation prior to issuance of appropriate permit(s).
 - H. Revised plans with subsequent review and approval of field changes may be required by Raleigh Water on a case-by-case basis. Therefore, the contractor that proceeds with construction prior to this approval, is at their own risk.
 - I. Contractors working (excavation, boring, or other subsurface breach) around or in the vicinity of existing water lines twelve (12) inches in diameter or larger shall be required to physically spot the existing line to be verified by Raleigh Water distribution staff or inspection staff. If other existing lines sizes are in question or conflict the contractor shall be directed by Raleigh Water staff as to the level of subsurface investigation needed to locate the existing line.
5. General Testing Requirements
- A. The City may perform and shall require the contractor to perform, such destructive and nondestructive testing, as it deems necessary in order to inspect the materials and work. These tests shall be in accordance with the procedures established by ASTM and AASHTO. The City shall reserve the right to modify the procedures in testing ditch and backfill compaction to allow a deeper test to be made by using the sand-core method and/or nuclear testing gauges.
6. Valve Operations
- A. No valve in the existing system shall be operated without following the procedure outlined below. Failure to comply with these requirements shall be grounds for suspension of pipe-laying operations until written assurance can be obtained from a company official that such noncompliance will not occur again. The contractor should be aware that the City regards violations of these requirements as justifying punitive measures.
 - B. Notification procedures are as follows:
 - 1) The contractor shall notify Raleigh Water's Water Distribution Division to request the operation of any valves. At least twenty-four (24) hours' notice must be given to Raleigh Water, and at least twenty-four (24) hours' notice must be given to each customer affected by a water cut-off. The contractor is responsible for notifying the affected customers. All valve operations shall be done by Raleigh Water personnel or by the City's inspector for a particular project. It is illegal for anyone other than a City employee to operate an existing water main valve, unless accompanied by a City employee.
 - 2) The contractor shall provide the following information when calling the Water Distribution Division for valve operation:
 - a) Name of person calling;
 - b) Name of company;
 - c) Telephone number of company;
 - d) Location of valve and map number if available;
 - e) Reason for requesting operating and whether to be closed or open;
 - f) Time valve to be opened or closed, and
 - g) Approximate time water line to be out of service.

- C. Contractors must secure permission following the steps above every time they need a valve operated.
- D. System valves shall be defined as any valve, which has main pressure against either gate face. Newly installed tapping valves and control valves to networks not yet accepted for service are considered as system valves and should only be operated under guidance of City Inspectors. Valves within a network still under construction are not considered as system valves.
- E. All newly installed system valves that connect to the active distribution system shall have a valve box cover painted “red” in color and installed on the corresponding valve box to signify that the valve and main are not in service. The “red” valve box cover shall remain in place until the new main is placed into service, when at such time it shall be replaced with a cover as shown on detail W-18.

7. Trench Preparation

- A. Trench excavation shall conform to the line and depth shown on the plans. The trench shall be properly braced and drained so that workers may work therein safely and efficiently. When water is being pumped from the trench, the pump discharge shall follow natural drainage channels, drains, or storm sewers. In discharging trench water, it will be necessary to follow standard erosion control measures so as to minimize erosion and sedimentation. In no case may trench water or groundwater be pumped into or allowed to enter the sanitary sewer system.
- B. The width of the trench may vary with the depth of cut and other conditions the trench shall be in accordance with the dimensions set forth by OSHA and other information shown on Detail W-3.
- C. The foundations for ductile iron shall be a firm and stable flat bottom (Type 1) trench with bell holes so that the pipe rests uniformly on the entire barrel length. See Detail W-3.
- D. Pipe clearance in rock shall be a minimum of six (6) inches below and on each side of the pipe for sized sixteen (16) inches and less in diameter. For sizes larger than sixteen (16) inches in diameter, the minimum clearance shall be nine (9) inches below and on each side.

8. Pipe Installation

- A. Ductile iron pipe shall be installed in accordance with the requirements of AWWA Standard C-600.
- B. Water pipe shall be laid to the line and grade shown on the plans with all valves and hydrants located as shown on the plans.
- C. Protection shall be afforded to all underground and surface structures using methods acceptable to the Raleigh Water Director or their designee or Engineer. This protection shall be furnished by the contractor at the contractors' own expense.
- D. Deviation from line and grade may be made only on revised plans upon approval by Public Utilities Department and identified on “as built drawings” when such deviations arise from grade or line conflicts with existing utilities, structures, or other sources of conflict.
- E. Subsurface explorations shall be made by the contractor at the direction of the Raleigh Water Director or their designee or Engineer where it is necessary to determine the location of existing pipes, valves or other underground structures.
- F. Depth of pipe cover, unless shown otherwise on the plans shall be three (3) feet above top of pipe. Depth of cover shall be measured from the established street grade or the surface of the permanent improvement to the top of the barrel of the pipe. If minimum cover cannot be

maintained due to other agency/development infrastructure projects existing water lines shall be relocated or protected with casings or concrete. In no case shall sub grade construction excavations come within less than two (2) feet of the existing pipe crown.

- G. After the foundation has been properly graded, bedded when applicable, and the bell holes dug, the pipe and accessories shall be carefully lowered into the trench by approved methods. Under no circumstances shall the pipe or accessories be dropped or dumped into the trench. All damaged pipe and accessories shall be removed from the job.
- H. Pipe interior shall be swabbed clean with sodium hypochlorite solution before it is laid, and any pipe which cannot be cleaned with a swab shall be removed and cleaned with suitable apparatus. Any pipe showing evidence of oil, tar or grease shall be permanently marked and removed from the job.
- I. Laying of pipe and jointing of pipe shall be done according to manufacturer's recommendation with care being taken to provide uniform bearing for the pipe. Bell and spigot of pipe shall be cleaned and properly lubricated where a mechanical joint of a "push on" type joint is employed. No chlorine powder or tablets shall be put in the lines during installation.
- J. Open ends of pipe shall be plugged with a standard plug or cap at all times when pipe laying is not in progress. Trench water shall not be permitted to enter pipe.
- K. Pipe cutting for inserting valves, fittings or closure pieces shall be done in a neat and professional manner in accordance with the manufacturer's recommendations and without damage to the pipe.
- L. Bell ends will face the direction of laying unless otherwise directed by the Raleigh Water Director or their designee or Engineer. For lines on an appreciable slope, the Raleigh Water Director or their designee or Engineer may also require that bell ends face upgrade.

- M. Maximum horizontal deflections for ductile iron pipe shall be as follows for an eighteen (18) foot joint of pipe:

Maximum Deflection in Inches		
Pipe Size (inches)	Mechanical Joint Deflection (inches)	Push-on-joint Deflection (inches)
6	27	19
8	20	19
10	20	19
12	20	19
14	13	11
16	13	11
18	11	11
20	11	11
24	9	11
30	9	11
36	8	11
42	7	7
48	7	7

- N. When installing water and/or sewer mains, the horizontal separation between utilities shall be ten (10) feet. If this separation cannot be maintained due to existing conditions, the variation allowed is the water main in a separate trench with the elevation of the water main at least eighteen (18) inches above the top of the sewer and must be approved by the Raleigh Water Director or their designee. All distances are measured from outside diameter to outside diameter.
- 1) Where it is impossible to obtain proper separation, or anytime a sanitary sewer passes over a water main, DIP materials or steel encasement extended ten (10) feet on each side of crossing must be specified and installed to waterline specifications.
- O. A five (5) foot minimum horizontal separation is required between all water mains and storm sewer facilities, structures, and pipes.
- P. includes driveway pipes.
- Q. Maintain eighteen (18) inch minimum vertical separation at all water main and storm drain crossings. Where adequate separations cannot be achieved, specify DIP materials and a concrete cradle having six (6) inch minimum clearance (per Raleigh Water details W-41).
- R. All other underground utilities shall cross water and sewer facilities with eighteen (18) inch minimum vertical separation required.
- S. All other underground utilities shall cross water and sewer facilities with eighteen (18) inch minimum vertical separation required.
- T. Railroad crossings shall be made following all precautionary construction measures required by the railroad officials.

- U. All water crossings under the state system roads shall be made in accordance with the requirements of the NCDOT as defined in its encroachment permits.
 - V. Where conditions are, in the opinion of the City Inspector unsuitable for laying pipe because of weather or trench conditions, the contractor shall be required to cease work until permission is given by the City Inspector for work to commence again providing such conditions have been corrected.
 - W. In accordance with General Statute 87-121(g), all underground utilities installed after October 1, 2014, shall be electronically locatable. Where nonmetallic water service pipe is allowed, all new nonmetallic water service pipes shall be provided tracing wire in such a manner as to be able to properly trace all mains and service laterals without loss or deterioration of signal or without the transmitted signal migrating off the trace wire. Tracing shall be #12 gauge solid (bare) copper and continuous to the greatest extent possible. The tracer wire shall be securely bonded together at all wire joints with an approved industrial crimp connector to provide electrical continuity. The meter box at the right of way and or easement shall serve as the test port with the tracing wire brought up into the meter box with the service lateral and looped in the meter box. The loop wire inside the meter box shall be a minimum of three (3) feet. The wire shall be protected from damage during the execution of the work. No breaks or cuts in the tracer wire shall be permitted. Spliced connections shall only be allowed between the main liner tracer wire (if applicable) and the lateral tracer wire. Industrial crimps shall be used to provide electrical continuity and the crimps shall be similar metal to eliminate galvanic corrosion. Contractor shall perform a continuity test on all tracer wire in the presence of the Owner or Owner's representative. If the tracer wire is found to be not continuous after testing, Contractor shall repair or replace the failed segment of wire at their own expense. Copper clad steel tracer wire (#12) as manufactured by Copperhead Industries or approved equal is an approved alternative to #12 bare solid copper tracer wire.
 - 1) For new nonmetallic water service laterals where no tracer is installed on the main, provide an anode (one (1) pound minimum) for the tracing wire termination at the point of the new tap on the main.
 - 2) For nonmetallic service lateral installations less than eight (8) feet, the tracing wire shall be attached to the pipe.
 - 3) For nonmetallic service lateral installations deeper than eight (8) feet, the tracing wire shall be installed at a depth of seven (7) to eight (8) feet.
 - 4) For nonmetallic service laterals that are installed in encasement pipe, the tracing wire shall be routed through the encasement pipe.
 - 5) For nonmetallic service lateral that installed by directional drilling, the tracer wire shall be attached to the service pipe and pulled through with the service pipe.
9. Reaction Blocking
- A. All fittings or components subject to hydrostatic thrust shall be securely anchored by the use of concrete thrust blocks poured in place, unless otherwise directed by the engineer. The reaction areas required for these thrust blocks shall be given to the contractor by the inspector, and the contractor shall install the blocks according to directions provided by the inspector. Where concrete must be reinforced, the contractor shall furnish such reinforcing as is required.
 - B. Required reaction bearing areas will be taken from the schedule herein. See Details W-10 and W-11. Areas given are vertical plans measured in solid material normal to the thrust line of the fitting.

- C. Material for reaction blocking shall be transit-mixed concrete. This concrete shall have a twenty-eight (28) day compressive strength of three thousand (3,000) psi. Any metal used to resist thrust which is not encased in concrete shall be 316 stainless steel.
- D. Valves on ductile iron lines shall be anchored with thrust collars as shown in Details W-7 thru W-9.

10. Backfilling Pipe

- A. The backfilling of the trench after the pipe installation and testing shall be in accordance with Details W-3 for ductile iron.
 - 1) Ductile iron pipe shall be backfilled with suitable native material. No rocks, boulders or stone four (4) inches or larger shall be included in the backfill for at least two (2) feet above the top of the pipe.
- B. All backfill shall be compacted in six (6) inch lifts measured from the pipe foundation upward. Backfill for roadway shall be compacted to at least ninety-five percent (95%) of maximum soil density in those areas where the supporting capacity of the soil is of prime consideration. Laboratory determination of maximum soil density will follow the procedure of AASHTO T99-86. Field determination of the density of the soil in place shall follow the procedure of AASHTO T191-86 or T204-86. The result of any one (1) test may be a minimum of ninety percent (90%) of maximum density, but the average of any three (3) tests in an area shall be ninety-five percent (95%) of maximum density. All tests shall be conducted at the direction of the City Inspector, and the cost of such tests will be borne by the contractor with the provision that the City will test an area two (2) times only where both tests fail. The contractor shall then be required to submit satisfactory evidence that the ditch compaction meets the specifications.
- C. Deficiency of backfill material shall be supplied by the contractor where this deficiency results from any cause other than rejection of unsuitable backfill material (other than rock) by the City Inspector. In cases where the City Inspector directs, the contractor shall dispose of unsuitable backfill material and provide suitable backfill material.
 - 1) Where excavated material has been rendered unsuitable, either before or after excavation, by inclement weather or type of material, the contractor must correct the moisture or furnish replacement backfill material.
- D. Backfilling shall not be allowed, except with permission of the City Inspector. When a ditch is flooded or the weather is unsuitable, the contractor shall not backfill unless permission is given by the City Inspector. No backfilling with frozen material shall be allowed.

11. Setting Valves and Valve Boxes

- A. Valves shall be set at locations shown on the plans with care being taken to support the valve properly and to accurately position the valve box over the operating nut of the valve. Where pavement exists, the box shall be adjusted to finished street grade and a concrete pad two (2) feet square and six (6) inches thick shall be poured around the box two (2) inches from the top of finished grade as shown in Detail W-17 (asphalt may also be used in-lieu of concrete for this pad). When valves are located in street rights-of-way, but out of pavement, the boxes shall be adjusted to finished grade and a concrete pad two (2) feet square and six (6) inches thick shall be poured around the box one-half (1/2) inch from the top. When valves are located outside of street rights-of-way, the boxes shall be at finish grade, and a concrete block two (2) feet square and six (6) inches thick shall be poured around the box at grade line. Valve locations out of street rights-of-way shall be marked with a metal post having a minimum diameter of two (2) inches and a minimum bury of three (3) feet with a minimum

of three (3) feet exposed. The exposed portion shall be painted bright orange and shall be placed so that a valve operating tool has free operation.

- B. When a tapping sleeve and valve are being used, the valve, sleeve and machine assembly shall be water tested to hold at eighty (80) psi for a fifteen (15) minute duration in the presence of the inspector prior to drilling or tapping the main. On a case-by-case basis, the inspector may require higher testing pressure based on actual system pressure at the tapping site. All tap coupons shall be given to the city inspector. The valve shall be in the closed position during the testing.
- C. Reverse taps are not permitted unless approved by the Raleigh Water Director or their designee. They must have sufficient cover and be marked with a four (4) inch PVC marker at the tapping valve identified with an "R" designation.

12. Setting Fittings

- A. Fittings shall be set at locations shown on the plans with care being taken to properly "bell-up" joints and support the body of the fitting. All dead-end lines shall be plugged with mechanical joint plugs or caps and anchored by using thrust collars and blocking as shown on Details W-7 thru W-12.

13. Setting Hydrant

- A. Specific directions are required for the setting of all hydrants. In streets where paving is proposed in the near future, the contractor will be given line and grade stakes for hydrants. It is mandatory for the contractor to preserve these stakes so the inspector to verify that the hydrant was set correctly. In areas where paving is not anticipated in the near future, hydrants shall be set according to the inspector's directions.
- B. When fire hydrants are installed behind guard rails, breakaway flanges shall be installed at the ground level and flush with the top of the guard rail. In these installations where multiple barrel extensions are required the fire hydrant stems shall be a single one (1) piece unit. In general, hydrants shall be located in a manner to provide complete accessibility and minimize possibility of damage from vehicles or injury to pedestrians.
- C. Hydrant installation shall be as shown in Detail W-4 and shall be restrained from the main to the hydrant with a mechanical joint pipe restraining system. If the distance is greater than twenty (20) feet, the hydrant branch shall be restrained for the entire length with a mechanical joint pipe restraining system. When hydrants are used as blow-off assemblies, the valves shall be rodded to a thrust block. Restraining rods and accessories shall be 316 stainless steel. Detail W-4A is another available option.
- D. Before a hydrant is set, all dirt and foreign matter shall be removed from the interior of the hydrant.
- E. Hydrants shall be bagged to indicate "out of service" until all testing is complete, and the mains are placed in service. Bags shall be large enough to cover the entire hydrant and shall be black in color. Bags shall be secured with duct tape at the base of the hydrant and shall be removed immediately after the hydrants are placed in service.

14. Setting Blow-Offs and Release Valves

- A. Blow-offs and drainage branches shall not be connected to any sewer, submerged in any stream, or be installed in any other manner that will permit back siphonage into the distribution system.
- B. All air release valves and blow-offs shall be installed as shown on Details W-19 thru W-22. Air release valves must be such that provisions can be made by the contractor to get the flow of water to a natural drainage way.

15. Maintaining Service

- A. When replacing or extending water mains the contractor shall maintain continuous water service to all existing residences and businesses.

16. General Water Main Testing Sequence

- A. Water mains shall be tested in the following general sequence:
 - 1) "Pigging" main (mains with gate valves);
 - 2) Flush the main (all flush water shall be de-chlorinated using methods acceptable to the City Public Utilities Department);
 - 3) Perform the hydrostatic tests;
 - 4) Introduce the appropriate amount of chlorine by tapping the main;
 - 5) Hold the chlorine solution in the main for at least twenty-four (24) hours and no more than seventy-two hours;
 - 6) Flush the main (all flush water shall be de-chlorinated using methods acceptable to the City Public Utilities Department);
 - 7) Sample for the bacteriological tests; and
 - 8) Water mains shall be placed into service within forty-eight (48) hours of meeting bacteriological analysis requirements. If no activity is anticipated on a water main for the first thirty (30) days after it is placed into service, the contractor shall notify the City and provide the location and permit number.

17. Pigging

- A. All new mains with gate valves must be pigged with a polyethylene "pig", 5#/cubic foot density at the conclusion of installation.
- B. The pig must be blown at the end of the main by means of the following:
 - 1) Four (4) inch main – four (4) inch blow-off (private only);
 - 2) Six (6) inch main – fire hydrant or six (6) inch blow-off;
 - 3) Eight (8) inch and twelve (12) inch through blow-off assembly as on Details W-21 and W-22; or
 - 4) Sixteen (16) inch – twenty-four (24) inches As determined by the field inspector.
- C. The contractor installing the line shall write the name of the company and street name in which the work is taking place on the pig in a manner in which it will not rub off.

18. Hydrostatic Tests

- A. All main installations including private distribution and fire lines to the buildings shall be pressure tested between each main line valve in accordance with AWWA C-600. Existing valves may not be used for testing. The test shall be performed using a suitable pump and an accurate pressure gauge. Immediately upon completion of a section of main, one hundred and fifty plus or minus five psi (150 ± 5 psi) of pressure shall be applied and held for two (2) hours. Fire lines shall be tested at two hundred (200) psi. The acceptable leakage rate shall not exceed ninety-two thousandths (0.092) gallons per inch of pipe diameter per one thousand (1,000) feet of pipe per hour. Testing shall be between two (2) newly installed valves. No existing valves may be used for pressure testing.
 - 1) Failure of the water main to comply with the above acceptable leakage rate, shall require the contractor to replace any defective materials to insure a watertight installation. If it

is deemed that the existing blow-off valve is the cause of failure, the party responsible for the water main extension shall also be responsible for adding a valve at that location and abandoning the existing valve. After any inadequacies have been corrected, the leakage rate will again be tested. This test shall be repeated until that portion of main is brought to compliance with the permissible leakage rate.

B. Prerequisite conditions for inspection prior to testing shall be as follows:

- 1) Hydrants shall be properly located, operable, plumb and at correct elevation.
- 2) Valves shall be properly located, operable and at correct elevation. Valve boxes or manholes shall be centered over operating nuts, and the top of the box or manhole shall be at proper elevation.
- 3) Lines shall be properly vented where entrapped air is a consideration.

19. Chlorination

- A. All additions or replacements to the water system, including fire lines and backflow prevention devices, shall be chlorinated before being placed in service. Such chlorination must take place under the supervision of an inspector.
- B. Pipe subjected to contaminating materials shall be treated as directed by Raleigh Water or Engineer. Should such treatment fail to cleanse the pipe, replacement shall be required. The City shall bear no portion of any cost sustained by the contractor in meeting this specification.
- C. Chlorination of a completed line shall be carried out after completing the pressure test and in the following manner.
 - 1) Taps will be made at the control valve at the upstream end of the line and at all extremities of the line including valves. These taps shall be located in such a manner as to allow HTH solution to be fed into all parts of the line.

- 2) A solution of water containing high test hypochlorite (HTH) seventy percent (70%) available chlorine or chlorine gas solution 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 fifty (50) ppm total chlorine immediately after chlorination. The chart below shows the required quantity of seventy percent (70%) HTH compound to be contained in solution in each one thousand (1000)-foot section of line to produce the desired concentration of fifty (50) ppm.

Required Quantity of HTH Compound by Pipe Diameter	
Pipe Size (inches)	Pounds of high-test Hypochlorite (70%) Per 1000' of Line
6	0.880
8	1.56
10	2.42
12	3.50
14	4.76
16	6.22
20	9.76
24	14.0
30	21.0
36	31.5
48	56.0

- D. 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 in order that a uniform concentration will be produced in the mains.
- E. Services shall be disinfected by methods acceptable to the Raleigh Water Director or Engineer, and the contractor shall have the same responsibility for laterals as for mains in regard to bearing full cost of any corrective measures needed to comply with bacteriological or other requirements.
- F. HTH solution shall remain in lines for no less than twenty-four (24) hours, unless otherwise directed by the Raleigh Water Director their designee or Engineer.
- G. Extreme care will be exercised at all times to prevent the HTH solution from entering existing mains.

20. Bacteriological Sampling

- A. Free residual chlorine twenty-four (24) hours after introduction of chlorine shall be at least ten (10) ppm, or Raleigh Water or Engineer will require the lines be re-chlorinated.
- B. Mains will be flushed with a blow-off assembly of sufficient size to effectively clean the main. Detail W-22. Flushing of lines may proceed after twenty-four (24) hours, provided the free residual chlorine analysis is satisfactory. Flushing shall be continued until chlorine returns to normal level. In times of water shortages or distribution main problems, the flushing operation may be delayed. Raleigh Water shall determine when flushing is

allowable. The contractor shall advise the inspector prior to the chlorination and flushing so that the inspector can advise Raleigh Water of the construction location, size and length of mains. All tests will be done in the presence of an inspector. Sufficient precautions must be taken to the satisfaction of the inspector to ensure that the impact of the water is absorbed, and the water is conveyed without erosion or property drainage. All flush water shall be de-chlorinated using methods acceptable to the City.

- C. After flushing is completed, the Planning and Development Department or Raleigh Water Inspector shall collect samples for turbidity and bacteriological analysis for each section of pipe between main line valves. Sample point locations shall be determined by a representative of the engineer or owner. A custody seal shall be placed on each set of turbidity and bacteriological bottles. A chain of custody form must be completed for sample set(s) collected and must be delivered along with the sample(s). A turbidity test will be done. If the turbidity exceeds one (1) NTU, the sample fails, and a bacteriological test will not be set up. Raleigh Water will perform the turbidity and bacteriological analysis.
- D. Samples will be accepted between normal business hours, Monday through Thursday, excluding official City holidays. Special arrangements may be made for samples to be accepted outside of this time frame by calling the laboratory in advance.
- E. In the event that two (2) successive bacteriologic tests fail, that section of the main shall be re-chlorinated by the contractor and new tests performed prior to moving to the next section of main.

21. Service Connections

- A. Taps shall be made only on a line under pressure and after the main has been tested and chlorinated. No taps on dry lines shall be allowed unless specific authorization from Raleigh Water is obtained.
- B. Taps shall be at an angle of forty-five degrees (45°) to a perpendicular plane through the center line of the pipe as shown is in Detail W-23.
- C. The maximum size of a direct tap shall be one (1) inch for mains six (6) inches and larger. Larger taps may be made by using a full circumferential service saddle.
- D. Services larger than two (2) inches shall be made by using a tapping sleeve and valve. Service size shall match tap size.
 - 1) The typical tapping sleeve and valve is shown in Standard Detail W-14.
- E. No taps or services shall be made on twenty-four (24) inch or larger transmission mains unless approved by the Raleigh Water Director or their designee.
- F. Before any water services are installed, the main shall be thoroughly flushed using a flow velocity sufficient to scour the pipe interior. All flush water shall be de-chlorinated using methods acceptable to the City.
- G. Each meter yoke shall be flushed before the installation crew proceeds to the next service installation.

Services shall not be crimped. Where a service is required to be repaired or cut, freezing is the preferred method of construction. Other methods will be considered, upon approval by Raleigh Water.

22. Water Main, Valve, and Service Abandonment

- A. Contractors abandoning water services shall remove the entire service stub. When available, a mechanical plug shall be used to abandon the corporation cock. If equipment necessary to plug the main is not available, the corporation stop shall be turned off and capped. A one-

half (1/2) inch PVC pipe shall extend a minimum of twelve (12) inches above the capped corporation stop, wrapped at least three (3) times with caution tape to identify an abandoned tap. All remaining portions of the service stub shall be removed from the main to the right of way line and shall be disposed of properly. Water main abandonment must be performed in accordance with a plan approved by Raleigh Water. Service and main abandonment requires a stub permit for inspection by the Planning and Development Department or a Public Utilities Inspector, in the Merger Communities.

- B. Water main valve approved for abandonment shall be removed when possible. If removal is not possible, the valve shall be abandoned by removing the valve nut and top section of the valve box and covering the valve with #57 stone.
- C. General Requirements
 - 1) A Property owner is responsible for proper abandonment of all unused existing service stubs.
 - 2) All abandoned meters are to be removed by the Raleigh Meters Division prior to service abandonment. Please contact the Raleigh Meters Division staff.
 - 3) The Raleigh Public Utilities operations staff will not abandon an existing service stub unless it is part of a service renewal as required by ordinance.
 - 4) For circumstances that may not be addressed by this clarification or a variance from this procedure please contact the Raleigh Public Utilities Department Development staff.

23. As-Built Plans

- A. Surveyed As-Built plans and profiles shall be furnished to Raleigh Water by the Engineer upon completion of the project.
- B. All coordinates shall tie into the NC grid coordinate system (NAD1983 State Plane) and the vertical datum NAVD88. All units are to be US survey feet. The closest geodetic monument to the project shall be identified in the “as-built” plans.
- C. All current Wake County parcel information in the project area is to be defined and properly labeled. All streets in the project area shall be defined and labeled.
- D. All “as-built” plans shall include a vicinity map and an overall site or utility plan and be clearly marked as an “as-built plan” or “record drawing”. The plan shall include the following information on a twenty-four by thirty-six (24x36) inch layout (paper for initial walk-through, mylar for final): “as-built” date, project title, permit number, page numbering, north arrow, scale of drawing, bar scale, all easements labeled with book and page number and dimensioned, pipe section, pipe size, pipe material, fitting type defined, valve type defined, meters, backflow preventers, length of bore and jack, abandoned and/or removed features, and connections to existing utilities.
- E. All service stubs shall be shown, and all mains shall be labeled as public or private.
- F. A twenty-four by thirty-six (24x36) inch paper copy shall be submitted to the Inspector for review and comment before initial walk-through. Once these comments are addressed, a twenty-four by thirty-six (24x36) inch mylar copy of each sheet shall be re-submitted. In addition to hard copy mylars, a PDF file of each signed and sealed mylar sheet must be submitted. A CAD file of utilities should show the overall water system as-built layout along with the property or subdivision boundaries. DWG, DGN, DXF, and SHP are acceptable formats.
- G. CAD files must be saved in “model space” on the current NC State Plane grid. A comma-delimited text file or Microsoft Excel file of survey information is required with the

following columns: FeatureType (Valve, Meter, Tee, etc.), X coordinate, Y coordinate, Z coordinate, Size, and Description. See example below.

FeatureType	X	Y	Z	Size	Description
Tee	2086904.78	732688.47	349.69	12x12x6	DI tee
Valve	2086907.12	7326892.41	349.78	6"	Gate valve
Hydrant	2086910.49	7326899.57	352.62	4.5"	2012 Mueller Super Centurion 250
Meter Box	2085638.36	731998.1	368.23	5/8"	specify domestic or irrigation
BFP	2085639.24	731996.33	368.35	3/4"	RPZ

H. Digital as-built data submittals shall be on a USB flash drive or transmitted electronically to the Raleigh Water GIS group and shall include the following:

- 1) Project name;
- 2) Name of firm which prepared the data;
- 3) As-built date, as depicted on mylar submittal;
- 4) Permit number(s); and
- 5) Raleigh Water plan identification number (if applicable).

I. Each digital as-built submittal shall include the following on digital media:

- 1) PDF files for each mylar sheet submitted;
- 2) PDF file(s) for recorded plat(s);
- 3) CAD file (see above); and
- 4) Data file denoting the coordinates and description for each utility feature in the project scope (see table above).

- J. Each plan sheet showing as-built information shall have an engineer's certification with N.C.P.E. seal, signature and date. See certification text below.

ENGINEER CERTIFICATION STATEMENT

I, _____, as a duly registered Professional Engineer in the State of North Carolina, having been authorized to observe (___ periodically, ___ weekly, ___ full time) the construction of the project, _____, hereby state that, to the best of my abilities, due care and diligence was used in the observation of the construction such that by my inspection of the constructed improvements and my review of the as-built survey data, I hereby certify that the (1)public improvements, (2) private improvements, and (3) public safety of the above referenced project as constructed are in compliance with the requirements of the improvements as prescribed in the approved Construction Drawings, approved design documents, and/or any approved modifications, except as noted in red on the 'As-Built' drawings. Furthermore, I certify that the red-noted exceptions do not adversely affect the required performance or public safety aspects of the improvements.

Name: _____ Date: _____

NCPE Seal:

LICENSED UTILITY CONTRACTOR REQUIRED SERVICE ABANDONMENT PERMITS

Contractor installed domestic (3/4" thru 12"), irrigation water (3/4" thru 10"), sewer (4" thru 8") and fire hydrant (6") service stub;

Commercial; All domestic and/or irrigation, sewer and fire hydrant abandonment requires a stub permit for each connection to a water or sewer main.

Residential/Individual; All domestic water and/or irrigation and sewer service stubs abandonment installation requires a stub permit.

Exception: Irrigation splits installed with a new domestic service. Irrigation splits on an existing tap requires a stub permit.

Demolition Permits; Plans are required to show all existing services to be abandoned included temporary construction water using existing meter(s). Plan review required.

Sewer Stubs in Easements; A licensed and bonded utility or plumbing contractor may install a sewer stub on a sewer main located within a dedicated easement and requires the issuance of a stub permit. Raleigh Ordinance 10-6082

Right-of-way permits are required for pavement repair in ROW.

City Capital Projects

A licensed utility contractor performing City contracted water or sewer main replacement work is not required to obtain a stub or right-of-way permit for abandoned services or mains.

Water and Sewer Main Abandonment

All water and sewer main abandonment requires plan submittal for review by the Raleigh Public Utilities Development Staff by submission of plans through the Raleigh Development Customer Service Center

END OF SECTION 2

SECTION 3

SEWER

DESIGN, MATERIAL, AND CONSTRUCTION STANDARDS

3.1 SEWER DESIGN STANDARDS

1. Unless otherwise indicated, all standards apply to both the public and private sewer systems. Described in this section are the general design standards which are to be followed by all parties in preparing development, utility extension, and utility replacement plans for the City. These design standards will ensure that the citizens of Raleigh and Merger Communities will continue to have a quality sewer collection system.
2. All engineering plans for public and private sewer systems must meet State and City minimum design standards as indicated in the most recent amended Administrative Code, Title 15A, Subchapter 2T – Waste Not Discharged To Surface Waters by the N.C. Department of Environmental Quality and/or the Raleigh Water Handbook, whichever, is the more stringent. All projects must be certified by the engineer of record or the City Engineer.
3. Plan and profile drawings shall be prepared by a registered professional engineer signed, sealed, and dated showing the various elements of the utility mains and shall include an overall utility plan layout on a single sheet with scale no smaller than one (1) inch = two hundred (200) feet. Design of improvements must be based upon actual field verification by the engineer of existing utilities. The utility drawings shall be on separate sheets, free of landscaping and other details not pertinent to the utility plans. The water and sewer drawings may be on the same sheets. A separate landscaping plan must also be submitted with the utility showing any proposed landscaping and all water or sewer utilities or easement. All adjacent tracts and topographic information must be shown on the landscaping plan. Landscaping plans shall show all utilities and engineering drawings and shall be on paper twenty-four by thirty-six inches (24x36 inches).
4. Plan view must be oriented north with north shown at the top of the page, whenever possible. Stationing must be performed in order of increasing station left to right and from downstream manhole to upstream. Plan and Profile must be shown on one sheet with the plan view on the top of the sheet and the profile sheet on the bottom of the sheet. Water, reuse, sewer, storm and any other utilities must be shown on the plan sheet and profile sheet and must not be shown on separate sheets.
5. Once installed, certified surveyed “as built” plans shall be provided to the City showing the utilities. “As built” drawings for the utilities shall be submitted to Raleigh Water prior to acceptance of the project by the City.

3.2 SEWER DESIGN – PUBLIC

1. Location Conditions for Design
 - A. All public sanitary sewer mains shall be installed within dedicated street rights-of-way or City dedicated sanitary sewer easements. When sanitary sewer mains are installed in street rights-of-way, they shall be located in the center of the pavement or right-of-way where practical or in the south or west side of the pavement.

- B. Sanitary sewer easements are to be recorded as "City Sanitary Sewer Easement". The minimum easement width for sanitary sewer is thirty (30) feet and may not include any other utility. Raleigh Water may approve a smaller easement width based on the site constraints, depth of sewer main, accessibility of the easement and infrastructure. Minimum widths of permanent and construction sanitary sewer easements, for public sewer mains, are:

Required Easement Widths		
Main Size (inches)	Permanent Easement (feet)	Temporary Construction Easement (feet)
8 – 16	30	10 feet total
≥18	40	20 feet total

- C. Larger size easements may be required based upon the depth of installation or other consideration as determined by Raleigh Water and Planning and Development Department. See table below for the extra easement typically required. Sewer mains shall be centered in the easement. Under special conditions, temporary construction easements may be required upon approval of Raleigh Water. All sewer easement boundaries must be field staked and flagged by the developer's surveyor and at the developer's expense.

Additional Easement Required for Deep Sewer	
Depth of Sewer (feet)	Additional Easement Required (feet)
0-12.5	See table above
12.5 – 20	Add 10 feet to table above 3.2.1.B Table
>20	Add 20 feet to 3.2.1.B Table

- D. All off-site easements shall be acquired by the developer. These off-site easements shall have functional access to public right of way and be recorded by map and by deed of easement prior to construction approval. The easements shall be dedicated to the City and entitled "City Sanitary Sewer Easement". Plan and elevation drawings of all access roads shall be shown on the plans prior to approval.
- E. No person shall place any part of a structure, construction fill material, permanent equipment, or impoundment on sanitary sewer easements or mains. Prohibited structures include but are not limited to buildings, houses, air conditioning units/heat pumps, decks, garages, tool or storage sheds, swimming pools, stormwater control devices, walls, and fences.
- 1) For structures being proposed directly adjacent to existing sanitary sewer easements, the engineer of record shall demonstrate through a sealed engineering report that the City will be able to safely excavate the easement to access, inspect, repair, and/or replace the existing pipe without diminishing the structural integrity of the structure being proposed.

If this protection cannot be achieved due to depth of sewer installation or size of proposed structure, the engineer can propose structural reinforcement just outside the easement to provide the protection or provide additional separation between the structure and the easement to allow the City to maintain the existing sewer.

- 2) Fences may be allowed across easements as long as there is an access gate the full width of the easement. No fences may be installed longitudinally (lengthwise) within easements. All permanent easements shall be graded and smoothed to allow sufficient access and use for mowing equipment and maintenance vehicles prior to acceptance by the City; typically, a minimum of three to one (3:1) slope will be required.
- F. No person shall plant trees, shrubs, or other plants within a sewer easement without prior written approval from the Raleigh Water Director or their designee. Any such plantings approved shall be done so at the risk of the property owner having to replace the plantings due to removal by the City during maintenance activities.
- G. When preparing the plans for sewer mains, deflection angles for all horizontal turns shall be shown on the drawings. All elevations shall be tied to mean sea datum and the benchmark shall be shown or described on the plans. Spot elevations on one hundred (100) foot stations, seventy-five (75) feet from the centerline on both sides, shall be shown on the plan, or cross-sections supplied to ensure that the sewer can adequately serve the property. The plans shall show the manhole number (MH#1 etc.), top elevation, station, depth along with invert elevations, length of sewer reach, and slope (in percent), diameter, and material. Established creek centerlines and inverts will be plotted on the sewer plan and profile sheets, adjacent to proposed sewer alignment, within seventy-five (75) feet.
- H. Proposed sewers paralleling a creek shall be designed to a proper depth to allow lateral connections, such that all creek crossings will be below the stream bottom elevation. When it can be demonstrated by the engineer that such sewer main would need to be at a depth greater than sixteen (16) feet to serve the opposite side of the creek, Raleigh Water may make an exception to this provision in the plan approval stage.
- I. The top of the sewer pipe should be at least one foot below the stream bed elevation and be of ductile iron pipe. All aerial stream crossings will be restrained joint pipe from manhole to manhole as shown in Detail S-12. The center line of a main paralleling a creek shall be a minimum of forty (40) feet as required by the Neuse Riparian Buffer from the top of the closest creek bank.
- J. Manholes along these sewers must be protected against the one hundred (100) year flood by raising top elevation three feet above or by providing sealed manholes (see S-24). All sealed manholes must be vented every thousand (1,000) feet along the sewer line as per details S-26 and S-27.
- K. Aerial sanitary sewer crossings will be permitted only if they follow the Details S-10 thru S-19. The bottom of the aerial creek crossing pipe must be at least one foot above the twenty-five (25) year flood elevation at the location.
- L. Connection to non-standard manholes (pipe tees) on large interceptors must follow the Detail S-33. Connection to these manholes must be performed by City forces or a contractor working for the City with the cost borne by the person extending the sewer mains from that point. Contact the Assistant Raleigh Water Director or their designee of Operations for coordination when making these connections.
- M. Sewer clean-outs are prohibited in driveways, sidewalks, and parking lots and may only be approved upon special request to the Raleigh Water Director or their designee. When

necessary and so approved they must be installed with a standard water-tight clean-out plug within the cast iron valve box with a cast iron lid indicating "Sewer".

- N. "Doghouse" manholes are allowed only on DIP, PVC, and concrete sewer mains. "Doghouse" manholes on VCP are prohibited. New manholes installed on existing VCP sewer lines shall be replaced with DIP or PVC pipe material from the existing downstream manhole to the existing upstream manhole. When new sewer mains are installed and connected to existing deteriorated or brick manholes, the manhole shall be replaced. Determination for maintaining or replacement of existing deteriorating manholes must be approved by the Raleigh Water Director or their designee.
- O. When a section of existing sewer line is replaced with new sewer pipe, all existing sewer services along this section must be replaced from the main line to the R/W line. The new cleanout assembly shall be connected to the existing service line on the customer side of the R/W. Coordinate with the Raleigh Water Director or their designee for cost sharing options when replacing these existing sewer lines and manholes.
- P. A dedicated and recorded driveway access easement shall be provided to all sanitary sewer siphons. Sanitary sewer siphons are only allowed in special circumstances and require approval of the Raleigh Water Director or their designee. Plan and elevation drawings of all access roads shall be shown on the plans prior to approval.
- Q. A distance of one hundred (100) feet shall be maintained between sanitary sewer and any private or public water supply source such as an impounded reservoir used as a source of drinking water. If adequate lateral separation cannot be achieved, ferrous sanitary sewer pipe shall be specified and installed to waterline specifications. However, the minimum separation shall not be less than twenty-five (25) feet from a private well or fifty (50) feet from a public well.
 - 1) When installing water and/or sewer mains, the horizontal separation between utilities shall be ten (10) feet. If this separation cannot be maintained due to existing conditions, the variation allowed is the water main in a separate trench with the elevation of the water main at least eighteen (18) inches above the top of the sewer and must be approved by the Raleigh Water Director or their designee. All distances are measured from outside diameter to outside diameter.
 - 2) Where it is impossible to obtain proper separation, or anytime a sanitary sewer passes over a water main, DIP materials or steel encasement extended ten (10) feet on each side of crossing must be specified and installed to waterline specifications.
 - 3) A five (5) foot minimum horizontal separation is required between all sanitary sewer and storm sewer facilities unless DIP material is specified for sanitary sewer.
 - 4) Maintain eighteen (18) inches minimum vertical separation at all sanitary sewer and RCP storm drain crossings. Where adequate separations cannot be achieved, specify DIP materials and a concrete cradle having six (6) inch minimum clearance (per Raleigh Water detail S-49).
 - 5) All other underground utilities shall cross water and sewer facilities with eighteen (18) inch minimum vertical separation required.
- R. All existing waterworks units, such as basins, wells, or other treatment units, within two hundred (200) feet of the proposed sanitary sewer main shall be shown on the engineering plans.
- S. Sanitary sewer services are not allowed in private easements. Sewer services cannot be installed inside and parallel to the right of way in order to serve an adjoining property. Private

sewer services must remain entirely on the property which it serves. In order for a sewer connection to be allowed, a manhole or sewer main must be located in front of the property which it will serve. In some cases, a forty-five-degree (45°) connection may be allowed to connect to a manhole which does not front on the property.

- T. Sewer service connections in existing sewer main easements shall be installed only by licensed utility contractors or licensed plumbers. Services on fifteen (15) inch and larger mains will require connection at an existing manhole or the installation of a manhole.
- U. Construction Plans showing a relocation of a sanitary sewer main will be required to provide a table showing a minimum of the following information:
 - 1) Suction MH;
 - 2) Discharge MH;
 - 3) Work to be performed;
 - 4) Suction static lift;
 - 5) Discharge static lift;
 - 6) Approximate length of FM;
 - 7) Peak flow, and;
 - 8) A note should on the plans stating:

“A bypass plan sealed by a NC Professional Engineer must be submitted to Public Utilities prior to pumping operations to coordinate with administration engineering staff. Pumps should be sized to handle the peak daily flow (2.5 times the average daily flow) for the line or area of work. The contractor shall secure pumps from a pump supplier according to the provided flow information. Pumping operations must be monitored 24 hours a day for each day of the pumping operation by qualified personnel in order to respond to problems or failures. 100% redundancy is required for pumping operations. In addition, back up pumps are to be connected to the bypass force main to facilitate immediate use upon failure of the primary pumps.”
- V. Hydraulic pump design is to be submitted by the contractor and sealed by an NC Registered PE.
- W. Sewer Force Main Air Release valves shall be two (2) inch minimum, A.R.I. Flow Control, Model D-020 Combination, with stainless steel body or equal as approved by the Raleigh Water Director or their designee. These valves shall be suitable for two-tenths to sixteen (0.2-16) bar working pressure range and designed to discharge air during filling of the system, admit air during drainage and water column separation, and release entrapped air when the system is pressurized. The valve shall be housed in a City approved eccentric manhole and shall be installed in accordance with Detail S-9 of these specifications. Air release valve locations shall be approved by Raleigh Water, or as shown on the plans. The engineer must field stake the air release location.
- X. Pipe bursting is allowed upon approval by Raleigh Water Director or their designee. If pipe bursting is allowed, Contractor shall follow requirements as given in Raleigh Water’s Pipe Bursting technical specification. Contact Raleigh Water to obtain Pipe Bursting technical specifications.
- Y. All public infrastructure must have three (3) feet of clearance on all sides. RW reserves the right to cut, clear, and remove all obstructions on public right of ways to maintain this clearance.

2. Size

- A. All gravity sewer mains shall be designed and sized to serve the total natural drainage basin. The total off-site drainage area in acres must be shown on the plans and calculations should be submitted to Raleigh Water upon request to justify pipe sizing. An eight (8) inch main shall be the minimum size permitted.
- B. Sewer size design shall be based on an average daily flow in gallons per day.
- 1) For residential type developments, it is based on 75gpd per bedroom for residential (Apartments, single Family dwelling, townhouse, condos).
 - 2) For commercial, industrial and any other type non-residential developments, it is based on 15A NCAC 02T .0114 Wastewater Design Flow Rates.
 - 3) For Merger Communities, use equivalent designs, or contact Raleigh Water.
 - 4) Sewer size design shall be to half full or fifty percent (50%) capacity for peak flow for all grades.
- C. Grades for sanitary sewers must be such that a minimum flow velocity of two (2) feet per second is maintained. For minimum pipe slopes, see table below from the NC Gravity Sewer Minimum Design Criteria:

Minimum Sanitary Sewer Grade	
Diameter of Pipe (inches)	Minimum Slope (feet per 100 feet)
6	0.60
8	0.50
10	0.28
12	0.22
14	0.17
15	0.15
16	0.14
18	0.12
21	0.10
24	0.08
27	0.07
30	0.06
36	0.05

- D. Any grades which exceed the maximum of ten percent (10%) must be approved by the Raleigh Water Director or their designee and must be accompanied with details of a high velocity manhole as shown in Detail S-23.

- E. Any time the grade is greater than fifteen percent (15%), ductile iron pipe shall be used with high velocity blocking (anchoring) provided as per Details S-6 and S-7.
- F. Pipe diameter changes shall occur in a manhole with the pipe crowns matched provided a minimum drop of approximately two-tenths (0.20) feet is maintained between inverts.
- G. Pipe material changes shall only occur in a manhole (i.e. DIP to PVC).

3. Manholes

- A. Manholes shall be spaced a maximum distance according to the chart below:

Manhole Spacing	
Pipe Diameter (inches)	Maximum Manhole Spacing (feet)
8-21	400
24-30	450
36 and greater	500

- B. Manholes shall be installed at each deflection of line and/or grade.
- C. Manholes shall be vented every one thousand (1,000) feet, or every other manhole, whichever is greater. Also see Sewer Materials section for venting of manholes.
- D. Manhole drops:
 - 1) The maximum “free” vertical drop for a gravity main into a manhole shall be thirty (30) inches. The maximum “free” vertical drop for a force main discharge into a manhole shall be twelve (12) inches above the crown of the main.
 - 2) Free vertical drop into major interceptor (twenty-four (24) inch or larger) shall be considered from the crown of the interceptor pipe.
 - 3) Design considerations shall avoid manhole drops where possible.
 - 4) Outside drop manholes are allowed when needed and cannot be avoided through design.
 - 5) Inside drop manholes may be allowed on a case-by-case basis where an outside drop is not feasible.
 - 6) All drop manholes shall feature redundant access to facilitate maintenance from all directions with adequate size and diameter facilitating the insertion of common sewer maintenance tools and appurtenances.
- E. Manholes will be supplied with a rubber boot sleeve that meets or exceeds ASTM C923 with stainless steel expansion bands and pipe clamps that meets ASTM C923 and A167 for connecting the sewer pipes with the barrel section. See Details S-20 thru S-29 for manhole standards. All traffic bearing castings must be Class 35 or greater. All exterior joints shall be wrapped with a butyl resin sealant of eight (8) inch width.
- F. Composite manhole rings and covers:
 - 1) May be used in lieu of cast iron.
 - 2) Shall be used on elevated outfall manholes.
 - 3) Shall not be used in traffic areas.

- G. Eccentric or concentric cones may be used on eight (8) inch through twelve (12) inch mains. On fifteen (15) inch and larger mains, concentric cones must be used.
- H. The following minimum diameter manholes shall be used dependent upon the size mains and depth of installation. The larger manhole sizes will be required if either the main size or the depth warrants as follows:

Minimum Manhole Diameter by Sewer Main Size and Depth		
Sewer Main Size (inches)	Depth of Installation (feet)	Manhole Diameter (feet)
8 - 12	0 - 12	4
15 - 30	12 - 20	5
36 - 54	>20	6

- 1) Extended manhole bases, maximum six (6) inches, may be used to minimize manhole diameter when a larger manhole is required because of the depth, in which case main size will dictate manhole diameter. Manhole sizes must be clearly identified on the construction plans. Each manhole must be of consistent diameter throughout its height.
 - I. The maximum flow deflection angle in manholes for sewer of twenty-four (24) inches and greater is sixty degrees (60°). The maximum flow deflection angle in manholes for sewer lines less than twenty-four (24) inch is ninety degrees (90°).
 - J. All interceptor/outfall manholes on lines twelve (12) inches and larger shall be made of polymer concrete or internally lined with approved coating to prevent hydrogen sulfide corrosion. See Sewer Materials Section for approved coatings and specifications.
 - K. Force main discharge manholes:
 - 1) All force main discharge manholes and the next downstream manhole shall be made of polymer concrete.
 - 2) All existing force main discharge manholes and the next downstream manhole shall be lined with Antimicrobial polyurea or epoxy liner (Sewpercoat, Sherwin Williams, Raven, or approved equal).
 - L. For phased construction, manholes located in future roadways shall be raised a minimum of one (1) foot above grade with a lockable cover (see Detail S-27).
 - M. Steps:
 - 1) Steps are not allowed inside of manholes.
 - 2) Steps shall be provided on outside of raised manholes when top elevation is greater than three (3) feet above existing ground elevation.
4. Installation Restrictions for Design
- A. Extensions of sanitary sewer mains are to be to the farthest property line of the tract where necessary to serve adjoining properties with gravity sewer along natural drainage patterns. In all instances, plans shall show the total area in acres draining to the uppermost bounds of the tract on any established watercourse. Additional sewer extensions may be required if Raleigh Water determines adjacent property can be served from extensions from the proposed site.
 - B. The depth of sewer mains shall be great enough to serve adjoining property, allowing for sufficient grade on the service line. Lateral connections are to be into manhole barrels (not the cone section) or into the top quarter of sewer mains.

- C. All four (4) inch sewer services may be tapped directly into eight, ten, and twelve (8, 10, and 12) inch mains or manholes in accordance with Details S-31 and S-32. Taps can only be made by using a mechanical tapping machine or other approved device. All sanitary sewer service connections six (6) inches and larger shall be made into manholes only. On mains fifteen (15) inches and larger, service connections are allowed only at manholes. Service clean-outs shall be located at the right-of-way line or the easement boundary line. The maximum vertical drop for a six (6) inch service into a manhole shall be ten (10) feet. Four (4) inch sanitary sewer services shall have no maximum vertical drop.
- D. Sewer main material shall be as shown in the table below.

Required Pipe Material						
Depth (feet)	DIP Class 1 Traffic Area Bedding	PVC - SDR 26 Traffic Area	PVC – SDR 35 Traffic Area	PVC - SDR 26 Non-Traffic Area	PVC – SDR 35 Non-Traffic Area	DIP (Director Approval)
1						
2						
3	X			X	X	
4	X			X	X	
5	X	X	X	X	X	
6		X	X	X	X	
7		X	X	X	X	
8		X	X	X	X	
9		X	X	X	X	
10		X	X	X	X	
11		X	X	X	X	
12		X	X	X	X	
13		X		X		
14		X		X		
15		X		X		
16		X		X		
17		X		X		
18		X		X		
19		X		X		
20						X
21						X
≥22						X

- E. Sewer mains that receive any new force main discharge shall be upgraded by means of replacing the existing concrete, ductile iron, or cast-iron main with PVC (if depths allow), ceramic epoxy lined ductile iron, or CIPP of the existing main. The extent of this main replacement will generally be to the next manhole upstream and downstream from the manhole into which the new force main discharges. The extent of existing main replacement upstream and downstream in no case shall be less than one hundred (100) feet in each direction. In addition to main replacement, the manhole in which the force main discharges into shall be vented. The developer is responsible for all of the costs associated with this upgrade.
- F. Services:
- 1) Service materials shall be as shown in the table and paragraphs below.

Service Material			
Service or Service Stack	Depth (feet)	Location	Material
Service	3-12	Public R/W or Easement	PVC
Service	> 12	Public R/W or Easement	DIP or CI
Service Stack	Any	Public R/W or Easement	PVC

- a) Services shall be no deeper than twelve (12) feet unless approved by the Raleigh Water Director or their designee.
- b) A clean-out is required at the easement or right-of-way line and must be constructed out of ductile iron pipe or if PVC is used then it must be equipped with a bronze clean-out plug to facilitate location if buried. Clean-outs inside the public right of way shall not be installed in sidewalks or driveways unless installed as shown in Detail S-30.
- G. Private collection systems installed outside of public easements and rights-of-way will be built to the applicable State Plumbing Code and Department of Health and Natural Resources Standards and must meet the requirements of Raleigh Water's Private Sewer System Standards.
- H. The placement of fill dirt around and over existing sanitary sewer mains above the pre-existing ground elevation is prohibited and may only be approved upon written request to the Raleigh Water Director or their designee. It is illegal to damage, cover, or bury a Raleigh Water sanitary sewer manhole. When approved, fill must be compacted under, beside and above the sanitary sewer main to ninety-five percent (95%) compaction. Slopes may not exceed two-to-one (2:1) and sufficient points for cross drainage must be provided.
- I. Pressure sewer services are prohibited except in existing pressure sewer collections system areas or by specific approval of the Raleigh Water Director or their designee.
- J. Calculation of residential wastewater flow rates shall be 75 GPD/ bedroom.
- K. For calculation of other flow rates, see the N.C. Division of Water Quality administrative code section 15A NCAC 02T.0114.
- L. Connection of Swimming Pools and Fountains to Sanitary Sewer:

- 1) Swimming pools or ornamental fountains shall discharge to the stormwater system under the general permit issued by the Division of Water Quality. Where discharge to the storm sewer system is not possible and a swimming pool or ornamental fountain is connected to the sanitary sewer system for the purpose of draining or flushing the pool, fountain or backwashing the filters, the drainage system shall be equipped with a pump or flow restrictor so that the discharge rate to the sanitary sewer does not exceed fifty (50) gallons per minute. The documentation of this flow rate must be provided to the Raleigh Water Director or their designee.

5. Force Mains

- A. Force mains shall be designed for a minimum fifty (50) year life span according based on the AWWA Manual of Practice M23 (PVC Pipe – Design and Installation) and Uni-Bell PVC Pipe Association’s Handbook of PVC Pipe. Design shall consider cyclical and surge pressures that are seen in a force main. The engineer shall submit calculations and/or computer modeling results.
- B. Force mains shall be made of C900 PVC, HDPE, or ductile iron in accordance with the Sewer Materials Section of these specifications and installed under the same construction specifications as water mains. Force mains shall include a plug valve ten (10) feet outside of the pump station but inside the fence and an air release valve at all high points. Force mains shall convert to gravity flow at a point where they can reasonably do so.
- C. Force mains shall be designed to minimize high points and the need for air release valves.
- D. The engineer shall provide calculations to confirm that a surge relief valve is not needed.
- E. Force main size and discharge point shall be shown on the construction drawings. Force mains shall convert to gravity flow at a point where they can reasonably do so.
- F. Force mains shall be designed with a minimum velocity of two-and-a-half (2.5) fps.
- G. The engineer shall provide calculations to confirm that a surge relief valve is not needed.

6. Pump Stations

- A. The City’s policy is to utilize gravity sewer extensions to provide sewer services to all corporate properties within the City’s service area, the ETJ, and the corporate limits. Therefore, sewer pump stations are prohibited and may only be approved by a special written request to the Raleigh Water Director or their designee.
- B. The pump station lot shall be recorded by itself in phase one (1) of any development proposing a pump station separate from any other phase. This will require the pumpstation to be recorded prior on its own lot and an address for the pump station is assigned. No other lots shall be recorded at that time.
- C. Public access to a public right-of-way shall be recorded to the pump station.
- D. Acceptance of a pump station shall occur prior to any certificate of occupancy or certificate of completion on any building that it is receiving flow from.
- E. The design engineer and developer must attend a pre-design meeting to discuss the requirements as noted in this section. The engineer for the project shall address the following factors in considering a pump station and force main. Additionally see Details S-35 thru S-37.
- F. Submersible type pump stations shall be the first option and vertical suction-lift type pump stations shall be the second option.

- G. The engineer shall evaluate the capacity of the receiving sewer main at the point of discharge and downstream to determine that the system can handle the transferred sewer flow.
- H. The engineer shall perform a cost analysis of the pump system with appurtenances and gravity system. The gravity system must be at least two-and-a-half (2.5) times more expensive for the City to consider a pump station. This cost is not to include rock excavation.
- I. The engineer shall size the pump station to accommodate the total basin area that could gravity flow into it.
- J. In some circumstances, Raleigh Water may choose to accept for permanent ownership and maintenance pump stations designed in accordance with the City Standards. Those stations suitable for acceptance by Raleigh Water must meet the following criteria:
 - 1) Be determined by the Raleigh Water Director or their designee to be in the "best interest" of the City.
 - 2) Be necessary due to limitations imposed by existing Public Utilities facilities.
- K. General Conditions for a Pump Station
 - 1) All pump stations must meet the guidelines set forth in this Handbook and the most recent version of Minimum Design Criteria for the Fast-Track Permitting of Pump Stations and Force Mains as published by NCDENR; whichever is most stringent.
 - 2) The calculation package submitted with the pump station construction plans should include a minimum of:
 - a) Peak and average daily flow calculations;
 - b) Total dynamic head calculations;
 - c) System curve and pump curve analysis with operation point;
 - d) Pump station cycle and run times;
 - e) Pump station flotation/buoyancy;
 - f) Minimum force main velocity;
 - g) Pump station and force main detention times; and
 - h) NPSH calculations.
 - 3) A dedicated and recorded driveway access easement to the pump station shall be obtained and shown on the as-built plans.
 - 4) In the case of phased development, future access shall also be addressed.
 - 5) Plan and elevation drawings of all access roads shall be shown on the plans prior to approval.
 - 6) The contractor/developer shall be responsible for obtaining all permits and payment of all fees for construction.
 - 7) The contractor/developer shall be responsible for establishing an account, payment of fees and connection of all utilities. The contractor/developer shall bear all associated utility costs until the date of final acceptance at which time the City shall assume these accounts and future costs.
 - 8) All Pump Station driveways must be a minimum twelve (12) feet wide and paved, with curb cut and apron if on curbed street, and not greater than ten percent (10%) slope.
 - 9) Driveways shall be designed with cross-slope such that runoff is diverted off the surface and does not create sheetflow toward pump station site.

- 10) A vehicle turnaround area large enough for City flush trucks (WB-40 minimum design vehicle type) shall be provided at the pump station.
- 11) The City reserves the right to require concrete instead of asphalt paving of driveways.
- 12) Sites with odor control chemical tanks must be accessible by eighteen (18) wheel tanker trucks.
- 13) A diesel fueled standby electrical generator in a weatherproof enclosure with automatic start and transfer of load with capacity sufficient to sequentially start and run all pumps and equipment shall be provided.
- 14) The engineer shall address the potential for odor at all sites. Odor control shall be required at all pump stations with force mains greater than two thousand five hundred (2,500) feet, unless exempted by the Raleigh Water Director or their designee.
- 15) Remote monitoring equipment as required by the City shall be provided. The engineer shall be responsible for a radio site survey of the proposed pump station site to ensure compatibility with the City's existing system before submitting plans for final approval. The contractor shall be responsible for providing all equipment including RTU's, PLC's, antennas, antenna pole, etc. This system will send and receive data using the existing telemetry network owned and operated by the City. The contractor is required to purchase the RTU SCADA cabinet from Raleigh Water. The contractor shall be required to provide the Wonderware HMI programming at the main server and the testing of all communication points. Required monitors include a mag-type flow meter on the force main, pressure sensor on force main, power monitor on pumps and runtime meters.
- 16) Pump stations shall have one hundred percent (100%) reserve peak pumping capacity (dual pumps) with vertical suction-lift type pump stations as the first option and wet well/dry well type as the second option unless specific approval is granted by the Raleigh Water Director or their designee for use of other type pumps. Detailed engineering plans will need to be approved by the Raleigh Water Director or their designee prior to construction.
- 17) Force mains shall include a plug valve ten (10) feet outside of the station but inside the fence and an air release valve at all high points.
- 18) Prior to the station being placed into service private pump stations shall be equipped with a sign indicating a twenty-four (24) hour on call service number, the current owner, and the responsible party.
- 19) Start-up services will be required for all equipment and must be performed by a qualified factory representative. A copy of all start-up reports will be due before final pump station acceptance.
- 20) On-site training by a qualified factory representative is required for all equipment.
- 21) An eight (8) foot-high green or black vinyl coated galvanized steel chain link fence with green or black privacy slats for restricted access to the site and equipment with a twelve-foot-wide double- leaf access gate is required at all sites. Wire gauge shall be No. 9 minimum with two-and-a-half (2 1/2) inch minimum OD vinyl coated posts and one-and-five-eighths (1 5/8) inch minimum OD vinyl coated top rails. Corner posts shall be three (3) inch minimum OD vinyl coated and gate posts shall be four (4) inch minimum OD vinyl coated. Fence shall be no less than ten (10) feet from property/easement line.
- 22) A potable water source with freeze proof yard hydrant shall be provided at site. A twenty-four (24) inch square concrete pad shall be installed at the base of the yard

hydrant. This must be a metered water service from the Raleigh Water unless approved otherwise by the Raleigh Water Director or their designee.

- 23) Backflow assemblies shall be provided for the water source per City standards. The unit shall be housed in a heated fiberglass enclosure, above grade. All backflow assemblies shall be tested by the installer and a copy of test results provided at final inspection.
- 24) Warranty on all equipment shall commence when the City accepts the pump station for operation.
- 25) All sewer force main valve box caps must be marked "SEWER".
- 26) The contractor shall provide the owner with a minimum of three (3) sets of operating and maintenance manuals for all equipment. Manuals must be original as provided by the manufacturer and bound. Spare parts as required by the City shall be boxed for long term storage with part numbers and identification labels. Items subject to handling damage will not be accepted if factory packaging has been opened. All manuals and spare parts are to be turned over at final inspection and acceptance of the pump station.
- 27) A screened vent shall be provided for the wet well. The vent shall be sized by the engineer for the wet well and installed so that gases are directed away from equipment. The vent shall be four (4) inch minimum size and supplied with a stainless-steel insect screen.
- 28) An aluminum panel backboard and weather hood mounted on galvanized posts with concrete standing pad is required for electric service and telemetry equipment. The weather hood shall be equipped with work lights and a convenience receptacle with weatherproof covers.
- 29) The minimum inside diameter of any new wet well shall be eight (8) feet.
- 30) Wet well components must be located such that normal maintenance can be performed without having to physically enter the wet well.
- 31) The site shall have a minimum of one (1) overhead area light with switch and photocell. Weather hoods over panels shall be provided with lights.
- 32) All bolts, mounting brackets, pump lifting chains, etc., shall be 316 stainless steel and sized and mounted to support applicable loads.
- 33) New installations are required to meet the latest revised OSHA standards at the time of final acceptance. The contractor shall provide and install all site-specific OSHA required labels and signs for the site.
- 34) The pump station shall have a high wet well alarm in the form of a horn and a light beacon. The horn shall be capable of being silenced through the telemetry system. The alarm light shall be red and mounted so as to be visible in a three hundred and sixty degrees (360°) degree radius.
- 35) The pump station shall be located three (3) feet above the one hundred (100) year flood elevation. One hundred (100) year flood elevations shall be shown on the plans.
- 36) All wet wells shall be internally factory lined with a polyurea/polyurethane coating. Duramer 1030 shall be applied in one coat of a twenty percent (20%) solids, deeply penetrating, dual-component polyurea primer (one-half to one (0.5-1.0) mils dry film thickness, one hundred and fifty (150) ft²/gal), one intermediate coat of a dual component polyurea (fifty to one hundred (50-100) mils dry film thickness, fifty (50) ft²/gal) and one (1) top coat of a sixty-five percent (65%) solids, two (2) part polyurea (seven-and-a-half to ten (7.5-10) mils dry film thickness, one hundred and twenty-five

(125) ft²/gal). All coats shall be applied by brush, spray, or roller. Sherflex Elastomeric Polyurethane shall be applied according to manufacturer's recommendations. Polyurea/polyurethane coatings shall be Duramer 1030 as manufactured by SewerKote, Sherflex Elastomeric Polyurethane as manufactured by Sherwin-Williams, or approved equal.

- 37) Landscaping shall be provided in accordance with the City landscaping ordinance.
- 38) Pump station components that are submitted for installation are to be the latest models by City approved manufacturers.
- 39) "As Built" plans, digital and paper of the pump station, access easement, force main indicating discharge point, all valves and air releases in force main, and initial float elevation settings must go to Raleigh Water.
- 40) The engineer or contractor shall forward shop drawing submittals for the generator, transfer switch, and package pump station to Raleigh Water for review.
- 41) Pump Stations will not be allowed to discharge to another pump station under any circumstance.
- 42) Site visits by City personnel will be required and scheduled as follows;
 - a) Before final plan approval;
 - b) When pumps are set;
 - c) Pump and generator startup testing; and
 - d) Final Inspection, and when flow is applied, and station is ready for service.

L. Requirements for Pump Station Pumps

- 1) Multiple pumps (minimum of two (2)). The pump station must be able to deliver peak flow with the largest pump out of service.
- 2) Pump-on/Pump-off elevations shall be set such that two to eight (2-8) pumping cycles per hour may be achieved in the pump station at average flow.
- 3) A spare rotating assembly consisting of impeller, key, nut, washer, and mechanical seal shall be included with each pump. A spare impeller, key, nut, and washer of opposite rotation than assembly shall also be furnished.
- 4) A spare electric pump motor shall be provided with the pump station.
- 5) The pumps must be equipped at a minimum with dry contacts for SCADA purposes indicating run time, O/L tripped, pump breaker tripped, priming failure, lag pump start, high wet well, three (3) phase power fail and control power fail for remote telemetry purposes.

M. Requirements for Pump Station Permanent Standby Generators.

- 1) The generators shall be sized to sequentially start all pumps and operate all equipment at the site.
- 2) The generators shall be equipped with an automatic transfer switch to start generator and transfer load to emergency in case of utility under-voltage, over-voltage, power loss, phase reversal, or phase loss.
- 3) There shall be a fuel tank with the capacity to run the generator a minimum of twenty-four (24) hours with a one hundred percent (100%) load. Fuel tanks shall be UL listed double wall with leak detection. Low fuel and leak detection status shall be available both at the site and through the SCADA.

- 4) At time of acceptance of operation by the City, the contractor shall be responsible for topping off the fuel tank.
- 5) The generators shall be equipped with a 304 stainless steel (including all internal components) critical grade exhaust silencer. The silencer shall be equipped with a rain cap and all connections, pipes, nuts, bolts, etc., which shall be 316 stainless steel.
- 6) There shall be dry contacts provided to indicate engine run, common engine fail, common engine warning, transfer switch position, utility power loss, low fuel level, and fuel tank leak for remote telemetry purposes. More items may also be required based upon the site.
- 7) The owner shall be furnished with one complete set of spare air, oil, and fuel filters for the generator. The owner shall also be furnished with one set of spare accessory belts.
- 8) The owner shall be given three (3) copies of the O&M and parts manuals specific for the generator unit and the automatic transfer switch.
- 9) The automatic transfer switch shall have a disconnect on the utility service main side.
- 10) The generator set, controls, and transfer switch shall be furnished by a single supplier. The supplier shall be the authorized dealer of the engine-generator set manufacturer and shall be fully qualified and authorized to provide service and parts for the engine and generator at any time during the day or night. The supplier must be located within a one hundred (100) mile radius of the site.

N. Electrical Requirements for the Pump Station

- 1) All electrical work shall conform to the latest NEC and local guidelines.
- 2) Control panels shall be labeled as an assembled panel and bear the UL label.
- 3) Sewage pump station utility voltage shall be four hundred and eighty (480) volt three (3) phase power.
- 4) All wiring shall be identified at each termination. Wiring shall have a unique wire number and shall be labeled at both ends. Wire numbers shall correspond with equipment terminal wire numbers as indicated in the accepted shop drawings. Where no wire numbers are indicated, the contractor shall advise the engineer in writing prior to assigning wire numbers. Wire numbers shall not be duplicated.
- 5) For instrumentation wiring, the contractor shall provide on the shop drawings, a schedule indicating the wire number, color code if applicable, origin and destination devices, and terminals.

- 6) Conductor insulation color coding: (Tape for identification shall only be allowed on conductors larger than #6 AWG.)

480 Volt AC Power	Phase A	Brown
	Phase B	Orange
	Phase C	Yellow
	Neutral	White

120/208 or 120/240 Volt Power	Phase A	Black
	Phase B	Red
	Phase C	Blue
	Neutral	White

DC Power	Positive Lead	Red
	Negative Lead	Black

DC Control	All wiring	Blue
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120 VAC Control	Single conductor 120 VAC control wire shall be RED except for a wire entering a motor control center compartment or control panel which is an interlock. This conductor shall be color coded YELLOW.	
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240 VAC Control	All wiring	ORANGE
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Equipment Grounding Conductor	All wiring	Green
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- 7) Phase sequence shall be A-B-C from rear to front, top to bottom, or left to right when facing the equipment.
- 8) The use of rigid hot-dipped galvanized steel or rigid aluminum electrical conduit is required. The contractor shall apply a section of heat shrink tubing to the conduit extending through and twelve (12) inches above and below concrete pads.

- 9) All panels shall be lockable and rated NEMA 4X minimum.
- 10) Weatherproof, insulated throat "Meyers" hubs shall be used on all conduit entries to panels, boxes, and devices without integral hubs.
- 11) All equipment shall be NEMA rated, IEC will not be accepted.
- 12) All electrical and control panels shall have weatherproof identifying labels attached with stainless steel screws, adhesive will not be acceptable.
- 13) All electrical conduits from wet well to control panel must be sealed to prevent gas entry to control panel or pump house enclosure. This only applies to conduit that enters the wet well area.
- 14) No electrical junction boxes or splices are permitted in the wet well.
- 15) All branch circuit panels shall have a typed index identifying breakers. Spare breakers are to be labeled "spare."
- 16) The owner shall be provided one complete set of spare fuses.
- 17) Conduit size, origin, destination, wire size and number of wires shall be shown on the plans.

RALEIGH WATER, BASIC TWO PUMP SEWAGE LIFT STATION MONITOR POINTS

DATA TYPE	DEFINITION	CONTROL HOOKUP
DI	CONTROL AC POWER FAIL	DRY CONTACT ON RELAY POWERED BY LOAD SIDE OF CONTROL CIRCUIT PROTECTED BY PHASE MONITOR THAT BREAKS CONTROL CIRCUIT
DI	HIGH WETWELL	DRY CONTACT ON HIGH WETWELL RELAY AND SEPARATE DIRECT FLOAT
DI	PUMP 1 BREAKER TRIPPED	DRY CONTACT ON RELAY POWERED BY LOAD SIDE OF BREAKER OR INTERNAL TO BREAKER
DI	PUMP 2 BREAKER TRIPPED	DRY CONTACT ON RELAY POWERED BY LOAD SIDE OF BREAKER OR INTERNAL TO BREAKER
DI	PUMP 1 O/L TRIPPED	AUX. DRY CONTRACT ON O/L
DI	PUMP 2 O/L TRIPPED	AUX. DRY CONTRACT ON O/L
DI	PUMP 1 RUNNING	AUX. DRY CONTACT ON MOTOR STARTER
DI	PUMP 2 RUNNING	AUX. DRY CONTACT ON MOTOR STARTER
DI	PUMP 1 PRIME FAIL	DRY CONTACT, MANUFACTURER PROVIDED
DI	PUMP 2 PRIME FAIL	DRY CONTACT, MANUFACTURER PROVIDED
DI	LAG PUMP RUNNING	DRY CONTACT, MANUFACTURER PROVIDED
DI	PM VISIT	ON DOOR OF RTU OR MOUNTED SWITCH
DI	GEN. RUN & HOUR METER	DRY CONTACT GENERATOR RUN RELAY
DI	GEN. FAIL, COMMON FAULT	DRY CONTACT COMMON FAULT RELAY
DI	GEN. WARNING, COMMON FAULT	DRY CONTACT COMMON WARNING RELAY
DI	TRX SWITCH EMERG/UTILITY POSITION	DRY CONTACT, TRX. SWITCH
DI	TRX SWITCH UTILITY POWER AVAILABLE	DRY CONTACT, TRX. SWITCH
DI	GEN. FUEL LOW	DRY CONTACT, MANUFACTURER PROVIDED
DI	GEN. FUEL TANK LEAK	DRY CONTACT, MANUFACTURER PROVIDED
DO	HIGH WETWELL HORN SILENCE	RELAY TO SILENCE ALARM HORN, NEEDS SCRIPT IN SCADA TO RESET AFTER 1 HOUR

Alarm wiring to be # 14 stranded MTW blue color. Pull alarm wiring in separate conduit from AC power circuits. Conduit size for alarm circuits to be min. 1" from PS control to RTU, 1" from generator to RTU and 3/4" from ATS to RTU.

These are basic points; site specific points will need to be addressed.

RALEIGH WATER, NEW SEWAGE PUMP STATION CHECKLIST

SITE:

THIS MUST BE COMPLETED IN FULL BEFORE RALEIGH WATER WILL ASSUME OPERATION AND MAINTENANCE OF SITE.

DATE	ITEM	COMMENTS	INITIAL
	AS BUILT PLANS PS & FORCE MAIN	NOTE 1	
	O&M MANUALS PS	NOTE 2	
	O&M MANUALS GENERATOR & TRANSFER SWITCH	NOTE 2	
	O&M MANUALS CHEMICAL FEED	NOTE 2	
	O&M MANUALS AIR RELEASE VALVES	NOTE 2	
	SPARE PARTS PUMP STATION	NOTES 3 and 4	
	SPARE PARTS GENERATOR	NOTE 5	
	SPARE PARTS FUSES	NOTE 7	
	RPZ TEST REPORT		
	GENERATOR START-UP TEST REPORT		
	PS START-UP TEST REPORT		
	CHEMICAL FEED START-UP TEST REPORT		
	SITE ADDRESS		
	KEYS, ELEC PANELS, GENERATOR, ETC.	NOTE 7	
	UTILITY BILLING ELECTRICAL SERVICE	NOTE 6	
	UTILITY BILLING WATER SERVICE	NOTE 6	

NOTES:

1. Provide one (1) hard paper, one (1) digital on CD
2. Provide three (3) copies O&M, original and bound
3. Provide one (1) pump motor, one (1) rotating assembly consisting of CW impeller and seal.
4. Provide one (1) CCW impeller key, nut and washer, one (1) mechanical seal, gaskets
5. Provide one (1) set of belts, air filter, fuel filter, and oil filter
6. Provide account info, so City can assume account
7. Provide one (1) complete set of each type and size used

7. Pretreatment Devices: Grease Interceptors and Oil/Water Separators

A. (Pretreatment Devices) Pretreatment Requirements for Food Services and Vehicle Maintenance facilities

- 1) All food service establishments and vehicle maintenance facilities shall have devices installed for separating and retaining grease and oils known as grease interceptors or separators approved by Raleigh Water. Operators of establishments whose grease interceptors or oil separators are not adequately maintained to prevent floatable oils, fats, and grease from entering the sanitary sewer system shall be notified in writing of any noncompliance and required to take immediate corrective action.
- 2) All food service establishment and vehicle maintenance facility grease interceptors or oil separators shall be subject to review, evaluation, and inspection by Raleigh Water representatives.
- 3) Food service establishment and vehicle maintenance facility operators who continue to violate the Raleigh Water Pretreatment requirements shall be subject to enforcement provisions of the Raleigh City Code.
- 4) Food service establishment and vehicle maintenance facility operators whose operations cause or allow excessive fats, oils, or greases of animal or plant-based origin to discharge or accumulate in the Raleigh Water sanitary sewer collection system may be liable to the City for costs related to line blockages, line cleanings, line and pump repairs, etc., including all labor, materials, and equipment. Food service establishment and vehicle maintenance facility operators that fail to pay the related charges will be subject to enforcement provisions of the Raleigh City Code.
- 5) Regularly scheduled maintenance of Pretreatment devices is required to ensure adequate operation.
 - a) All grease interceptors shall be completely pumped out at a minimum frequency of once per thirty (30) calendar days, unless a variance issued by Raleigh Water is allowed for less frequent pumping or a pretreatment discharge permit has been issued specifically for these devices.
 - b) For exterior grease interceptors shall be pumped dry when seventy-five percent (75%) of the retention capacity of the device inlet and or outlet compartment has been reached. (Or when twenty-five (25%) of the total volume of the grease trap is comprised of grease and solids.)
 - i. The business owner shall be responsible for ensuring that no waste or wastewater pumped from the grease interceptor or oil/water separator is reintroduced back into the device. This is a violation of the City Sanitary Sewer Use Ordinance and will result in enforcement action.
 - ii. Any Food Service Establishment or Vehicle Maintenance Facility whose pretreatment device(s) effluent discharges to the sanitary sewer collection system is determined by Raleigh Water to cause interference in the conveyance or operation of the sanitary sewer collection system may be required to sample the wastewater discharge and have it analyzed for oil and grease at the expense of the owner and leaseholder. Results of such analyses shall be reported to Raleigh Water.
 - c) All grease interceptors and oil separators shall be designed, installed, and maintained to allow for complete access for inspection and maintenance of the inner chamber(s) and sampling of effluent wastewater discharged to the sanitary

sewer in accordance with S-25, S-40, and S-41 design standards (Landscaping shall not prevent or inhibit access to the grease interceptor or oil separator.)

- d) Interceptors utilizing remote access ports for cleaning shall not be permitted.

B. Standards for New Facilities

- 1) All new food service establishments or vehicle maintenance facilities shall be required to install an adequately sized pretreatment device. Below are the required sizing procedures. Other sizing criteria may be considered but should be justified. Variances to the tank size requirements may also be considered if the space available does not allow for the installation of the appropriately sized grease interceptor (see Variance Procedures below).

C. Sizing Procedure for Food Service Establishments (FSE's)

- 1) The minimum size for grease interceptors shall be one thousand (1,000) Gallons.
- 2) The equation used for sizing grease interceptor:
 - a) Volume of Grease Interceptor (gallons) = [(A x B) + C + D] x F
 - b) "A" is GPM/fixture:

These values are derived from the Manning's Equation. The Manning's Equation takes into account the slope; roughness of the pipe, and pipe diameter size. Listed below are the drainage rates of various pipe diameters using the Manning's Equation:

Pipe Diameter (inches)	A GPM/Fixture
0.5	0.7
1.0	4
1.5	13
2.0	28
2.5	51
3.0	82

- c) "B" is the total sum of the Fixture Rating of Greasy Waste Streams.

Fixtures that have more grease in their waste stream received higher values while less grease corresponds to a lower rating. The table is shown below:

Table of Common Commercial Kitchen Fixtures and their Corresponding Rating:

Fixture	Rating
2 or 3 compartment pot sink	1.0
1 or 2 compartment meat prep sink	0.75
Pre-rinse sink	0.75
Wok/tilt kettle	1.0
1 or 2 compartment vegetable prep sink	0.1
Floor Drain	0

- d) “C” is the Direct Flow from Dishwashers, Sanitizers, Garbage Disposals, Food Waste Grinders, or Glass Washers.
- e) These flows must be added directly to the GPM flow. The manufacturer’s peak discharge rate for flow in GPM must be used.
- f) “D” is the Flow from Can Washes and Mop Sinks.
- g) Can washes and mop sinks are typically used intermittently. For the purpose of sizing, 7 GPM will be used for can washes and mop sinks.
- h) “F” is the Thirty (30) Minute Retention Time.

Example #1: A restaurant with the following fixtures (all fixtures have a 1.5” pipe dia.):

- (1) 3-comp pot sink
- (1) pre-rinse sink
- (1) 2-compartment vegetable prep sink
- (1) dishwasher that discharges 5 GPM
- (1) can wash

1) Use the above formula:

$$\text{Volume of Grease Interceptor (gallons)} = [(A \times B) + C + D] \times F$$

2) Solve for A,B,C, D and F

“A” is 13 GPM/Fixture because the pipe diameter is 1.5” (See table above)

“B” is the Fixture Rating

Fixture	Rating
2 or 3 compartment pot sink	1.0
Pre-rinse sink	0.75
1 or 2 compartment vegetable prep sink	0.1
Total (“B”) =	1.85

“C” is the Direct flow from Dishwashers etc.

The Dishwasher Discharges 5 GPM so “C” = 5 GPM

“D” is the Flow from the Can Wash = 7 GPM

“F” is the 30 min Retention Time

3) Solve the Equation

Volume of Grease Interceptor (gallons) = $[(13 \times 1.85) + 5 + 7] \times 30 \text{ minutes} = 1,082$ gallons

Round up to the minimum size of 1,000 gallons.

Example #2: A restaurant with the following fixtures:

1.5-inch pipe diameter:

- (1) 3-comp pot sink
- (2) meat prep sinks
- (1) vegetable prep sink
- (1) pre-rinse sink
- (1) dishwasher that discharges 10 GPM
- (1) can wash

1) Use the above formula:

Volume of Grease Interceptor (gallons) = $[(A \times B) + C + D] \times F$

2) Solve for A,B,C, D and F

“A” is 13 GPM/Fixture because the pipe diameter is 1.5” (See table above)

“B” is the Fixture Rating

Fixture	Rating
3 comp pot sink	1.0
Meat prep sink	0.75
Meat prep sink	0.75
Vegetable prep sink	0.1
Pre-rinse sink	0.75
Total “B”=	3.35

“C” is the Direct flow from Dishwashers etc.

The Dishwasher Discharges 10 GPM so “C” = 10 GPM

“D” is the Flow from the Can Wash = 7 GPM

“F” is the 30 min Retention Time

3) Solve the Equation

Volume of Grease Interceptor (gallons) = $[(13 \times 3.35) + 10 + 7] \times 30 \text{ minutes} = 1,817$ gallons

Round up to the next available size: 2,000 gallons.

D. Sizing Procedure for Single Fixture Only

- 1) When the space available does not allow for the installation of an exterior grease interceptor, sizing based on fixture size may be considered. A single fixture is considered a utensil wash sink, prep sink, culinary sink or other fixture where wastewater is discharged through a single outlet that contains fats, grease or oils.
 - a) **Step 1:** Determine the cubic contents of the fixture by multiplying length x width x depth.
 - b) **Step 2:** Determine the capacity in gallons. 1 gallon = 231 cubic inches.
 - c) **Step 3:** Determine the actual drainage load. The fixture is usually filled to about 75 percent of capacity with wastewater. The items to be washed displace about 25 percent of the fixture content. Actual drainage load = $0.75 \times (\text{fixture capacity})$
 - d) **Step 4:** Determine the drainage period (usually 1 or 2 min) and calculate the flow rate in GPM equal to or greater than 75 percent of the fixture capacity.
 - e) **Step 5:** Select the grease separation device that matches the calculated design flow rate.

E. Sizing Procedure for Vehicle Maintenance Facilities

- 1) The minimum size of grease interceptor or oil separator for a vehicle maintenance facility shall be one thousand (1,000 gallons).
- 2) Where automobiles are serviced, greased, repaired, or washed, the oil/water separators shall have a minimum capacity of six (6) cubic feet for the first one hundred (100) square feet of area to be drained, plus one (1) cubic foot for each additional one hundred (100) square feet of area to be drained into the oil/water separator.

Note: Parking garages in which servicing, repairing, or washing is not conducted, and in which gasoline is not dispensed, shall not require an oil/water separator. Areas of commercial garages utilized only for storage of automobiles are not required to be drained through an oil/water separator.

F. Additional Requirements for Food Service Establishments and Vehicle Maintenance Facilities

- 1) No new food service establishment or vehicle maintenance facility will be allowed to discharge wastewater to the City's collection system until an adequately sized grease interceptor, or oil/water separator is installed and approved by Raleigh Water. Grease interceptors shall conform to Details S-25, S-40, and S-41. Interceptors constructed of metal or carbon steel shall not be approved.
- 2) All grease interceptors and oil/water separators shall have each chamber directly accessible from the surface for servicing, maintaining, and sampling the device. Cleaning via use of remote port access shall not be an acceptable alternative to this requirement. All interceptors shall have installed an inlet and outlet sanitary tee as prescribed in the S-40 design standard. The ring and manhole covers shall be installed in such a way to prevent the exposure of the inlet and outlet chambers. Interceptors shall be installed so that the manhole covers, or interior interceptor lids are installed flush to grade.
- 3) A basket, screen, trap, or other intercepting device shall be installed within all fixture drains to prevent passage into the drainage system of solids one-half (1/2) inch or larger in size. The basket or device shall be removable for cleaning purposes.
- 4) All fixtures and drains receiving food service or vehicle maintenance wastewater shall pass through a grease interceptor or separator.

- 5) All new buildings or strip centers containing spaces designated for commercial enterprise are encouraged to provide a stub-out for a separate grease line to accommodate future grease interceptor or oil/water separator installation.
- 6) The owner of a new strip center shall provide suitable property space and sewer gradient that will be conducive for the installation of an exterior, in-ground grease interceptor(s) or oil/water separator(s) for any flex space contained within the strip center. Physical property restrictions and sewer gradient shall not be a defense for failure to install an exterior, in-ground grease interceptor or oil/water separator.
- 7) Shared Grease Interceptors
 - a) If a grease waste system is provided for a strip center a minimum of 1,000-gallons of grease interceptor capacity shall be added per food service establishment to calculate the total size of the installed system.
 - i. As an example, for a proposed center with four (4) food service establishments, 4 X 1,000 = 4,000-gallons of interceptor capacity would be required..
 - b) Initial plan review and approval will take place for construction of a strip center, however a business specific sizing calculation shall be submitted and approved for each potential food service establishment prior to interior completion. (This means that initial plan approvals for a strip center do not constitute approvals for each individual establishment seeking to use each space.)
 - c) Final approval of businesses to use a shared interceptor shall not exceed the total capacity allotted, regardless if the total number of establishments is less than what was planned.
 - d) A Maintenance Agreement from the management company shall be provided on the plumbing plan sheet (8.5" x 11" attachments will not be accepted) accepting responsibility for the operation, maintenance, fees, and any fines associated with the grease interceptor(s). This agreement should follow in perpetuity to all property owners.
- 8) All oil/water separators that are constructed of porous material must be coated with corrosion resistant epoxy to ensure that the tank will not leak. (Concrete oil separators must be coated with corrosion resistant epoxy.)
- 9) Mobile food establishments in a vehicle, cart, or trailer are typically required by the local health department to service these vehicles, trailers, or carts at a regulated commissary kitchen. Raleigh Water reserves the right to limit the number of mobile food establishments and / or revoke the use privileges of the mobile food establishment from discharging to the commissary's pretreatment device. Food Service Establishments seeking approval to function as commissary kitchen must meet the following requirements for approval:
 - a) Must have a functioning exterior gravity grease interceptor. Facilities with hydromechanical grease interceptors, located inside or outside of the building, will not be approved for use as a commissary kitchen.
 - b) Must have an exposed clean out connected to the inlet pipe of the exterior grease interceptor.
 - c) Must have a compliance history with no notices of violation within the twelve (12) month time period prior to requesting approval as a commissary.

- d) Must provide proof that an application with Wake County Environmental Services has been submitted for commissary approval.

10) Standards for Existing Facilities

- a) All existing food service establishments and vehicle maintenance facilities shall have grease interceptors or separators approved by the Raleigh Water Director or their designee. Food service establishments and vehicle maintenance facilities without a grease interceptor or separator will be given a compliance deadline to have a new grease interceptor/separator approved and installed. Failure to do so will be considered a violation of the City Sanitary Sewer Use Ordinance and may subject the business owner to penalty assessments and/or service termination.
 - b) In the event an existing food service establishment's and/or vehicle maintenance facility's grease interceptor or separator is either undersized or substandard in accordance with this ordinance, the owner and/or leaseholder will be notified of the deficiencies and required improvements and given a compliance deadline to conform to the requirements of this Ordinance. In the event the interceptor is determined to have any negative effects on the sanitary sewer system or pose any environmental risk immediate action shall be required. Failure to do so will be considered a violation of the City Sanitary Sewer Use Ordinance and may subject the facility to penalty assessments and/or service termination. There is no grandfather clause releasing the property owner of the responsibility to install or replace their pretreatment device.
 - c) For cases in which outdoor in-ground grease interceptors are infeasible to install, existing Food Service Establishments will be required to install adequate interior (hydromechanical) grease interceptors approved by Raleigh Water for use on plumbing fixtures that have the potential to convey fats, oils, or greases of animal or plant-based origin (See specifications section D. "Sizing Procedure for Single Fixture Only" above).
- G. Sizing of grease interceptors and separators shall be determined in accordance with procedures under specification section D. Sizing Procedure for Single Fixture Only.
- 1) The exclusive use of enzymes, emulsifiers, etc., is not considered an acceptable grease interceptor or separator maintenance practice.
 - 2) All new and existing Food Service Establishments or Vehicle Maintenance Facilities shall comply with these provisions as well as all applicable North Carolina State plumbing codes.
 - 3) Food Service Establishments or Vehicle Maintenance Facilities that are located in grease intensive areas or are out of compliance on a regular basis may be inspected more frequently until compliance is maintained.
 - 4) Maintenance, Reporting and Record Keeping
 - a) Maintenance records shall be kept onsite where the grease interceptor or oil/water separator is located. Maintenance records for a period of three (3) years shall be immediately available upon request. Maintenance records managed by a third party shall be kept on site and immediately available upon request.

- b) Grease interceptor maintenance records must include the following information.
 - FSE name and physical location
 - Date and time of grease interceptor service
 - Name of grease interceptor service company
 - Name and signature of person doing said service
 - Established service frequency and type of service (Example Full pump out, partial pump out, on site treatment, etc.)
 - Number and size of each grease interceptor serviced
 - Approximated amount, per best professional judgment, of grease and solids removed from each grease interceptor
 - Total volume of waste removed from each grease interceptor
 - Destination of removed wastes, food solids, and wastewater disposal
 - c) Maintenance records that do not include all the above information will be considered incomplete. Incomplete records are considered a violation of the City Sanitary Sewer Use Ordinance and may subject the facility to penalty assessments and/or service termination.
 - d) Facilities for which a specific pretreatment permit has been issued will follow the requirements for maintenance and record keeping as stated in the permit.
- 5) Variance to Tank Sizing Requirements
- a) Variance Requests are intended to give food service establishments and vehicle maintenance facilities an avenue to provide substantial evidence to reduce the size of the grease interceptor or oil separator. Said variance only applies to the size of the grease interceptor or separator. All other requirements of the City Sanitary Sewer Use Ordinance, NC plumbing code, or Raleigh Water Handbook remain in effect.
 - b) Food service establishments and vehicle maintenance facilities shall provide a written explanation for the need to vary from the pretreatment device requirements. All establishments requesting a variance shall agree to conform to the given variance stipulations. Raleigh Water has the right to dismiss the variance at any time the pretreatment device discharge adversely affects the sanitary sewer collection system and treatment works. Costs associated with meeting pretreatment device system requirements will not be accepted as a valid reason for granting a variance. Establishments must demonstrate that the scope of their operation will be conducive to an alteration in requirements without adversely impacting the sanitary sewer collection system.
 - Correspondence from Raleigh Water must be obtained prior to plan submittal for a building permit.

- c) The variances request shall be made to Raleigh Water regarding size and shall include the list below at a minimum. In addition, all variance requests must include a detailed future operation and maintenance plan that identifies the operational constraints, maintenance schedule, and oil and grease waste disposal procedures.
 - Facility location;
 - Menu items;
 - Seating capacity;
 - Facility square footage;
 - Appliance/fixture inventory;
 - Service type (single or full service);
 - Hours of operation;
 - Sizing calculation based on D. Sizing Procedures for Single Fixtures Only;
 - General plumbing description; and
 - Site plan or description.
 - d) Establishments that have been granted variances may be subject to having the allowed variance rescinded if the operation of the establishment changes in any way or if the wastewater discharge from the establishment begins to interfere with the sanitary sewer collection system.
- 6) Easement Map Requirements
- a) The City is standardizing the format for plat information. For a complete list of all information required, refer to the Planning and Development Customer Service Center. The following items must be included:
 - b) Minimum scale established – one (1) inch = fifty (50) feet;
 - c) Project title – consistent with council authorization;
 - d) Vicinity map;
 - e) Identify map number of total (example: map #9 of 14);
 - f) Street number on each parcel;
 - g) Owner name on each parcel;
 - h) Successive lot numbers on each parcel – beginning with Lot #1;
 - i) Locate footprint of structure on parcel;
 - j) Reference any recorded easements on each parcel;
 - k) “Line” legend somewhere on map;
 - l) Owner/parcel/take data table somewhere on map to include: Owner’s name, street address, Wake county Tax ID number (7 digit number), Lot number, each take listed, Parcel Deed Book and page number;
 - m) No easements labeled “utility”; and
 - n) No overlapping easements.

3.3 SEWER DESIGN – PRIVATE

1. Private sewer collection systems with a flow rate of two hundred thousand (200,000) GPD or more must apply to the NCDEQ Division of Water Resources – Water Quality Section for an operating permit. Please refer to Appendix F for a definition of what constitutes a private collection system. Private sewer collection systems located within the City's and Merger Communities' Utility Service Areas and proposed for connection to the City's public system now or in the future shall conform to all the public system standards listed within this document with the following conditions:
 - A. Private sewer collection lines shall not be required to be located in public road right-of-way or publicly dedicated easements.
 - B. Change of direction or slope for private six (6) inch sewers does not require manholes but does require cleanouts.
 - C. Cleanouts shall not be used for connection of private collections systems to public mains. Manholes are required.
 - D. Private sewers shall not be sized to handle any off-site sewer flows.
 - E. Ductile iron or PVC must be used with a minimum diameter of six (6) inches.
 - F. Profile drawings will not be required for 6-inch lines however, equivalent information must be provided on detail engineering plans such as minimum depth of cover, culvert elevations, slope, length of reach between manholes/cleanouts, pipe material, vertical separation of sewer from conflicting water main or storm drainage, etc. Profile drawings will be required for main sizes of eight (8) inch and larger. The minimum slope for six (6) inch lines is one percent (1.0%). Flow will be based on a half full pipe.
2. All new aerial sewer services shall be constructed of restrained joint pipe with a casing.

3.4 SEWER MATERIAL STANDARDS

1. GENERAL MATERIAL
 - A. Current specifications of the American Society for Testing Materials (ASTM), American Water Works Association (AWWA), the American National Standards Institute (ANSI), the American Association of State Highway and Transportation Officials (AASHTO), and Ductile Iron Pipe Research Association (DIPRA) shall apply in all cases where material is covered by an item in these specifications. All material used shall conform fully to these current standards or be removed from the job at the direction of the Raleigh Water Director or their designee.
 - B. Pipe specimens shall be subjected to tests by an independent testing laboratory at such time as Raleigh Water may direct or as specified herein. Pipe not meeting these specifications will be ordered removed by the inspector. Such pipe shall be immediately removed from the job site and not transported to any portion of the project being constructed.
 - C. These specifications are not to be considered as proprietary in any way. When a particular brand is listed, it is only used as an aid in describing the type of material being requested.
2. PIPE MATERIALS (Gravity Mains Only)
 - A. Centrifugally Cast Fiberglass Reinforced Polymer Mortar (CCFRPM) Pipe
 - 1) CCFRPM Pipe shall conform to ASTM D3262 for CCFRPM pipe manufactured of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) materials and to the following requirements.

- a) CCFRPM pipe shall be as manufactured by HOBAS Pipe USA or approved equal.
- b) CCFRPM pipe shall only be allowed for eighteen (18) inch diameter and larger pipes.
- c) Pipe shall be suitable for laying condition as shown in standard detail S-1 at the depth indicated on the drawings. Pipe manufacturer shall verify pipe selection and document to the Engineer prior to ordering and manufacture of pipe.
- d) Pipe shall conform to ASTM D2412 for minimum stiffness and external loading characteristics.
- e) Couplings, fittings, and push-on joints shall be manufactured with flexible elastomeric seals conforming to the requirements of ASTM D4161 and ASTM F477 and shall meet or exceed the pipe class at the location of its installation.
- f) Pipe joint shall be push-on type couplings unless specified otherwise.
- g) Pipe shall meet the minimum requirements of ASTM D3681 and ASTM D3262. Manufacturer shall provide complete ten thousand (10,000) hour test results on pipe produced at the proposed location of manufacture. Results shall reflect that the pipe has a minimum allowable strain of no less than nine-tenths percent (0.9%) at fifty (50) years when tested in accordance with ASTM D3681 and ASTM 3262.
- h) Normal production pipe for this project shall not incorporate raw materials that are not in compliance with ASTM D3681 and ASTM D3262
- i) Interior of the pipe shall be manufactured using a non-structural resin with a minimum allowable elongation of fifty percent (50%) when measured in accordance with ASTM D638. The liner nominal thickness shall be forty (40) millimeters.
- j) Exterior pipe surfaces shall be comprised of a layer of sand and resin to provide UV protection to the exterior.
- k) For pipe installed in steel encasement pipe joint shall be flush type and capable of meeting the above requirements.

B. Ductile Iron Pipe and Fittings

- 1) Ductile iron pipe and fittings used for sanitary sewers shall be manufactured in accordance with AWWA Standards C-150 and C-110 respectively. The minimum pressure class pipe shall be class 250. A greater class may be required based upon the depth of cover and laying conditions. Pipe shall be supplied in eighteen (18) or twenty (20) foot nominal lengths. Pipe and fittings shall have a minimum working pressure of two hundred and fifty (250) psi, and minimum iron strength of thirty thousand (30,000) psi. Ductile iron may be used for any sewer main eight (8) inch and larger. Pipe joints shall be the "Push-on" type manufactured in accordance with AWWA Standard C-111-95.
- 2) Interior Linings for Ductile Iron Force Mains and Sewer Interceptors
 - a) All force mains, fittings, and gravity interceptors twelve (12) inches and larger shall be lined with an amine cured Novolac ceramic epoxy containing at least twenty percent (20%) by volume of ceramic quartz pigment. The lining material shall have a permeability rating of zero when tested in accordance with Method A – ASTM E96-66, Procedure A with test duration of thirty (30) days. The lining shall be applied by a competent firm with a successful history of applying linings to the interior of ductile iron pipe and fittings. Within eight (8) hours of surface preparation, the interior of the pipe shall receive forty (40) millimeters nominal DFT.

No lining shall take place when the substrate or ambient temperature is below forty degrees (40°) F. The surface shall also be dry and dust free. The lining shall not be used on the faces of the flanges (if applicable).

- b) Due to the tolerances involved, the gasket area and spigot end up to six (6) inches back from the end of the spigot end must be coated with six (6) millimeters nominal, ten (10) millimeters maximum of PROTECTO Joint Compound or approved equal. The Joint Compound shall be applied by brush to ensure coverage. Care should be taken that the Joint Compound is smooth without excess buildup in the gasket seat or on the spigot ends. Coating of the gasket seat and spigot ends shall be done after the application of the lining.
- c) The number of coats of lining material applied and the touch up and repair of the lining shall be as recommended by the manufacturer. The pipe manufacturer shall provide a certification attesting that the application meets or exceeds the requirements of these specifications.
- d) Lining material shall be PROTECTO 401 or approved equal.

C. PVC Gravity Sanitary Sewer Pipe

- 1) All pipe and fittings shall use integral elastomeric rubber gaskets, which conform to the requirements of ASTM F477.
- 2) Nominal pipe length shall be a minimum of fourteen (14) feet, unless approved differently by the Raleigh Water Director or their designee.
- 3) Less than eighteen (18) inch Diameter:
 - a) Pipe shall be manufactured in accordance with all the requirements of ASTM D-3034 Type PSM Poly (Vinyl Chloride) Sewer Pipe and Fittings.
 - b) Pipe shall be SDR 26 (pipe stiffness of one hundred and fifteen (115) psi) or greater (higher stiffness).
 - c) Joints shall meet the requirements of ASTM D-3212.
- 4) Eighteen (18) inch Diameter and larger:
 - a) Pipe shall be manufactured in accordance with all the requirements of AWWA C900.
 - b) Pipe shall be DR 25 (pipe stiffness of one hundred and twenty-nine (129) psi) or greater (higher stiffness).
 - c) Joints shall meet the requirements of ASTM D-3139.

3. PIPE MATERIALS (Force Mains)

A. Polyvinyl Chloride (PVC) Force Main Pipe and Fittings

- 1) Pipe and fitting size, pressure class and DR shall be as indicated on the drawings.
- 2) PVC Materials shall comply with ASTM D1784 with a cell classification of 12454.
- 3) PVC force mains shall conform to the following requirements:
 - a) Outside diameter shall conform to Ductile Iron pipe.
 - b) Pipe shall meet AWWA C900 requirements and have a minimum fifty (50) year lifespan based on cyclical loading.
 - c) Pipe shall be a minimum of pressure class 200 with a minimum standard dimension ratio of DR21.

- d) Pipe shall have plain end and elastomeric-gasket bell ends.
- e) Fittings shall conform to AWWA C100 or C153 and have mechanical joints. Fittings shall be made of gray-iron or ductile iron. Interior of fittings shall be lined with Protecto 401 as specified above.

B. Ductile Iron Pipe and Fittings

- 1) All Ductile Iron sewer force mains shall be pressure class or thickness class ductile iron pipe designed in accordance with AWWA Standard C-150. Design shall be done for external and internal pressures separately, using the larger of the two (2) for the next design thickness. An additional allowance shall be made for corrosion and casting tolerances. The thickness design for external and internal pressures shall use the following conditions:
 - a) Three (3) feet minimum cover or as shown on the plans;
 - b) Laying condition - Type 1 per ANSI Standards;
 - c) A minimum working pressure of one hundred and fifty (150) psi for pipes sixteen (16) inches and smaller in diameter, and for twenty-four (24) inches and larger pipe, the design working pressure shall be as determined by the Raleigh Water Director or their designee, and
 - d) A surge pressure of three hundred (300) psi.
- 2) All calculations for thickness shall be in accordance with AWWA Standard C-150, and the calculations shall be submitted to the Raleigh Water Director or their designee for approval prior to shipping any pipe. The minimum thickness shall be pressure class 350 for pipes six (6) inches through twelve (12) inches and pressure class 250 for pipes sixteen (16) inches and larger in diameter.
- 3) The ductile iron pipe shall be manufactured in accordance with all applicable requirements of AWWA Standard C-151. The ductile iron pipe shall be supplied in nominal lengths of eighteen (18) or twenty (20) feet.
- 4) Ductile iron pipe shall be externally bituminous coated in accordance with AWWA C-151.
- 5) Pipe joints shall be mechanical or "push-on" manufactured in accordance with AWWA Standard C-111.
- 6) Each joint of ductile iron pipe shall be hydrostatically tested before the outside coating and inside lining are applied at the point of manufacture to five hundred (500) psi. Testing may be performed prior to machining bell and spigot. Failure of ductile iron pipe shall be defined as any rupture or leakage of the pipe wall.
- 7) All materials used in the production of the pipe are to be tested in accordance with AWWA Standard C-151 for their adequacy within the design of the pipe, and certified test results are to be provided to the City upon request. All certified tests, hydrostatic and material are to be performed by an independent testing laboratory at the expense of the pipe manufacturer.
- 8) Push-on and mechanical joint pipe shall be as manufactured by the American Cast Iron Pipe Company, United States Pipe and Foundry Company, Griffin Pipe Products Company, McWane Cast Iron Pipe Company, or approved equal.
- 9) Restrained joints shall be TR Flex or HP LOK as manufactured by U.S. Pipe, Lok-Ring or Flex-Ring as manufactured by American Pipe, Super-Lock as manufactured by Clow, Bolt-Lok or Snap-Lok as manufactured by Griffin or approved equal.

10) Bolts, nuts, and rods for restraint shall be 316 stamped stainless steel.

11) Interior Linings for Ductile Iron Force Mains

- a) All force mains and fittings shall be lined with an amine cured novalac ceramic epoxy containing at least twenty percent (20%) by volume of ceramic quartz pigment. The lining material shall have a permeability rating of zero when tested in accordance with Method A – ASTM E96-66, Procedure A with test duration of thirty (30) days. The lining shall be applied by a competent firm with a successful history of applying linings to the interior of ductile iron pipe and fittings. Within eight (8) hours of surface preparation, the interior of the pipe shall receive forty (40) millimeters nominal DFT. No lining shall take place when the substrate or ambient temperature is below forty degrees Fahrenheit (40° F). The surface shall also be dry and dust free. The lining shall not be used on the faces of the flanges (if applicable).
- b) Due to the tolerances involved, the gasket area and spigot end up to six (6) inches back from the end of the spigot end must be coated with six (6) millimeters nominal, ten (10) millimeters maximum of PROTECTO Joint Compound or approved equal. The Joint Compound shall be applied by brush to ensure coverage. Care should be taken that the Joint Compound is smooth without excess buildup in the gasket seat or on the spigot ends. Coating of the gasket seat and spigot ends shall be done after the application of the lining.
- c) The number of coats of lining material applied and the touch up and repair of the lining shall be as recommended by the manufacturer. The pipe manufacturer shall provide a certification attesting that the application meets or exceeds the requirements of these specifications.
- d) Lining material shall be PROTECTO 401 or approved equal.

C. High Density Polyethylene (HDPE) Force Main Pipe and Fittings

- 1) Pipe and fitting size, pressure class and DR shall be as indicated on the drawings. Pressure class shall be no less than PC200.
- 2) The pipe shall conform to the following requirements:
 - a) Meet the requirements of ANSI/AWWA C901 (three-quarter (3/4) inch to three (3) inches) or ANSI/AWWA C906 (four (4) inch to sixty-five (65) inches).
 - b) Outside diameter shall conform with ductile-iron pipe for pipes twenty (20) inch and smaller and iron pipe size for twenty-four (24) inch and above.
 - c) Material for pipe manufacturing shall be PE 4710 high density polyethylene (HDPE) with a minimum ASTM D3350 cell classification of 445574C.
 - d) Pipe shall be supplied with a green stripe along the entire length to designate wastewater pipe use.
 - e) Fittings shall be mechanical, butt fusion, or electrofusion and have pressure rating equal to the pipe. Use stiffening inserts in pipe ends where required. Stiffening inserts shall be stainless steel.

4. STEEL PIPE (AERIAL and BORED)

- A. Steel pipe for aerial creek crossings shall be high strength steel, helical or straight seam welded manufactured in accordance with ASTM A 139 and consisting of grade “B” steel with a minimum yield strength of thirty-five thousand (35,000) psi. Thickness, diameter, and allowable spans shall be according to Detail S-12.

- B. Boring installations shall be high strength steel, spiral welded or smooth-wall seamless manufactured in accordance with ASTM A252 and consisting of grade 2 steel with a minimum yield strength of thirty-five thousand (35,000) psi. The minimum inside diameter of steel encasements shall be eight (8) inches greater than the inside dimension of the carrier pipe. The minimum casing pipe wall thickness shall be three-eighths (0.375) inch for bored encasement and in accordance with the table provided below. Thicker encasement pipe may be required by the North Carolina Department of Transportation, railroads, or other agencies.

Encasement Diameter and Thickness by Nominal Pipe Diameter		
Carrier Pipe Nominal Diameter (inches)	Encasement Minimum Inside Diameter (inches)	Encasement Nominal Wall Thickness (inches)
6	14	0.375
8	16	0.375
10	18	0.375
12	20	0.375
14	24	0.375
16	26	0.500
18	30	0.500
20	32	0.500
24	36	0.625
30	42	0.625
36	48	0.750
42	56	0.875

- C. The outside of steel pipe for aerial crossings shall be coated with one (1) coat of a compatible acrylic polyurethane with a total dry film thickness of two to five (2–5) millimeter per coat. The Acrylic Polyurethane coating shall be Tnemec Endura Shield Series 73, or approved equal. Primer shall be applied as recommended by the manufacturer.
- D. No coatings required for buried or bored encasements but must conform to the noted wall thickness in the table above. All encasement pipe must be approved by the appropriate controlling agency (i.e. NCDOT, RR, etc.) prior to ordering the material.
- E. All carrier piping shall be restrained joint ductile iron TR Flex as manufactured by U.S. Pipe, Lok-Ring or Flex-Ring as manufactured by American Pipe, Super-Lock as manufactured by Clow, Bolt-Lok or Snap-Lok as manufactured by Griffin or approved equal. One (1) joint of restrained pipe must extend beyond the ends of the encasement pipe for boring installations. The restrained joint pipe shall be from manhole to manhole in aerial installations. The minimum inside diameter casing pipe shall be eight (8) inches greater than the inside dimension of the carrier pipe.

- F. Both ends of the casing shall be mortared. Metal "spider" pipe alignment devices shall be installed in all casings with a minimum of two (2) spiders per pipe joint one fourth of the pipe joint length in from both the bell and spigot ends. See Detail S-39.

5. CURED IN PLACE PIPE LINING (CIPP)

- A. CIPP lining may be allowed in lieu of replacing the existing downstream sewer main with Protecto 401 lined DIP or PVC pipe when a new force main discharges to an existing sanitary sewer main,
- B. When allowed, the CIPP must adhere to the following specifications.

References:

- 1) The latest revision of the publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.
American Society of Testing Materials (ASTM)
 - a) D790 Test Method for Flexural Properties of Unreinforced Plastics and Electrical Insulation Materials.
 - b) D2412 Test Method for determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
 - c) F1216 Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube.
- 2) Fabricate a flexible tube to a size that when installed will neatly fit the internal circumference of the conduit specified. Allowance shall be made for circumferential stretching during insertion.
- 3) The minimum length shall be that deemed necessary by the contractor to effectively span the distance from the inlet to the outlet of the respective manholes. The contractor shall verify the lengths in the field before impregnation. Individual inversion runs can be made over one or more manhole sections as determined in the field by the contractor and approved by the Engineer.
- 4) Furnish a general purpose, unsaturated, polyester resin and catalyst system compatible with the reconstruction inversion process that provides the cured physical strengths specified. CIPP lining shall be Insituform by Insituform Technologies, INC., Inliner by Inliner USA, Inc., KM-Inliner by Spiniello Limited, Inc. or Cure-Line by pipelining Products, Inc. or approved equal.

Physical Strength:

Physical Strength	
U.S. Licensor Standard	Results
Flexural Stress	#101 (Modified ASTM D-790) 4,500 psi
Flexural Modulus of Elasticity	#101 (Modified ASTM D-790) 250,000psi

Design Thickness:

- a) The liner shall be designed in accordance with the applicable provision of the referenced ASTM standards as structural pipe linings for "fully deteriorated gravity pipe conditions" and shall meet the following design conditions:
 - i. AASHTO H-20 Live Load with two (2) trucks passing CIPP in streets.

- ii. Soil weight one hundred and twenty (120) pounds per cubic foot. Coefficient of friction $K' = 0.130r$ for the installed depths.
- iii. Estimated maximum groundwater levels at the height of the manholes.
- iv. Service temperature range shall be forty to one hundred and fifty degrees Fahrenheit (40-150° F).
- v. All cured-in-place lines shall have the following minimum thickness shown in the table below, regardless of the thickness indicated by the design calculations.

Minimum Thickness by Nominal Pipe Diameter	
Nominal Pipe Diameter (inches)	Minimum Thickness (mm)
8	6.0
10	6.0
12	7.0
15	10.0
18	12.0
21	15.0
24	16.0
30	19.5
36	22.5
42	27.0
48	30.0

6. MANHOLES AND RELATED MATERIALS

- A. Manholes will be precast reinforced concrete. Eccentric or concentric cones may be used on eight to twelve (8-12) inch mains. Concentric cones will be used on all fifteen (15) inch and larger mains. These different type manholes shall conform to these specifications and the Raleigh Water Standard Details.
- B. All manholes located outside public right-of-way must be three feet above the one hundred (100) year flood or be sealed as per Details S-24 & S-27. "Candy cane" vent stacks on sewer manholes must be "factory" fabricated and "hot dipped" galvanized, not field fabricated and galvanized.
- C. All manholes with vent stacks shall be watertight per Detail S-24. All Cam Lock manhole covers outside the one hundred (100) year flood plain must be vented with one 1-inch hole in the cover and as per Detail S-27.
- D. All manhole covers installed within streets, parking lots, and other paved areas shall have only one one-inch (1 inch) hole, which shall be off center and fitted with a rubber grommet, unless seal-down manholes are required.
- E. Manholes on lines twelve (12) inches and larger in diameter shall be polymer concrete manholes or precast concrete manholes internally coated with a polyurea or epoxy coating.

F. Manholes that directly receive a force main discharge shall be polymer concrete manholes.

G. Polymer Concrete Manhole

- 1) All manholes receiving a sanitary sewer force main discharge and the next downstream manhole shall be made of polymer concrete. Manhole shall be made of resin, sand, and aggregate. All material shall be suitable for sewer applications. All additives used such as curing agents, pigments, dyes, fillers, or thixotropic agents shall not be detrimental to the manhole. The resin content shall be a minimum of seven percent (7%) by weight and resin shall be suitable for sewer applications. Reinforcement shall be acid resistant. Portland cement shall not be used.

H. Interior Linings for Existing Precast Reinforced Concrete Manholes

- 1) Existing manholes to be lined for protection from corrosion shall be lined with an epoxy system suitable for wastewater environments. The epoxy system shall be a spray applied, two (2) component, one hundred percent (100%) solids, solvent-free epoxy developed specifically for use in the wastewater environment. Epoxy liner shall be Raven 405, manufactured by Raven Lining Systems; Dura-Plate 5900 or 6100 manufactured by Sherwin-Williams; Perma-shield H2S Series 434 and Perma-glaze Series 435, manufactured by Tnemec, or approved equal.

I. Interior Linings for New Precast Reinforced Concrete Manholes

- 1) All sanitary sewer interceptor/outfall manholes on lines twelve (12) inches and larger, shall be polymer concrete manholes or internally coated with a polyurea/polyurethane coating. Duramer 1030 shall be applied in one coat of a twenty percent (20%) solids, deeply penetrating, dual-component polyurea primer (five-tenths to one (0.5 – 1.0) millimeters dry film thickness, one hundred and fifty (150) ft²/gal), one (1) intermediate coat of a dual component polyurea (fifty to one hundred (50-100) millimeters dry film thickness, fifty (50) ft²/gal) and one top coat of a sixty-five percent (65%) solids, two (2) part polyurea (seven-and-a-half to ten (7.5-10) millimeters dry film thickness, one hundred and twenty-five (125) ft²/gal). All coats can be applied by brush, spray, or roller. Sherflex Elastomeric Polyurethane shall be applied according to manufacturer's recommendations. Polyurea/polyurethane coatings shall be Duramer 1030 as manufactured by SewerKote, Sherflex Elastomeric Polyurethane as manufactured by Sherwin-Williams, or approved equal.
- 2) An epoxy liner system may be used on new manholes. Epoxy liner system shall meet requirements of Interior Linings for Existing Precast Reinforced Concrete Manholes listed above.
 - a) Precast Reinforced Concrete Manholes
 - i. The concentric and eccentric manholes shall be designed and manufactured in accordance with ASTM C478-97. Manhole shall be four, five, or six (4, 5, or 6) feet in diameter as determined by the table within Sewer Design standards for main size or depth. The walls shall be a minimum of five (5) inches thick and have a six (6) inch minimum base. O-ring or "ram neck" joint seal shall be used for all manhole joints. All exterior joints shall be wrapped with a butyl resin sealant of eight (8) inch width. The "O" ring joint shall conform to the requirements of ASTM C443-98. A flexible rubber boot shall be supplied with the manholes to tie the pipe to the barrel section. These gaskets and clamps shall meet the requirements of ASTM C923. See Detail S-24 – S-27.
 - ii. The manufacturer shall submit drawings showing the reinforcing, pipe openings and other details for approval by the Raleigh Water Director or their designee.

Also, the manufacturer shall provide certified test reports indicating that the materials comply with the requirements of ASTM C478-97. "Extended base" precast sections must comply with Detail S-21 dimensions and equivalent reinforcing.

J. Related Materials

- 1) Manhole rings and covers shall be manufactured to the dimensions shown on the Details S-25 through S-27 and shall be made from Class 30 gray iron, meeting the requirements of ASTM A48-94a or approved composite. All covers must be domestically cast and so indicated by manufacturer name and "USA" in castings. Covers shall have "DANGER PERMIT REQUIRED – CONFINED SPACE DO NOT ENTER" cast onto the face as shown in Detail S-25. All manhole rings on flat-top manholes shall be cast into the manhole top, as well as the flange for the vent stack, if applicable. See Details S-24. Cam Lock covers shall be used on all manholes that are within easements. See details 24 and 27.
- 2) All manhole covers installed within streets, parking lots, and other paved areas shall have only a single one (1) inch hole, which shall be off center, unless seal-down manholes are required. A rubber grommet should only be installed by maintenance personnel when an area is identified as a problem.
- 3) Manhole steps:
 - a) Shall be made from reinforcing steel which is rubber plastic coated to provide for safer footing.
 - b) Steps shall be furnished in accordance with the Detail S-28 and the applicable OSHA regulations.
- 4) Cement used in masonry or reinforced concrete units shall be Type I, CSA normal, meeting ASTM C150-99, unless otherwise approved by the Raleigh Water Director or their designee.

Concrete shall be only plant-mixed or transit-mixed concrete conforming to ASTM C33-99 as to aggregates and to ASTM C94/C94M-99 for ready-mixed concrete.

Concrete shall be of three types as based on twenty-eight (28) day compressive strength:

Concrete Type	
Concrete Type	28 Day Compressive Strength (psi)
Type AA	4500 psi
Type A	3000 psi
Type B	2500 psi

Concrete shall be air-entrained, unless specified otherwise, with four to six percent (4 - 6%) air. Retarders and accelerators shall be used only as directed by the engineer.

Concrete used for structures such as sewage lift stations and other reinforced concrete structures shall meet all applicable provisions of the NCDOT specifications regarding manufacturer, delivery, and placement.

- 5) Steel reinforcing for concrete structures shall meet all applicable provisions of the NCDOT specifications as to manufacture, fabrication and placement.
- 6) Mortar used for sewer structures shall conform to ASTM specification C144-99 as to aggregate and strength. Mortar shall be prepared from cement in perfect condition and

shall be prepared in boxes for that purpose. No mortar that has stood beyond forty-five (45) minutes shall be used. Proportion by volume for different kinds of work shall be:

- Brick Masonry – one (1) part cement to two (2) parts sand
 - Pointing – one (1) part cement to one (1) part sand
- 7) Rubber boot sleeves shall meet or exceed ASTM C923 for connecting pipes to thru the barrel section of the manhole. Boot sleeves shall have stainless steel expansion bands and pipe clamps that meet or exceed ASTM C923 and A167.
 - 8) Manhole inverts shall be constructed with a width equal to that of the effluent pipe, height to the springline and invert “shelves” from that point upward at a sixty-degree (60°) angle to the manhole walls. The invert shall be brushed and troweled that a minimum energy loss occurs in the manhole from invert roughness. “Bowl” shaped invert will not be allowed.

7. MISCELLANEOUS MATERIALS

A. PVC Sewer Service Pipe

- 1) PVC sewer service pipe shall be schedule 40 PVC including the clean-out stack provided that a bronze clean-out slotted plug for location purposes.

B. PVC Sewer Pipe and Saddles

- 1) PVC sewer pipe, saddles and adapters shall conform to the requirements of ASTM D3034-98. The saddle shall be installed in accordance with Standard Details S-31 and S-32.

C. Sewer Air Release/Vacuum Breaker Valve Material

- 1) Air release/vacuum breaker valves on sewer force mains shall be in accordance with Detail S-9.
- 2) Mounting bolts and nuts shall be 316 stamped stainless steel.

D. Concrete Structures and Access Hatches

- 1) All other concrete structures and access hatches installed within highway right of ways shall be H-20 load rated.

3.5 SEWER CONSTRUCTION STANDARDS

1. As part of the requirement to obtain construction approval for sewer main extensions, the engineer shall affix the appropriate permit sticker to the original drawings. The various permit stickers are included in appendix D.
2. The requirements contained in this section shall apply to sanitary sewer main installations constructed for Raleigh Water or for private developers who may or may not dedicate the sewer improvements to the City. All necessary construction permits must be obtained before construction may begin in accordance with the North Carolina State Law. A sewer plug permit must also be obtained.
3. Any Contractor performing work within the City or Merger Communities shall have a copy of these specifications on each job site.
4. Scope of Work
 - A. The contractor shall furnish all materials, equipment, and labor for excavation, installation, backfilling of sewer mains and related appurtenances as shown on the plans.
 - B. The City of Raleigh Public Infrastructure Inspectors and/or Raleigh Water Department shall conduct all City inspections on main extension projects.
 - C. It shall be the contractor's responsibility to schedule a pre-construction meeting in Raleigh and the Merger Communities prior to the start of any work.
 - D. On main replacement or upgrade projects that affect existing streets or established neighborhoods, it shall be the contractor's responsibility to provide notice to adjacent property owners fifteen (15) days before beginning any construction work on the project in accordance with NCGS Chapter 160A-499.4.
 - E. The City's website is the primary source of inspection information. See below to schedule inspections or view inspections information:
 - 1) Raleigh Water Phone Center
 - 2) Merger Community Water and Sewer Utility Inspection program on the Raleigh Website
 - 3) Inspection request on City Website
 - F. Once construction has begun, the contractor shall contact Planning and Development Department each morning by 9:00 a.m. to notify where and what will be done that day. The City requires a twenty-four (24) hour notice prior to an inspection. Any work requiring inspector's observation outside of the normal business hours, shall be charged at the current inspector hourly rate.
 - G. In all Sewer Bypass Pumping operations, a bypass plan sealed by a N.C. Professional Engineer must be submitted for approval to Raleigh Water prior to pumping operations (Plans may be submitted to administration staff at the Raleigh Water offices) Pumps should be sized to handle the peak daily flow (two-and-a-half (2.5) times the average daily flow) for the line or area of work. The contractor shall secure pumps from a pump supplier according to the provided flow information. Pumping operations must be monitored twenty-four (24) hours a day for each day of the pumping operation by qualified personnel in order to respond to problems or failures. One hundred percent (100%) redundancy is required for pumping operations. In addition, back up pumps are to be connected to the bypass force main to facilitate immediate use upon failure of the primary pumps. Sewer service outages must be scheduled one week in advance and may not last longer than eight hours. After

installation, the sewer bypass pumping system shall be pressure tested prior to being placed in service.

- H. If a developer, engineer, or contractor proceeds with the main installation prior to permit issuance the City requires the main to be reinstalled and the developer, engineer or contractor shall be fully liable for all actions and costs, including prosecution by the City or the State for proceeding with installation prior to issuance of appropriate permit(s).
- I. "Field changes" are not considered approved by Raleigh Water unless revised plans have been submitted to Raleigh Water, reviewed and approved. Therefore, the contractor that proceeds with construction prior to this approval is at their own risk.
- J. Contractors working (excavation, boring, blasting, or other subsurface breach) around or in the vicinity of sewer force mains eight (8) inches in diameter or larger shall be required to physically spot the existing line to be verified by Raleigh Water distribution staff or inspection staff. If other existing lines sizes are in question of conflict the contractor shall be directed by Raleigh Water staff of the level of subsurface investigation needed to locate the existing line.

5. General Testing Requirements

- A. The City may perform and shall require the contractor to perform, such destructive and nondestructive testing, as it deems necessary in order to inspect the materials and work. See specific testing requirements within this section. These tests shall be in accordance with the procedures established by ASTM and AASHTO. The City shall reserve the right to modify the procedures in testing ditch and backfill compaction to allow a deeper test to be made by using the sand-cone method and/or nuclear testing gauges.
- B. All new sanitary sewer mains must be cleaned to the satisfaction of the inspector by jetting or bailing prior to final inspection and acceptance by the City.
- C. Prior to final inspection all sanitary sewer mains shall be camera inspected. In areas where the manholes are installed within the street, the camera inspection shall take place just prior to the final lift of surface course asphalt. Failed inspections will require a follow up inspection and subsequent re-inspection fee.

6. Sewer Construction Plugs

- A. A sewer plug permit must be obtained during construction and is issued by the field inspector at the time of plug installation. See General Policies and Regulation Section for application.
- B. Mechanical plugs (non-pneumatic) must be installed for the duration of construction of any sanitary sewer extension. Plugs are to be installed on the upstream end of the new main at the first manhole from the existing tie-in, until final acceptance.
- C. All plugs must be securely tied off with steel cable within the manhole and must have a secure marking attached to the plug indicating the utility contractor to whom the plug belongs.
- D. All plugs must be monitored during construction to ensure the plug is functioning as required.
- E. Prior to removing the plug, the contractor must sign a plug removal form verifying that the sewer facilities are sufficient and functionally complete. All plugs must be removed by the contractor upon acceptance that the sewer facilities are sufficiently functionally complete to accept flow and prior to the mains above the plug location being placed into service and/or accepting any flow of sewage.

7. Handling and Storage of Materials

- A. All PVC sewer pipe shall be protected from the sun's ultraviolet rays if stored on the job site longer than twenty (20) days.
 - B. Machined manhole frames and covers shall remain intact until construction is complete.
8. Trench preparation
- A. Trench excavation shall conform to the line and depth shown on the plans. The trench shall be properly braced and shored so that workers may work safely and efficiently. When water is being pumped from the trench, the pump discharge shall follow natural drainage channels, drains or storm sewers. In no case may trench water or groundwater be pumped into or allowed to enter the sanitary sewer system. See erosion control section for appropriate siltation prevention measures prior to pumping.
 - B. The width and type of trench may vary with the depth of cut, and the trench shall be constructed in accordance with the dimensions and other information shown on Details S-4 and S-5.
 - C. Pipe Clearance in rock shall be a minimum of six (6) inches on each side and bottom for mains fifteen inches (15) in diameter and less. For larger size mains, the minimum clearance shall be nine inches (9) on the sides and bottom.
 - D. If unstable conditions are encountered, the trench shall conform to the requirements as stated in this Handbook.
9. Pipe Installation
- A. The pipe material listed above shall be installed in accordance with the manufacturer's recommendations and the requirements of these specifications.
 - B. All sewer mains and manholes shall be laid to the line and grade shown on the plans.
 - C. No deviations from line and grade shall be made unless they have been approved by Raleigh Water or Engineer and identified on the "as-builts".
 - D. The sewer pipe installation shall start at the outlet end and proceed upstream to the termination of the project as shown on the plans. The bell ends shall point upstream. Exceptions to this provision will be considered on a case-by-case basis, when requested in writing by the owner of the development at the time engineering construction plans are submitted to the City for review and approval. The development owner must agree to hold the City harmless. They must accept full responsibility for compliance with state and federal regulations of the Clean Water Act, including any associated penalties which could reach up to twenty-five thousand dollars a day (\$25,000/day), for the release of wastewater from sanitary sewer to the environment, which are not connected to existing sewer due to the granting of an exception to the pipe laying sequence required in the Public Utilities Handbook. The development owner must further agree to not request building permits, if an exception is granted for that portion of the development, until connecting sewer is constructed and accepted by the City.
 - E. While working on any part of an existing sewer main, the contractor shall maintain the existing sewage flow. No discharge of sewage to the storm waters will be allowed. Water for the flushing of new sanitary sewer mains must be obtained through a fire hydrant meter and must be pumped out and may not be discharged into the sanitary sewer system. Construction requiring existing sewer flow to be pumped from existing manholes shall be the responsibility of the contractor and must be approved prior to proceeding by the Raleigh Water Director or their designee or the City Inspector according to Section 3.5.4.G Sewer Bypass Pumping requirements.

- F. After the trench foundation has been properly graded with bell holes, the pipe shall be carefully lowered into the trench with approved methods. Under no circumstances shall the pipe or accessories be dropped or dumped into the trench. All damaged pipe shall be properly repaired or replaced at the contractor's expense.
- G. The pipe interior shall be kept clean before and after installation by means approved by the Raleigh Water Director or their designee or Engineer. Pipe ends shall be plugged at the end of each workday or when work is temporarily stopped. The plugs shall be watertight so the water and debris will be kept out.
- H. When installing a sewer main, the horizontal separation from any water main shall be ten (10) feet. If this separation cannot be maintained due to existing conditions, the variation allowed is the water main in a separate trench with the elevation of the water main at least eighteen (18) inches above the top of the sewer and must be approved by the Raleigh Water Director or their designee. All distances are measured from the outside diameter to outside diameter. Where it is impossible to obtain proper separation, or anytime a sanitary sewer passes over a water main, DIP materials or steel encasement extended ten (10) on each side of crossing must be specified and installed to waterline specifications.
- I. Maintain eighteen (18) inches minimum vertical separation at all sanitary sewer and storm drain crossings. Where adequate separations cannot be achieved, specify DIP materials and a concrete cradle having six (6) inch minimum clearance (per Raleigh Water detail S-49).
- J. All other underground utilities shall cross water and sewer facilities with eighteen (18) inch minimum vertical separation required.
- K. Railroad crossings shall be made following all precautionary construction measures required by the railroad officials.
- L. All sewer crossings under state system roads shall be made in accordance with the requirements of NCDOT as defined in their encroachment permits.
- M. Where conditions are, in the opinion of Raleigh Water or Engineer, unsuitable for laying pipe because of weather or trench conditions, the Contractor shall be required to cease work until permission is given by the Raleigh Water Director or their designee or Engineer for work to commence again, providing such conditions have been corrected.
- N. In accordance with North Carolina General Statute 87-121(g), all underground utilities installed after October 1, 2014, shall be electronically locatable.
 - 1) All new gravity sewer main and sanitary sewer lateral shall be provided tracing wire in such a manner as to be able to properly trace all mains and laterals without loss or deterioration of signal or without the transmitted signal migrating off the trace wire.
 - 2) Tracing shall be #12 gauge solid (bare) copper and continuous to the greatest extent possible. The tracer wire shall be securely bonded together at all wire joints with an approved industrial crimp connector to provide electrical continuity. It shall be accessible at all tracer wire test ports.
 - 3) For gravity mains, test ports shall be provided at frequency of five hundred (500) feet or at every manhole, whichever is the shorter of the distance. The test port shall consist of a standard valve box and shall be H-20 traffic load rated flush with grade in non-paved areas with concrete collar as shown on detail W-17, and flush with final asphalt or concrete pavement elevation and shall be located over the downstream or outgoing main.
 - 4) The valve box shall be equipped with a lid stamped "TS" and painted green. At each test port, a loop of wire shall be brought up and looped inside the box. The loop of wire inside the box shall be a minimum of three (3) feet. All tracing wire for branch mains

and laterals that terminate into the manhole shall be routed around the circumference of the manhole and spliced to the main tracing line.

- 5) For sanitary sewer laterals, the cleanout at the right of way and or easement shall serve as the test port with the tracing wire brought up outside the cleanout assembly and wrapped around the assembly stack twice at a depth of approximately twelve (12) inches below grade. Extend a loop of the wire to the top of cleanout.
 - 6) For new sanitary sewer laterals where no tracer is installed on the main, provide an anode (one (1) pound minimum) for the tracing wire termination at the point of the new tap on the existing main.
 - 7) For gravity main and or lateral installations less than 8 feet, the tracing wire shall be attached to the pipe. Tracer wire shall be laid flat and securely affixed to the pipe at ten (10) foot intervals. Where lateral taps are made by service saddles, the tracer wire shall not be allowed to be placed between the saddle and main.
 - 8) For gravity main and or lateral installation deeper than eight (8) feet, the tracing wire shall be installed at a depth of seven to eight (7-8) feet. The wire shall be protected from damage during the execution of the work. No breaks or cuts in the tracer wire shall be permitted. Spliced connections shall only be allowed between the main liner tracer wire and branch main and lateral tracer wire. Industrial crimps shall be used to provide electrical continuity and the crimps shall be similar metal to eliminate galvanic corrosion.
 - 9) Contractor shall perform a continuity test on all tracer wire in the presence of the Owner or Owner's representative. If the tracer wire is found to be not continuous after testing, Contractor shall repair or replace the failed segment of wire at their own expense.
 - 10) Where existing branch mains are reconnected to a main line that is replaced or realigned, tracing wire is not required for the section of branch main that is reconnected unless it is replaced from manhole to manhole.
 - 11) All main lines that are replaced or realigned shall be provided tracing wire. For gravity sewer mains and laterals that are installed in encasement pipe, the tracing wire shall be routed through the encasement pipe.
 - 12) Manhole markers shall be placed adjacent to manholes at the discretion of Owner or Owner's representative. Refer to Details S-20A and S-30A. Copper clad steel tracer wire (#12) as manufactured by Copperhead Industries, or approved equal is an approved alternative to #12 bare solid copper tracer wire.
- O. All non-ferrous force mains and other pressure mains shall be provided tracing wire and test ports in accordance with the requirements for gravity mains, except test ports with marker posts shall be located at bends and no further than three hundred (300) feet apart.

10. Laying CCFRPM Gravity Sewer Pipe

All CCFRPM pipe shall be installed per manufacturer recommendations and the following requirements:

- 1) Do not exceed forces recommended by the manufacturer when joining pipe.
- 2) Gasket shall be wiped clean prior to joining. Damaged, defective, or bulging gaskets shall be replaced with a new coupling.
- 3) Wipe the plain end of pipe clean prior to insertion in the socket.
- 4) Apply joint lubricant, as approved by the pipe manufacturer, to pipe end and elastomeric gaskets.

- 5) For handling pipe, use textile slings or other suitable materials or a forklift. Use of cables or chains is not permitted. Damaged pipe will be rejected.
- 6) Pipe shall be free of nicks, scratches, and gouges at the time of installation. Visible gouges shall be cause for rejection of pipe.
- 7) For depths of cover of zero to forty (0-40) feet CCFRPM pipe shall be bedded in a minimum of six (6) inches Class I material. Embedment and initial backfill shall be Class I material to six (6) inches above the top of pipe. Backfill the remaining six (6) inches of initial backfill with Class I, II, or III material. Install geotextile fabric wrap as shown in detail. See Detail S-1.

11. Laying PVC Gravity Sewer Pipe

- A. The foundation for PVC gravity sewer pipes shall be a firm flat bottom trench of four (4) inches of Class I material as defined in ASTM D2321 compacted with bell holes. See Details S-2, S-3, and S-5. Class II material may be used if contractor can verify that this type of soil is native to the site by having soil tests made by a soil testing agency. Sample borings shall be taken on two hundred (200) feet intervals and to a depth equal to or greater than the trench bottom shown on the plans. The results must be approved by the Raleigh Water Director or their designee prior to pipe installation.

12. Laying PVC Gravity Sewer Pipe

- A. Install C900 and C905 PVC pipe in conformance with AWWA C605. Bell and spigot ends shall be cleaned prior to jointing. Ends of field cut pipe shall be beveled with file. Gasket shall be clean and lightly lubricated. Joint shall be made as recommended by the manufacturer.

13. Laying Ductile Iron Sewer Pipe

- A. Ductile iron pipe shall be installed in accordance with the requirements of AWWA Standard C-600. See Detail S-4.
- B. Sewer pipe shall be laid to the line and grade shown on the plans. There shall be a minimum horizontal separation between water and sewer utilities of ten feet and a vertical separation of eighteen (18) inches.
- C. Protection shall be afforded to all underground and surface structures using methods acceptable to the Raleigh Water Director or their designee or Engineer. This protection shall be furnished by the contractor at the contractors' own expense.
- D. Deviation from line and grade may be made on revised plans upon approval by Raleigh Water and identified on "as built" when such deviations arise from grade or line conflicts with existing utilities, structures or other sources of conflict.
- E. Subsurface explorations shall be made by the contractor at the direction of the Raleigh Water Director or their designee or Engineer where it is necessary to determine the location of existing pipes, valves or other underground structures.
- F. Depth of pipe cover, unless shown otherwise on the plans shall be a minimum of three feet outside of travel ways and five feet inside of travel ways. Depth of cover shall be measured from the established street grade or the surface of the permanent improvement to the top of the barrel of the pipe.
- G. After the foundation has been properly graded, bedded when applicable, and the bell holes dug, the pipe and accessories shall be carefully lowered into the trench by approved methods. Under no circumstances shall the pipe or accessories be dropped or dumped into the trench.

All damaged pipe and accessories shall be removed from the job. All damaged pipe shall be replaced at the expense of the contractor.

- H. Installation of pipe and jointing of pipe shall be done according to manufacturer's recommendation with care being taken to provide uniform bearing for the pipe. Bell and spigot of pipe shall be cleaned and properly lubricated where a mechanical joint of a "push on" type joint is employed.
- I. Open ends of pipe shall be plugged with a standard plug or cap at all times when pipe installation is not in progress. Trench water shall not be permitted to enter pipe.
- J. Bell ends will face the direction of installation which must be upgrade unless otherwise directed by the Raleigh Water Director or their designee or Engineer.
- K. Where conditions are, in the opinion of the City Inspector, unsuitable for pipe installation because of weather or trench conditions, the contractor shall be required to cease work until permission is given by the City Inspector for work to commence again providing such conditions have been corrected.

14. Installing CIPP Liner (Hot Water or Steam Cured)

- A. Adhere to the methods listed below to produce a high-quality rehabilitated pipeline by the cured-in-place inversion method. The finished product is to be of highest quality and shall eliminate infiltration problems which exist in the existing wastewater pipeline.
- B. Installation Preparation: The following installation preparation procedures shall be adhered to by the Contractor.
 - 1) Cleaning of Sewer Line: Remove debris from the sewer line in accordance with Raleigh Water standards.
 - 2) Inspection of Pipelines: Perform inspection of pipelines shall be by experienced personnel trained in locating breaks, obstacles, and service connections by closed circuit television and pipe PACP scored. Carefully inspect the interior of the pipeline to determine the location of conditions which may prevent proper installation and it shall be noted so that these conditions can be corrected. Internal T.V. inspection shall be in accordance with Raleigh Water standards.
 - 3) Bypassing Sewage: Provide for the flow of sewage around the section or sections of pipe designated for reconstruction. The bypass shall be made in accordance with Raleigh Water Standards set forth in this Handbook.
 - 4) Line Obstructions: Clear the line of obstruction such as solids, dropped joints, protruding service connections or collapse pipe that will prevent the installation. If inspection reveals an obstruction that cannot be removed by conventional sewer cleaning equipment, then make a point repair excavation to uncover and remove or repair the obstruction. Such excavation shall be approved in writing by the engineer prior to the commencement of the work.
- C. Installation Procedure
 - 1) Designate a location where the reconstruction tube will be vacuum impregnate prior to the installation. Allow the engineer to inspect the materials and "wet-out" procedure. Use a catalyst system compatible with the resin and reconstruction tube.
 - 2) The wet out reconstruction tube shall be inserted through an existing manhole or other approved access by means of an inversion process and the application of hydrostatic head or air pressure sufficient to fully extend it to the next designated manhole or termination point. Insert the reconstruction tube into the vertical inversion standpipe

with the impermeable plastic membrane side out. At the lower end of the inversion standpipe, the reconstruction tube shall be turned inside out and attached to the standpipe so that a leak proof seal is created. The inversion head will be adjusted to be of sufficient height to cause the impregnate tube in the invert from manhole to manhole and hold the tube tight to the pipe wall, produce dimples at side connections and flared ends at the manholes. The use of a lubricant is recommended. Care shall be taken during the elevated curing temperature so as not to overstress the felt fiber. In certain cases, the contractor may elect to use a top inversion where the reconstruction tube is attached to the top ring and the standpipe is formed from the reconstruction tube itself.

- 3) Curing: After inversion is completed, supply a suitable heat source and water recirculation equipment, if using hot water curing. Equipment shall be capable of delivering hot water or steam throughout the section by uniformly raising the water or steam temperature above the temperature required to affect a cure of the resin. The temperature shall be determined by the resin/catalyst system employed.
- 4) Fit heat source with suitable monitors to gauge the temperature of the incoming and outgoing water or steam supply. Place a gauge between the impregnated reconstruction tube and the pipe invert at the remote manhole to determine the temperature during cure. Water temperature in the line during the cure period shall be as recommended by the resin manufacturer. Initial cure shall be deemed to be completed when inspection of the exposed portion of cured pipe appears to be hard and sound and the remote temperature sensor indicates that the temperature is of a magnitude to realize an exothermic. The cure period shall be of a duration recommended by the resin manufacturer, as modified for the cured in place inversion process, during which time the steam or recirculation of the water and cycling of the heat exchanger to maintain the temperature continues.
- 5) Cool down: cool the hardened pipe to a temperature below one hundred degrees Fahrenheit (100° F) before relieving the pressure or relieving the static head in the inversion standpipe. For hot water cure, cool-down may be accomplished by the introduction of cool water into the inversion standpipe to replace water being drained from a small hole made in the downstream end. Care shall be taken in the release of the static head so that a vacuum will not be developed that could damage the newly installed pipe.
- 6) Finish: the finished pipe shall be continuous over the entire length of an inversion run and be as free as commercially practicable from vision defects such as foreign inclusions, dry spots, pinholes, and delaminating.
- 7) Sealing pipe at manholes: if due to broken or misaligned pipe at the manhole wall, the new pipe fails to make a tight seal, apply the seal at that point. The seal shall be of a resin mixture compatible with the pipe.
- 8) Service connections: Fully reopen the existing active service connections in each length of sewer following lining. Reopen service connections from inside the sewer by means of a closed-circuit television camera, controlled cutting device appropriate for CIPP lining and the rehabilitates sewer pipe. Clean and neatly cut openings flush with the lateral pipe. Liner penetrations of openings shall be watertight.
- 9) Air test and Camera the main per specifications below. Additional sampling and/or testing may be required by the City to inspect the materials and work. These tests shall be in accordance with the procedures established by ASTM and AASHTO. The wet out and cure logs shall be made available to the Raleigh Water Director or their designee or Engineer upon request and must be kept in an orderly manner.

15. Sewer Laterals

- A. Pipe for four (4) inch sewer laterals shall be PVC or DIP. Where installation by boring is specified, four (4) inch ductile iron pipe shall be used. DIP (four (4) inch only) must be used for deep or shallow installations under the same standards as sewer mains. Aerial service installations shall be constructed of four (4) inches DIP. A minimum grade of one percent (1%) shall be maintained with four and six-inch pipe. Each lateral shall be sealed at the end with an approved watertight plug. Lateral installation for four (4) inch services shall conform to Standard Detail S-30. A six (6) inch service lateral must connect to a manhole. All laterals shall be left exposed until the inspectors can verify the installation of each plug.
- B. Each sewer lateral shall be installed from the main to the street right-of-way line or easement line where a one (1) piece combination wye and one-eighth (1/8) bend and cleanout stack will be installed. The wyes on the laterals shall be sealed at the property line with a permanent plug.
- C. Trench support, bedding and backfill for laterals shall conform to the same specifications as those for sewer mains. Class II, III, and IV materials may be used for PVC sewer lateral bedding in lieu of Class I materials. The contractor shall properly backfill under all wye and lateral connections at the main. The lateral connection at the main shall be backfilled with #67 stone.
- D. Where laterals are bored, the face of the bore cut shall be a distance of five feet from the edge of the pavement on either side, unless approval to the contrary is given by the Raleigh Water Director or their designee.
- E. Sewer laterals four (4) inches in diameter shall be connected to the main by means of an in-line wye or a tap and saddle, installed over a hole cut in the top quadrant of the main at an angle of forty-five degrees (45°), with respect to direction of flow. The hole shall be cut with a mechanical circle type saw cutter designed for the particular use and rendering a smooth, uniform cut with no damage to the main and which retrieves the coupon. See saddle installations on Standard Detail S-31.
- F. All four (4) inch sewer services may be tapped directly into eight, ten, and twelve (8, 10, and 12) inch mains or manholes in accordance with Details S-31 and S-32. Taps can only be made by using a mechanical tapping machine or other approved device. All sanitary sewer service connections six (6) inches and larger shall be made into manholes only. Service connections on mains fifteen (15) inches and larger are only allowed at manholes. Service clean-outs shall be located at the right-of-way line or the easement boundary line. The maximum vertical drop for a six (6) inch service into a manhole shall be ten (10) feet.
- G. All laterals tapped on newly constructed mains shall be air tested with the main. All laterals tied to a newly constructed manhole shall be vacuum tested with the manhole or conduct a separate air or water head test before any plumber connections are made.

16. Manholes

- A. Manhole dimensions shall conform to those shown on Detail S-24. Manholes on all lines twelve (12) inches in diameter or smaller shall have an inside diameter of four (4) feet.
- B. Inverts shall be constructed with a width equal to that of the effluent pipe, height to the springline and invert "shelves" from that point upward at sixty degrees (60°). to manhole walls, it shall be so brushed and troweled that a minimum energy loss occurs in the manhole from invert roughness. The maximum grade on an invert of less than two-and-a-half (2.5) feet shall be no greater than six (6) inches across the manhole. "Bowl" shaped inverts shall not be allowed in the sanitary sewer collection system.
- C. Foundation for manholes shall be in accordance with Detail S-21, unless approval to the contrary is given by the Raleigh Water Director or their designee.

- D. All manholes in road right-of-ways will be flush with grade not withstanding one hundred (100) year flood requirements. In easements, manholes will be a minimum of twelve (12) inches above ground.
- E. All new manholes must be vacuum tested in accordance with the following procedure:
- 1) The Contractor shall furnish all labor, equipment, and any appurtenant items necessary to satisfactorily perform the vacuum test. All equipment will be approved for vacuum testing.
 - 2) All lifting holes shall be plugged with an approved non-shrink grout.
 - 3) All pipes entering the manhole shall be plugged. The contractor shall securely brace the plugs to keep them from being drawn into the manhole. All service connections tied to manholes shall also be vacuum tested with the manholes.
 - 4) The test head shall be placed inside the top of the cone section of the manhole and the seal inflated in accordance with the manufacturer's recommendations.
 - 5) Manhole vacuum tester shall be as manufactured by Cherne Manhole Testing or approved equal. A vacuum of ten (10) inches of mercury shall be drawn and the vacuum pump shut off. Inflate the compressor band to effect a seal between the vacuum base and the manhole cone section. Connect the vacuum pump to the outlet port with the valve open. With the valves closed, the time for the vacuum to drop one (1) inch of mercury to a total of nine (9) inches of mercury shall not be less than that shown in the following table.

Minimum Mercury Drop Time (seconds)			
Manhole Depth (feet)	Manhole Diameter (inches)		
	48" Dia.	60" Dia.	72" Dia.
≤10 ft.	60 Sec.	75 Sec.	90 Sec.
>10 ft. but <15 ft.	75 Sec.	90 Sec.	105 Sec.
≥15 ft.	90 Sec.	105 Sec.	120 Sec.

(Times shown are minimum elapsed times for a drop-in vacuum of one (1) inch of mercury).

- 6) If the manhole fails the initial test, necessary repairs shall be made with an approved non-shrink grout while the vacuum is still being drawn. Retesting shall proceed and continue until a satisfactory test is accomplished.
- F. All manhole rings on manholes other than flat-tops shall be bolted to the cone section and sealed down with asphaltic cement or "ram-neck". See Detail S-25.
- G. All manhole joints must be waterproofed with asphaltic cement or "ram-neck". All exterior joints shall be wrapped with a butyl resin sealant of eight (8) inch width.
- H. All main and service pipe connections into manholes must be cored with a concrete coring machine and the pipe connection must be made with a flexible rubber boot.
- I. Adjustment rings used within streets shall be fixed with mortar or a urethane-based manhole joint seal by A.I.T. or approved equal.
- J. Adjustment rings may be concrete, polymer concrete, HDPE, or approved equal.
17. Backfilling

- A. The backfilling of the trench after the pipe installation and testing shall be in accordance with Details S-4, S-5 and S-1 for the various pipe materials.
- 1) For depths of cover of zero to forty (0-40) feet CCFRPM pipe shall be bedded in a minimum of six (6) inches of Class I material. Embedment and initial backfill shall be Class I material to six (6) inches above the top of pipe. Backfill the remaining six (6) inches of initial backfill with Class I, II, or III material. See Detail S-1.
 - 2) The haunching for PVC pipes shall be with #67 stone (Class I material) four (4) inches below and up to the springline of the pipe. Care shall be taken to work the haunching well under the bottom of the pipe. The initial and final backfill shall be with suitable native material. No rocks, boulders or stones four inches or larger shall be included in the backfill. The haunching shall be tamped to ninety-five percent (95%) standard Proctor density in six (6) inch lifts.
 - 3) For PVC sewer installations, Class II material may be allowed for the bedding, housing and initial backfill if the contractor can verify that this type of soil is native to the site by having soil tests made by a soil testing agency. Soil sample borings shall be taken as directed by the City inspector to a depth equal to or greater than the trench bottom elevation shown on the plans or in the specs. The results must be approved by the Raleigh Water Director or their designee prior to pipe installation. The bedding and backfilling shall be in conformance with ASTM standards and the various soil classes are defined below:
 - a) Class I - Angular, six to forty (6-40) millimeters (one-quarter to one-and-a-half (1/4-1 1/2) inch), graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.
 - b) Class II - Coarse sands and gravels with maximum particle size of forty (40) millimeter (one-and-a-half (1 1/2) inch), including variously graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class. (GW - well graded gravel, GP - poorly graded gravel, SW - well graded sand, SP - poorly graded sand.)
 - c) Class III - Fine sand and clay type gravels, including fine sands, sand-clay mixtures and gravel-clay mixtures. Soil Types GM, GC, SM, and SC are included in this class. (GM - silty gravel, GC - clayey gravel, SM - silty sand, SC - clayey sand.)
 - d) Class IV - Silt, silty clays, and clays, including inorganic clays and silts of medium to high plasticity and liquid limits. Soil Types MH, ML, CH and CL are included in this class. These materials are not recommended for bedding, haunching, or initial backfill on PVC pipes. (MH - silty soil with high liquid limit, ML - silty soil with low liquid limit, CH - clayey soil with high liquid limit, CL - clayey soil with low liquid limit.)
 - 4) All backfill shall be compacted in six (6) inch lifts measured from the foundation to one (1) foot above the top of the pipe and then in twelve (12) inch lifts to the top of the trench when in easements. Sewer mains in street rights-of-way shall be compacted in six (6) inch lifts all the way to the top of the trench.
 - 5) Material for backfilling shall be approved by the inspector. In areas where settlement or bearing capacity are not a major consideration, the engineer may give permission for a low grade of material to be backfilled from a point two (2) foot above the top of the pipe, but in no event will excavated rock larger than four (4) inches at any point be used for backfill material.

- 6) Where backfill material is unsuitable, in the opinion of the Raleigh Water Director or their designee or Engineer, the contractor may be directed to dispose of the unsuitable material and provide material suitable to the Raleigh Water Director or their designee or Engineer.
- 7) All backfill shall be compacted in six-inch lifts measured from the pipe foundation upward. Backfill for roadway shall be compacted to at least ninety-five percent (95%) of maximum soil density in those areas where the supporting capacity of the soil is of prime consideration. Laboratory determination of maximum soil density will follow the procedure of AASHTO T99-86. Field determination of the density of the soil in place shall follow the procedure of AASHTO T191-86 or T204-86. The result of any one (1) of the tests may be a minimum of ninety percent (90%) of maximum density, but the average of any three (3) tests in an area shall be ninety-five (95%) of maximum density. All tests shall be conducted at the direction of the City Inspector, and the cost of such tests will be borne by the contractor with the provision that the City will test an area two (2) times only where both tests fail. The contractor shall then be required to submit satisfactory evidence that their ditch compaction meets the specifications.

B. PVC Force mains

- 1) PVC pipe shall be installed in accordance with AWWA C605. At a minimum, all PVC pipes shall be installed at a Type 3 laying condition as specified by AWWA C605 for depth of installation from four to ten (4-10) feet measured from the top of the pipe. The Type 3 laying condition requires the pipe to be bedded on a minimum of four (4) inches of select granular material that will conform to the bottom of the pipe. Select granular material shall consist of well-graded sand, gravel, crushed gravel, crushed stone, or crushed slag composed of hard, tough, and durable particles, and shall contain no more than ten percent (10%) by weight of material passing seventy-five-thousandths (0.075) millimeters (No. 200) mesh sieve and no less than ninety-five percent (95 %) by weight passing the twenty-five (25) millimeters (one (1) inch) sieve. Pipe installation on a flat bottom trench is unacceptable.
- 2) Embedment material shall be compacted to the top of the pipe. When using mechanical compactors, avoid contact with the pipe. When compacting over the pipe crown, a minimum cover of at least eight (8) inches or more in conformance with the manufacturer's requirements shall be maintained over the top of the pipe prior to compacting. The maximum embedment sizing shall be limited to materials passing a three-quarter (3/4) inch sieve for angular materials or one-and-a-half (1 1/2)-inches for rounded rock. Embedment materials consisting of select material or native soils shall be well drained, granular, free of rocks and other foreign materials, and shall be selected and placed to prevent gouges, crimping, or puncture of pipe, joints, or appurtenances.

18. Maintaining Service

- A. When replacing or extending sewer mains, the contractor shall maintain existing service to all property being served through bypass pumping or other means of maintaining service.

19. Test and Inspection (Gravity sewers)

- A. Sewer lines shall be visually inspected from every manhole by use of television cameras, or other devices for visual inspections, and the lines shall exhibit a fully circular pattern when viewed from one manhole to the next. Lines which do not exhibit a true line and grade and have structural defects shall be corrected to meet these specifications.
- B. Sewer mains, services, and manholes shall be camera tested prior to the start of the Warranty period and prior to final acceptance at the completion of the Warranty period. For

commercial installations, the Warranty period extends for one year after all site final infrastructure inspections are completed. For residential installations, the Warranty period extends for a minimum of one year or until 75% of Certificate of Occupancies are approved within the phase.

- C. Sewer lines will be tested by using the low-pressure air test. Sewer laterals will be tested along with the main. It is imperative that proper plugs be installed on the laterals at the cleanout stack. All plugs should be properly installed to withstand the test pressure. Mechanical plugs must be installed throughout the time of construction of any sanitary sewer extension, until final acceptance. All plugs must be securely tied off with steel cable within the manhole and must have a secure marking attached to the plug indicating the utility contractor to whom the plug belongs. All plugs must be removed by the contractor upon acceptance that the sewer facilities are sufficiently functionally complete so as to accept flow and prior to the mains above the plug location being placed into service and/or accepting any flow of sewage. A completed plug installation/ removal form completed by the inspector is required for plug usage. A fine of \$500 will be applied for all violations.
- D. The low-pressure air test in accordance with ASTM F1417 or C924 (F1417 for PVC and Ductile; C924 for Concrete Pipe) will be used on all mains and laterals. Prior to testing, the main shall be clean of debris (to the satisfaction of the inspector) and flushed with water. In doing the air test, it is necessary that plugs be secured properly and braced. In doing the air test, no person will be allowed in the system while it is pressurized. The line is to be pressurized to four (4) psi initially and stabilized. After stabilization, the pressure will be decreased to three-and-a-half (3.5) psi, and the inspector will determine how long it takes for the pressure in the line to drop to two-and-a-half (2.5) psi.

To simplify the ASTM procedure, use the following table to determine the test time. If there are multiple sizes, add the various times together.

Test Time by Normal Pipe Diameter	
Normal Pipe Diameter (inches)	Time (minutes/100 ft.)
4	0.3
6	0.7
8	1.2
10	1.5
12	1.8
15	2.1
18	2.4
21	3.0
24	3.6
27	4.2
30	4.8
33	5.4
36	6.0
42	7.3

If the pressure stays between three-and-a-half (3.5) and two-and-a-half (2.5) psi for the test time length, the pipe is acceptable. If not, the section is not properly installed. Correct and retest.

- 1) A hydrostatic leakage exfiltration or infiltration test shall not exceed one hundred (100) gallons per inch of pipe diameter per mile per day for any section of the system. An exfiltration or infiltration test shall be performed with a minimum positive head of two (2) feet. All tests shall be made in the presence of the contractor or their representative and the Raleigh Water Director or their designee, City Inspector or Engineer.
- 2) Materials and construction methods called for in these specifications are of such nature as to insure maximum protection for the sewer from infiltration. The contractor shall be responsible for the sewer conforming to the above limits for duration of the Warranty period.
- 3) When sanitary sewer services are installed as a part of the same approval of the sanitary sewer mains, such as in new developments or annexation areas, the air test of the sewer mains shall be performed with the services and clean-outs in place. Services tied to a newly constructed manhole shall be vacuum tested with the manhole. Services not tested with newly constructed mains or manholes shall have a separate air test before any plumber connections are made.

20. Deflection Testing for PVC Sewer Pipes

- A. No sooner than thirty (30) days after final backfill installation, a deflection test shall be executed on the sewer line. The maximum allowable deflection shall be five percent (5%) for PVC sewer pipes. The test shall use a minimum of nine (9) pronged mandrel pulled through the pipe. The mandrel size shall be calculated by (one (1) allowable deflection percent) x (Base Inside Diameter). The base inside diameter is the diameter as identified in the shop drawing or advertised pipe literature. It shall not include any additional reduction pipe diameter due to manufacturing tolerances.
- B. The contact length of the mandrel shall be at least eight (8) inches.
- C. Any lines not meeting this test shall be corrected by the contractor and the test repeated.
- D. During bypass and pipe upgrade scenarios, deflection testing may not be required at the discretion of the inspector.

21. CCTV Inspection

- A. CCTV testing is required for all sewer mains within the public right of way, public easements, and private installations. CCTV inspection and approval are required prior to any private sewer service connections onto a new system. As the end of the Warranty period approaches, CCTV inspection and approval are also required prior to final acceptance of the public infrastructure. The City of Raleigh will provide CCTV services at either occurrence noted above, but not both. The Developer / Contractor is responsible for the cost of one approved CCTV inspection via Third Party or additional fees paid to the City for services.
- B. CCTV inspection may be scheduled after approval of the Engineer submitted as-builts, a complete flushing of the system witnessed by the Inspector, and proper grouting and adjustments made to the manholes to insure no future infiltration.

- C. All failed CCTV inspections must be repaired at the directive of the City of Raleigh and retested.
- D. Re-inspection fees will be assessed for each failed inspection prior to rescheduling.
- E. Third Party CCTV Inspection requirements
 - 1) All third party inspections must be performed by an approved City of Raleigh vendor. Vendor approval is granted by the City of Raleigh Public Utilities Sewer Maintenance Division. Please contact RALEIGH WATER at 919-996-3245
 - 2) Visually inspect sewer line by means of closed-circuit television. Perform inspection on one manhole section at a time in accordance with National Association of Sewer Service Companies (NASSCO) Pipeline Assessment and Certification (PACP) standards. The inspection report shall be in NASSCO PACP v.7 Database format and recorded onto external hard drive, thumb drive, or cloud-based server as agreed upon by Contractor and City of Raleigh Public Utilities Department (RALEIGH WATER). All inspection reports and photographs shall become the property of RALEIGH WATER.
 - 3) CCTV Inspection shall follow Contractor's cleaning operation.
 - 4) Television camera used for the inspection shall be one specifically designed and constructed for such inspection. Lighting for the camera shall be suitable to allow a clear picture for the entire periphery of the pipe. Camera shall be operative in 100 percent humidity conditions. Components of the video system shall be capable of producing a high-resolution (minimum 300 line) images and video. Lighting system shall minimize reflective glare.
 - 5) Move camera through the line in either direction at a uniform rate, but in no case at a speed greater than 30 feet per minute. Stop camera when necessary to insure proper documentation of the sewer's condition. Camera cables shall not obstruct the camera view or interfere with proper documentation of the sewer. If the camera will not pass through the entire sewer section, re-set the equipment to allow inspection from the opposite manhole.
 - 6) Whenever non-remote powered and controlled winches are used to pull the television camera through the line, suitable means of communication shall be set up between the two manholes of the inspected section to ensure that good communication exists between members of the crew.
 - 7) Measurement for location of defects shall be above ground by means of a meter device. Marking on cable which would require interpolation for depth of manhole, will not be allowed. Measurement meters will be accurate to two tenths (0.2) of a foot over the length of the section being inspected. Accuracy of the measurement meters shall be checked daily by use of a walking meter, roll-a-tape or other suitable device.
 - 8) Prepare and maintain printed location records that clearly show the location, in relation to adjacent manholes, of each service lateral connection and defect requiring repair. During each inspection, make visual and audio recordings of the data on the television monitor onto external hard drive, thumb drive, or cloud-based server as agreed upon by Contractor and RALEIGH WATER. Label copies of the recordings and logs as to the content. Labels shall include the sewer segment reach designation, street location and manhole facility identifications numbers on the tape. Contractor shall obtain most current manhole ID numbers from City before CCTV.
 - 9) For live mains in use, the contractor is required to conduct CCTV during low flow periods (overnight) if flow in pipe is too high during normal working hours for existing

active lines. If bypass pumping is required, notify Owner, Engineer and Raleigh Water for approval.

- 10) CCTV inspection approvals will be provided per project and/or phase completed. Approval boundaries are defined by the limits identified in the Raleigh Water approved utility phasing plan(s). Acceptance of individual lines, unapproved sub-phases and/or partially complete phases will not be considered. A digital copy of as-built plans clearly identifying the limits of proposed CCTV inspection(s) shall be provided to Raleigh Water prior to commencing CCTV inspections.
- 11) Statement of review from a Professional Engineer.
- 12) All failed CCTV inspections or footage review by Raleigh Water staff will result in a reinspection fee.

22. Pigging (Force Main Sewers)

- A. All new mains with gate valves must be pigged with a polyethylene "pig", five (5) #/cubic foot density, at the conclusion of installation.
- B. The pig must be blown at the end of the main by means of the following:
 - 1) Four (4) inch mains: four (4) inch blow-off
 - 2) Six (6) inch mains: six (6) inch blow-off
 - 3) Eight (8) inch and twelve (12) inch mains: blow-off assembly as shown on Standard Water Details W-21 and W-22
 - 4) Sixteen to twenty-four (16 – 24) inch mains: to be determined by the field inspector.
- C. The contractor installing the line shall write the name of the company and street name in which the work is taking place on the pig in a manner in which it will not rub off.

23. Hydrostatic Testing (Force Main Sewers)

- A. All main installations shall be pressure tested between each main line valve in accordance with the latest AWWA Standard C-600-87. The test shall be performed using a suitable pump and an accurate pressure gauge. Immediately upon completion of a section of main, one hundred and fifty plus or minus five (150 ± 5) psi of pressure shall be applied and held for two hours. The acceptable leakage rate shall not exceed ninety-two-thousandths (0.092) gallons per inch of pipe diameter per one thousand (1,000) feet of pipe per hour.
- B. Failure of the force main to comply with the above acceptable leakage rate shall require the contractor to replace any defective materials to insure a watertight installation. After any inadequacies have been corrected, the leakage rate will again be tested. This test shall be repeated until that portion of main is brought to compliance with the permissible leakage rate.
- C. Prerequisite conditions for inspection prior to testing shall be as follows:
 - 1) Valves shall be properly located, operable, and at correct elevation. Valve boxes or manholes shall be centered over operating nuts, and the top of the box or manhole shall be at proper elevation.
 - 2) Lines shall be properly vented where entrapped air is a consideration.

24. Hydrostatic Testing (Tapping Sleeve and Valve)

- A. A Raleigh Water representative shall be present for testing. After installation of the tapping sleeve and valve and prior to performing the tap, the assembly shall be hydrostatically tested at a pressure of eighty (80) psi. Pressure shall be maintained with no loss for a minimum time of fifteen (15) minutes. Tapping sleeves shall not be air tested.

25. Sewer Bypass Testing

- A. Perform leakage and pressure test of the temporary bypass pumping system using clean water prior to placing bypass system in service. Minimum pressure for leakage and pressure tests shall be one-and-a-half (1.5) times the maximum bypass system working pressure. Testing shall last a period of two (2) hours. Document and submit pressure at start of test, at fifteen (15) minute intervals, and end of test.

26. Sewer Main and Service Stub Abandonment

A. Sewer Main

- 1) Sewer main abandonment must be performed in accordance with a plan approved by the Raleigh Water. Main to be abandoned shall be flushed clean and each end plugged with a minimum eighteen (18) inches long concrete plug. Some mains (e.g. located under a building) may require filling all of the pipe with flowable fill. This will be determined by Raleigh Water on a case-by-case basis.

B. Sewer Service

- 1) Sewer service stub to a main shall be abandoned by removing the saddle and replacing the saddle with a three hundred and sixty degrees (360°) stainless steel sleeve. At in-line wyes the service lateral shall be cut within twelve (12) inches of the wye and a mechanical cap installed on DIP/cast services or glued to PVC services and the abandoned wye to be surrounded with one cubic foot (1 ft³) of concrete. The remaining portion of the sewer service stub shall be removed from the main to the right of way line and shall be disposed of properly. Service stub and main abandonment require a stub permit for inspection by the Planning and Development Department. Raleigh Public Utilities Department will oversee stub abandonment in the Merger Communities.

C. General Requirements

- 1) A Property owner is responsible for proper abandonment of all unused existing service stubs.
- 2) All abandoned meters are to be removed by the Raleigh Meters Division prior to service abandonment.
- 3) The Raleigh Public Utilities operations staff will not abandon an existing service stub unless it is part of a service renewal as required by ordinance.
- 4) For circumstances that may not be addressed by this clarification or a variance from this procedure please contact the Raleigh Public Utilities Department Development.

LICENSED UTILITY CONTRACTOR REQUIRED SERVICE ABANDONMENT PERMITS

Contractor installed domestic (3/4" thru 12"), irrigation water (3/4" thru 10"), sewer (4" thru 8") and fire hydrant (6") service stub;

Commercial; All domestic and/or irrigation, sewer and fire hydrant abandonment requires a stub permit for each connection to a water or sewer main.

Residential/Individual; All domestic water and/or irrigation and sewer service stubs abandonment installation requires a stub permit. Exception; Irrigation splits installed with a new domestic service. Irrigation splits on an existing tap requires a stub permit.

Demolition Permits; Plans are required to show all existing services to be abandoned included temporary construction water using existing meter(s). Plan review required.

Sewer Stubs in Easements; A licensed and bonded utility or plumbing contractor may install a sewer stub on a sewer main located within a dedicated easement and requires the issuance of a stub permit. Raleigh Ordinance 10-6082

Right-of-Way permits are required for pavement repair in ROW.

Raleigh Water Capital Projects

A licensed utility contractor performing City contracted water or sewer main replacement work is not required to obtain a stub or Right-of-way permit for abandoned services or mains.

Water and Sewer Main Abandonment

All water and sewer main abandonment requires plan submittal for review by the Raleigh Public Utilities Development Staff by submission of plans through the Raleigh Development Customer Service Center

27. Sewer Backwater Valve

- A. Pursuant to NC State Plumbing Code, homes and other buildings constructed with sanitary sewer drains with an elevation lower than one (1) foot above the next upstream manhole in the sanitary sewer collection system must be equipped with a sewer backwater valve, installed at a location where it can be maintained. See Details S-38 and S-42.

28. As-Built Plans

- A. Surveyed As-Built plans and profiles shall be furnished to Raleigh Water by the Engineer upon completion of the project.
- B. All coordinates shall tie into the NC grid coordinate system (NAD1983 State Plane) and the vertical datum NAVD88. All units are to be US survey feet. The closest geodetic monument to the project shall be identified in the "as-built" plans.

- C. All current Wake County parcel information in the project area is to be defined and properly labeled. All streets in the project area shall be defined and labeled.
- D. All “as-built” plans shall include a vicinity map and an overall site or utility plan and be clearly marked as an “as-built plan” or “record drawing”. The plan shall include the following information on a twenty-four by thirty-six (24x36) inch layout (paper for initial walk-through, mylar for final): “as-built” date, project title, permit number, page numbering, north arrow, scale of drawing, bar scale, all easements including book and page reference and dimensioned, pipe section, pipe size, pipe material, fitting type defined, valve type defined, meters, backflow preventers, length of bore and jack, abandoned and/or removed features, and connections to existing utilities.
- E. All service stubs shall be shown, and all mains shall be labeled as public or private.
- F. A twenty-four by thirty-six (24x36) inch paper copy shall be submitted to the Inspections Department for review and comment before initial walk-through. Once these comments are addressed, a twenty-four by thirty-six (24x36) inch mylar copy of each sheet shall be re-submitted. In addition to hard copy mylars, a PDF file of each signed and sealed mylar sheet must be submitted. A CAD file of utilities should show the overall water system as-built layout along with the property or subdivision boundaries. DWG, DGN, DXF, and SHP are acceptable formats. Please save CAD files in “model space” on the current NC State Plane grid. A comma-delimited text file or Microsoft Excel file of survey information is required with the following columns: FeatureType (Valve, Meter, Tee, etc.), X coordinate, Y coordinate, Z coordinate, Size, and Description. See example below.

FeatureType	X	Y	Z	Size	Description
Tee	2086904.78	732688.47	349.69	12x12x6	DI tee
Valve	2086907.12	7326892.41	349.78	6”	Gate valve
Hydrant	2086910.49	7326899.57	352.62	4.5”	2012 Mueller Super Centurion 250
Meter Box	2085638.36	731998.1	368.23	5/8”	specify domestic or irrigation
BFP	2085639.24	731996.33	368.35	3/4”	RPZ

- G. Digital as-built data submittals shall be on a USB flash drive or transmitted electronically to the Raleigh Water GIS group and shall include the following:
 - 1) Project name;
 - 2) Name of firm which prepared the data;
 - 3) As-built date, as depicted on mylar submittal;
 - 4) Permit number(s); and
 - 5) Raleigh Water plan identification number (if applicable).
- H. Each digital as-built submittal shall include the following on digital media:
 - 1) PDF files for each mylar sheet submitted;
 - 2) PDF file(s) for recorded plat(s);

- 3) CAD file (see above); and
 - 4) Data file denoting the coordinates and description for each utility feature in the project scope (see table above).
- I. Each plan sheet showing as-built information shall have an engineer's certification with N.C.P.E. seal, signature and date. See certification text below.

ENGINEER CERTIFICATION STATEMENT

I, _____, as a duly registered Professional Engineer in the State of North Carolina, having been authorized to observe (___ periodically, ___ weekly, ___ full time) the construction of the project, _____, hereby state that, to the best of my abilities, due care and diligence was used in the observation of the construction such that by my inspection of the constructed improvements and my review of the as-built survey data, I hereby certify that the (1)public improvements, (2) private improvements, and (3) public safety of the above referenced project as constructed are in compliance with the requirements of the improvements as prescribed in the approved Construction Drawings, approved design documents, and/or any approved modifications, except as noted in red on the 'As-Built' drawings. Furthermore, I certify that the red-noted exceptions do not adversely affect the required performance or public safety aspects of the improvements.

Name: _____ Date: _____

NCPE Seal:

END OF SECTION 3

SECTION 4

REUSE

DESIGN, MATERIAL, AND CONSTRUCTION STANDARDS

4.1 REUSE DESIGN STANDARDS

1. The words “Reuse” and “Reclaimed” are used interchangeably in this document.
2. Unless otherwise indicated, all standards apply to Public Reuse systems. Private Reuse Systems are prohibited. Private reuse services with multiple branches and meters may be permitted by the Raleigh Water Director or their designee on a case by case basis. Unless otherwise indicated, all standards apply to private reuse services. Described in this section are the general design standards, which are to be followed by all parties in preparing development, utility extension, and utility replacement plans for Raleigh Water. These design standards will ensure that the citizens of Raleigh will have a safe, reliable, and quality reuse water system. Reuse water service is subject to the availability and capacity of facilities, as determined by the City. The City shall control and schedule availability of reuse water.
3. All engineering plans for reuse systems must meet State and City minimum design standards as indicated in the most recent amended North Carolina Administrative Code Title 15A Subchapter 2T Section .0200 by the N.C. Department of Environmental Quality, Division of Water Resources, Water Quality Section and/or this Raleigh Water Handbook, whichever is the more stringent. All projects except for residential connections must be certified by the engineer of record or the City Engineer. The engineer shall be responsible for determining the reuse water pressure at the point of connection and adequacy for services at the highest point of the project. Reuse water pressure information is available from the Public Utilities Administrative office.
4. Plan and profile drawings shall be prepared by a professional engineer registered in the State of North Carolina, signed, sealed, and dated showing the various elements of the utility mains and shall include an overall utility plan layout on a single sheet with scale no smaller than one (1) inch = two hundred (200) feet. The design of improvements must be based upon actual field verification by the engineer of existing utilities. The utility drawings shall be on separate sheets, free of landscaping and other details not pertinent to the utility plans. A separate landscaping plan must be submitted with the utility plan showing any proposed landscaping and all water, sewer, and reuse utilities or easement. Landscaping plans shall include all reuse irrigation system components and show setbacks from streams, wells, property lines, vertical/horizontal separations to water, sewer, reuse lines and any other features required to show compliance with the State and City rules governing reuse water. All adjacent tracts and topographic information must be shown on the landscaping plan. The water, sewer, and reuse drawings may be on the same sheets. Landscaping plans shall show all utility engineering drawings and shall be on paper twenty-four by thirty-six (24x36). No private reuse service connection or utilization system may be installed without a reuse utilization permit from the Raleigh Water Reuse Division Superintendent. The Reuse Division Superintendent reserves the right to require additional information on all submitted plans on a case by case basis to determine the appropriate utilization of reuse water. See the flow chart and application in appendix C.
5. Once installed, certified surveyed “as built” plans shall be provided to the City showing the utilities. “As built” drawings for the utilities shall be submitted to Raleigh Water prior to acceptance of the project by the City. For development projects in the Communities, as-builts must be submitted directly to the inspector.

4.2 REUSE DESIGN – PUBLIC

1. Location Conditions for Design

- A. All reuse mains shall be installed within dedicated street rights-of-way except major transmission mains not affording direct service connection or within Raleigh Water dedicated reuse easements. Reuse mains within the street right-of-way shall be a minimum of five (5) feet from the outside of the pipe to the edge of the right-of-way. Greater separation may be required for greater depth. Reuse mains as specified by Raleigh Water will be marked as indicated on Standard Reuse Detail R-10 and as described in the Identification section of these specifications. The City reserves the right to determine the location of reuse service lines.
- B. Minimum widths of permanent and construction reuse easements for public reuse mains are twenty (20) feet each.
- C. Larger size easements may be required based upon the depth of installation or other consideration as determined by Raleigh Water and Engineering Department. Reuse mains shall be centered in the easement. All reuse easement boundaries must be field staked and flagged by the developer's surveyor and at the developer's expense.
- D. The minimum easement width for reuse is twenty (20) feet and may not include any other utility. Such easements are to be recorded as "City Reuse Easement".
- E. All off-site easements shall be acquired by the developer. These off-site easements shall be recorded by map and by deed of easement prior to construction approval. The easements shall be dedicated to the City and entitled "City Reuse Easement".
- F. No person shall construct permanent structures or impoundments, plant trees, shrubs or other vegetation (except shallow rooted ground cover) on reuse mains, reuse transmission mains or within reuse easements without prior written approval through an encroachment agreement form the Raleigh Water Director or their designee.
- G. All public infrastructure must have three (3) feet of clearance on all sides. RW reserves the right to cut, clear, and remove all obstructions on public right of ways to maintain this clearance.

2. Main Size

- A. Major mains shall be sized according to the Reuse Water System Master Plan and/or Raleigh Water Director or their designee. The City reserves the right to determine the size of reuse service lines.
- B. The minimum size reuse main shall be four (4) inches unless dictated otherwise by sound engineering and approved by Raleigh Water prior to construction.
- C. Raleigh Water is required to provide a minimum pressure of twenty-five (25) pounds per square inch (psi). If an individual needs greater pressure, then it is his/her responsibility to incorporate the necessary booster pumping facilities.

3. Fire Hydrants

- A. The installation of fire hydrants on the reuse system for public or private use is prohibited unless approved by the Raleigh Water Director or their designee.

4. Reuse Water Main Type

- A. Generally, C900 PVC and Ductile Iron are approved for reuse distribution mains. The Raleigh Water Director or their designee reserves the right to restrict approved water main

material to ductile iron pipe when site, soil or system operational conditions dictate, at the discretion of the Raleigh Water Director or their designee.

5. Valves

- A. Each proposed new intersection shall have a main line valve for every leg, i.e., a four (4) way intersection shall have four (4) main line valves and a TEE intersection shall have three (3) main line valves. All valves shall be rodded to a tee or cross in accordance with Standard Reuse Detail R-12.
- B. Mains twelve (12) inches and larger in diameter that have a change in elevation of fifteen (15) feet or greater shall have an air release valve installed at the highest elevation of such change, as per Standard Reuse Detail R-16. Additional air release valves may be required by the Raleigh Water Director or their designee on mains less than twelve (12) inches based on elevation changes of fifteen (15) feet or greater.
- C. Pressure reducing and/or sustaining stations shall be installed when directed by the Raleigh Water Director or their designee to connect high- and low-pressure systems. The pressure reducing valve shall allow enough flow from the high side to maintain a specified pressure on the low side and will not reduce the high side below a certain amount. This type valve will be a pressure sustaining/pressure reducing valve.
- D. All reuse valves and appurtenances shall be color-coded, taped, or otherwise marked to identify the source of the water as being reuse water, as described in the Identification section of these specifications.

6. Meters

- A. All reuse services will be metered, and the meter will be located in the rights-of-way or in a two (2) foot easement adjacent to the rights-of-way. In no case shall meters be located inside of buildings. The City will maintain all reuse connections within the street right-of-way at no charge to the property owner. Repairs on private property shall be the responsibility of the property owner or customer.
- B. All meters will be furnished and set by the Meters Division once all fees are paid and accounts have been set up. Meter installation and spacing shall be in accordance with applicable Standard Water Details W-23 through W-34 and R-18.
- C. All reuse meters and appurtenances shall be color-coded, taped, or otherwise marked to identify the source of the water as being reuse water, as described in as described in the Identification section of these specifications of these specifications.
- D. A master meter should be used if the building permit and plat show single ownership and a single lot. If a building is sold from the complex, then it will require a separate reuse service, with an individual meter with those services originating from a City maintained reuse main.

7. Installation Restrictions for Design

- A. All reuse mains, of proper size as determined by Raleigh Water, shall be installed complete, along all boundaries abutting existing public roadways, from property line to property line regardless of the land use, proposed lot arrangement of the subdivided property or the availability of connection to a main in service.
- B. Within all dead-end streets that may be extended, the water main must extend to the property line of the subdivision.
- C. All DIP reuse mains shall be installed with a minimum cover of four (4) feet from the top of finished grade to pipe crown and shall be in accordance with all applicable City Standards.

All PVC reuse mains shall be installed with a minimum cover of four (4) feet from the top of finished grade to pipe crown and shall be in accordance with all applicable City Standards.

- D. When mains are to be installed to a dead end, or mains are stubbed for future extension, at least one eighteen (18) foot joint of pipe, or more when required, shall be designed, and fitted with a thrust collar in accordance with Standard Water Details R-4 through R-8, of these specifications. Blow-off assemblies shall be provided on all dead ends or as directed by the Raleigh Water Director or their designee. In no case shall a blow-off assembly be installed such that the discharge would be to ground surface, drainage ditches, stormwater ponds, stormwater systems, or other non-treated systems. Blow-off assembly sizing shall match pipe sizing through twelve (12) inch diameter. The blow-off for twenty-four (24) inch and larger mains shall require approval by the Raleigh Water Director or their designee. Blow-off assemblies shall be in accordance with Standard Reuse Details R-19 and R-20 of these specifications. Mains that are determined to be extended in the future must also terminate with a full-size main line gate valve prior to the last joint of pipe.

8. Identification

- A. All reuse piping, valves, outlets, and other appurtenances shall be color-coded and taped, or otherwise marked to identify the source of the water as being reuse water. All new distribution piping in the reuse water system, including service lines, valves and other appurtenances shall either be colored purple and embossed or be integrally stamped/marked with the words “CAUTION: RECLAIMED WATER - DO NOT DRINK,” or be installed with a purple identification tape, and a purple polyethylene vinyl wrap. The warning shall be stamped on opposite sides of the pipe and repeated every three (3) feet or less. Existing potable or non-potable water lines that are being converted to reuse water use should first be accurately located and tested in accordance with regulatory requirements. If required, the necessary actions to bring the line and appurtenances into compliance with regulatory standards should be taken. If the existing lines meet approval of the reuse water supplier and NCDENR, the lines can be approved for reclaimed water distribution. If verification of the existing lines is not possible, the lines should be uncovered, inspected, and identified prior to use.
- B. Polyethylene Wrap: Buried ductile iron pipe, fittings, gate valves and other appurtenances shall either be painted Pantone 522 purple and marked “CAUTION: RECLAIMED WATER – DO NOT DRINK” and/or wrapped with a Pantone 522 purple polyethylene membrane conforming to ANSI A21.5 and installed in accordance with AWWA C105. The polyethylene sheets shall be a minimum eight (8) millimeters thick.
- C. Tracer wire shall be installed along all PVC reclaimed water mains and must conform to requirements described in the Reuse Materials section of these Standards.
- D. Identification Tape: Identification tape shall be required for all instances in which the reclaimed water piping for main lines is not labeled, embossed, or integrally stamped/marked with the words “CAUTION: RECLAIMED WATER - DO NOT DRINK”, repeated on opposite sides of the pipe every three (3) feet or less. Identification tape shall be prepared with white or black printing on a purple field 522) having the words “CAUTION: RECLAIMED WATER - DO NOT DRINK”. The overall width of the tape should be at least three (3) inches. Identification tape shall be installed on the top of the distribution piping longitudinally and should be centered over the pipe. The identification shall be continuous in its coverage on the pipe and should be fastened to each pipe length in at least ten (10) feet intervals. Tape attached to sections of pipe before they are placed in the trench should have flaps sufficient for continuous coverage. Other satisfactory means of securing the tape during backfill of the trench may be used if suitable for the work, as determined by the Raleigh

Water Director or their designee. The identification tape differentiating the reclaimed water piping from other utility lines should be consistent throughout the service area.

9. Easement Map Requirements

- A. The City is standardizing the format for plat information. For a complete list of all information required, refer to the Planning and Development Department Customer Service Center tab at the City website and link to the “Recorded Maps”. The following items must be included:
- 1) Minimum scale established – one (1) inch = fifty (50) feet;
 - 2) Project title – consistent with council authorization;
 - 3) Vicinity map;
 - 4) Identify map number of total (example: map #9 of 14);
 - 5) Street number on each parcel;
 - 6) Owner name on each parcel;
 - 7) Successive lot numbers on each parcel – beginning with Lot #1;
 - 8) Locate footprint of structure on parcel;
 - 9) Reference any recorded easements on each parcel;
 - 10) “Line” legend somewhere on map;
 - 11) Owner/parcel/take data table somewhere on map to include: Owner’s name, street address, Wake county Tax ID number (7 digit number), Lot number, each take listed, Parcel Deed Book and page number;
 - 12) No easements labeled “utility”; and
 - 13) No overlapping easements.

4.3 REUSE DESIGN – PRIVATE

1. Private reuse systems are prohibited.
 - A. Multibranch reuse services located behind a master reuse meter will be built to the applicable State Plumbing Code and the Department of Human Services regulations.
 - B. In no case shall aboveground hose bibs (spigots or other hand-operated connections) be installed on the private reuse system. Hose bibs for private reuse systems shall be installed downstream of the backflow preventer, in below-ground service boxes, lockable or designed to be operated with the use of a special tool, and clearly labeled “REUSE WATER – DO NOT DRINK”.
 - C. Private reuse services may not cross property lines, may not serve more than one parcel, and may not be installed in private easements.
2. Conversion to Reuse Service
 - A. When a user proposes the conversion of any existing potable water irrigation system to a reuse water irrigation system, a comprehensive investigation of the proposed reuse water system shall be performed for the City at the expense of the user. On a case-by-case basis, the City shall review the as-built drawings and other available records and determine the measures necessary to bring the existing system into full compliance with the requirements of this Handbook. The City may deny issuance of a reuse water permit if the City determines that the proposed conversion cannot be safely made.

4.4 REUSE MATERIAL STANDARDS

1. GENERAL MATERIAL REQUIREMENTS

- A. Current specifications of the American Society for Testing Materials (ASTM), American Water Works Association (AWWA), Ductile Iron Pipe Research Association (DIPRA), American Association of State Highway and Transportation Officials (AASHTO), and the American National Standards Institute (ANSI) shall apply in all cases where material is covered by an item in these specifications. All material used shall conform fully to these current standards or be removed from the job at the direction of the Raleigh Water Director or their designee.
- B. Pipe specimens shall be subjected to tests by an independent testing laboratory at such time as Raleigh Water may direct or as specified herein. Pipe not meeting these specifications will be ordered removed by the inspector, and such pipe shall be immediately removed from the job site and not transported to any portion of the project being constructed.
- C. Detail or shop drawings of valves, air release valves, tapping sleeves, and tapping saddles must be approved by Raleigh Water prior to installation.
- D. These specifications are not to be considered as proprietary in any way. When a particular brand is listed, it is only used as an aid in describing the type of material being requested.

2. REUSE SYSTEM MATERIALS

The words “Reuse” and “Reclaimed” are used interchangeably in this document.

A. Reuse Mains

- 1) All four (4) inches through twelve (12) inches reuse mains shall be either buried polyvinyl chloride (PVC) pressure pipe or ductile iron pipe (DIP) as specified herein.
- 2) Polyvinyl Chloride (PVC) Pressure Pipe
 - a) PVC pressure reuse mains shall conform to the applicable requirements of ANSI/AWWA C900 for four (4) inch through twenty-four (24) inch pipes and ANSI/AWWA C905 for four (4) inch through twelve (12) inch diameter pipes. PVC pipe and fittings shall be provided with cast-iron-pipe-equivalent outside diameters. Wall thickness dimension ratios for twelve (12) inches and smaller pipe shall be DR 14 in accordance with the applicable requirements of ANSI/AWWA C900. Wall thickness dimension ratios for fourteen (14) inch and larger pipes shall be DR 18 in accordance with the applicable requirements of ANSI/AWWA C905. PVC pipe shall be designed in accordance with AWWA M23, PVC Pipe – Design and Installation, 1980.
 - b) All PVC pipe joints shall be provided with an approved method of restraint, as determined by the Raleigh Water Director or their designee. All PVC pipe supplied for reclaimed water applications shall be color coded purple, Pantone 522 as required by the North Carolina Administrative Code, 15A, NCAC, 02T 0909. Pipe identification for reclaimed water by the manufacturer with the words “CAUTION - RECLAIMED WATER DO NOT DRINK” repeated on opposite sides of the pipe every three (3) feet or less.
 - c) PVC pressure pipe shall be furnished complete with all fittings, jointing materials, anchors, blocking, encasement, and other necessary appurtenances. All fittings shall be appropriately marked, wrapped and color coded as detailed elsewhere in these standards.

- d) Polyethylene encasement shall be tube or sheet type and conform to ANSI/AWWA C105/A21.5. Joint tape shall be self-sticking, PVC or polyethylene, ten (10) millimeters thick; such as Chase "Chasekote 750", Kendall "Polyken 900", or 3M "Scotchrap 50".
 - e) All PVC pipes shall be provided with tracer tape to allow for location of the buried pipe. The tracer tape shall be at least three (3) inches wide and one-half (0.5) millimeters thick. The tracer tape shall have an aluminum foil core and be encased in a protective inert plastic jacket. The tracer tape shall have a minimum tensile strength of five thousand (5,000) psi and a minimum mass of two-and-a-half (2.5) lbs. per inch per one thousand (1,000) feet. The tracer tape shall be Allen Systems "Detectatape", Lineguard "Type III", or Reef Industries "Terra Tape D". Tracer tape shall be buried beside the PVC pipe, not more than two (2) feet below the ground surface.
 - f) Pipe, fittings, and accessories shall be handled in accordance with Chapter 6 of AWWA Manual M23, to ensure installation in sound, undamaged condition. Pipe shall not be stored uncovered in direct sunlight.
- 3) Ductile Iron Pipe (DIP)
- a) All DIP reuse mains shall be pressure class or thickness class designed in accordance with AWWA Standard C-150. Design shall be done for external and internal pressures separately, using the larger of the two for the next design thickness. An additional allowance shall be made for corrosion and casting tolerances. To be painted Pantone 522 purple and marked "CAUTION: RECLAIMED WATER – DO NOT DRINK". The thickness design for external and internal pressures shall use the following conditions:
 - i. Four (4) feet minimum cover or as shown on the plans;
 - ii. Laying condition - Type 1 per ANSI Standards;
 - iii. A minimum working pressure of one hundred and fifty (150) psi for pipes sixteen (16) inches and smaller in diameter, and for twenty-four (24) inches and larger pipe, the design working pressure shall be as determined by the Raleigh Water Director or their designee, and
 - iv. A surge pressure of three hundred (300) psi.
 - b) All calculations for thickness shall be in accordance with the latest AWWA Standard C-150, and the calculations shall be submitted to the Raleigh Water Director or their designee for approval prior to shipping any pipe. The minimum thickness shall be pressure class 350 for pipes four (4) inches through twelve (12) inches and pressure class 250 for pipes sixteen (16) inches and larger in diameter.
 - c) The ductile iron pipe shall be manufactured in accordance with all applicable requirements of the latest AWWA Standard C-151. The ductile iron pipe shall be supplied in nominal lengths of eighteen (18) or twenty (20) feet.
 - d) The ductile iron pipe shall be cement-mortar lined with a sealcoat in accordance with the latest AWWA Standard C-104. Ductile iron pipe shall be externally bituminous coated in accordance with the latest AWWA Standard C-151.
 - e) Pipe joints shall be mechanical or "push-on" manufactured in accordance with the latest AWWA Standard C-111-95.
 - f) Each joint of ductile iron pipe shall be hydrostatically tested before the outside coating and inside lining are applied at the point of manufacture to five hundred

(500) psi. Testing may be performed prior to machining bell and spigot. Failure of ductile iron pipe shall be defined as any rupture or leakage of the pipe wall.

- g) All materials used in the production of the pipe are to be tested in accordance with the latest AWWA Standard C-151 for their adequacy within the design of the pipe, and certified test results are to be provided to the City upon request. All certified tests, hydrostatic and material are to be performed by an independent testing laboratory at the expense of the pipe manufacturer.
- h) Push-on and mechanical joint pipe shall be as manufactured by the American Cast Iron Pipe Company, United States Pipe and Foundry Company, Griffin Pipe Products Company, McWane Cast Iron Pipe Company, or approved equal.
- i) Restrained joints shall be TR Flex or HP LOK as manufactured by U.S. Pipe, Lok-Ring or Flex-Ring as manufactured by American Pipe, Super-Lock as manufactured by Clow, Bolt-Lok or Snap-Lok as manufactured by Griffin or approved equal.

B. Fittings

1) Polyvinyl Chloride (PVC) Pressure Pipe Fittings:

- a) All fittings to be used with PVC pipe shall be cast iron and conform to the applicable requirements of ANSI/AWWA C110/A21.10 with a two hundred and fifty (250) psi pressure rating,
- b) PVC to PVC joints shall be stab type, with elastomeric synthetic rubber gaskets, and conform to ANSI/AWWA C900. PVC to cast iron joints shall conform to ANSI/AWWA C111/A21.11, except gaskets shall be synthetic rubber. Natural rubber gaskets will not be acceptable. All surfaces for gasketed joints shall be lubricated immediately before the joint is completed. Gaskets and lubricants shall be supplied by the pipe manufacturer, shall be suitable for use in potable water, shall be compatible with the pipe materials, shall be stored in closed containers, and shall be kept clean. Each spigot shall be suitably beveled to facilitate assembly. All PVC pipe fittings shall be provided with an approved method of restraint.

2) Ductile Iron Pipe (DIP) Fittings:

- a) All ductile iron pipe fittings shall be manufactured in accordance with AWWA Standard C-110-98 or C-153-88 for ductile iron compact fittings. The fittings shall be tested, and the manufacturer shall provide certified test results when requested by the City. This testing shall include hydrostatic proof testing of the fittings.
- b) All fittings shall be all-bell or mechanical joint. Mechanical joints shall be manufactured in accordance with the latest AWWA Standard C-111 and painted Pantone 522.
- c) All fittings shall be cast iron or ductile iron and shall have a minimum working pressure rating of two hundred and fifty (250) psi and a minimum iron strength of thirty thousand (30,000) psi.
- d) All fitting interiors shall be cement-mortar lined with a sealcoat in accordance with the latest AWWA Standard C-104-95, and the outside shall be bituminous coated.
- e) Restrained mechanical glands may be used where restraint is needed except when welded restraining rings are required.

C. Gate Valves

- 1) Cast iron or ductile iron resilient wedge style vertical or horizontal gate valves and tapping valves shall be used. Gate valves twelve (12) inches in diameter and smaller,

shall be mechanical joint or hub-end all-bell. They shall be "O" ring, open-left valves of the non-rising stem type. These valves shall be designed for a minimum of 175 psi working pressure and three hundred (300) psi hydrostatic test pressure with a two (2) inch operating nut.

- 2) Gate valves, horizontal gate valves, or butterfly valves shall be used for all main line valves in sizes sixteen (16) inches through twenty-four (24) inches.
- 3) Gate valves shall be as manufactured by American, Mueller, Kennedy, AVK, Clow, M&H, or Waterous valves, in accordance with the latest AWWA Standard C-509-94, C-515, or the appropriate AWWA standard. All resilient wedge valves shall have internal and external epoxy coating, O-ring seals at the stuffing box and bonnet to body and dual O-rings at the stem seal above the thrust collar.
- 4) Tapping valves shall be the same valves as gate valves listed above, subject to the standards, providing that tapping valves shall have the tapping ring.

D. Valve Boxes

- 1) Adjustable valve boxes shall be class 35 gray cast iron and manufactured in accordance with ASTM A48 and be of the dimensions specified in Detail R-14 and R-15 of these specifications. Lids shall have the word "Reuse", "Reuse Water", or "Reclaimed Water" cast into the lid. See Detail W-18. All castings must be domestically cast and so indicated by the manufacturers name and "USA" cast into all sections of the valve box. All castings must meet or exceed AASHTO H-20 load rating. Total valve box weight shall be a minimum of eighty-five (85) lbs. and have a minimum lid weight of twenty-five (25) lbs. All valve boxes shall be furnished with an approved operating key which shall allow operation by authorized personnel only.

E. Butterfly Valves

- 1) Butterfly valves sixteen inches or greater than sixteen (16) inches in diameter shall be Class 150B and shall conform to the latest AWWA Standards C-504, as manufactured by Mueller, Kennedy, Pratt, DeZURIK, or Val-Matic for rubber sealed butterfly valves and valve operating assemblies. "O" ring seals shall also be used exclusively with worm gear.
- 2) All valve end connections shall be mechanical joint or Victaulic, as required by the detail drawings. Valve seats shall be stainless steel, bronze mating, or resilient material. Resilient seat shall be mechanically attached to the valve disc, or mechanically retained in the valve body. Resilient seat shall be fully field adjustable by mechanical means. The valve disc shaft shall be stainless steel or either stub or thru-shaft design. Shafts shall be provided with two-way disc thrusters that are fully adjustable from the outside. Valve shaft bearings shall be heavy duty bronze, properly fitted into hubs integrally cast in the body of the valves.
- 3) All butterfly valve gear actuators shall be according to AWWA C-504. The valve operator shall be furnished with a two (2) inch square operating nut and be so mounted that the valve will open-left (counter-clockwise). The butterfly valve operator shall have AWWA stops, be suitable for submersible service and be sized in accordance with AWWA torque requirements for a full 150 lb. rated valve.
- 4) The manufacturer of the butterfly valve shall be fully responsible for the satisfactory performance of the assembled valve and operator unit. The specified operators shall be factory mounted by the valve manufacturer and shipped to the job site as an operating unit. External painting, hydrostatic testing, travel stop adjustments and crating for

shipment shall be in complete compliance with the latest AWWA specification for butterfly valves.

- 5) All butterfly valves shall be installed in a standard eccentric precast manhole (diameter appropriate with size valve). See Standard Reuse Detail R-13.

F. Air Release Valves

- 1) Reuse Air release valves shall be two (2) inch Crispin Pressure Air Valves, Model P 20, with a vacuum check unit, or two (2) inch Val-Matic, Model VM-45, with a vacuum check unit or equal as approved by the Raleigh Water Director or their designee. These valves shall be suitable for one hundred and fifty (150) psi working pressure and designed to allow air to escape automatically while the main is in service and under pressure. The valve shall be housed in a Raleigh Water approved eccentric manhole and shall be installed in accordance with Standard Reuse Detail R-16 of these specifications. Air release valve locations shall be approved by Raleigh Water, or as shown on the plans. The engineer must field stake the air release location. Cover, hatch, and interior of the air release valve manhole or vault must be painted with standard reuse identification color Pantone 522 C.

G. Tapping Sleeves and Tapping Saddles

- 1) Tapping sleeves shall be Mueller mechanical joint, Mueller Outlet Seal, American Uniseal, Kennedy Square Seal, or Clow F5205 or F5207. One hundred percent (100%) stainless steel sleeves may also be used, as manufactured by Smith-Blair, Romac, Ford, or JCM provided that all metallic parts of the sleeves shall be One hundred percent (100%) stainless steel including bolts. Ductile iron flanges may be included on sleeves or saddles. Test assembly seals with water according to AWWA C-223. All sleeves shall have a minimum of one hundred and fifty (150) psi working pressure. All taps shall be machine drilled—no burned taps will be allowed.
- 2) Tapping saddles may be used on mains sixteen (16) inches and larger. In sixteen (16) and twenty-four (24) inch saddles as manufactured by Mueller, American, Kennedy and Clow, tapping saddles shall be manufactured of ductile iron providing a factor of safety of two-and-a-half (2.5) at a working pressure of two hundred and fifty (250) psi. In main sizes of thirty (30) inch and larger, ductile iron tapping saddles as manufactured by American Pipe Company or US Pipe Company shall be utilized.
- 3) Saddles shall be equipped with a standard AWWA C-110-98 flange connection. Sealing gaskets shall be "O" ring type, high quality molded rubber having an approximate seventy durometer hardness, placed into a groove on the curved surface of the tapping saddle. Straps shall be of alloy steel. Saddles may be used for taps one-half (1/2) the size of the main or less (i.e., eight (8) inch tapping saddle for use on a sixteen (16) inch main).

H. Reuse Service Connections

- 1) Reuse service pipe shall be a minimum of one (1) inch. Service connections up to two (2) inches shall be type "K" soft copper with purple polyethylene wrap consistent with the identification section of these standards. On these reuse services, the fittings shall be flared copper type brass fittings or compression type fittings.
- 2) One-and-a-half (1 1/2) inch and two (2) inch taps may only be made with use of a stainless steel, full circumferential saddle.
- 3) Corporation cocks for direct taps may be used on ductile iron pipe, shall be bronze-construction, and shall have AWWA Standard tapered threads. Unions shall be three (3) piece copper-to-copper.

- 4) Curb stops shall be as manufactured by Mueller, Oniseal, Hayes NuSeal, Ford, A.Y. McDonald ball valve. All corporation stops and curb stops shall be bronze ball valves and shall be appropriate material to material corporation and curb stops as manufactured by Mueller, Ford, and A.Y. McDonald and must have a complete ball and installed in a valve box.
- 5) Curb stops are required for one (1) inch meters and shall be located one (1) foot from the meter box on the street side. If this conflicts with sidewalk, Curb stop may be installed between sidewalk and curb. Curb stops shall be installed in a curb stop box as manufactured by Ford, A. Y. McDonald, or Trumbull.
- 6) Service saddles shall be all bronze with double bronze straps and with a neoprene "O" ring gasket attached to the body. The clamp shall have corporation cock threads. These clamps shall be as Mueller H-16100 series, Jones J 979, or approved equal.
- 7) For services two (2) inches and smaller, the reuse service pipe shall be wrapped with purple polyethylene. Services four, six, eight, or twelve (4, 6, 8 or 12) inches in diameter shall be of ductile iron pipe or PVC as specified above. Cast iron fittings shall be used on these services as specified above. All taps will be made by using the appropriate size tapping sleeve and valve. See Standard Reuse Details R-11, and R-18. On a "dry line", the connection may be made with a "TEE and Valve" as shown in Standard Reuse Detail R-12.
- 8) Copper setters or copper meter yokes shall be one by one-and-a-quarter (1 x 1.25) inches and twelve (12) inches in height as manufactured by A. Y. McDonald, Ford Meter Box Company, or approved equal. All copper setters shall have locking wings on the angle valve and be of the angle check type. All service lines shall be wrapped with a Pantone 522 purple polyethylene membrane conforming to ANSI A21.5 and installed in accordance with AWWA C105. The polyethylene sheets shall be eight (8) millimeters thick, minimum. All DIP service lines shall also be identified with two (2) three (3) inch strips running the length of the pipe on polar opposites of the pipe exterior.

I. Meters

- 1) All reuse meters shall be installed by the Raleigh Water Meters Division.
- 2) One (1) inch reuse meters shall be Neptune with one (1) inch inlets and one-and-a-quarter (1 1/4) inch outlets.
- 3) Meters two (2) inches and larger must have sample ports.

J. Meter Boxes and Vaults

- 1) For users with potable water service, reuse meter boxes shall be located within five (5) feet of the potable water meter boxes.
- 2) All meter boxes and vaults shall be constructed of cast iron, precast concrete, concrete block, high density polyethylene, or cast-in-place concrete as on Standard Reuse Detail R-3. No synthetic polymer or plastic boxes shall be allowed, on either public or private systems connected to the City reuse system.
- 3) Meter boxes and vaults shall not be placed within sidewalks or driveways unless no other alternatives are available (i.e., downtown). If placed within five (5) feet of driveways traffic rated lids shall be used.
- 4) Meter Boxes for one (1) inch Services: Meter boxes for one (1) inch reclaimed water services shall be high density polyethylene construction with a wall thickness of no less than fifty-five hundredths (0.550) inches or heavy-duty fiberglass reinforced polymer. The box shall be molded as one piece and provided in a circular shape with a diameter

of twenty-one (21) inches and a depth of twenty-four (24) inches, Bingham and Taylor or approved equal. The box shall be provided with pre-cut entry areas approximately three (3) inches wide by four (4) inches high for the service pipe entrance and exit. The plastic box shall be provided with a black exterior and a reflective white on the interior. The meter box cover shall be made of light weight polymer concrete dyed purple, Pantone 522 with the words, "CAUTION RECLAIMED WATER - DO NOT DRINK", embossed in the cover. The meter box cover shall be provided as a solid polymer cement cover with no reader door. A one-and-a-half (1.5) inch diameter hole shall be provided by the manufacture to allow installation of AMR telemetry units through the lid. The meter box cover shall be provided with one (1) stainless steel locking bolt. The stainless-steel locking bolt shall be provided in a penta-head configuration. The box and cover shall be load rated for a vertical load of twenty thousand (20,000) lbs. The inside of the meter box shall be painted Pantone 522 purple, and text shall be stenciled on the inside of the interior indicating, "CAUTION RECLAIMED WATER - DO NOT DRINK" in lettering at least one-and-a-half (1-1/2) inches in height that is clearly legible when opening the cover. The lid shall be Bingham Taylor BTPLASA 12.25RECV2 Purple and BTA-32 frame or approved equal.

- 5) Meter Box Assembly and Setters for one-and-a-half (1 1/2) and two (2) inch services: Meter Boxes for one-and-a-half (1 1/2) and two (2) inch services shall be made of fiberglass reinforced polymer and provided with heavy duty rated polymer concrete covers. All meter box covers shall be consistently color-coded purple (Pantone 522 C) and marked on the top surface with a recognizable inscription indicating "RECLAIMED WATER - DO NOT DRINK". Meter box covers shall be provided as a solid polymer cement cover with no reader doors and provided with two (2) stainless steel bolt locks on opposite ends of the meter box cover. A one-and-a-half (1 1/2) inch diameter hole shall be provided by the manufacture to allow installation of AMR telemetry units through the lid. The stainless-steel bolts for locking the cover shall be provided in a penta head configuration. The box shall have an open bottom to allow drainage through stone. The inside of the meter box shall be painted Pantone 522 purple, and text shall be stenciled on both sides of the interior indicating, "CAUTION RECLAIMED WATER - DO NOT DRINK" in lettering at least one-and-a-half (1 1/2) inches in height that is clearly legible when opening the cover. The setter and meter shall also be painted or provided in Pantone 522 purple.
- 6) Meter Vaults for Services Larger than two (2) inches in Diameter: Please contact Raleigh Water to determine design criteria for reclaimed water services larger than two (2) inches in diameter.

K. Steel Encasement Pipe

- 1) Steel pipe for boring installations shall be high strength steel, welded or smooth-wall seamless manufactured in accordance with ASTM A252 and consisting of grade 2 steel with a minimum yield strength of thirty-five thousand (35,000) psi. The minimum inside diameter of steel encasements shall be eight (8) inches greater than the inside dimension of the carrier pipe. The minimum casing pipe wall thickness shall be three hundred and seventy-five thousandths (0.375) inches for bored encasement. See the following table for encasement diameter and thickness:

Encasement Diameter and Thickness by Nominal Pipe Diameter		
Carrier Pipe Nominal Diameter (inches)	Encasement Minimum Inside Diameter (inches)	Encasement Nominal Wall Thickness (inches)
6	14	0.375
8	16	0.375
10	18	0.375
12	20	0.375
14	24	0.375
16	26	0.500
18	30	0.500
20	32	0.500
24	36	0.625
30	42	0.625
36	48	0.750
42	56	0.875

- 2) No coatings required for buried or bored encasements but must conform to the noted wall thickness in the table above. All encasement pipe must be approved by the appropriate controlling agency (i.e. NCDOT, RR, etc.) prior to ordering the material.
- 3) All carrier piping shall be restrained joint ductile iron and the minimum inside diameter casing pipe shall be eight (8) inches greater than the inside dimension of the carrier pipe. Restrained joint pipe shall extend one joint beyond the ends of the encasement pipe.
- 4) Both ends of the casing shall be mortared. Metal "spider" pipe alignment devices shall be installed in all casings with a minimum of two (2) "spiders" per pipe joint one-fourth (1/4) of the pipe joint length in from both the bell and spigot ends. See Standard Water Detail W-40.

L. Ground Hydrants

- 1) Ground hydrants are only acceptable in non-residential applications.
- 2) Hose bibs for private reuse systems shall be below grade non-freeze ground hydrants that are lockable or designed to be operated with the use of a special tool. Below ground hose bibs shall be identified as reuse and purple in color. Ground hydrants shall be Watts HY-500, Woodford Y95, Zurn Z-1360, or approved equal.

M. Paint

- 1) An approved Pantone 522 purple is required to meet color identification requirements under NC ACAC 02T .0909 and referenced herein as the color code identification for reclaimed water piping, valves and other appurtenances. Field application of Pantone 522 purple to valves, fittings, manholes and other appurtenances shall be implemented in conformance with manufacturer specifications including surface preparation. In all cases a minimum film thickness of ten (10) millimeters shall be applied. For applications

open to daylight, the paint shall have UV protection. The paint shall consist of a two (2) coat system consisting of a part high solids cured epoxy as the primer with a polyurethane top coat. For applications not exposed to sunlight, the paint shall be a two (2) coat application of a high solids cured epoxy.

4.5 REUSE CONSTRUCTION STANDARDS

1. The words "Reuse" and "Reclaimed" are used interchangeably in this document.
2. As part of the requirement to obtain construction approval for reuse main extensions, the engineer shall affix the appropriate permit sticker to the original drawings. The various permit stickers are included in appendix D.
3. The requirements contained in this section shall apply to all reuse main installations whether public or private. All necessary construction permits must be obtained before construction may begin in accordance with North Carolina State Law.
4. Any contractor performing work within the City or Merger Communities shall have a copy of these specifications on each job site.

5. SCOPE OF WORK

- A. The contractor shall furnish all materials, equipment, and labor for excavation, installation, and backfilling of reuse mains and related appurtenances as shown on the plans. The Planning and Development Department and/or Public Utilities Department shall conduct all City inspections on reuse main extension projects.
- B. It shall be the contractor's responsibility to notify the Public Utilities and Planning and Development Department at least twenty-four (24) hours in advance of beginning any construction work on any project. The contractor must call Raleigh Water and give the location, project name, individual's name, company name, start date, and indicate if it involves reuse extensions.
- C. On main replacement or upgrade projects that affect existing streets or established neighborhoods, it shall be the contractor's responsibility to provide notice to adjacent property owners fifteen (15) days before beginning any construction work on the project in accordance with NCGS Chapter 160A-499.4.
- D. Contractor shall contact the Planning and Development Department by 4:00 p.m. EST each day to notify where and what will be done the following day. Any work conducted in the Merger Communities or outside the Raleigh Water Service Area shall contact Raleigh Water by 4:00 p.m. EST to notify where and what will be done the following day. Any work requiring inspector observation outside of the normal business hours will be charged to the contractor at the current inspector hourly rate.
- E. If a developer, engineer, or contractor proceeds with the reuse main installation prior to permit issuance, the City may require the work to be reinstalled and the developer, engineer, or contractor shall be fully liable for all actions and costs, including prosecution by the City or the State for proceeding with installation prior to issuance of appropriate permit(s).
- F. "Field changes" are not considered approved by Raleigh Water unless revised plans have been submitted to Raleigh Water, reviewed, and approved. Therefore, the contractor that proceeds with construction prior to this approval is at their own risk.
- G. No one shall make any changes to the reuse system without prior approval from Raleigh Water. Any changes to existing facilities, whether intentional or unintentional, shall be reported immediately to Raleigh Water.

- H. Contractors working (excavation, boring, or other subsurface breach) around or in the vicinity of reuse mains six (6) inches in diameter or larger shall be required to physically spot the existing line to be verified by Raleigh Water distribution staff or inspection staff. If other existing lines sizes are in question of conflict the contractor shall be directed by Raleigh Water staff of the level of subsurface investigation needed to locate the existing line.

6. GENERAL TESTING REQUIREMENTS

- A. The City may perform and shall require the contractor to perform such destructive and nondestructive testing as it deems necessary in order to inspect the materials and work. These tests shall be in accordance with the procedures established by ASTM and AASHTO. The City shall reserve the right to modify the procedures in testing ditch and backfill compaction to allow a deeper test to be made by using the sand-core method and/or nuclear testing gauges.

7. ENCROACHMENT CONTRACTS AND PERMITS

- A. Reuse Water shall not be utilized without an operational permit from the Reuse Division of Raleigh Water. Please see Appendix C for permit applications and permit process flow charts.

8. VALVE OPERATIONS

- A. No valve in the existing system shall be operated without following the procedure outlined below. Failure to comply with these requirements shall be grounds for suspension of pipe-laying operations until written assurance can be obtained from a company official that such noncompliance will not occur again. The contractor should be aware that the City regards violations of these requirements as justifying punitive measures.
- B. Notification procedures are as follows:
 - 1) The contractor shall notify Raleigh Water's Reuse Division in order to request the operation of any valves. At least twenty-four (24) hours' notice must be given to Raleigh Water, and at least twenty-four (24) hours' notice must be given to each customer affected by a reuse or potable water cut-off. The contractor is responsible for notifying the affected customers. All valve operations shall be done by a Public Utilities Department personnel or by the City's inspector for a particular project. It is illegal for anyone other than a Raleigh Water employee to operate existing potable water or reuse main valve, unless accompanied by a Raleigh Water employee.
 - 2) The contractor shall provide the following information when calling the Reuse Division for valve operation:
 - a) Name of person calling;
 - b) Name of company;
 - c) Telephone number of company;
 - d) Location of valve and map number, if available;
 - e) Reason for requesting operating and whether to be closed or open;
 - f) Time valve to be opened or closed; and
 - g) Approximate time potable water or reuse line to be out of service.
- C. Each time a contractor needs a valve operated, they shall again secure permission, following the steps outlined above.
- D. System valves shall be defined as any valve that has main pressure against either gate face. Newly installed tapping valves and control valves to networks not yet accepted for service

are considered system valves. Valves within a network still under construction are not considered as system valves.

9. CONSTRUCTION WATER

Please see “construction water” in the Policies and Procedures section.

- A. In all cases where potable water is used to temporarily charge a reuse water system, there shall be a certified above-ground reduced pressure principal backflow preventer or air gap separation between the potable water system and the reuse water system.
- B. Note: Individuals caught using water unmetered and/or unauthorized by Raleigh Water will be prosecuted to the fullest extent of the law.

10. TRENCH PREPARATION

- A. Trench excavation shall conform to the line and depth shown on the plans. The trench shall be properly braced and drained so that workers may work therein safely and efficiently. When water is being pumped from the trench, the pump discharge shall follow natural drainage channels, drains or storm sewers. In discharging trench water, it will be necessary to follow standard erosion control measures so as to minimize erosion and sedimentation. In no case may trench water or groundwater be pumped into or allowed to enter the sanitary sewer system.
- B. The width of the trench may vary with the depth of cut and other conditions the trench shall be in accordance with the dimensions set forth by OSHA and other information shown on Standard Reuse Detail R-3a and R-3b.
- C. The foundations for ductile iron shall be a firm and stable flat bottom (Type 1) trench with bell holes so that the pipe rests uniformly on the entire barrel length. See Standard Reuse Detail R-3a and R-3b.
- D. Pipe clearance in rock shall be a minimum of six (6) inches below and on each side of the pipe for sizes sixteen (16) inches and less in diameter. For sizes larger than sixteen (16) inches in diameter, the minimum clearance shall be nine (9) inches below and on each side.

11. PIPE INSTALLATION

- A. Ductile iron pipe shall be installed in accordance with the requirements of the latest AWWA Standard C-600. PVC pipe shall be installed in accordance with AWWA C605.
- B. Reuse pipe shall be laid to the line and grade shown on the plans with all valves and hydrants located as shown on the plans.
- C. Protection shall be afforded to all underground and surface structures using methods acceptable to the Raleigh Water Director or their designee or Engineer. This protection shall be furnished by the contractor at the contractors' own expense.
- D. Deviation from line and grade may be made only on revised plans upon approval by Public Utilities Department and identified on “as built” when such deviations arise from grade or line conflicts with existing utilities, structures, or other sources of conflict.
- E. Subsurface explorations shall be made by the contractor at the direction of the Raleigh Water Director or their designee or Engineer where it is necessary to determine the location of existing pipes, valves, or other underground structures.
- F. Depth of pipe cover, unless shown otherwise on the plans shall be four (4) feet. Depth of cover shall be measured from the established street grade or the surface of the permanent improvement to the top of the barrel of the pipe.

- G. After the foundation has been properly graded, bedded when applicable, and the bell holes dug, the pipe and accessories shall be carefully lowered into the trench by approved methods. Under no circumstances shall the pipe or accessories be dropped or dumped into the trench. All damaged pipe and accessories shall be removed from the job.
- H. Pipe shall be swabbed clean with sodium hypochlorite solution before it is laid, and any pipe which cannot be cleaned with a swab shall be removed and cleaned with suitable apparatus. Any pipe showing evidence of oil, tar, or grease shall be permanently marked and removed from the job.
- I. Pipe installation and jointing of pipe shall be done according to manufacturer's recommendation with care being taken to provide uniform bearing for the pipe. Bell and spigot of pipe shall be cleaned and properly lubricated where a mechanical joint of a "push on" type joint is employed. No chlorine powder or tablets shall be put in the lines during installation. The Raleigh Water Director or their designee reserves the right to require restrained joint pipe in new construction.
- J. Open ends of pipe shall be plugged with a standard plug or cap at all times when pipe laying is not in progress. Trench water shall not be permitted to enter pipe.
- K. Pipe cutting for inserting valves, fittings, or closure pieces shall be done in a neat and professional manner in accordance with the manufacturer's recommendations and without damage to the pipe.
- L. Bell ends will face the direction of installation unless otherwise directed by the Raleigh Water Director or their designee or Engineer. For lines on an appreciable slope, the Raleigh Water Director or their designee or Engineer may also require that bell ends face upgrade.

- M. Maximum horizontal deflections for ductile iron pipe shall be as follows for an eighteen (18) foot joint of pipe:

Maximum Deflection in Inches		
Pipe Size (inches)	Mechanical Joint Deflection (inches)	Push-on-joint Deflection (inches)
4	31	19
6	27	19
8	20	19
10	20	19
12	20	19
14	13	11
16	13	11
18	11	11
20	11	11
24	9	11
30	9	11
36	8	11
42	7	7
48	7	7

- N. When installing a reuse main, the horizontal separation from any water main shall be ten (10) feet. If this separation cannot be maintained due to existing conditions, the variation allowed is the water main in a separate trench with the elevation of the water main at least eighteen (18) inches above the top of the reuse and must be approved by the Raleigh Water Director or their designee. All distances are measured from the outside diameter to outside diameter. Where it is impossible to obtain proper separation, or anytime a reuse main passes over a water main, DIP materials or steel encasement extended ten (10) feet on each side of crossing must be specified and installed to waterline specifications.
- O. Maintain twenty-four (24) inch minimum vertical separation at all reuse and storm drain crossings. Where adequate separations cannot be achieved, specify DIP materials and a concrete cradle having six (6) minimum clearance (per Raleigh Water detail S-49)
- P. All other underground utilities shall cross water, sewer, and reuse facilities with eighteen (18) inches minimum vertical separation required.
- Q. Where practical, water, reuse, and sewer mains shall be located in order of descending quality from the ground surface.
- R. The following minimum horizontal separations shall be maintained:
- 1) Reclaimed water distribution lines shall be located ten (10) feet horizontally from and eighteen (18) inches below any water line where practicable. Where these separation distances cannot be met, the piping and integrity testing procedures shall be to water

main standards in accordance with 15A NCAC 18C. (Ductile Iron pipe with joints equivalent to water mains standards for ten (10) feet each side of the point of crossing).

- 2) One hundred (100) feet from any private or public water supply source, including wells, WS-1 waters or Class I or Class II impounded reservoirs used as a source of drinking water (except as noted below).
- 3) Fifty (50) feet from any waters (from normal high water) classified WS-II, WS-III, B, SA, ORW, HQW or SB (except as noted below).
- 4) Ten (10) feet from any other stream, lake, or impoundment (except as noted below).
- 5) Twenty-five (25) feet from private wells (with no exceptions).
- 6) Fifty (50) feet from sources of public water supply (with no exceptions).
- 7) Reuse shall be eighteen (18) inches vertically above sewer mains at crossings or a minimum of two (2) feet horizontally as per 15A NCAC 02T .0305.

Where the required minimum separations cannot be obtained, ductile iron sanitary sewer pipe with joints equivalent to potable water main standards shall be used.

- S. Railroad crossings shall be made following all precautionary construction measures required by the railroad officials.
- T. All reuse crossings under the state system roads shall be made in accordance with the requirements of the NCDOT as defined in their encroachment permits.
- U. Where conditions are, in the opinion of the City Inspector, unsuitable for laying pipe because of weather or trench conditions, the contractor shall be required to cease work until permission is given by the City Inspector for work to commence again, providing such conditions have been corrected.
- V. All reuse piping, valves, outlets, and other appurtenances shall be color-coded, taped, or otherwise marked to identify the source of the water as being reuse water, as described in the Reuse Materials Section of these specifications.
- W. In accordance with General Statute 87-121(g), all underground utilities installed after October 1, 2014, shall be electronically locatable. Tracer wire to be installed on all PVC reuse pipe in such a manner as to be able to properly trace all mains without loss or deterioration of signal or without the transmitted signal migrating off the trace wire. Tracer wire shall be #12 gauge solid (bare) copper and continuous to the greatest extent possible. The tracer wire shall be securely bonded together at all wire joints with an approved industrial crimp connector to provide electrical continuity. It shall be accessible at all tracer wire test ports. Test ports with marker posts shall be located at bends and no further than three hundred (300) feet apart. The test port shall consist of a standard valve box with a concrete collar, shall be H-20 traffic load rated flush with grade in non-paved areas with concrete collar as shown on detail W-17, and flush with final asphalt or concrete pavement elevation and shall be located over the downstream or outgoing main. The valve box shall be equipped with a lid stamped "TS" and painted Pantone 522C for reuse mains. At each test port, a loop of wire shall be brought up and looped inside the box. The loop of wire inside the box shall be a minimum of three (3) feet. The wire shall be protected from damage during the execution of the work. No breaks or cuts in the tracer wire shall be permitted. Industrial crimps shall be used to provide electrical continuity and the crimps shall be similar metal to eliminate galvanic corrosion. Contractor shall perform a continuity test on all tracer wire in the presence of the Owner or Owner's representative. If the tracer wire is found to be not continuous after testing, Contractor shall repair or replace the failed segment of wire at their own expense. All main lines that are replaced or realigned shall be provided tracing wire.

For reuse mains that are installed in encasement pipe, the tracing wire shall be routed through the encasement pipe. Copper clad steel tracer wire (#12) as manufactured by Copperhead Industries or approved equal is an approved alternative to #12 bare solid copper tracer wire.

12. REACTION BLOCKING

- A. All fittings or components subject to hydrostatic thrust shall be securely anchored by the use of concrete thrust blocks poured in place, unless otherwise directed by the engineer. The reaction areas required for these thrust blocks shall be given to the contractor by the inspector, and the contractor shall install the blocks according to directions provided by the inspector. Where concrete must be reinforced, the contractor shall furnish such reinforcing as is required.
- B. Required reaction bearing areas will be taken from the schedule herein. See Standard Reuse Details R-4a through R-9. Areas given are vertical plans measured in solid material normal to the thrust line of the fitting.
- C. Material for reaction blocking shall be transit-mixed concrete. This concrete shall have a minimum twenty-eight (28) day compressive strength of two thousand five hundred (2,500) psi. Any metal used to resist thrust that is not encased in concrete shall be 316 stainless steel.
- D. Valves on ductile iron lines shall be anchored with thrust collars as shown in Standard Reuse Details R-4a through R-5.

13. BACKFILLING PIPE

- A. The backfilling of the trench after the pipe installation and testing shall be in accordance with Reuse Details R-R-3b for ductile iron and Reuse Detail R-3a for PVC.
- B. PVC pipe shall be installed in accordance with AWWA C605. At a minimum, all PVC pipes shall be installed at a Type 3 laying condition as specified by AWWA C605 for depth of installation from four to ten (4-10) feet measured from the top of the pipe. The Type 3 laying condition requires the pipe to be bedded on a minimum of four (4) inches of select granular material that will conform to the bottom of the pipe. Select granular material shall consist of well-graded sand, gravel, crushed gravel, crushed stone, or crushed slag composed of hard, tough and durable particles, and shall contain no more than ten percent (10%) percent by weight of material passing a seventy-five thousandths (0.075) millimeter (No. 200) mesh sieve and no less than ninety-five percent (95%) by weight passing the twenty-five (25) millimeter (one (1) inch) sieve. Pipe laying on a flat bottom trench is unacceptable.

Embedment material shall be compacted to the top of the pipe. When using mechanical compactors, avoid contact with the pipe. When compacting over the pipe crown, a minimum cover of at least eight (8) inches or more in conformance with the manufacturer's requirements shall be maintained over the top of the pipe prior to compacting. The maximum embedment sizing shall be limited to materials passing a three-quarter (3/4) inch sieve for angular materials or one-and-a-half (1 1/2) inches for rounded rock. Embedment materials consisting of select material or native soils shall be well drained, granular, free of rocks and other foreign materials and shall be selected and placed to prevent gouges, crimping, or puncture of pipe, joints, or appurtenances.

- C. Ductile iron pipe shall be backfilled with suitable native material. No rocks, boulders, or stone four (4) inches or larger shall be included in the backfill for at least two (2) feet above the top of the pipe.
- D. All backfill shall be compacted in six (6) inch lifts measured from the pipe foundation upward. Backfill for roadway shall be compacted to at least ninety-five percent (95%) of maximum soil density in those areas where the supporting capacity of the soil is of prime

consideration. Laboratory determination of maximum soil density will follow the procedure of AASHTO T99-86. Field determination of the density of the soil in place shall follow the procedure of AASHTO T191-86 or T204-86. The result of any one test may be a minimum of ninety percent (90%) of maximum density, but the average of any three tests in an area shall be ninety-five percent (95%) of maximum density. All tests shall be conducted at the direction of the City Inspector, and the cost of such tests will be borne by the contractor with the provision that the City will test an area two (2) times only where both tests fail. The contractor shall then be required to submit satisfactory evidence that their ditch compaction meets the specifications.

- E. Deficiency of backfill material shall be supplied by the contractor where this deficiency results from any cause other than rejection of unsuitable backfill material (other than rock) by the City Inspector. In cases where the City Inspector directs, the contractor shall dispose of unsuitable backfill material and provide suitable backfill material.

Where excavated material has been rendered unsuitable, either before or after excavation, by inclement weather or type of material, the contractor must correct the moisture or furnish replacement backfill material.

- F. Backfilling shall not be allowed, except with permission of the City Inspector. When a ditch is flooded or the weather is unsuitable, the contractor shall not backfill unless permission is given by the City Inspector. No backfilling with frozen material shall be allowed.

14. SETTING VALVES AND VALVE BOXES

- A. Valves shall be set at locations shown on the plans with care being taken to support the valve properly and to accurately position the valve box over the operating nut of the valve. Where pavement is existing, the box shall be adjusted to finished street grade as shown in Standard Reuse Detail R-14. When valves are located in street rights-of-way, but out of pavement, the boxes shall be adjusted to finished grade and a concrete pad two (2) feet square and six (6) inches thick shall be poured around the box one-half (1/2) inch from the top. When valves are located outside of street rights-of-way, the boxes shall be at finish grade, and a concrete block two-feet square and six (6) inches thick shall be poured around the box at grade line. Valve locations out of street rights-of-way shall be marked with a metal post having a minimum diameter of two (2) inches and a minimum bury of three (3) feet with a minimum of three (3) feet exposed. The exposed portion shall be painted purple and shall be placed so that a valve operating tool has free operation.
- B. When a tapping sleeve and valve are being used, the valve, sleeve, and machine assembly shall be air tested to hold at eighty (80) psi for a fifteen-minute duration in the presence of the inspector prior to drilling or tapping the main. On a case-by-case basis, the inspector may require higher testing pressure based on actual system pressure at the tapping site. The valve shall be in the closed position during the testing. All tap coupons shall be given to the City's inspector. High pressure reuse transmission mains (greater than one hundred and fifty (150) psi operating pressure) may require more stringent testing, as recommended by the manufacturer and required by the Raleigh Water Director or their designee.

15. SETTING FITTINGS

- A. Fittings shall be set at locations shown on the plans with care being taken to properly "bell-up" joints and support the body of the fitting. All dead-end lines shall be plugged with mechanical joint plugs or caps and anchored by using thrust collars and blocking as shown on Standard Reuse Details R-4a through R-5

16. SETTING BLOW-OFFS AND RELEASE VALVES

- A. Blow-offs and drainage branches shall not be submerged in any stream or be installed in any other manner that will permit back siphonage into the reuse distribution system.
- B. All blow-offs shall be installed as shown on Standard Reuse Details R-19 and R-20 to divert flow to the sewer collection system. Blow-offs shall not be installed to allow drainage to any area other than a sewer manhole.
- C. Drainage of air release valves shall be not be directed to the sanitary sewer system. See detail R-16

17. MAINTAINING SERVICE

- A. When replacing or extending reuse mains, the contractor shall maintain existing reuse services.

18. GENERAL REUSE MAIN TESTING SEQUENCE

Reuse mains shall be tested in the following general sequence:

- A. "Pigging" main (mains with gate valves);
- B. Flush the main (flush water shall be routed to the sanitary sewer system);
- C. Perform the hydrostatic tests;
- D. Introduce the appropriate amount of chlorine by tapping the main;
- E. Hold the chlorine solution in the main for at least twenty-four (24) hours and no more than seventy-two (72) hours; and
- F. Flush the main (flush water shall be routed to the sanitary sewer system).

19. PIGGING

- A. All new mains with gate valves must be pigged with a polyethylene "pig", 5 lbs/cubic foot density, at the conclusion of installation.
- B. The pig must be blown at the end of the main by means of the following:
 - 1) Four (4) inch mains: four (4) inch blow-off
 - 2) Six (6) inch mains: six (6) inch blow-off
 - 3) Eight (8) inch and twelve (12) mains: blow-off assembly as shown on Standard Reuse Detail R-19
 - 4) Sixteen to twenty-four (16–24) inch mains: to be determined by the field inspector
- C. The contractor installing the line shall write the name of the company and street name in which the work is taking place on the pig in a manner in which it will not rub off.

20. HYDROSTATIC TESTS

- A. All main installations, including private distribution lines to the buildings, shall be pressure tested between each main line valve in accordance with the latest AWWA Standard C-600-87. The test shall be performed using a suitable pump and an accurate pressure gauge. Immediately upon completion of a section of main, one hundred and fifty plus or minus five psi (150 ± 5 psi) of pressure shall be applied and held for two (2) hours. The acceptable leakage rate shall not exceed ninety-two thousandths (0.092) gallons per inch of pipe diameter per one thousand (1,000) feet of pipe per hour.

Failure of the reuse main to comply with the above acceptable leakage rate shall require the contractor to replace any defective materials to insure a watertight installation. If it is deemed that the existing blow-off valve is the cause of failure, the party responsible for the water main extension shall also be responsible for adding a valve at that location and abandoning

the existing valve. After any inadequacies have been corrected, the leakage rate will again be tested. This test shall be repeated until that portion of main is brought to compliance with the permissible leakage rate. High pressure reuse transmission mains (greater than one hundred and fifty (150) psi operating pressure) may require more stringent testing, as recommended by the manufacture and required by the Raleigh Water Director or their designee.

B. Prerequisite conditions for inspection prior to testing shall be as follows:

- 1) Valves shall be properly located, operable, and at correct elevation. Valve boxes or manholes shall be centered over operating nuts, and the top of the box or manhole shall be at proper elevation.
- 2) Lines shall be properly vented where entrapped air is a consideration.

21. CHLORINATION

- A. All additions or replacements to the reuse system, including backflow prevention devices, shall be chlorinated before being placed in service. Such chlorination must take place under the supervision of an inspector.
- B. Pipe subjected to contaminating materials shall be treated as directed by Raleigh Water or Engineer. Should such treatment fail to cleanse the pipe, replacement shall be required. The City shall bear no portion of any cost sustained by the contractor in meeting this specification.
- C. Chlorination of a completed line shall be carried out after completing the pressure test and in the following manner.
 - 1) Taps will be made at the control valve at the upstream end of the line and at all extremities of the line including valves. These taps shall be located in such a manner as to allow HTH solution to be fed into all parts of the line.
 - 2) A solution of potable water containing high test hypochlorite seventy percent (70%) available chlorine or chlorine gas solution 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 fifty (50) ppm total chlorine immediately after chlorination. The table below shows the required quantity of seventy percent (70%) HTH compound to be contained in solution in each one thousand (1000) foot section of line to produce the desired concentration of fifty (50) ppm.

Required Quantity of HTH Compound by Pipe Diameter	
Pipe Diameter (inches)	Pounds of high-test Hypochlorite (70%) Per 1000' of Line
4	0.40
6	0.88
8	1.56
10	2.42
12	3.50
14	4.76
16	6.22
20	9.76
24	14.00
30	21.00
36	31.50
48	56.00

- 3) The HTH solution shall be circulated in the main opening the control valve and systematically manipulating taps at the line extremities. The HTH solution must be pumped in at a constant rate for each discharge rate in order that a uniform concentration will be produced in the mains.
 - 4) Services shall be sterilized by methods acceptable to the Raleigh Water Director or their designee or Engineer, and the contractor shall have the same responsibility for laterals as for mains in regard to bearing full cost of any corrective measures needed to comply with bacteriological or other requirements.
 - 5) HTH solution shall remain in lines for no less than twenty-four (24) hours, unless otherwise directed by the Raleigh Water Director or their designee or Engineer.
 - 6) Extreme care will be exercised at all times to prevent the HTH solution from entering existing mains.
- D. Free residual chlorine after twenty-four (24) hours shall be at least ten (10) ppm, or Raleigh Water or Engineer will require that the lines be re-chlorinated.
- E. Mains will be flushed with potable water with a blow-off assembly of sufficient size to effectively clean the main. See Standard Reuse Detail R-19. The flushing connection shall include cross connection control measures, including an appropriately sized reduced pressure principal backflow preventer, and shall be approved by Raleigh Water. In cases where a connection to the potable water system is not practical and flushing with reuse water is proposed, written authorization from Raleigh Water will be required prior to proceeding with flushing operations. The party making the written request to flush with reuse shall prepare a flushing plan for review and approval by Raleigh Water. Flushing of lines may proceed after twenty-four (24) hours, provided the free residual chlorine analysis is satisfactory. Flushing shall be continued until chlorine returns to normal level. During times of water shortages or distribution main problems, the flushing operation may be delayed. Raleigh Water shall determine when flushing is allowable. The contractor shall advise the

inspector prior to the chlorination and flushing so that the inspector can advise Raleigh Water of the construction location, size, and length of mains. All tests will be done in the presence of an inspector. Flushing will be for short duration. Sufficient precautions must be taken to the satisfaction of the inspector to ensure that the impact of the water is absorbed, and the water is conveyed without erosion or property drainage. All flush water shall be de-chlorinated using methods acceptable to Raleigh Water.

22. SERVICE CONNECTIONS

- A. Taps shall be made only on a line under pressure and after the main has been tested and chlorinated. No taps on dry lines shall be allowed unless specific authorization from the engineer is obtained.
- B. Taps shall be at an angle of forty-five degrees (45°) to a perpendicular plane through the center line of the pipe as shown is in Standard Reuse Detail R-18.
- C. The maximum size of direct taps shall be as follows:

Maximum Tap Size by Main Diameter	
Main Diameter (inches)	Maximum Tap Size (inches)
4	1
6	1
8	1 1/4
10	1 1/2
≥12	2

On four (4) through ten (10) inch mains, larger size taps may be made by using a service saddle.

- D. Services larger than two (2) inches shall be made by using a tapping sleeve and valve. The service line from the main shall be:
 - Four (4) inch D.I. for four (4) inch services;
 - Six (6) inch D.I. for six (6) inch services; and
 - Eight (8) inch D.I. for eight (8) inch services.

The typical tapping sleeve and valve is shown in Standard Reuse Detail R-11.

- E. No taps or services shall be made on the sixteen (16) inch or larger transmission mains unless approved by the Raleigh Water Director or their designee.
- F. Before any reuse services are installed, the main shall be thoroughly flushed using a flow velocity sufficient to scour the pipe interior. All flush water originating from a reuse main or other reuse water source shall be discharged to the sanitary sewer system.
- G. Each meter yoke shall be flushed before the installation crew proceeds to the next service installation.

23. REUSE MAIN AND SERVICE ABANDONMENT

- A. Reuse services to be abandoned must remove the corporation cock and insert a plug in the main. When plugging the line is not available, the corporation cock may be turned off, capped, and surrounded with 1 ft³ of concrete. All remaining portions of the service shall be

removed from the main to the right of way line and shall be disposed of properly. Water main abandonment must be performed in accordance with a plan approved by Raleigh Water. Service and main abandonment require inspection by the Planning and Development Department.

24. AS-BUILT PLANS

- A. Surveyed As-Built plans and profiles shall be furnished to Raleigh Water by the Engineer upon completion of the project.
- B. All coordinates shall tie into the NC grid coordinate system (NAD1983 State Plane) and the vertical datum NAVD88. All units are to be US survey feet. The closest geodetic monument to the project shall be identified in the “as-built” plans.
- C. All current Wake County parcel information in the project area is to be defined and properly labeled. All streets in the project area shall be defined and labeled.
- D. All “as-built” plans shall include a vicinity map and an overall site or utility plan and be clearly marked as an “as-built plan” or “record drawing”. The plan shall include the following information on a twenty-four by thirty-six (24x36) inch layout (paper for initial walk-through, mylar for final): “as-built” date, project title, permit number, page numbering, north arrow, scale of drawing, bar scale, all easements with book and page number and dimensioned, pipe section, pipe size, pipe material, fitting type defined, valve type defined, meters, backflow preventers, length of bore and jack, abandoned and/or removed features, and connections to existing utilities.
- E. All service stubs shall be shown, and all mains shall be labeled as public or private.
- F. A twenty-four by thirty-six (24x36) inch paper copy shall be submitted to the Inspections Department for review and comment before initial walk-through. Once these comments are addressed, a twenty-four by thirty-six (24x36) inch mylar copy of each sheet shall be re-submitted. In addition to hard copy mylars, a PDF file of each signed and sealed mylar sheet must be submitted. A CAD file of utilities should show the overall water system as-built layout along with the property or subdivision boundaries. DWG, DGN, DXF, and SHP are acceptable formats. Please save CAD files in “model space” on the current NC State Plane grid. A comma-delimited text file or Microsoft Excel file of survey information is required with the following columns: FeatureType (Valve, Meter, Tee, etc.), X coordinate, Y coordinate, Z coordinate, Size, and Description. See example below.

FeatureType	X	Y	Z	Size	Description
Tee	2086904.78	732688.47	349.69	12x12x6	DI tee
Valve	2086907.12	7326892.41	349.78	6”	Gate valve
Hydrant	2086910.49	7326899.57	352.62	4.5”	2012 Mueller Super Centurion 250
Meter Box	2085638.36	731998.1	368.23	5/8”	specify domestic or irrigation
BFP	2085639.24	731996.33	368.35	3/4"	RPZ

- G. Digital as-built data submittals shall be on a USB flash drive or transmitted electronically to the Raleigh Water GIS group and shall include the following:
- 1) Project name;
 - 2) Name of firm which prepared the data;
 - 3) As-built date, as depicted on mylar submittal;
 - 4) Permit number(s); and
 - 5) Raleigh Water plan identification number (if applicable).
- H. Each digital as-built submittal shall include the following on digital media:
- 1) PDF files for each mylar sheet submitted;
 - 2) PDF file(s) for recorded plat(s);
 - 3) CAD file (see above); and
 - 4) Data file denoting the coordinates and description for each utility feature in the project scope (see table above).
- I. Each plan sheet showing as-built information shall have an engineer's certification with N.C.P.E. seal, signature and date. See certification text below.

ENGINEER CERTIFICATION STATEMENT

I, _____, as a duly registered Professional Engineer in the State of North Carolina, having been authorized to observe (____ periodically, ____ weekly, ____ full time) the construction of the project, _____, hereby state that, to the best of my abilities, due care and diligence was used in the observation of the construction such that by my inspection of the constructed improvements and my review of the as-built survey data, I hereby certify that the (1)public improvements, (2) private improvements, and (3) public safety of the above referenced project as constructed are in compliance with the requirements of the improvements as prescribed in the approved Construction Drawings, approved design documents, and/or any approved modifications, except as noted in red on the 'As-Built' drawings. Furthermore, I certify that the red-noted exceptions do not adversely affect the required performance or public safety aspects of the improvements.

Name: _____ Date: _____

NCPE Seal:

END OF SECTION 4



Appendix A

Guidelines and Requirements for the Cross Connection and Hydrant Meter Programs



Raleigh
Water

SECTION 1 - GENERAL INSTALLATION REQUIREMENTS FOR CONTAINMENT ASSEMBLIES	5
1.1 INTRODUCTION	5
1.2 OTHER IMPORTANT NUMBERS.....	5
1.3 DEFINITIONS.....	6
SECTION 2 - IRRIGATION (RESIDENTIAL/COMMERCIAL) CONTAINMENT ASSEMBLIES REQUIREMENTS.....	9
2.1 ACCESSIBILITY	9
2.2 ALTERATIONS/MODIFICATIONS.....	9
2.3 APPROVAL OF ALTERNATE INSTALLATIONS	9
2.4 AUTHORIZED TO INSTALL, REPLACE, OR REPAIR:	9
2.5 APPROVED BACKFLOW ASSEMBLIES.....	10
2.6 AUXILIARY WATER SUPPLY (RECYCLED WATER, GREY WATER, RAIN WATER, REUSE WATER, IRRIGATION WELL, AND CISTERN).....	10
2.7 DRAIN REQUIREMENTS	10
2.8 ENCLOSURES	10
2.9 FLOOD PRONE AREAS	11
2.10 IDENTIFICATION TAG	11
2.11 LOCATION	11
2.12 MATERIALS.....	11
2.13 PERMITS.....	11
2.14 PRE-EXISTING ISSUES	11
2.15 RELIEF OUTLET PIPING AND VALVE.....	11
2.16 REPAIRS	12
2.17 SERVICE VALVE	12
2.18 SUPPORT	12
2.19 TESTING.....	12
2.20 WINTERIZATION.....	13
SECTION 3 - DOMESTIC (RESIDENTIAL/COMMERCIAL) CONTAINMENT ASSEMBLY REQUIREMENTS AND USES	14
3.1 ACCESSIBILITY	14
3.2 ALTERATIONS/MODIFICATIONS.....	14
3.3 APPROVAL OF ALTERNATE INSTALLATIONS.....	14

3.4	APPROVED BACKFLOW ASSEMBLIES	14
3.5	AUTHORIZED TO INSTALL, REPLACE, AND REPAIR	14
3.6	AUXILIARY WATER SUPPLY (RECYCLED WATER, GREY WATER, RAIN WATER, REUSE WATER, IRRIGATION WELL, CISTERN)	15
3.7	BYPASS /PARALLEL INSTALLATION	15
3.8	CULINARY USE	15
3.9	DEAD END	15
3.10	DRAIN REQUIREMENTS	16
3.11	ENCLOSURES	16
3.12	FLOOD PRONE AREAS	16
3.13	HAZARDOUS USES	17
3.14	IDENTIFICATION TAG	19
3.15	LOCATION	19
3.16	LOOPED SYSTEMS	19
3.17	MATERIALS	19
3.18	PERMITS	19
3.19	PRE-EXISTING ISSUES	19
3.20	RELIEF OUTLET PIPING AND VALVE	19
3.21	REPAIRS	20
3.22	SERVICE VALVE	20
3.23	SUPPORT	20
3.24	TESTING	20
3.25	TESTING SCHEDULE	21
3.26	THERMAL EXPANSION CONTROL	22
SECTION 4 - FIRE PROTECTION CONTAINMENT ASSEMBLY REQUIREMENTS		23
4.1	ACCESSIBILITY	23
4.2	ALTERATIONS/MODIFICATIONS	23
4.3	APPROVAL OF ALTERNATE INSTALLATIONS	23
4.4	APPROVED BACKFLOW ASSEMBLIES	23
4.5	AUTHORIZED TO INSTALL, REPLACE, AND REPAIR	23
4.6	AUXILIARY WATER SUPPLY (RECYCLED WATER, GREY WATER, RAIN WATER, REUSE WATER, IRRIGATION WELL, CISTERN)	24
4.7	BYPASS /PARALLEL INSTALLATION	24
4.8	DRAIN REQUIREMENTS	24
4.9	ENCLOSURES	25
4.10	FIRE DEPARTMENT CONNECTIONS	25

4.11	FIRE PUMP ACCEPTANCE TEST	25
4.12	FLOOD PRONE AREAS	25
4.13	HAZARDOUS USES	25
4.14	IDENTIFICATION TAG	26
4.15	LOCATION	26
4.16	LOOPED SYSTEMS.....	26
4.17	MATERIALS.....	26
4.18	MODIFICATION OF DCDA/RPDA UNITS	26
4.19	PERMITS.....	26
4.20	PRE-EXISTING ISSUES	27
4.21	PRIVATE FIRE HYDRANTS AND DEAD END MAIN LINES.....	27
4.22	RELIEF OUTLET PIPING.....	27
4.23	REPAIRS	27
4.24	SERVICE VALVE	27
4.25	SUPPORT	27
4.26	TESTING	28
4.27	TESTING SCHEDULE	28
4.28	WYE STRAINER	29
SECTION 5 - CERTIFIED TESTERS		30
5.1	QUALIFICATIONS	30
5.2	APPROVED BACKFLOW CERTIFICATION SCHOOLS	30
5.3	CERTIFIED TESTER RESPONSIBILITIES.....	30
5.4	REQUIRED DOCUMENTATION	30
5.5	SUSPENSION/PROBATION.....	31
5.6	REVOCATION OF CITY OF RALEIGH BACKFLOW CERTIFICATION	31
5.7	RIGHT TO APPEAL	31
SECTION 6 - EXEMPTION FOR BACKFLOW INSTALLATION		32
6.1	COMMERCIAL USES.....	32
6.2	RESIDENTIAL USES	32
SECTION 7 - EXTENSION OF TIME FOR COMPLIANCE.....		33
7.1	EXTENSION OF TIME FOR COMPLIANCE APPLICATION.....	33
SECTION 8 - EXCEPTION FOR LOCATION.....		34
8.1	EXCEPTION FOR LOCATION APPLICATION	34

SECTION 9 - CERTIFICATE OF COMPLIANCE.....35

9.1 PURPOSE35

9.2 EXISTING SERVICES35

SECTION 10 - HYDRANT METER RENTAL UNITS.....37

10.1 GENERAL37

10.2 HYDRANT METER RENTAL UNITS USAGE INSTRUCTIONS38

SECTION 1

GENERAL INSTALLATION REQUIREMENTS FOR CONTAINMENT ASSEMBLIES

1.1 INTRODUCTION

1. The City of Raleigh Public Utilities Department as the water purveyor for Raleigh, Garner, Rolesville, Wake Forest, Knightdale, Zebulon and Wendell has the primary responsibility of protecting the public water supply from potential sources of contamination and/or pollution. All commercial and residential connections to the public water supply are required to be protected with a containment assembly as determined by Part 8-Public Utilities Article D: Water Quality Protection of the Raleigh City Code and the policies and design criteria identified within this document. This document may be appended by technical bulletin or as published by annual updates of this manual.
2. Any references to the North Carolina Plumbing, Fire, or Electrical Code, Raleigh City Code or Public Utilities Handbook shall include subsequent revisions.
3. For any application not specifically mentioned within this document, level of hazard shall be determined by the Raleigh Director of Public Utilities or his designee.
4. No containment assembly shall be installed in a manner as to allow the assembly to be looped around or by-passed either temporarily or permanently. There shall be no taps, piping branches, unapproved bypass piping, hydrants, fire department connection points, or other water using appurtenances connected to the supply line before any containment assembly.
5. Upon identification of the potential for contamination or a hazard to the City of Raleigh's drinking water supply system, or a failure to comply with a requirement of this handbook, the Public Utilities Director or his designee shall notify the owner pursuant to the procedures established in Sec. 8-2151 "Notification of Hazard".
6. For existing commercial facilities with multiple meters, the Cross Connection Coordinator can propose the option to master meter the facility.
7. Raleigh owns and operates the water wastewater and reuse systems within each of these merger communities. The policies listed in this handbook apply to all customers making connections, modifications, or extensions to Raleigh water systems.

1.2 OTHER IMPORTANT NUMBERS

City of Raleigh Inspections Department	919-996-2495
Town of Garner Inspections Department	919-773-4433
Town of Wake Forest Inspections Department	919-435-9530
Town of Rolesville Permits (Wake County Inspections Department)	919-856-6060
Town of Knightdale Permits (Wake County Inspections Department)	919-856-6060

Town of Zebulon Permits (Wake County Inspections Department)	919-856-6060
Town of Wendell Permits (Wake County Inspections Department)	919-856-6060

1.3 DEFINITIONS

As used in this handbook, the following terms shall have the meanings provided in this section unless the context clearly indicates otherwise.:

Air-gap: A physical separation sufficient to prevent backflow between the free-flowing discharge end of the potable water system and any other system. Physically defined as a distance equal to twice the diameter of the supply side diameter but never less than one (1) inch.

Approved enclosure: An enclosure that meets or exceeds ASSE Standard 1060 by being on the agency's approval list.

Auxiliary intake: Any piping connection or other device whereby water may be obtained from a source other than the City's public water supply.

Auxiliary water supply: Any water other than the City of Raleigh public water supply as defined herein; including, but not limited to ***recycled*** water, grey water, rain water, well water, cistern water, reuse water and any other water supply from other water purveyors other than the City of Raleigh.

Backflow: The flow of water or other liquids, mixtures or substances, under positive or reduced pressure in the distribution pipes of a potable water supply from any source other than its intended source.

Backflow assembly: An inline testable and repairable mechanical arrangement used to protect the public water supply that meets or exceeds standards set forth by the University of Southern California for Cross Connection Control and Hydraulic Research (USCFCCHR) and the American Society of Sanitary Engineering (ASSE) by being on the agency's approval list. A backflow assembly used on fire suppression systems must have the additional approval of Factory Mutual (FM) and comply with the National Fire Protection Association (NFPA) code.

Backflow device: A mechanical backflow assembly without shut-off valves or test ports and therefore not inline testable.

Backpressure: A condition in which the owner's system pressure is greater than the supplier's system pressure.

Backsiphonage: The flow of water or other liquids, mixtures or substances into the distribution pipes of a potable water supply system from any source other than its intended source caused by the sudden reduction of pressure in the potable water supply system.

Base Flood Elevation (BFE): A determination of the water surface elevations of the base flood based on current conditions hydrology or future conditions hydrology as published in the flood insurance study. When the BFE has not been provided in a flood hazard area, it may be obtained from engineering studies available from a Federal or State other source using FEMA approved engineering methodologies. This elevation, when combined with 2 additional vertical feet establishes the regulatory flood protection elevation in flood hazard areas.

Building story: A building story is equal to 10' for the purpose of this handbook.

Certified tester: A person who has proven his/her competency to test and make reports on containment assemblies as evidenced by certification of successful completion of a training program approved by the Raleigh Director of Public Utilities or his designee.

Containment assembly: A backflow assembly installed at the point of separation between the public water supply and a private service or private distribution system or at the point of metering.

Containment protection: A containment assembly installed at the point of separation between the public water supply and a private service or private distribution system or at the point of metering.

Cross-connection: Any actual or potential connection between the public water supply and a source of contamination or pollution.

Cross Connection Coordinator: The official position established and authorized by the City and designated by the Raleigh Director of Public Utilities to administer, interpret this section and who shall be a certified tester and may serve as Operator in Responsible Charge as recognized by North Carolina Department of Environment and Natural Resources 15A NCAC 18D.0701.

Double check valve assembly (DCVA): A type of backflow assembly manufactured pursuant to ASSE Standard 1015.

Double check detector assembly (DCDA): A type of backflow assembly manufactured pursuant to ASSE Standard 1048.

Dual check valve: A type of backflow device manufactured pursuant to ASSE Standard 1024.

Fire line: A system of pipes and equipment used to supply water in an emergency for extinguishing fire.

Interconnection: Any system of piping or other arrangement whereby the public water supply is connected directly to a sewer, drain, conduit, pool, heat exchanger, storage reservoir, or other device which does or may contain sewage or other waste or substance which would be capable of imparting contamination to the public water supply.

Isolation assembly: A backflow assembly required by the NC Plumbing Code that is installed within a private plumbing or distribution system to isolate a localized hazard from the remainder of the private system.

Moderate hazard: A cross-connection or potential cross-connection involving any substance that generally would not be a health hazard but would constitute a nuisance or be aesthetically objectionable if introduced into the public water supply.

Owner: Any person who has legal title to, or license to operate or inhabit, a property upon which a cross-connection inspection is to be made or upon which a cross-connection is present.

Potable Water: Water which is approved for drinking and other household uses and provided by the City of Raleigh Public Utilities Department.

Public water supply: The water and waterworks system of the City of Raleigh and its customers outside the corporate limits, for general use as potable water and which is recognized as the public water supply by the North Carolina Department of Environment and Natural Resources as system number 03-92-010.

Reduced pressure zone principle backflow assembly (RPZ): A type of backflow assembly manufactured pursuant to ASSE Standard 1013.

Reduced pressure detector assembly (RPDA): A type of backflow assembly manufactured pursuant to ASSE Standard 1047.

Severe hazard: A cross-connection or potential cross-connection involving any substance that could, if introduced into the public water supply, cause death or illness, spread disease, or have a high probability of causing such effects.

END OF SECTION 1

SECTION 2

IRRIGATION (RESIDENTIAL/COMMERCIAL) CONTAINMENT ASSEMBLIES REQUIREMENTS

Any water fee only service, which is split from the primary domestic service (see detail W-34 and W-35) will be considered an “irrigation service” for the purposes of this policy. This water fee only service may not be used as domestic water and may not enter or cross under any existing or proposed structure. This also applies to water fee only meters, which are installed for irrigation or yard hydrants, car washing, or similar outdoor use shall be protected with a Severe Hazard containment assembly in the form of an RPZ.

2.1 ACCESSIBILITY

1. All containment assemblies must be installed where the Raleigh Director of Public Utilities or his designee deems them readily accessible. Backflow assemblies may not be installed in an inaccessible, hazardous or otherwise unsuitable location, including but not limited to in traffic medians, chemical rooms with corrosive fumes, behind walls, under kitchen or bathroom lavatory cabinets, crawl space, ceilings, drainage areas, side of a hill without level access or working surface, behind vent hoods etc. Readily accessible means having direct access to a containment assembly without the requirement to remove any panel, door or similar covering of the item described, and without requiring the use of portable ladders, chairs, etc. The proper installation of an insulated approved enclosure may be deemed readily accessible. Approved enclosure clearances shall comply with ASSE Standard 1060. Clearances shall allow adequate room for servicing and maintaining the containment assembly in the approved enclosure.

2.2 ALTERATIONS/MODIFICATIONS

1. No containment assembly shall be altered or modified from its approved factory configuration unless such modifications are made with strict adherence to manufacturer’s recommendations. All alterations or modifications must be inspected by the Raleigh Director of Public Utilities or his designee.

2.3 APPROVAL OF ALTERNATE INSTALLATIONS

1. When a special circumstance precludes the ability to comply with these requirements, the Raleigh Director of Public Utilities or his designee may approve alternate installations.

2.4 AUTHORIZED TO INSTALL, REPLACE, OR REPAIR

1. Any containment assembly required to be installed by the provisions of this article or by a corrective order issued by the Raleigh Director of Public Utilities or his designee shall be installed by one of the following:
 - A. Licensed Class I Plumber: can install, replace, or repair irrigation, domestic, and fire (outside installations only) containment assemblies for all structures.
 - B. Licensed Class II Plumber: can only install, replace, or repair irrigation, domestic, and fire containment assemblies for single-family residential dwellings.
 - C. Limited Plumbing License: can install, replace, or repair irrigation or domestic containment assemblies of two-inch diameter or smaller.

- D. Licensed Fire Sprinkler Contractors: can only install, replace, or repair containment assemblies that are a part of the fire sprinkler system. They cannot install, replace, or repair irrigation or domestic containment assemblies.
- E. Licensed Utility Contractor: can install, replace, or repair irrigation, domestic, and fire containment assemblies within 5' of the building.

2.5 APPROVED BACKFLOW ASSEMBLIES

- 1. A list of approved backflow assemblies can be found on the City of Raleigh's website www.raleighnc.gov or contact the Raleigh Cross-Connection Control Office via email at cross.connection@raleighnc.gov.

2.6 AUXILIARY WATER SUPPLY (RECYCLED WATER, GREY WATER, RAIN WATER, REUSE WATER, IRRIGATION WELL, AND CISTERN)

- 1. Interconnections between an auxiliary water supply and the public water supply are not permitted and considered unlawful. (Sec. 8-2143) Premises where an auxiliary water supply exists or is installed shall have an approved containment assembly in the form of an RPZ installed on the public water supply service line. (Sec. 8-2147) Make-up water connections to an auxiliary water supply including but not limited to cisterns, grey water, rain water, reuse water, recycled water, and irrigation well systems shall have a containment assembly in the form of an approved RPZ and an air gap installed on the public water supply service line. Any unapproved interconnection between an auxiliary water supply and a public water supply shall be corrected according to City of Raleigh's Article D: Water Quality Protection and NC Plumbing Code 606.6 Cross-connection control.
- 2. Residential owners desiring to install or maintain a well must install a containment assembly in the form of an RPZ on their domestic water service unless all auxiliary plumbing connections are completely isolated outside of any structure accepting a public water supply. RPZs must be tested annually at the customer's expense. Water meters will not be installed on dual plumbing systems until the Raleigh Director of Public Utilities or his designee receives confirmation from the local plumbing inspector or the Authority Having Jurisdiction (AHJ) that all the potable and auxiliary systems are not interconnected and the auxiliary system piping is marked non-potable.

2.7 DRAIN REQUIREMENTS

- 1. RPZ containment assemblies are not allowed to be installed below ground level. RPZs installed in above ground approved enclosures shall be installed so that the relief outlet of the assembly does not become submerged. A minimum clearance of 12" must be maintained from the most bottom part of the assembly to concrete pad or floor. Drain size is a minimum of 4" or two times the size of the containment assembly whichever is greater and provide positive drainage with adequate gravity drainage to atmosphere.

2.8 ENCLOSURES

- 1. Any RPZ Irrigation containment assembly:
 - A. Minimum non-heated, insulated Class II, approved enclosure. Containment assembly is to be drained during winter months. Approved enclosure to be mounted on a concrete pad, fiberglass, or approved mounting pad. OR

B. The containment assembly for a lawn irrigation system may be removed for winterization when installed with unions and an upstream shut off valve not subject to freezing.

C. Consumer is responsible for protecting the containment assembly from freezing.

2. If multiple containment assemblies are installed within one approved enclosure, all components of each containment assembly must be accessible for testing, repair and or replacement without having to remove another containment assembly or piping that serves another assembly. The test ports to all containment assemblies must be accessible. Approved enclosures that are damaged and do not provide adequate freeze protection may be required to be repaired or replaced.

2.9 FLOOD PRONE AREAS

1. Containment assemblies installed in a flood plain must be installed at base flood elevation.

2.10 IDENTIFICATION TAG

1. No manufacturer's tag or stamp that bears pertinent information shall be removed from the unit. If a manufacturer's tag or stamp is removed or damaged and rendered unreadable and the containment assembly is an approved model, the containment assembly must be marked with the original serial number or issued a new number by the Cross Connection Program

2.11 LOCATION

1. Lawn irrigation containment assemblies must be installed no more than 50 linear piping feet from the most downstream edge of the meter box unless prior written approval for an alternative location is granted in writing by the Raleigh Director of Public Utilities or his designee. (See Section 8: Exception for Location). The containment assembly must remain accessible and visible after landscape maturity. Containment assemblies may not be installed in a hazardous location, traffic site triangle or within the right-of-way (ROW).

2.12 MATERIALS

1. Piping materials shall conform to one of the standards listed in NC Plumbing Code Table 605.3 for water service pipe and 605.4 for water distribution pipe.

2.13 PERMITS

1. A plumbing permit is required for all new and relocated containment assembly installations. Assemblies to be replaced where the piping configuration will not be changed or modified are not required to have a permit for installation. The receipt of a plumbing permit does not relieve the owner of compliance with all applicable Cross Connection rules and regulations.

2.14 PRE-EXISTING ISSUES

1. Any approved containment assembly that has not been installed in accordance to Sec. 8-2149 of Raleigh City Code and whose location does not pose an imminent threat to the public water supply shall be considered pre-existing and compliant.

2.15 RELIEF OUTLET PIPING AND VALVE

1. In some applications, it is practical to install a drain line off the relief port of the RPZ assembly so that in the event that there is some spillage from the device the water can be directed to a floor

drain. When drains from the relief port of an approved containment RPZ are utilized, the following conditions must be met:

- A. An approved pre-fabricated "air gap drain" as available from the backflow assembly manufacturers must be utilized.
- B. All relief port drain lines shall be piped to an outside point of termination.
- C. The RPZ relief valve shall be a minimum of 12" above any material or ground.

2.16 REPAIRS

- 1. If a containment assembly fails its operational test, the property owner will have 45 days from the date of notification to have all repairs made except those owners of properties with a cross-connection, auxiliary intake, interconnection or severe hazard as defined by Article D: Water Quality Protection and Appendix A: Guidelines and Requirements for the Cross Connection and Hydrant Meter Programs that is deemed, by the Cross Connection Coordinator, to be an imminent threat shall install a containment assembly required by the Raleigh City Code immediately. Failure to install the appropriate containment assembly within 15 days where there is an imminent threat, may result in the discontinuance of water service until such violations are corrected. Defective parts must be replaced with factory approved parts. If repair is not possible, the assembly must be replaced with an approved RPZ backflow assembly according to the Raleigh City Code, Public Utilities Handbook, and North Carolina Plumbing Code.

2.17 SERVICE VALVE

- 1. The #1 shut-off valve is part of the containment assembly and may not be used as a service valve. A service valve shall be installed after the meter, outside of the ROW, and prior to every containment assembly to allow testing, maintenance and replacement of the containment assembly without the use of a City of Raleigh Public Utilities operating valve. The service valve shall be installed underground and a minimum of 18" distance from the meter.

2.18 SUPPORT

- 1. Containment assemblies shall be properly supported so that stress on surrounding piping does not occur. Adequate support must be provided for the assembly in the approved orientation either vertically or horizontally. The assembly may not be supported by other piping or unapproved methods of support. (See: North Carolina Plumbing Code Section 308.5)

2.19 TESTING

- 1. All residential irrigation containment assemblies are to be tested by June 1st every three years. Containment assemblies on commercial irrigation systems are to be tested annually by June 1st. Testing of containment assemblies shall be conducted by a certified tester at the customer's expense in accordance with Sec. 8-2154 of Raleigh City Code. The owner shall cause such maintenance or repairs to be made, rendering the containment assembly fully operational. Additional testing and maintenance requirements may be requested or imposed as determined by the Raleigh Director of Public Utilities or his designee. It is the owner's responsibility to keep a complete, written record of any repairs and testing of the containment assembly for at least three years.
- 2. Any location that does not have a current passing operational electronic test report [Sec. 8-

2154(b)] on file with the Cross Connection Program will be considered noncompliant. Owners that are in noncompliance can come into compliance by:

A. **Testing:** Hire a certified tester to perform an operational test and submit the report to the Cross Connection Program. Irrigation report submittal period: containment assembly test reports will be accepted no more than five (5) months prior to the required test due date and year.

B. **Deactivating:**

1) **Metered Irrigation Services:** If an irrigation meter is present and you do not wish to test the backflow assembly, please call 919-996-3245 and request to stop the irrigation service and have the meter removed. Upon notification from the owner and verification by the Cross Connection Program that the irrigation account is inactive, the resident's information will be removed from the City's backflow records.

2) **Branched Irrigation Services:** To deactivate an irrigation system that branches off a domestic service, the unions on the riser/stand pipes must be permanently capped. At the completion of the required work, the property owner must submit a completed Deactivated Branched Irrigation System form to the Cross Connection Program (cross.connection@raleighnc.gov or fax: 919-996-1868) Upon inspection and approval by the Raleigh Director of Public Utilities or his designee, the account will be marked inactive and testing will not be required until the system is brought back into service.

C. **Terminating:** To permanently remove a containment assembly on a branched irrigation system, all controls and valves shall be removed with the piping capped or plugged below ground near the source of connection. An Irrigation Termination Permit and inspection is required upon completion of the required work. Please contact the Cross Connection Program to schedule an inspection of the terminated branched irrigation system. Cross.Connection@raleighnc.gov or 919-996-2747

1) Note: Branched irrigation systems that are re-activated must be done with a separate meter and all City of Raleigh and North Carolina Plumbing Code policies on new installations must be followed.

D. **Failed Operational Test:** If a containment assembly fails its operational test, the consumer will have 45 days to have all repairs made.

2.20 WINTERIZATION

1. The containment assembly for a lawn irrigation system may be removed for winterization when installed with unions and an upstream shut off valve not subject to freezing.

END OF SECTION 2

SECTION 3

DOMESTIC (RESIDENTIAL/COMMERCIAL) CONTAINMENT ASSEMBLY REQUIREMENTS AND USES

3.1 ACCESSIBILITY

1. All containment assemblies must be installed where the Raleigh Director of Public Utilities or his designee deems them readily accessible. Backflow assemblies may not be installed in an inaccessible, hazardous or otherwise unsuitable location including but not limited to in traffic medians, chemical rooms with corrosive fumes, behind walls, under kitchen or bathroom lavatory cabinets, crawl space, ceilings, drainage areas, side of a hill without level access or working surface, behind vent hoods etc. Readily accessible means having direct access to a containment assembly without the requirement to remove any panel, door or similar covering of the item described, and without requiring the use of portable ladders, chairs, etc. The proper installation of an insulated approved enclosure may be deemed readily accessible. Approved enclosure clearances shall comply with ASSE Standard 1060. Clearances shall allow adequate room for servicing and maintaining the containment assembly in the approved enclosure.

3.2 ALTERATIONS/MODIFICATIONS

1. No containment assembly shall be altered or modified from its approved factory configuration unless such modifications are made with strict adherence to manufacturer's recommendations. All alterations or modifications must be approved by the Raleigh Director of Public Utilities or his designee.

3.3 APPROVAL OF ALTERNATE INSTALLATIONS

1. When a special circumstance precludes the ability to comply with these requirements, the Raleigh Director of Public Utilities or his designee may approve alternate installations.

3.4 APPROVED BACKFLOW ASSEMBLIES

1. A list of approved backflow assemblies can be found on the City of Raleigh's website www.raleighnc.gov or contact the Raleigh Cross-Connection Control Office via email at cross.connection@raleighnc.gov.

3.5 AUTHORIZED TO INSTALL, REPLACE, AND REPAIR

1. Any assembly required to be installed by the provisions of this article or by a corrective order issued by the Raleigh Director of Public Utilities or his designee shall be installed by one of the following:
 - A. Licensed Class I Plumber: can install, replace, or repair irrigation, domestic, and fire (outside installations only) containment assemblies for all structures.
 - B. Licensed Class II Plumber: can only install, replace, or repair irrigation, domestic, and fire containment assemblies for single-family residential dwellings.
 - C. Limited Plumbing License: can install, replace, or repair irrigation or domestic containment assemblies of two-inch diameter or smaller.

- D. Licensed Fire Sprinkler Contractors: can only install, replace, or repair containment assemblies that are a part of the fire sprinkler system. They cannot install, replace, or repair irrigation or domestic containment assemblies.
- E. Licensed Utility Contractor: can install, replace, or repair irrigation, domestic, and fire containment assemblies within 5' of the building.

3.6 AUXILIARY WATER SUPPLY (RECYCLED WATER, GREY WATER, RAIN WATER, REUSE WATER, IRRIGATION WELL, CISTERN)

1. Interconnections between an auxiliary water supply and the public water supply are not permitted and considered unlawful. (Sec. 8-2143) Premises where an auxiliary water supply exists or is installed shall have an approved containment assembly in the form of an RPZ installed on the public water supply service line. (Sec. 8-2147) Make-up water connections to an auxiliary water supply including but not limited to cisterns, grey water, rain water, reuse water, recycled water, and irrigation well systems shall have a containment assembly in the form of an approved RPZ and an air gap installed on the public water supply service line. Any unapproved interconnection between an auxiliary water supply and a public water supply shall be corrected according to City of Raleigh's Article D: Water Quality Protection and NC Plumbing Code 606.6 Cross-connection control.
2. Residential owners desiring to install or maintain a well must install a containment assembly in the form of an RPZ on their domestic water service unless all auxiliary plumbing connections are completely isolated outside of any structure accepting a public water supply. RPZs must be tested annually at the customer's expense. Water meters will not be installed on dual plumbing systems until the Raleigh Director of Public Utilities or his designee receives confirmation from the local plumbing inspector or the Authority Having Jurisdiction (AHJ) that all the potable and auxiliary systems are not interconnected, and the auxiliary system piping is marked non-potable.

3.7 BYPASS /PARALLEL INSTALLATION

1. Facilities that cannot temporarily shut off the water systems to provide for a containment assembly test or repair shall install a bypass containment assembly of the same type and in some cases the same size as the main line unit. The bypass parallel assembly unit must have the square diameters equal to the square of the supply service "tap". For example, an 8" service would need at a minimum two 6" assemblies in parallel. The total capacity of the assemblies should equal or exceed the required flow for the application.

3.8 CULINARY USE

1. Containment assemblies used for culinary purposes such as canned food preparation or in dairies shall have a FDA (Food and Drug Administration) approved coating and shall be stamped with the appropriate seal.

3.9 DEAD END

1. A containment assembly shall be installed to contain a private distribution system that dead ends.

3.10 DRAIN REQUIREMENTS

1. DCVA backflow drain requirements:

A. DCVA assemblies shall be installed so that the assembly does not become submerged. A minimum clearance of 12" must be maintained from the most bottom part of the assembly to the concrete pad or floor. If DCVA is installed below grade, the underground enclosure must provide at a minimum the following:

- 1) Adequate drainage
- 2) Overlapping locking lid
- 3) Test ports capped

2. RPZ backflow drain requirements:

A. RPZ containment assemblies are not allowed to be installed below ground level. RPZs installed in above ground approved enclosures shall be installed so that the relief outlet of the assembly does not become submerged. A minimum clearance of 12" must be maintained from the most bottom part of the assembly to concrete pad or floor. Drain size shall be twice the diameter of the containment assembly or 4" minimum whichever is greater and must provide a means of positive drainage with adequate gravity drainage to atmosphere.

3.11 ENCLOSURES

1. Any DCVA or RPZ containment assembly installed outside on a domestic water service must comply with the following:

- A. Minimum insulated Class I or II approved enclosure anchored to concrete pad, fiberglass, or approved mounting pad.
- B. If Class II approved enclosure is provided, it is recommended that the containment assembly be wrapped in 1" thick pipe insulation. The relief port of the RPZ is not to be obstructed by insulation.
- C. If an RPZ is installed, provide drain port for positive drainage out of approved enclosure.
- D. If heating the approved enclosure, standard 120v GFCI electrical receptacle to be installed in accordance with the North Carolina Electrical Code.
- E. Consumer is responsible for protecting the containment assembly from freezing.
- F. If multiple containment assemblies are installed within one approved enclosure, all components of each containment assembly must be accessible for testing, repair and or replacement without having to remove another containment assembly or piping that serves another assembly. The test ports to all containment assemblies must be accessible. Approved enclosures that are damaged and do not provide adequate freeze protection may be required to be repaired or replaced.

3.12 FLOOD PRONE AREAS

1. Backflow assemblies installed in a flood plain must be installed at base flood elevation.

3.13 HAZARDOUS USES

1. Hazards are divided into the following categories:

A. Residential Moderate Hazard- Dual Check Valves

- 1) Single service connections that serve no more than two dwelling units without an auxiliary water supply or other severe hazard application within the property boundaries shall have a dual check valve installed.

B. Moderate Hazard – DCVA:

- 1) All other connections not defined as severe hazard, including but not limited to individual office buildings for Lawyers, Insurance Agents, Financial Advisors, Real Estate Agencies, Banks etc. (conditional upon the non-existence of a severe hazard within the building as listed below)

C. Severe Hazard- List includes but is not limited to the following and requires RPZ :

- 1) All lawn sprinkler systems or yard hydrants.
- 2) Wastewater treatment plants, pumps and tanks or any other container for conveying, storing or otherwise handling sewage, sewer waste lines.
- 3) Make-up water connections to a private non-potable auxiliary water system water supply including but not limited to cisterns, grey water, rain water collection and irrigation well systems. RPZ and AIR GAP required.
- 4) Pumps and tanks or any other container for conveying, storing or otherwise handling sewage, radioactive, lethal or toxic substances, boiler and steam connections, sewer waste lines, low inlets to receptacles containing toxic substances, coils or jackets used as heat exchangers, bacterial and viral materials, radioactive materials, private well or other private water supply, irrigation systems, water systems or hose connections with booster pumps such as fire department connections (FDC) and private hydrants used in conjunction with FDCs, carbonation equipment, or similar severe hazards or potential as determined by the Cross Connection Coordinator.
- 5) Buildings with five or more stories above ground level.
- 6) Hospitals, dental offices, veterinary clinics and other medical facilities that may have X-ray equipment, laboratory, medical washing equipment, autoclaves, aspirators, vacuum pumps.
- 7) Morgues, mortuary, autopsy facility, and crematory
- 8) Metal plating or fabrication facility
- 9) Bottling plant, chiller systems
- 10) Cannery, Packing House, Poultry House, Cold Storage Plant, Chemical Processing Plant
- 11) Battery manufacturer

- 12) Exterminator
- 13) Lawn care company, Green house
- 14) Solar Water Heater
- 15) Dairy
- 16) Film laboratory
- 17) Car wash facility
- 18) Dye work
- 19) Laundry facility, Commercial Kitchen
- 20) Swimming pool
- 21) Tattoo parlor
- 22) Water front, marine facility
- 23) Restaurant
- 24) Beauty Shop, Barber, Massage and Spa
- 25) Nursing Home, Day Care, Long Term Care Facility
- 26) Flex space occupancies such as strip centers and mall buildings or spaces approved for multiple types of occupancy use or which frequent alterations are made to the plumbing.
- 27) Power plant, Nuclear Reactor
- 28) Any location where an approved containment RPZ is required for isolation of a contaminant, an approved RPZ is required for containment. A water fee only meter requires an approved containment RPZ regardless of proposed use.
- 29) No potable water line can be directly or indirectly connected to any piping or equipment that conveys sewage.
- 30) Special use tanks or tankers containing pesticides, fertilizers, or other toxic chemicals or their residues may not be filled from a public water system except at a location equipped with an approved air gap (2 times diameter of supply pipe with a 1" minimum) and RPZ.
- 31) No supplier of water shall permit filling of such special use containers except at locations so equipped.
- 32) Hazard level is unknown at time of review.
- 33) This is not an exhaustive list. Any other hazard not specifically listed shall be determined by the Raleigh Director of Public Utilities or his designee.

3.14 IDENTIFICATION TAG

1. No manufacturer's tag or stamp that bears pertinent information shall be removed from the unit. If a manufacturer's tag or stamp is removed or damaged and rendered unreadable and the containment assembly is an approved model, the containment assembly must be marked with the original serial number or issued a new number by the Cross Connection Program.

3.15 LOCATION

1. Domestic containment assemblies must be installed no more than 50 linear piping feet from the most downstream edge of the meter box unless prior written approval for an alternative location is granted in writing by the Raleigh Director of Public Utilities or his designee. (See Section 8: Exception for Location). The containment assembly must remain accessible and visible after landscape maturity. Containment assemblies may not be installed in a hazardous location, traffic site triangle or within the right-of-way (ROW).

3.16 LOOPED SYSTEMS

1. A containment assembly shall be installed to contain a private distribution system that is looped.

3.17 MATERIALS

1. Piping materials shall conform to one of the standards listed in NC Plumbing Code Table 605.3 for water service pipe and 605.4 for water distribution pipe.

3.18 PERMITS

1. A plumbing permit is required for all new and relocated containment assembly installations. Assemblies to be replaced where the piping configuration will not be changed or modified are not required to have a permit for installation. The receipt of a plumbing permit does not relieve the owner of compliance with all applicable Cross Connection rules and regulations.

3.19 PRE-EXISTING ISSUES

1. Any approved containment assembly that has not been installed in accordance to Sec. 8-2149 of Raleigh City Code and whose location does not pose an imminent threat to the public water supply shall be considered pre-existing and compliant.

3.20 RELIEF OUTLET PIPING AND VALVE

1. In some applications, it is practical to install a drain line off of the relief port of the RPZ assembly so that in the event that there is some spillage from the device the water can be directed to a floor drain. When drains from the relief port of an approved containment RPZ are utilized, the following conditions must be met:
 - A. An approved pre-fabricated "air gap drain" as available from the backflow prevention assembly manufacturer must be utilized
 - B. All relief port drain lines shall be piped to an outside point of termination.
 - C. The RPZ relief valve shall be a minimum of 12" above any material or ground.

3.21 REPAIRS

1. If a containment assembly fails its operational test, the property owner will have 45 days from the date of notification to have all repairs made except those owners of properties with a cross-connection, auxiliary intake, interconnection or severe hazard as defined by Article D: Water Quality Protection and Appendix A: Guidelines and Requirements for the Cross Connection and Hydrant Meter Programs that is deemed, by the Cross Connection Coordinator, to be an imminent threat shall install a containment assembly required by the Raleigh City Code immediately. Failure to install the appropriate containment assembly where there is an imminent threat may result in the discontinuance of water service until such violations are corrected. Defective parts must be replaced with factory approved parts. If repair is not possible, the assembly must be replaced with a containment assembly according to the Raleigh City Code, Public Utilities Handbook, and North Carolina Plumbing Code.

3.22 SERVICE VALVE

1. The #1 shut-off valve is part of the containment assembly and may not be used as a service valve. A service valve shall be installed after the meter, outside of the ROW, and prior to every containment assembly to allow testing, maintenance and replacement of the containment assembly without the use of a City of Raleigh Public Utilities operating valve. The service valve shall be installed underground and a minimum of 18” distance from meter.

3.23 SUPPORT

1. Containment assemblies shall be properly supported so that stress on surrounding piping does not occur. Adequate support must be provided for the assembly in the approved orientation either vertically or horizontally. The assembly may not be supported by other piping or unapproved methods of support. (See: North Carolina Plumbing Code Section 308.5)

3.24 TESTING

1. Testing of containment assemblies shall be conducted by a certified tester at the customer's expense in accordance with Sec. 8-2154 of Raleigh City Code. All newly installed containment assemblies are to be tested by a certified tester after the meter is set and annually thereafter in accordance with 3.25 Testing Schedule. The meter will not be set until the containment assembly is installed. Meter jumpers are not approved under any condition. All water use for construction purposes is to be metered. See “construction water” under the policies and procedures section of the Public Utilities Handbook and Section 9: Construction Water/Hydrant Meters. The owner shall cause such maintenance or repairs to be made, rendering the containment assembly fully operational. Additional testing and maintenance requirements may be requested or imposed as determined by the Raleigh Director of Public Utilities or his designee. It is the owner's responsibility to keep a complete, written record of any repairs and testing of the containment assembly for at least three years.
2. Any location that does not have a current passing operational electronic test report [Sec. 8-2154(b)] on file with the Cross Connection Program will be considered noncompliant. Consumers that are in noncompliance can bring their facility into compliance by:
 - A. **Testing:** hire a City of Raleigh certified tester to perform an operational test and submit the report to the Cross Connection Program. Domestic and private distribution report submittal period: containment assembly test reports accepted only three (3) months prior to the required annual test due date.

- B. **Deactivating:** If a domestic meter is present and you do not wish to test the backflow assembly, please call 919-996-3245 and request the domestic service stopped and the meter removed. Upon notification from the owner and verification by the Cross Connection Program that the domestic account is inactive, the owner's information will be removed from the City's backflow records.
- C. **Terminating:** To permanently remove a containment assembly, all controls and valves shall be removed with the piping capped or plugged below ground near the source of connection. The meter box, if existing, shall be removed. A plumbing permit and inspection is required to cap or plug piping.
- D. **Failed Operational Test:** If a containment assembly fails its operational test, the owner will have 45 days to have all repairs made.

3.25 TESTING SCHEDULE

1. Property owners who have containment assemblies installed on fire sprinkler systems as well as domestic services may test domestic containment assemblies in accordance with the annual testing date for fire containment assemblies. Property owners or certified testers are to contact the City of Raleigh's Cross Connection Program or contracted vendor to arrange this testing schedule exception. All other containment assemblies installed on domestic services are to be tested upon installation, replacement, and annually thereafter on or before annual test due date according to zip code:

Zip Code	Annual Test Date	Zip Code	Annual Test Date
27529	September 1st	27606	December 1st
27545	May 1st	27607	December 1st
27560	December 1st	27608	April 1st
27571	January 1st	27609	April 1st
27587	January 1st	27610	September 1st
27591	May 1st	27612	March 1st
27597	May 1st	27613	March 1st
27601	October 1st	27614	February 1st
27602	November 1st	27615	February 1st
27603	November 1st	27616	February 1st
27604	August 1st	27617	March 1st
27605	October 1st	27703	November 1st

3.26 THERMAL EXPANSION CONTROL

1. Reference NC Plumbing Code 603.7 Thermal Expansion

END OF SECTION 3

SECTION 4

FIRE PROTECTION CONTAINMENT ASSEMBLY REQUIREMENTS

4.1 ACCESSIBILITY

1. All containment assemblies must be installed where the Raleigh Director of Public Utilities or his designee deems them readily accessible. Backflow assemblies may not be installed in an inaccessible, hazardous or otherwise unsuitable location including but not limited to in: traffic medians, chemical rooms with corrosive fumes, behind walls, under kitchen or bathroom lavatory cabinets, crawl space, ceilings, drainage areas, side of a hill without level access or working surface, behind vent hoods etc. Readily accessible means having direct access to a containment assembly without the requirement to remove any panel, door or similar covering of the item described, and without requiring the use of portable ladders, chairs, etc. The proper installation of an insulated approved enclosure may be deemed readily accessible. Approved enclosure clearances shall comply with ASSE Standard 1060. Clearances shall allow adequate room for servicing and maintaining the containment assembly in the approved enclosure.

4.2 ALTERATIONS/MODIFICATIONS

1. No containment assembly shall be altered or modified from its approved factory configuration unless such modifications are made with strict adherence to manufacturer's recommendations. All alterations or modifications must be inspected by the Raleigh Director of Public Utilities or his designee.

4.3 APPROVAL OF ALTERNATE INSTALLATIONS

1. When a special circumstance precludes the ability to comply with these requirements, the Raleigh Director of Public Utilities or his designee may approve alternate installation.

4.4 APPROVED BACKFLOW ASSEMBLIES

1. A list of approved backflow assemblies can be found on the City of Raleigh's website www.raleighnc.gov or contact the Raleigh Cross Connection Control Office via email at cross.connection@raleighnc.gov.

4.5 AUTHORIZED TO INSTALL, REPLACE, AND REPAIR

1. Any containment fire sprinkler assembly required to be installed by the provisions of this article or by a corrective order issued by the Raleigh Director of Public Utilities or his designee shall be installed by one of the following:
 - A. Licensed Class I Plumber: can install, replace, or repair irrigation, domestic, and fire (outside installations only) containment assemblies for all structures
 - B. Licensed Class II Plumber: can only install, replace, or repair irrigation, domestic, and fire containment assemblies for single-family residential dwellings.

- C. Limited Plumbing License: can install, replace, or repair irrigation or domestic containment assemblies of two-inch diameter or smaller.
- D. Licensed Fire Sprinkler Contractors: can only install, replace, or repair containment assemblies that are a part of the fire sprinkler system. They cannot install, replace, or repair irrigation or domestic containment assemblies.
- E. Licensed Utility Contractor: can install, replace, or repair irrigation, domestic, and fire containment assemblies within 5' of the building.

4.6 AUXILIARY WATER SUPPLY (RECYCLED WATER, GREY WATER, RAIN WATER, REUSE WATER, IRRIGATION WELL, CISTERN)

- 1. Interconnections between an auxiliary water supply and the public water supply are not permitted and considered unlawful. (Sec. 8-2143) Premises where an auxiliary water supply exists or is installed shall have an approved containment assembly in the form of an RPZ installed on the public water supply service line. (Sec. 8-2147) Make-up water connections to an auxiliary water supply including but not limited to cisterns, grey water, rain water, reuse water, recycled water, and irrigation well systems shall have a containment assembly in the form of an approved RPZ and an air gap installed on the public water supply service line. Any unapproved interconnection between an auxiliary water supply and a public water supply shall be corrected according to City of Raleigh's Article D: Water Quality Protection and NC Plumbing Code 606.6 Cross-connection control.

4.7 BYPASS /PARALLEL INSTALLATION

- 1. Facilities that cannot temporarily shut off the water systems to provide for a containment assembly test or repair shall install a bypass containment assembly of the same type and in some cases the same size as the main line unit. The bypass parallel assembly unit must have the square diameters equal to the square of the supply service "tap". For example, an 8" service would need at a minimum two 6" assemblies in parallel. The total capacity of the assemblies should equal or exceed the required flow for the application.

4.8 DRAIN REQUIREMENTS

- 1. DCVA/DCDA backflow drain requirements:
 - A. DCVA/DCDA assemblies shall be installed so that the assembly does not become submerged. A minimum clearance of 12" must be maintained from the most bottom part of the assembly to the concrete pad or floor. If DCVA is installed below ground, the underground enclosure must provide at a minimum the following:
 - 1) Adequate drainage
 - 2) Overlapping locking lid
 - 3) Test ports capped
- 2. RPZ/RPDA backflow drain requirements:
 - A. All RPZ/RPDA containment assemblies are not allowed to be installed below ground level. RPZ/RPDAs installed in above ground approved enclosures shall be installed so that the relief outlet of the assembly does not become submerged. A minimum clearance of 12" must

be maintained from the most bottom part of the assembly to concrete pad or floor. Drain size shall be twice the diameter of the containment assembly or 4" minimum whichever is greater and must provide a means of positive drainage with adequate gravity drainage to atmosphere.

4.9 ENCLOSURES

1. All containment assemblies installed above ground shall be centered and secured on a 4" concrete pad. Installing a permanent hard piped electrical service according to North Carolina Electrical Code to a thermostatically controlled heater or heat trace is required to ensure that the unit does not freeze during prolonged periods of extreme cold weather conditions.
2. If multiple containment assemblies are installed within one approved enclosure, all components of each containment assembly must be accessible for testing, repair and or replacement without having to remove another containment assembly or piping that serves another assembly. The test ports to all containment assemblies must be accessible. Approved enclosures that are damaged and do not provide adequate freeze protection may be required to be repaired or replaced.

4.10 FIRE DEPARTMENT CONNECTIONS

1. If an FDC is installed on a heated approved enclosure, there is a minimum of 4' of empty pipe required between check valves and outside of box. (See Detail Drawing FP-17, FP-18) If the building has a fire pump, the FDC must be installed on the system side of the pump and not at the approved enclosure. The FDC cannot be installed on the supply at the street if the containment assembly is inside the building.

4.11 FIRE PUMP ACCEPTANCE TEST

1. The containment assembly installed on a fire service line must be certified and the report submitted to the City of Raleigh's Cross Connection Program before the new fire pump acceptance test.

4.12 FLOOD PRONE AREAS

1. Containment assemblies installed in a flood plain must be installed at base flood elevation.

4.13 HAZARDOUS USES

1. Severe hazards requiring a containment RPDA:
 - A. Fire Sprinkler Systems with booster pump facilities (such as fire department connections [FDCs])
 - B. Fire Sprinkler Systems with transfer pumps
 - C. Fire Sprinkler Systems with storage tanks (plus air gap)
 - D. Fire Sprinkler Systems with antifreeze solutions or chemical additives
 - E. Fire Sprinkler Systems serving 5 or more stories above ground level of the containment assembly
 - F. Fire Sprinkler Systems that are not behind a master meter (RPZ allowed on systems after a master meter)

G. Private Hydrants

2. Moderate hazard fire sprinkler systems requiring a containment DCDA:
 - A. Fire Sprinkler Systems less than 5 stories above ground level with no pumps
 - B. Fire Sprinkler Systems without antifreeze solutions or chemical additives
 - C. Dry pipe systems
 - D. Systems that are not behind a master meter (DCVA allowed on systems after a master meter)

4.14 IDENTIFICATION TAG

1. No manufacturer's tag or stamp that bears pertinent information shall be removed from the unit. If a manufacturer's tag or stamp is removed or damaged and rendered unreadable and the containment assembly is an approved model, the containment assembly must be marked with the original serial number or issued a new number by the Cross Connection Program.

4.15 LOCATION

1. Fire containment assemblies must be installed no more than 50 linear piping feet from the ROW/private property line unless prior written approval for an alternative location is granted in writing by the Raleigh Director of Public Utilities or his designee. (See Section 8: Exception for Location). The containment assembly must remain accessible and visible after landscape maturity. Containment assemblies may not be installed in a hazardous location or traffic site triangle.

4.16 LOOPED SYSTEMS

1. An approved containment assembly shall be installed to contain a private distribution system that is looped.

4.17 MATERIALS

1. Piping materials shall conform to one of the standards listed in NC Plumbing Code Table 605.3 for water service pipe and 605.4 for water distribution pipe.

4.18 MODIFICATION OF DCDA/RPDA UNITS

1. When the DCDA/RPDA bypass is in need of replacement, the defective parts must be replaced with factory approved parts (i.e. the bypass containment assembly or bypass meter must be replaced with a unit of the same size, brand and model number) since the detector assembly and main line unit are a matched set from the factory. All components of a containment assembly shall be accessible without having to remove piping that serves the FDC connection.

4.19 PERMITS

1. A plumbing and fire permit is required for all new and relocated fire containment assembly installations. The receipt of a plumbing and/or fire permit does not relieve the owner of compliance with all applicable Cross Connection rules and regulations.

4.20 PRE-EXISTING ISSUES

1. Any approved containment assembly that has not been installed in accordance to Sec. 8-2149 of Raleigh City Code and whose location does not pose an imminent threat to the public water supply shall be considered pre-existing and compliant.

4.21 PRIVATE FIRE HYDRANTS AND DEAD END MAIN LINES

1. All fire systems, fire hydrant lines and dead-end mains extending more than 10 feet from the Right of Way (ROW) are considered to be private, dead end systems and are required to have an approved Reduced Pressure Detector Assembly (RPDA) installed within 10 linear feet of the ROW/private property line.

4.22 RELIEF OUTLET PIPING

1. In some applications, it is practical to install a drain line off of the relief port of the RPZ assembly so that in the event that there is some spillage from the device the water can be directed to a floor drain. When drains from the relief port of an approved containment RPZ are utilized, the following conditions must be met:
2. An approved pre-fabricated "air gap drain" as available from the backflow assembly manufacturer must be utilized.
3. All relief port drain lines shall be piped to an outside point of termination.
4. The RPZ relief valve shall be a minimum of 12" above any material or ground.

4.23 REPAIRS

1. If a containment assembly fails its operational test, the property owner will have 45 days from the date of notification to have all repairs made except those owners of properties with a cross-connection, auxiliary intake, interconnection or severe hazard as defined by Article D: Water Quality Protection and Appendix A: Guidelines and Requirements for the Cross Connection and Hydrant Meter Programs that is deemed, by the Cross Connection Coordinator, to be an imminent threat shall install a containment assembly required by the Raleigh City Code immediately. Failure to install the appropriate containment assembly where there is an imminent threat may result in the discontinuance of water service until such violations are corrected.. Defective parts must be replaced with factory approved parts. If repair is not possible, the assembly must be replaced with an approved containment assembly according to Raleigh City Code, Public Utilities Handbook, and North Carolina Plumbing Code.

4.24 SERVICE VALVE

1. The #1 shut-off valve is part of the containment assembly and may not be used as a service valve. A service valve shall be installed after the meter, outside of the ROW, and prior to every containment assembly to allow testing, maintenance and replacement of the containment assembly without the use of a City of Raleigh Public Utilities operating valve. The service valve shall be installed underground and a minimum of 18" distance from meter.

4.25 SUPPORT

1. Containment assemblies shall be properly supported so that stress on surrounding piping does not occur. Adequate support must be provided for the assembly in the approved orientation either

vertically or horizontally. The assembly may not be supported by other piping or unapproved methods of support. (See: North Carolina Plumbing Code Section 308.5)

4.26 TESTING

1. Testing of containment assemblies shall be conducted in accordance with Sec. 8-2154 of Raleigh City Code by a certified tester at the customer's expense. All newly installed containment assemblies on fire service water lines are to be tested after installation and annually thereafter. A fire service water line may not be used to provide water for any purpose other than fire sprinkler systems. All water use for construction purposes is to be metered. See "Construction Water" under the policies and procedures section of the Public Utilities Handbook. Additional testing and maintenance requirements may be requested or imposed as determined by the Raleigh Director of Public Utilities or his designee. It is the owner's responsibility to keep a complete, written record of any repairs and testing of the containment assembly for at least three years.
2. Any location that does not have a current passing operational electronic test report [Sec. 8-2154(b)] on file with the Cross Connection Program will be considered noncompliant. Owners that are in noncompliance can come into compliance by:
 - A. **Testing:** hire a certified tester to perform an operational test and submit the report to the Cross Connection Program. Fire report submittal period: containment assembly test reports accepted only three (3) months prior to the required annual test due date.
 - B. **Terminating:** To permanently remove a containment assembly, all controls and valves shall be removed with the piping capped or plugged below ground near the source of connection. The meter box, if existing shall be removed. A plumbing permit and inspection are required to cap or plug piping.
 - C. **Failed Operational Test:** If a containment assembly fails its operational test, the property owner must immediately notify the Fire Marshal's office. The property owner will have 45 days to have all repairs made and the passing operational test turned into the Cross Connection Control Program

4.27 TESTING SCHEDULE

1. Property owners who have containment assemblies on fire sprinkler systems as well as domestic services may test domestic containment assemblies in accordance with the annual testing date for the fire containment assembly. Property owners or certified testers are to contact the City of Raleigh's Cross Connection Program or contracted vendor to arrange this testing schedule exception. All other containment assemblies installed on fire services are to be tested upon installation, replacement, and annually thereafter on or before annual test due date according to zip code:

Zip Code	Annual Test Date	Zip Code	Annual Test Date
27529	September 1st	27606	December 1st
27545	May 1st	27607	December 1st
27560	December 1st	27608	April 1st

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27603	November 1st	27616	February 1st
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27605	October 1st	27703	November 1st

4.28 WYE STRAINER

1. No strainer shall be allowed on a fire suppression system.

END OF SECTION 4

SECTION 5

CERTIFIED TESTERS

5.1 QUALIFICATIONS

1. The City of Raleigh requires that a *certified tester* perform all testing. A certified tester is a person who has proven his/her competency to perform an operational test using a nationally accepted process and accurately complete reports on containment assemblies as evidenced by the successful completion of an approved Cross Connection Control School and compliance with all rules, regulations and policies associated with the Raleigh City Code, North Carolina DENR rules, North Carolina Plumbing Code and the applicable Contractor's licensing board. All contractors who wish to test within the City of Raleigh's water service area must be registered with the City of Raleigh's Cross Connection Control Program and attend an orientation session. Information regarding becoming a certified tester for the City of Raleigh can be found at www.raleighnc.gov under Cross Connection.

5.2 APPROVED BACKFLOW CERTIFICATION SCHOOLS

1. Information regarding training programs recognized by the City of Raleigh's Cross Connection Control Program can be found at www.raleighnc.gov under Cross Connection.

5.3 CERTIFIED TESTER RESPONSIBILITIES

1. Any certified tester who performs an operational test on any containment assembly connected to the City's public water supply shall file a report regarding the results of that operational test using the City's designated electronic reporting system managed by the currently contracted vendor as published at www.raleighnc.gov. Certified testers shall supply all testing information required by the designated electronic reporting system to included but not limited to test values for containment assembly, size, make, model, serial number and location of containment assembly, name and address of owner as recorded on notice, premise number for fire services, meter number for domestic and irrigation services, and Wake County PIN number for containment assemblies on private distribution and fire sprinkler systems. The fee for any report filed using the electronic reporting system shall be in accordance with Section 8-2154 (b) Testing and Maintenance of Assemblies. In addition, certified testers shall comply with all requirements of this code and the Raleigh Public Utilities handbook. Failure to comply may result in revocation of certified tester status.

5.4 REQUIRED DOCUMENTATION

1. A current copy of the following information is required to be on file with the Cross Connection Control Program office in order to be eligible to test within the City of Raleigh's water service area:
 - A. Tester's certificate of training and subsequent recertification training from an approved backflow certification school
 - B. Annual test kit calibration
 - C. Completed orientation packet

5.5 SUSPENSION/PROBATION

1. The Raleigh Director of Public Utilities or his designee may suspend or impose probationary provisions on a certified tester who fails to comply with any provision or requirement related to the practice of backflow installation, testing, repair or replacement that may be found in the City of Raleigh Code, rules, or policies, North Carolina DENR rules, North Carolina Plumbing Code, the code of another jurisdiction governing testing of backflows, or the rules of the licensing Board applicable to the Contractor ; or who commits fraud, deceit, negligence, incompetency, or other misconduct in the practice of backflow installation, testing, repair or replacement. The City of Raleigh will recognize and comply with any action taken by another agency to suspend or impose probationary provisions to test.

5.6 REVOCATION OF CITY OF RALEIGH BACKFLOW CERTIFICATION

1. In 2014, the City of Raleigh established a Cross Connection school for the purpose of certifying and recertifying backflow testers. The City of Raleigh may revoke its certification of a tester who is found guilty of negligence or who fails to comply with any provision or requirement of the Raleigh City Code, rule, or policy, North Carolina DENR rules, North Carolina Plumbing Code, another jurisdiction's code and the applicable Contractor's licensing boards and for gross negligence, incompetency, or misconduct, in the practice of backflow testing.

5.7 RIGHT TO APPEAL

1. The Raleigh Director of Public Utilities or his designee may provide an opportunity for an approved tester who has been suspended, placed on probation, or had certification revoked to obtain reconsideration of said action upon receipt of a written request received no later than 10 days following the effective date of suspension.

END OF SECTION 5

SECTION 6

EXEMPTION FOR BACKFLOW INSTALLATION

6.1 COMMERCIAL USES

1. Property owners whose service line connections (i) are 1” in diameter or smaller, (ii) do not provide water to multiple tenants, (iii) are not otherwise required by Raleigh City Code to have other containment assemblies, and (iv) were installed before February 21, 2015, may apply to the Raleigh Director of Public Utilities or his designee for an exemption from the requirement to install a containment assembly. Applications can be found at www.raleighnc.gov under Cross Connection/Hydrant Meter Rental Units Program.

6.2 RESIDENTIAL USES

1. Property owners whose service line connections (i) are 2” in diameter or smaller, (ii) are not otherwise required by this Code to have other containment assemblies, and (iii) were installed before February 21, 2015, may apply to the Raleigh Director of Public Utilities or his designee for an exemption to install a double check valve assembly as required by Article D: Water Quality Protection §8-2148(b). After receiving a completed application, the Raleigh Director of Public Utilities or his designee will determine whether a facility is eligible for exemption pursuant to the standards above. In the event that such exemption is approved, a letter of approval will be sent to the facility owner and the owner shall install the required containment device(s). If a facility is denied exemption, a letter of denial will be sent to the owner who will thereafter be required to install the appropriate containment assembly. Failure to comply could result in enforcement action.

END OF SECTION 6

SECTION 7

EXTENSION OF TIME FOR COMPLIANCE

7.1 EXTENSION OF TIME FOR COMPLIANCE APPLICATION

1. Owners of a facility containing a cross-connection that does not pose an imminent threat to the public water supply and who wish to apply for an extension of time for compliance not to exceed one year from the date of the original notice issued pursuant to §8-2151 of the Raleigh City Code must provide the Cross Connection Coordinator in writing the following:
 - A. A completed City of Raleigh Extension Application
 - B. Three installation bids
 - C. Completion date for required work
 - D. Proof of existing or proposed containment assemblies for any severe hazards located within the facility by means a submittal of a passing operational test report.
2. After receiving the completed application and supporting documentation, Raleigh Director of Public Utilities or his designee will determine if and for how long a facility will be granted an extension considering the length of the estimated time for completion, the cost to achieve compliance and the degree of risk of the cross connection to the public water supply system. In no instance will an extension be granted until all imminent threats at the facility are brought into compliance. The owner who is granted the extension shall indemnify and hold harmless the City from any harm or damages that may result from such person's failure to install any required containment assembly as required by Article D- Water Quality Protection of the Raleigh City Code.

END OF SECTION 7

SECTION 8

EXCEPTION FOR LOCATION

8.1 EXCEPTION FOR LOCATION APPLICATION

1. Owners, who due to installation complications, need to install a containment assembly further than the maximum 10 linear piping feet after the meter or ROW for fire service lines, may apply to the Cross Connection Program for an exception. Requests may not be made for a location that is further than 50' from the meter or ROW for fire service line. Applications can be found at www.raleighnc.gov under Cross Connection.
2. After receiving a completed application, the Raleigh Director of Public Utilities or his designee will determine, based on site conditions, if a facility will be granted an exception. A letter of approval or denial will be sent to the owner. Failure to comply with the containment assembly location installation requirements may result in enforcement action.

END OF SECTION 8

SECTION 9

CERTIFICATE OF COMPLIANCE

9.1 PURPOSE

1. The purpose of the Certificate of Compliance is to create a process to assist all property owners/water customers with the reviewing and approving of building plans for existing and new construction projects and/or the starting/transferring of water services by verifying whether or not an owner is compliant with all containment backflow requirements, and if not, to ensure that such owner/water customer becomes compliant.

9.2 EXISTING SERVICES

1. Upfit Plan Reviews:

- A. Any commercial owner of a property that currently has a domestic, irrigation and/or fire sprinkler system or residential owner who has an irrigation system served water by the City of Raleigh public water supply must apply for a Certificate of Compliance before submitting building plans for review with the City's Public Utilities Department or Development Services.
- B. Upon receipt of a completed application and verification by the Cross Connection Coordinator or his/her designee that the owner's water services are contained with approved backflows, the Cross Connection Coordinator or his/her designee will issue a Certificate of Compliance. This certificate must be presented when submitting plans for review with the City of Raleigh's Development Services Department or requesting the start of water services.
- C. If the Cross Connection Coordinator or his/her designee determines that the owner's water services are properly contained, but do not have current test reports on file with the Cross Connection Program, the Cross Connection Coordinator or his/her designee will issue a Temporary Certificate of Compliance allowing water service to be started/transferred to the new customer. The owner/water customer will have 15 business days to have all containment backflows tested by a City of Raleigh Certified Tester and all test reports submitted online to the third party vendor for backflow test reporting. Failure to submit the proper paperwork online within 15 business days will result in termination of water service. A Temporary Certificate of Compliance may be used when submitting building plans for initial review to validate there is proper backflow protection at the facility.

2. Starting/Transferring of Existing Services:

- A. Any water customer or commercial owner of a property that currently has a domestic, irrigation and/or fire sprinkler system or residential water customer or owner who has an irrigation system served water by the City of Raleigh public water supply must apply for a Certificate of Compliance before contacting Customer Care and Billing to request the start or transfer of water services.
- B. Upon receipt of a completed application and verification by the Cross Connection Coordinator or his/her designee that the owner's water services are contained with approved backflows, the Cross Connection Coordinator or his/her designee will attach the Certificate

of Compliance to the account and notify the customer the account can be started.

- C. If the Cross Connection Coordinator or his/her designee determines that the water customer's or owner's water services are properly contained, but do not have current test reports on file with the Cross Connection Program, the Cross Connection Coordinator or his/her designee will issue a Temporary Certificate of Compliance allowing water service to be started/transferred to the new customer. The owner or water customer will have 15 business days to have all containment backflows tested by a City of Raleigh Certified Tester and all test reports submitted online to the third party vendor for backflow test reporting. Failure to submit the proper paperwork online within 15 business days will result in termination of water service.
 - D. A Certificate of Compliance will be valid until the next scheduled test due date of the water customer's or owner's account unless the facility or residence has use changes. At which time the water customer or owner will surrender this Certificate of Compliance to the Cross Connection Program and install the proper approved containment backflow assemblies according to the City of Raleigh's ordinance, handbook, and NC Plumbing and Fire Code.
 - E. Owners or water customers that do not have approved containment backflow assemblies installed on all City of Raleigh water services will not be given water service. Upon installation of all approved backflow assemblies, a Temporary Certificate of Compliance will be granted to the water customer or owner thereby enabling all backflows to be tested and the paperwork submitted online to the Cross Connection Program.
 - F. Existing commercial owners, who do not have a severe hazard according to 3.13 of the City of Raleigh's Cross Connection Handbook, may apply for an Exemption for Backflow Installation.
3. New Construction:
- A. Any owner who desires to connect to the City of Raleigh's public water supply for a domestic, irrigation, fire, or private distribution system must apply for a Certificate of Compliance before submitting building plans for review
 - B. Upon receipt of a completed application and verification that the owner's facility will be contained with the proper backflows, the owner will receive a letter granting a Certificate of Approval. This certificate may be presented when submitting building plans for review with the City of Raleigh's Development Services Department.
 - C. Upon installation and verification of all approved backflow assemblies specified on the application, the water customer or owner will receive a letter granting a Temporary Certificate of Compliance allowing a water service to be started. The water customer or owner will have 15 business days to have all backflows tested and the paperwork submitted online to our Cross Connection Program. Failure to submit the paperwork online to the Cross Connection Program will result in the termination of water service. A temporary certificate must be obtained from the Cross Connection Program before contacting the City of Raleigh's Public Utilities Customer Care and Billing Division to start water services or initiate a fire service line.

END OF SECTION 9

SECTION 10

HYDRANT METER RENTAL UNITS

10.1 GENERAL

1. The City of Raleigh Public Utilities Department does not provide free or otherwise unmetered construction water or bulk water use. Customers may apply for temporary water through the City of Raleigh's Hydrant Meter Program located at the Public Utilities Meters Division Office at 3304 Terminal Dr. Bldg. 200, Raleigh, NC 27604. A hydrant rental unit consists of a hydrant meter, approved backflow assembly, and all accessories. Hydrant meter rental units are issued as temporary water service and may be recalled at any time and for any reason by the Raleigh Director of Public Utilities or his designee. The application must be accompanied with a deposit as required by the published scheduling fee per account. Additionally, there will be a charge for the cost of the water used at the outside City rate. Hydrant meter rental units are read in 100 cubic feet (ccf). Customers are responsible for notifying the Meters Division if the meter is not registering usage.
 - A. Customers will be allowed to rent the hydrant rental unit by the day, month, or year. Non-refundable rental rates for the hydrant rental unit are listed in our published fee schedule. There will be no prorating allowed on monthly and yearly accounts.
 - B. The customer is responsible for paying for the actual amount of water used (consumed) and will be billed by the City of Raleigh based on the meter readings for the rental period. Rental and consumption charges shall be billed monthly or on the date of account closure.
 - C. Hydrant meter rental unit accounts are billed monthly and readings are to be emailed, faxed, or called in by the 7th. Failure to report meter readings by the 7th of each month will result in an estimated bill of 25 ccfs for 5/8" hydrant rentals and 100 ccfs 3". When accurate readings are acquired and the usage is under the estimated billed amount, there will be a credit adjustment. If usage is over the estimated billed amount, the customer will be billed for the difference. Accounts will be assessed a fee according to the published Schedule of Charges for Water, Sewer and Reuse Water Utilities found at www.raleighnc.gov.
 - D. Hydrant rental units can only be used when the temperature is above 35 degrees. Damage to hydrant rental units from the cold weather or abuse will be charged to the customers.
 - E. Hydrant meter rental units are to be tested and maintenance performed annually; therefore, customers must return rental units to the Hydrant Program at the end of each one year block. Non-compliant accounts will be assessed an administration fee according to the published Schedule of Charges for Water, Sewer and Reuse Water Utilities found at www.raleighnc.gov.
 - F. Upon completion of hydrant usage, deposits shall be applied to the final bill. Applicable refunds will be refunded to customers within 30 days provided the following has occurred:
 - 1) Hydrant rental unit and all associated equipment is returned in good condition with no excessive wear or damage. The cost of repairs or replacement of equipment due to damage or missing equipment will be deducted from the deposit prior to any refund being processed. Repair or replacement costs that exceed the deposit will be charged

back to the customer.

- 2) All outstanding water usage and rental charges for the hydrant meter rental unit assembly have been paid in full by the customer.
- G. Office hours are Monday through Friday from 7:45am-3:45pm excluding published City of Raleigh holidays.
- H. It is a violation of the Raleigh City Code to establish a direct connection to a fire hydrant to fill a tank or tank vehicle. It is also illegal to use the test cocks of a backflow assembly for temporary water service. Violations of the Raleigh City Code will result in loss of service, fines, and other measures as specified by the Code.
- I. The City of Raleigh also offers bulk reuse water. For more information concerning bulk reuse water, contact the Neuse River Resource Recovery Facility at 919-996-3700.
- J. Continued use of a hydrant meter rental unit, when usage readings are not being registered is considered theft of City water and subject to civil penalties of up to \$5,000.00/day. It is the responsibility of the customer to notify the Meters Division at 919-996-2747 when the meter is not registering/recording the water usage properly.
- K. Hydrant meter rental units and backflow assemblies approved for use in this program are the property of the City of Raleigh's Public Utilities Department. Failure to return the hydrant rental unit at the end of the rental period will be considered theft of City property and prosecuted to the fullest extent of the law.

10.2 HYDRANT METER RENTAL UNITS USAGE INSTRUCTIONS

1. The City of Raleigh's Public Utilities Department will require all customers to view a training video and provide written instructions on the proper operation of fire hydrants and the proper techniques for the connection and removal of the hydrant meter rental unit. Additional training can be provided upon request.
2. Hydrant meter rental units may only be used on public hydrants and are not permitted to be used on private hydrants.
3. Customers must ensure that the hydrant meter rental unit is registering usage and that no leaks are present. Any broken or leaking hydrant meter rental unit shall be returned immediately to the City of Raleigh for repair. Any leaking or broken fire hydrants shall be reported immediately. Call the City of Raleigh at 919-996-2747 to report these issues. Early reporting of leaks and damage may mitigate the issuance of Civil Penalties due to the overriding interest in the conservation of water.
4. Any damage to the City of Raleigh, Towns of Garner, Wake Forest, Wendell, Knightdale, Rolesville and Zebulon fire hydrants and/or City-owned potable water system caused by the negligent use of the hydrant meter rental units and/or fire hydrant may result in the issuance of a Notice of Violation that may include Civil Penalties and will include all costs related to the damage under Raleigh City Code 8-2103 "Damage to Utility System" and 8-2014 "Enforcement Procedure".
5. Customers must follow the provided instructions and use the equipment (hose, adapter and hydrant wrenches) that is provided by the City.

6. At no time shall any hydrant meter rental unit be disassembled or altered by anyone other than City of Raleigh staff.
7. At no time shall any hose be connected to a fire hydrant that is not connected to a hydrant meter rental unit. If a hose is found to be directly connected to a fire hydrant without a hydrant meter rental unit, a Notice of Violation may be issued for receiving unmetered water from the City of Raleigh's public water supply.
8. Hydrant meter rental units may be securely mounted to water truck/tankers and must be clearly displayed at all times. If the hydrant meter rental unit cannot be displayed while on a truck/tanker, the customer must provide the designated location at the time of rental. Truck/tankers shall NOT be filled within residential areas.
9. Only use the provided hydrant wrenches and adapters. Do NOT use a pipe wrench, crescent wrench, etc.
10. Before installing the hydrant meter rental unit, open the hydrant slowly and let the water flow for approximately 30 seconds to clear the line of debris.
11. When opening a hydrant, turn the wrench slowly counterclockwise until the wrench stops turning, then back off ¼ turn.
12. Make sure you regulate the water flow by turning your hydrant meter rental unit's gate valve, NOT by partially opening the hydrant or adjusting the ball valves on either side of the backflow (handles have been removed to prevent this). A fire hydrant must be turned completely on or it will drain. The draining is through a valve underground and will damage the area surrounding the fire hydrant and/or the fire hydrant itself.
13. Large 3" hydrant meter rental units shall not be connected directly to the fire hydrant. You must use the provided fire hose to attach the hydrant meter rental unit to the fire hydrant. However, 5/8" hydrant meter rental units can be directly connected to the fire hydrant.
14. Do NOT leave your hydrant meter rental unit on the ground. The hydrant meter rental unit must be supported and no less than 12" off the ground at its lowest point to allow for proper backflow support and drainage. The customer is responsible for providing the materials to support the hydrant meter rental unit.
15. The fire hydrant or hydrant meter rental unit should NOT be left on overnight. The hydrant meter rental unit should not be left unsecure or unattended at any time unless the construction site is securely fenced in during non-work hours or the hydrant meter rental unit is locked securely to the hydrant.
16. When closing a fire hydrant, turn the wrench slowly clockwise until the wrench stops turning, then back off a quarter turn.
17. Be sure to replace and tighten all fire hydrant caps after use. Make sure they are hand tight.
18. Do NOT let anyone drive over or place materials on the fire hose connecting the hydrant meter rental unit to the fire hydrant. It may cause severe damage to the hydrant meter rental unit, fire hydrant and water lines in the area.
19. Individuals caught using unmetered, unauthorized water and/or an altered hydrant meter rental

unit shall be prosecuted to the fullest extent of the law. This shall include both civil and criminal penalties.

END OF SECTION 10

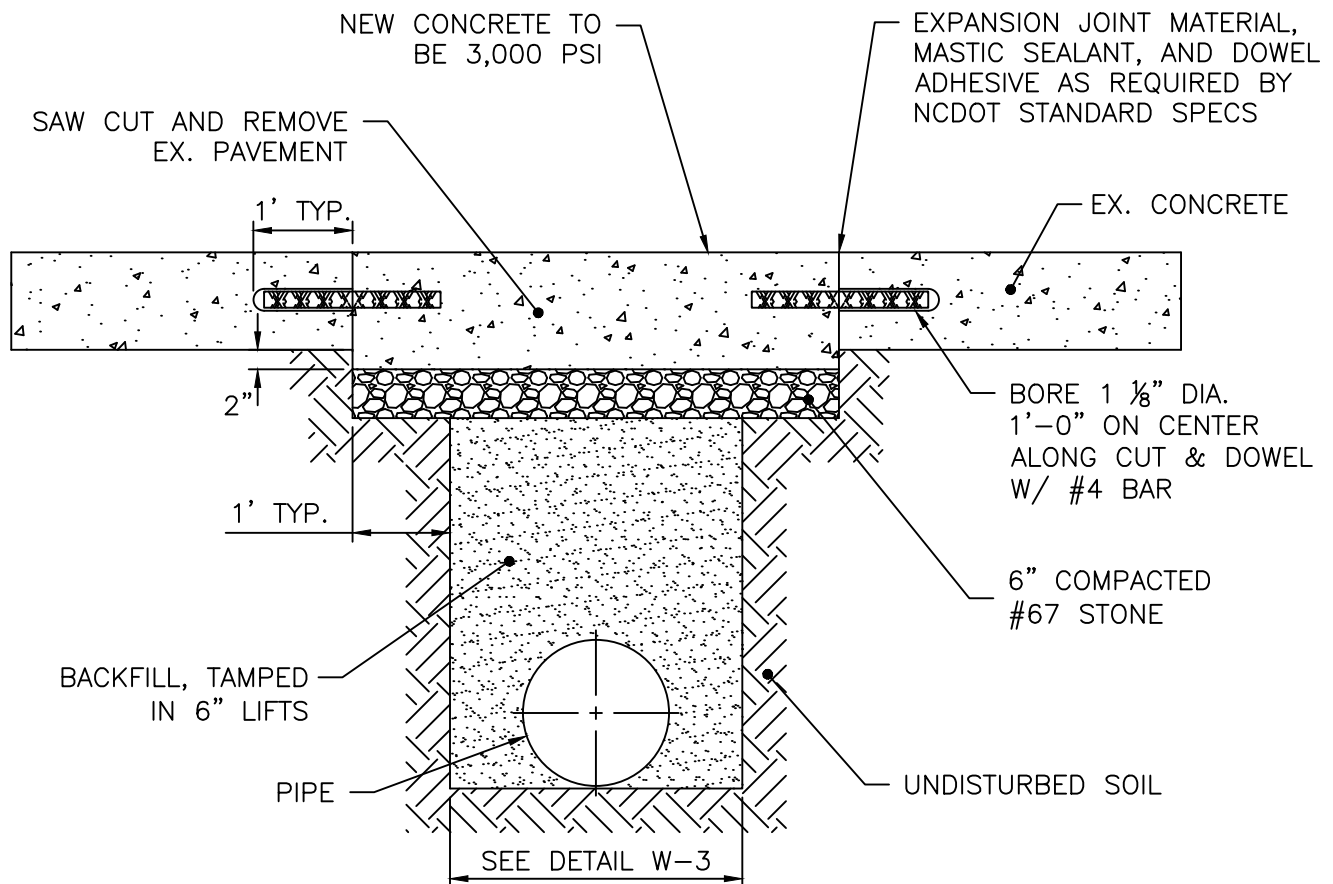


Appendix B

Standard Details



Raleigh
Water



NOTES:

1. SEE DETAIL W-3 FOR ADDITIONAL TRENCH AND PIPE BEDDING DETAILS.
2. PAVEMENT CUTS WITHIN NCDOT ROW SHALL CONFORM TO THE APPROVED ON SITE ENCROACHMENT PERMIT.
3. THE PAVEMENT CUT SHALL BE DEFINED BY A STRAIGHT EDGE AND CUT WITH AN APPROVED SAW CUT MACHINE.
4. THE TRENCH SUBGRADE MATERIAL SHALL BE BACKFILLED WITH SUITABLE MATERIAL AND COMPACTED TO AT LEAST 95% OF THE MAXIMUM DRY DENSITY AS DETERMINED BY AASHTO T 99 AS MODIFIED BY NCDOT.
5. THE FINAL 6" OF FILL SHALL CONSIST OF ABC MATERIAL COMPACTED TO AT LEAST 100% OF THE MAXIMUM DRY DENSITY AS DETERMINED BY AASHTO T 180 AS MODIFIED BY NCDOT.

CITY OF RALEIGH
STANDARD DETAIL

REVISIONS DATE: 05/24/2024 NOT TO SCALE

STANDARD CONCRETE
PAVEMENT PATCH

W-1

SEE TRANSPORTATION DETAIL
T-10.05.1 FOR ASPHALT REPAIR

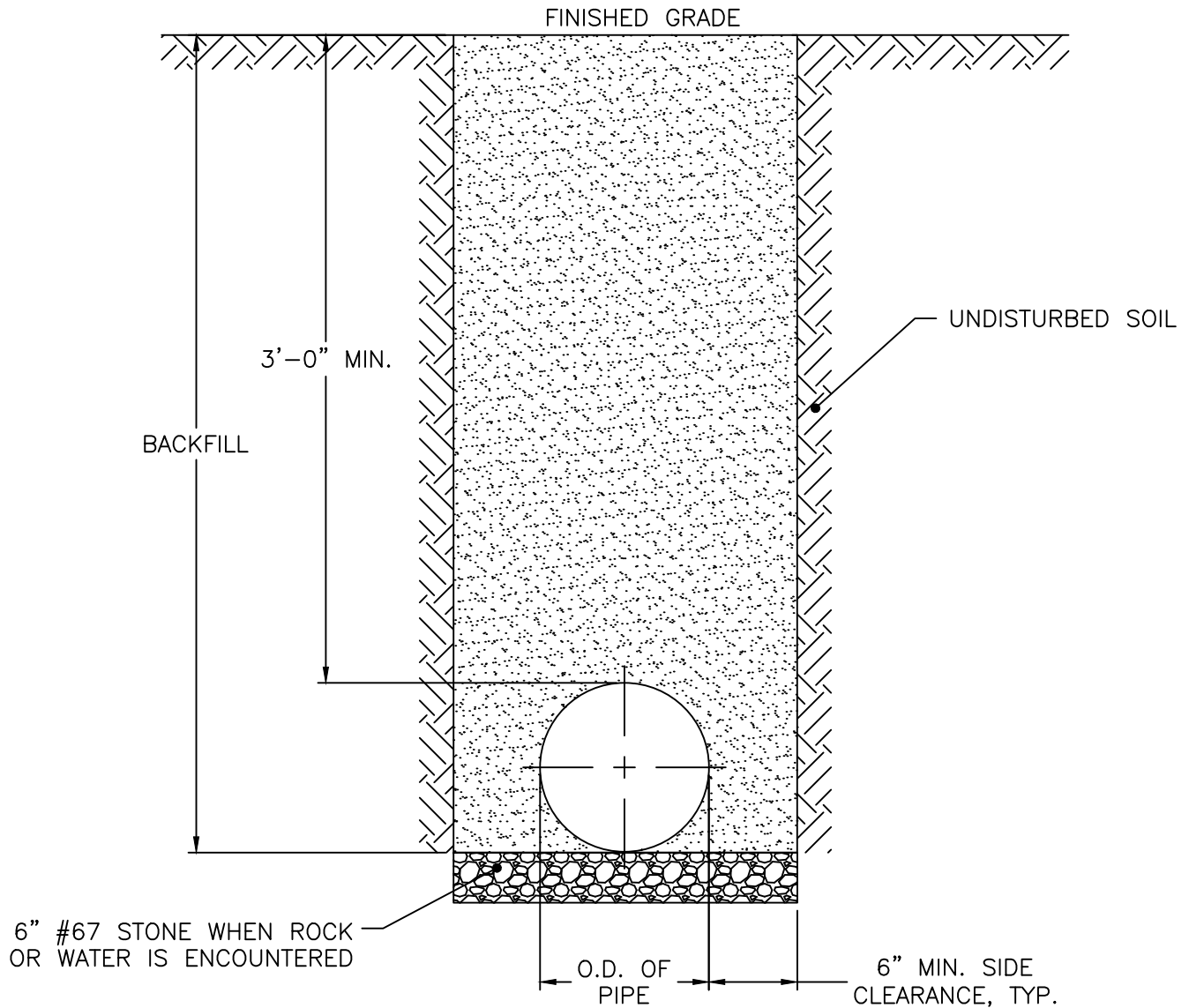
SEE TRANSPORTATION DETAIL
T-10.05.2 FOR ASPHALT REPAIR EXTENTS

CITY OF RALEIGH
STANDARD DETAIL

<i>REVISIONS</i>	<i>DATE: 05/24/2024</i>	<i>NOT TO SCALE</i>
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	STANDARD ASPHALT PAVEMENT PATCH

	W-2
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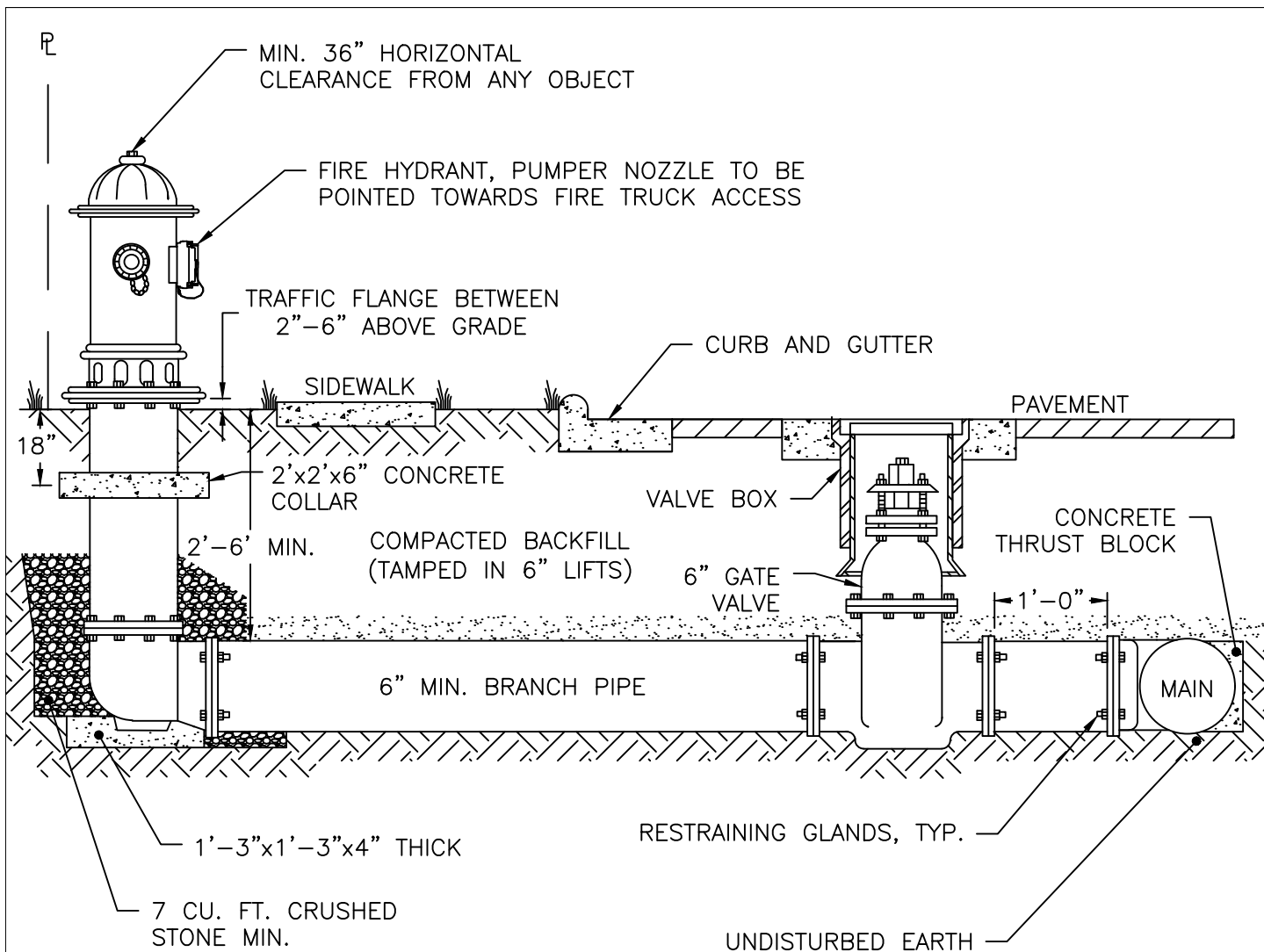


NOTES:

1. TRENCHES REQUIRING SHORING AND BRACING, DIMENSIONS SHALL BE TAKEN FROM THE INSIDE FACE OF THE SHORING AND BRACING.
2. NO ROCKS OR BOULDERS 4" OR LARGER TO BE USED IN BACKFILL.
3. ALL BACKFILL MATERIAL SHALL BE SUITABLE NATIVE MATERIAL.
4. BACKFILL SHALL BE TAMPED IN 6" LIFTS.
5. ACHIEVE 95% COMPACTION IN BACKFILL.

CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	TRENCH BOTTOM DIMENSIONS AND BACKFILLING REQUIREMENTS FOR DUCTILE IRON	
	W-3	

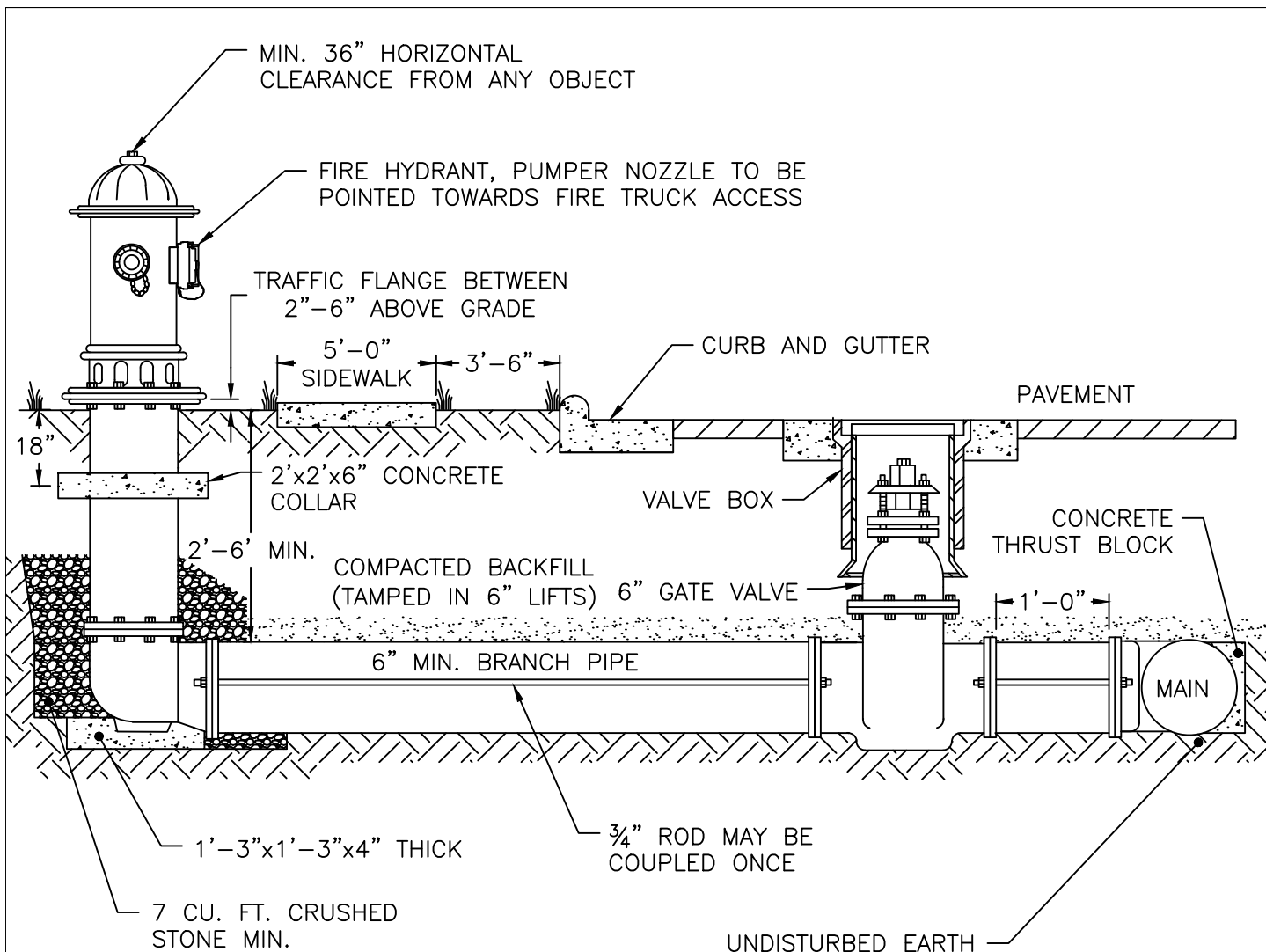


NOTES:

1. FIRE HYDRANT SHALL BE AS MANUFACTURED: MUELLER, AMERICAN DARLING, KENNEDY OR CLOW.
2. BRANCH PIPE SHALL BE DUCTILE IRON AWWA C150.
3. 6" GATE VALVE SHALL BE AWWA C500 OPEN LEFT.
4. RODS AND BOLTS SHALL BE $\frac{3}{4}$ " 316 STAINLESS STEEL.
5. FIRE HYDRANTS WILL BE INSTALLED IN TRUE VERTICAL POSITION.
6. RODS SHALL NOT BE COUPLED MORE THAN ONCE. IF THE LENGTH FROM THE VALVE TO THE HYDRANT EXCEEDS 20' THEN A MECHANICAL RESTRAINING GLAND WITH A REBAR CAGE SHALL BE INSTALLED NO MORE THAN 10' FROM HYDRANT AND POURED IN CONCRETE.
7. FIRE HYDRANTS TO BE LOCATED IN ROW OR 2.5 FOOT EASEMENT (ON ALL SIDES OF HYDRANT) FOOT EASEMENT ADJACENT TO ROW.
8. ANYTIME SITE WORK, CONSTRUCTION, ROAD WORK, OR ANY OTHER WORK CHANGES THE GRADE OF THE FIRE HYDRANT, THE PERSON RESPONSIBLE FOR THE WORK IS RESPONSIBLE FOR ADJUSTING THE FIRE HYDRANT TO STAY WITHIN COMPLIANCE.

CITY OF RALEIGH STANDARD DETAIL

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	STANDARD FIRE HYDRANT INSTALLATION (RESTRAINT GLANDS)	
	W-4	

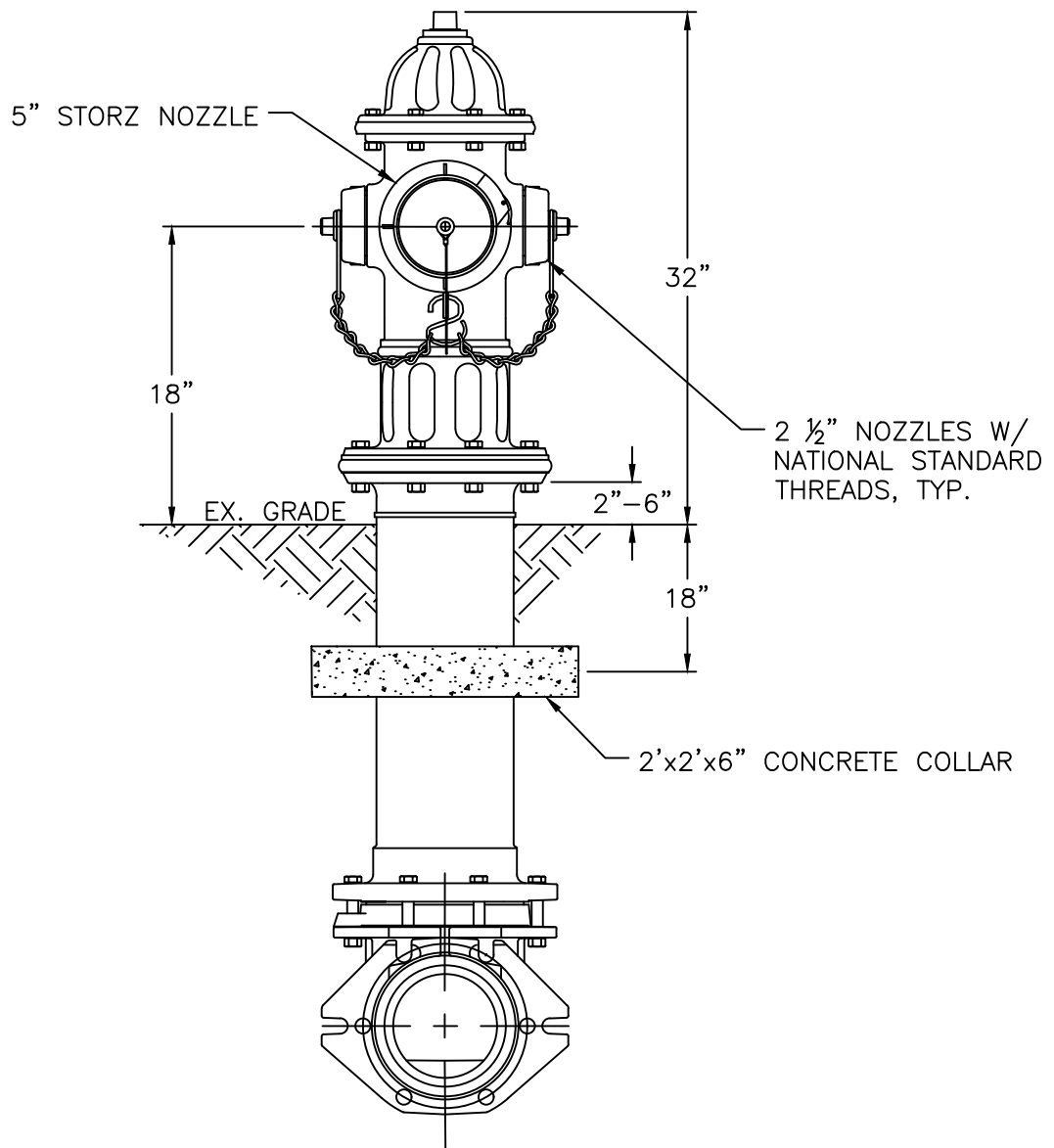


NOTES:

1. FIRE HYDRANT SHALL BE AS MANUFACTURED: MUELLER, AMERICAN DARLING, KENNEDY OR CLOW.
2. BRANCH PIPE SHALL BE DUCTILE IRON AWWA C150.
3. 6" GATE VALVE SHALL BE AWWA C500 OPEN LEFT.
4. RODS AND BOLTS SHALL BE 3/4" 316 STAINLESS STEEL.
5. FIRE HYDRANTS WILL BE INSTALLED IN TRUE VERTICAL POSITION.
6. RODS SHALL NOT BE COUPLED MORE THAN ONCE. IF THE LENGTH FROM THE VALVE TO THE HYDRANT EXCEEDS 20' THEN A MECHANICAL RESTRAINING GLAND WITH A REBAR CAGE SHALL BE INSTALLED NO MORE THAN 10' FROM HYDRANT AND POURED IN CONCRETE.
7. FIRE HYDRANTS TO BE LOCATED IN ROW OR 2.5 FOOT EASEMENT (ON ALL SIDES OF HYDRANT) FOOT EASEMENT ADJACENT TO ROW.
8. ANYTIME SITE WORK, CONSTRUCTION, ROAD WORK, OR ANY OTHER WORK CHANGES THE GRADE OF THE FIRE HYDRANT, THE PERSON RESPONSIBLE FOR THE WORK IS RESPONSIBLE FOR ADJUSTING THE FIRE HYDRANT TO STAY WITHIN COMPLIANCE.

CITY OF RALEIGH STANDARD DETAIL

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	STANDARD FIRE HYDRANT INSTALLATION (RESTRAINT RODS)	
	W-4A	

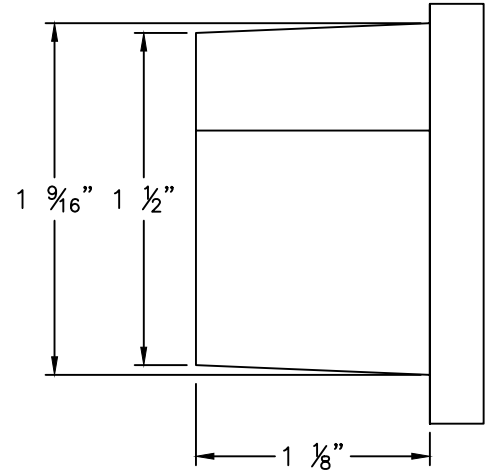
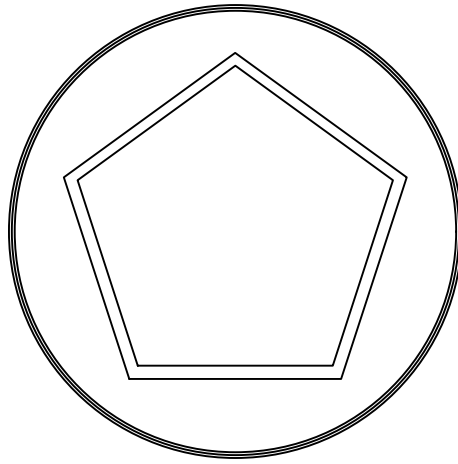


NOTES:

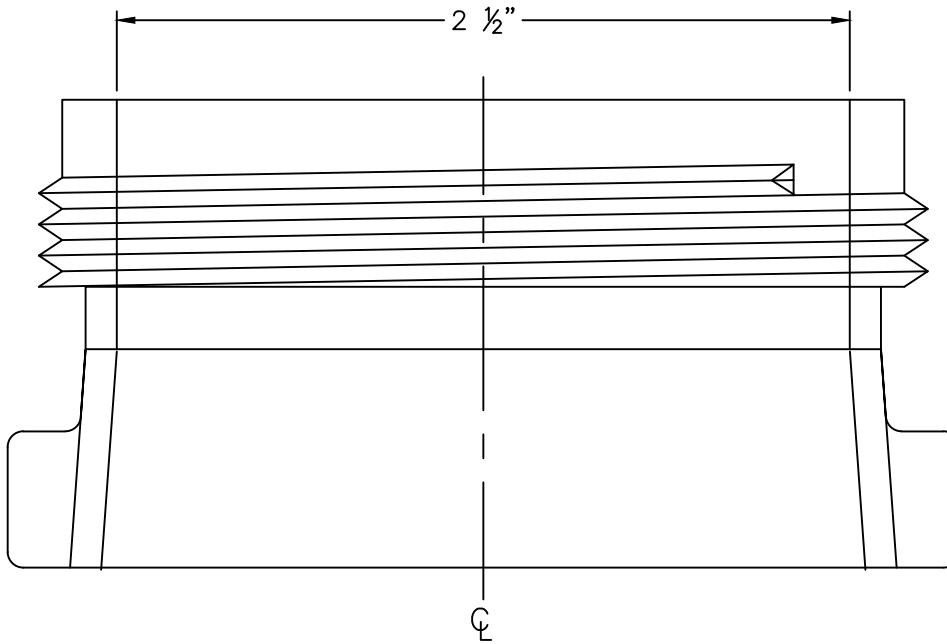
1. ALL PUBLIC FIRE HYDRANTS IN THE CITY OF RALEIGH AND THE MERGER TOWNS OF GARNER, ROLESVILLE, WAKE FOREST, KNIGHTDALE, WENDELL AND ZEBULON SHALL BE PAINTED CHROME YELLOW WITH HIGH REFLECTIVE ALUMINUM SILVER CAPS, BONNETS AND OPERATING NUTS.
2. ALL PRIVATE FIRE HYDRANTS SHALL BE RED.

CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	STANDARD FIRE HYDRANT WITH 5" STORZ PUMPER NOZZLE	
	W-5	



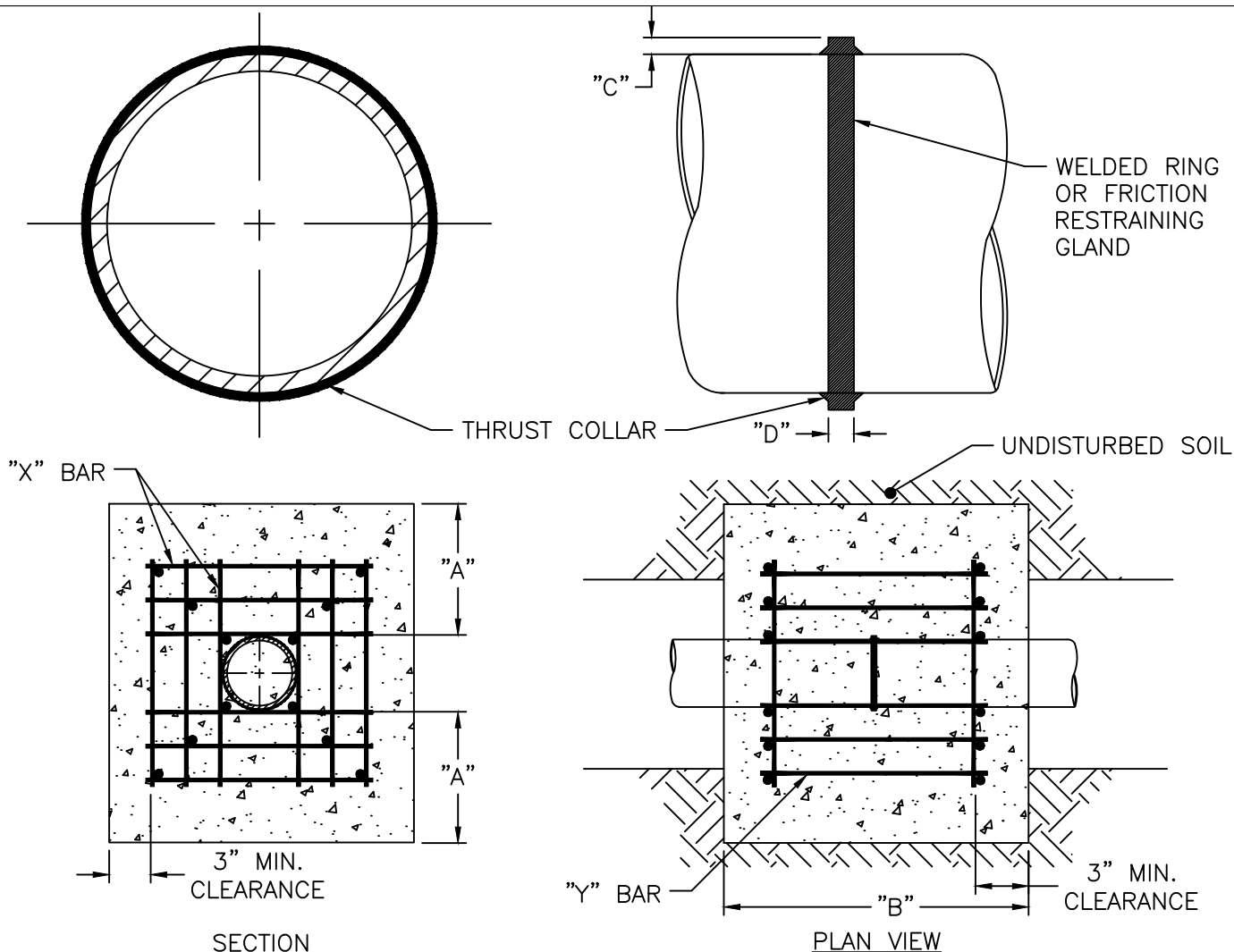
1 $\frac{9}{16}$ " OPERATION NUT



2 $\frac{1}{2}$ " NATIONAL STANDARD OUTLET THREADS

CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	HYDRANT OPERATING NUT AND 2 $\frac{1}{2}$ " OUTLET THREADS	
	W-6	



SECTION

PLAN VIEW

REINFORCING REQUIREMENTS

I.D. PIPE	REBAR SIZE	"X" BAR LENGTH	"X" BAR WEIGHT	"Y" BAR LENGTH	"Y" BAR WEIGHT	NO. REQUIRED
6"-36"	#5	2'-2"+ O.D. PIPE	1.043 LBS/FT	1'-1"	1.1 LBS. EACH	X-24 Y-12
≥48"	#6	3'-0"+ O.D. PIPE	1.502 LBS/FT	1'-3"	1.9 LBS. EACH	X-24 Y-12

THRUST COLLAR AND THRUST SCHEDULE

I.D. PIPE	"A"	"B"	"C"	"D"
6"-16"	1'-4"	1'-7"	2"	3/8"
20"-24"	1'-4"	1'-7"	3"	1/2"
30"-36"	1'-4"	1'-7"	4"	5/8"
≥48"	1'-8"	1'-9"	6"	7/8"

NOTES:

1. SEE DETAIL W-9 FOR THRUST BLOCK LOCATIONS.
2. CONCRETE SHALL BE 3,000 PSI AND TRANSIT MIXED.
3. REINFORCING BARS SHALL BE DEFORMED AND TIED TOGETHER.
4. TRENCH BOTTOM WIDTH IN VICINITY OF THRUST BLOCK INSTALLATION SHALL BE THE MINIMUM WIDTH AS SHOWN ON DETAIL W-3.
5. BACKFILL TAMPED IN 6" LIFTS, SEE DETAIL W-3.
6. THRUST COLLAR MUST BE FACTORY WELDED ON BOTH SIDES ALONG BOTH EDGES OF COLLAR AROUND CIRCUMFERENCE.

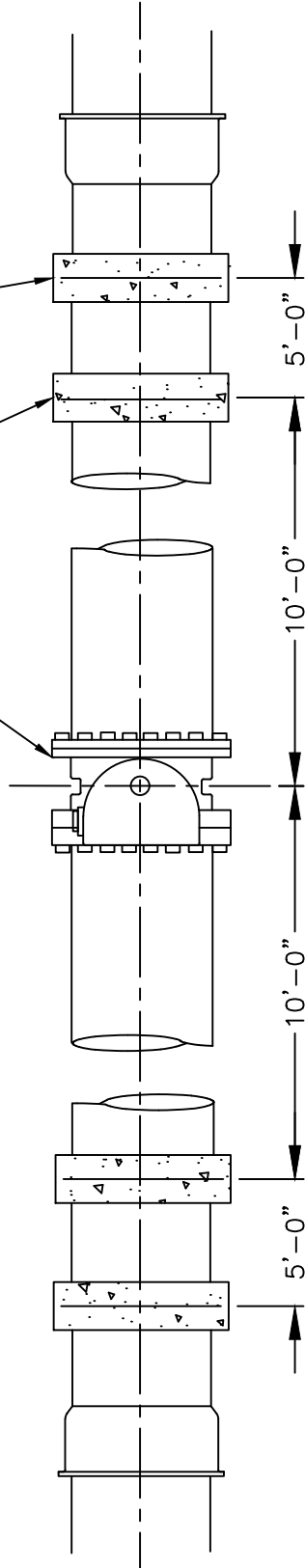
CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	THRUST BLOCKING DESIGN DATA FOR WATER MAINS	
	W-7	

16" MAIN - 1 THRUST BLOCK
REQUIRED, ON MAINS GREATER THAN
16" 2 THRUST BLOCKS REQUIRED

STANDARD THRUST BLOCK,
SEE DETAIL W-7

VALVE



THRUST BLOCKING AT VALVES 16" AND LARGER

CITY OF RALEIGH
STANDARD DETAIL

REVISIONS

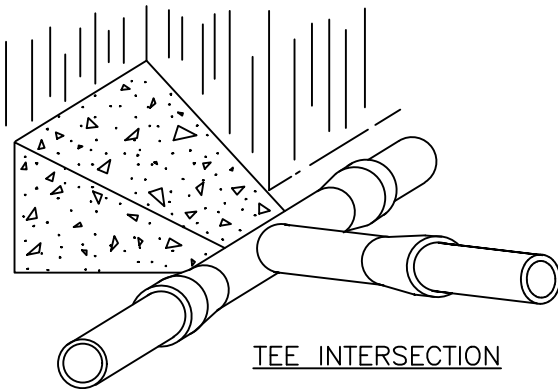
DATE: 05/24/2024

NOT TO SCALE

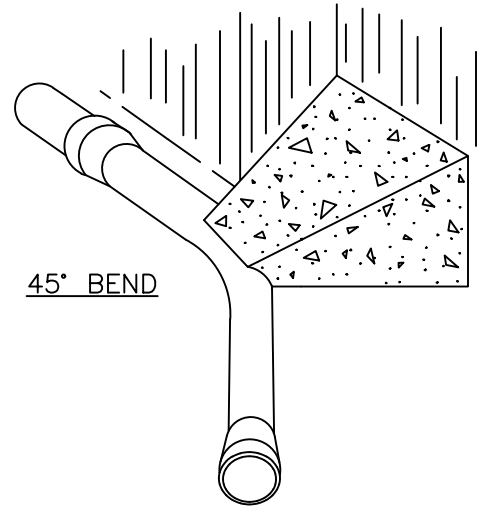
STANDARD THRUST BLOCKING
INSTALLATION FOR 16" AND LARGER
VALVES AND DEAD END MAINS

W-8

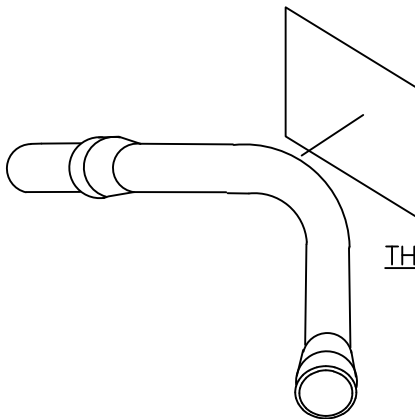
THRUST BLOCKING



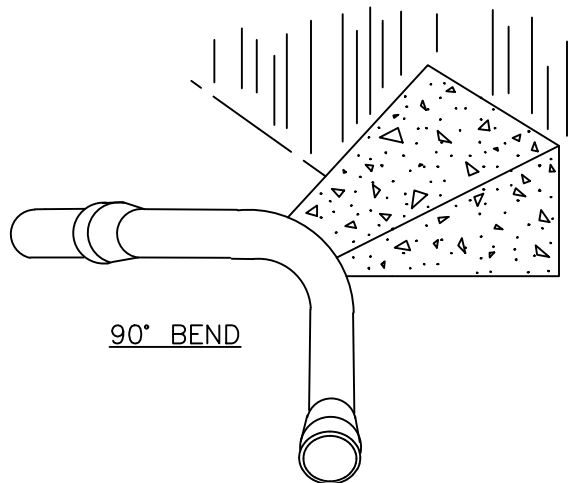
TEE INTERSECTION



45° BEND



THRUST BLOCK AREA



90° BEND

NOTES:

1. CONCRETE SHALL BE 3,000 PSI.
2. CONCRETE SHALL NOT CONTACT BOLTS OR ENDS OF MECHANICAL JOINT FITTINGS.
3. TRENCHES SHALL CONFORM TO DETAIL W-3.
4. SEE DETAIL W-10 & W-11 (THRUST BLOCK TABLES) FOR AREA OF CONCRETE REQUIRED.
5. ALL BENDS AND INTERSECTIONS SHALL HAVE CONCRETE THRUST BLOCKING.

CITY OF RALEIGH **STANDARD DETAIL**

REVISIONS DATE: 05/24/2024 NOT TO SCALE

THRUST BLOCKING VIEWS

W-9

REACTION BEARING AREAS FOR HORIZONTAL WATER PIPE BENDS
BASED ON TEST PRESSURE OF 200 PSI

ALL AREAS GIVEN IN SQUARE FEET

SIZE OF BEND	DEGREE OF BEND	STATIC THRUST IN POUNDS	MODERATELY DRY CLAY 4,000 LBS/FT ²	SOFT CLAY 2,000 LBS/FT ²	1,600 LBS/FT ² GRAVEL/COARSE SAND	8,000 LBS/FT ² DRY CLAY (ALWAYS DRY)	SAND, COMPACT FIRM 8,000 LBS/FT ²	SAND—CLEAN DRY 4,000 LBS/FT ²	SOIL 1,000 LBS/FT ² QUICKSAND (VERY POOR)	ROCK—POOR 10,000 LBS/FT ²
6"	11 ¼°	1,108	1	1	1	1	1	1	2	1
	22 ½°	2,207	1	2	2	1	1	1	3	1
	45°	4,328	2	3	3	1	1	2	5	1
	90°	7,996	2	4	5	1	1	2	8	1
	PLUG	5,655	2	3	4	1	1	2	6	1
8"	11 ¼°	1,970	1	1	2	1	1	1	2	1
	22 ½°	3,922	1	2	3	1	1	1	4	1
	45°	7,694	2	4	5	1	1	2	8	1
	90°	14,215	4	8	9	2	2	4	15	2
	PLUG	10,053	3	5	6	2	2	3	10	1
12"	11 ¼°	4,433	2	3	3	1	1	2	5	1
	22 ½°	8,826	3	5	6	2	2	3	9	1
	45°	17,312	5	9	11	3	3	5	18	2
	90°	31,983	8	16	19	4	4	8	32	4
	PLUG	22,619	6	12	14	3	3	6	23	3
16"	11 ¼°	7,881	2	4	5	1	1	2	8	1
	22 ½°	15,691	4	8	10	2	2	4	16	2
	45°	30,779	8	16	19	4	4	8	31	4
	90°	56,861	15	29	35	8	8	15	57	6
	PLUG	40,213	10	21	25	5	5	10	41	5

NOTES:

- REACTION BEARING AREAS ARE IN SQUARE FEET MEASURED IN A VERTICAL PLANE IN THE TRENCH SIDE AT AN ANGLE OF 90° TO THE THRUST VECTOR.
- USE 6" 90° BEND VALUE FOR HYDRANTS FOR ADDITIONAL SAFETY FACTOR.

CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	THRUST BLOCKING DESIGN QUANTITY TABLE	
	W-10	

REACTION BEARING AREAS FOR HORIZONTAL WATER PIPE BENDS
BASED ON TEST PRESSURE OF 200 PSI

ALL AREAS GIVEN IN SQUARE FEET

SIZE OF BEND	DEGREE OF BEND	STATIC THRUST IN POUNDS	MODERATELY DRY CLAY 4,000 LBS/FT ²	SOFT CLAY 2,000 LBS/FT ²	1,600 LBS/FT ² GRAVE/COARSE SAND	8,000 LBS/FT ² DRY CLAY (ALWAYS DRY)	SAND, COMPACT FIRM 8,000 LBS/FT ²	SAND—CLEAN DRY 4,000 LBS/FT ²	SOIL 1,000 LBS/FT ² QUICKSAND (VERY POOR)	ROCK—POOR 10,000 LBS/FT ²
24"	11 ¼°	17,734	5	9	11	3	3	5	18	2
	22 ½°	35,305	9	18	22	5	5	9	36	4
	45°	69,252	18	35	42	9	9	18	70	7
	90°	127,936	32	64	77	16	16	32	128	113
	PLUG	90,478	23	46	55	12	12	23	91	10
30"	11 ¼°	27,709	7	14	17	4	4	7	2	3
	22 ½°	55,163	14	28	34	7	7	14	56	6
	45°	108,206	28	55	65	14	14	28	109	11
	90°	199,900	50	100	120	25	25	50	200	20
	PLUG	141,372	36	71	85	18	18	36	142	15
36"	11 ¼°	39,901	10	20	24	5	5	10	40	4
	22 ½°	79,439	20	40	48	10	10	20	30	8
	45°	155,816	39	78	94	20	20	39	156	16
	90°	287,855	72	144	172	36	36	72	288	29
	PLUG	203,575	51	102	122	26	26	51	204	21
48"	11 ¼°	70,935	18	36	43	9	9	18	71	8
	22 ½°	141,218	36	71	85	18	18	36	142	15
	45°	277,007	70	139	166	35	35	70	277	28
	90°	511,742	128	256	320	64	64	128	512	52
	PLUG	361,911	91	181	217	46	46	91	362	37

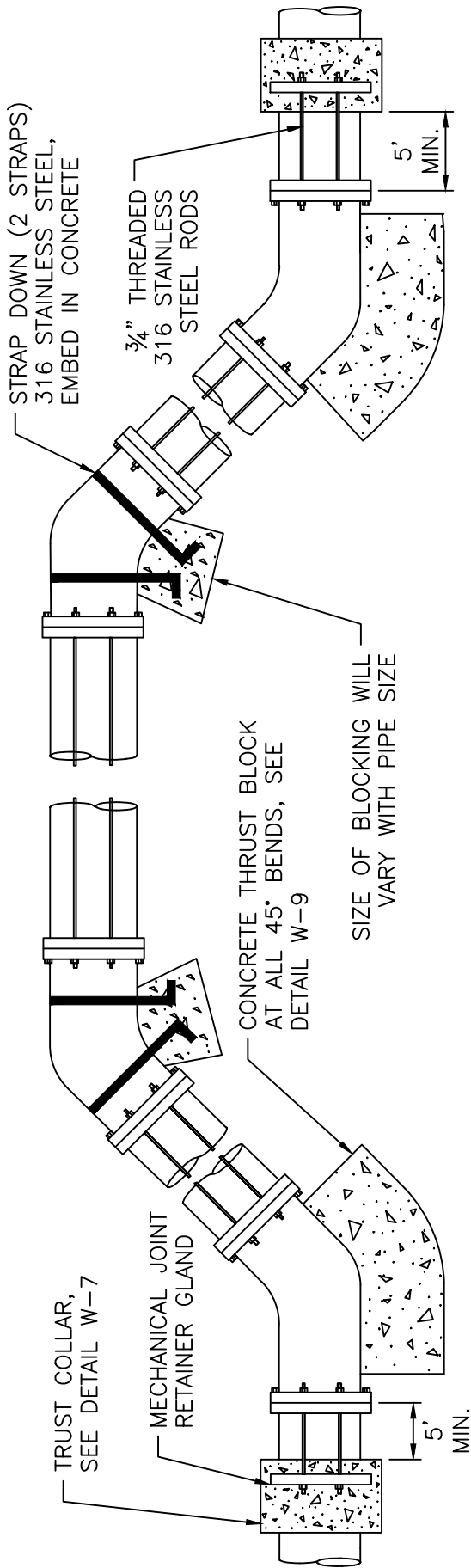
NOTES:

- REACTION BEARING AREAS ARE IN SQUARE FEET MEASURED IN A VERTICAL PLANE IN THE TRENCH SIDE AT AN ANGLE OF 90° TO THE THRUST VECTOR.
- USE 6" 90° BEND VALUE FOR HYDRANTS FOR ADDITIONAL SAFETY FACTOR.

CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	THRUST BLOCKING DESIGN QUANTITY TABLE	
	W-11	

TOP OF GROUND



STRAP REQUIREMENTS

SIZE OF 45° BEND	STATIC TRUST IN POUNDS	NO. OF RODS REQUIRED	STRAP WIDTH	STRAP THICKNESS
6"	4,328	2	1"	3/16"
8"	7,694	4	1.5"	3/16"
12"	17,312	4	2"	1/4"
16"	30,779	8	2"	1/2"
24"	69,252	8	4"	1/2"

ROD REQUIREMENTS

SIZE OF 45° BEND	STATIC TRUST IN POUNDS	NO. OF RODS REQUIRED
6"	4,328	2
8"	7,694	4
12"	17,312	4
16"	30,779	8
24"	69,252	8

RESTRAINT REQUIREMENTS

PIPE DIA	RODDING	RJ GLANDS	THRUST COLLAR	THRUST BLOCKING
<12"	X	X	X	
≥12"	X	X	X	X

"X" DENOTES REQUIRED RESTRAINT.

NOTES:

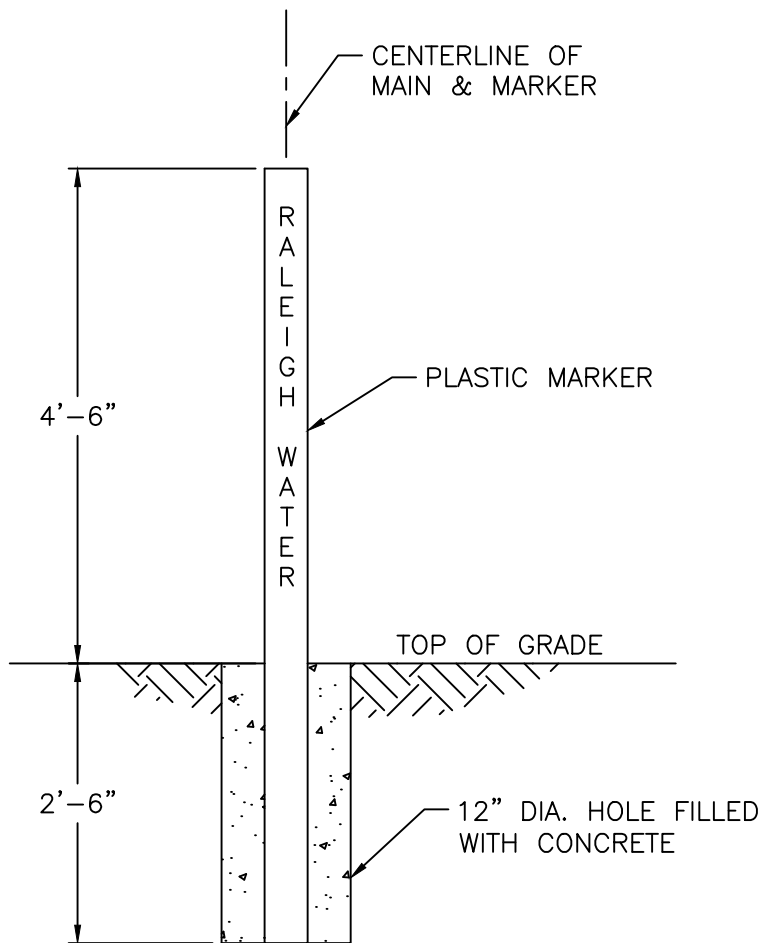
- STEEL RODS AND BOLTS SHALL BE 3/4" 316 STAINLESS STEEL.
- CONCRETE SHALL NOT CONTACT BOLTS OR ENDS OF MECHANICAL JOINT BENDS.
- RESTRAINED MECHANICAL GLANDS TO BE USED AT ALL FITTINGS.
- MUST USE DUCTILE IRON EYE BOLTS WHERE NECESSARY.
- 3' MINIMUM COVER MUST BE MAINTAINED.
- EXTERNAL RESTRAINT REQUIRED. INTEGRAL BELL RESTRAINT REQUIRES DIRECTOR'S APPROVAL.

CITY OF RALEIGH
STANDARD DETAIL

REVISIONS DATE: 05/24/2024 NOT TO SCALE

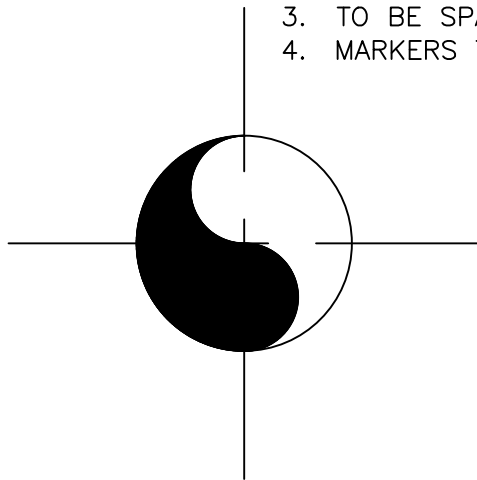
STANDARD VERTICAL BEND

W-12



NOTES:

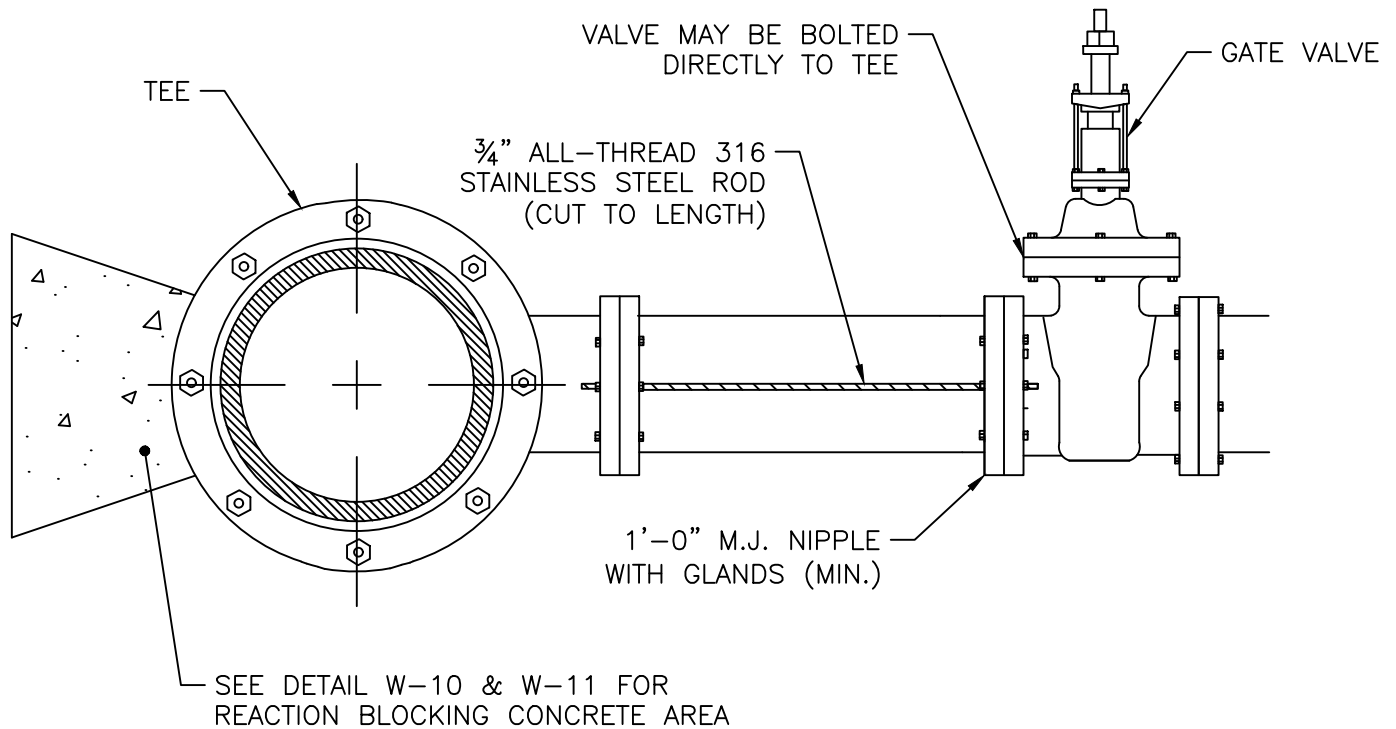
1. POTABLE WATER MARKER TO BE BLUE IN COLOR.
2. POTABLE WATER MARKER TO BE LABELED "RALEIGH WATER"
3. TO BE SPACED ALONG CENTERLINE OF MAIN EVERY 300 FEET.
4. MARKERS TO BE ROUND AND 4" IN DIAMETER.



WATER MAIN

CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	MAIN & VALVE MARKER FOR POTABLE WATER IN EASEMENTS	
		W-13



ROD REQUIREMENTS

BRANCH SIZE	NO. OF RODS
4"	2
6"	2
8"	4
12"	4
16"	6
24"	6
30"	8
36"	8

NOTES:

1. STEEL RODS AND BOLTS SHALL BE 3/4" 316 STAINLESS STEEL.
2. SEE DETAIL W-10 AND W-11 (THRUST BLOCK TABLES) FOR CONCRETE.
3. CONCRETE SHALL NOT CONTACT BOLTS OR ENDS OF MECHANICAL FITTINGS.
4. THIS RODDING REQUIREMENT DOES NOT APPLY TO FIRE HYDRANTS.

CITY OF RALEIGH STANDARD DETAIL

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	VALVE RESTRAINT AT TEES AND CROSSES FOR LINES (4"-24")	
	W-15	

VALVE SIZE	MH DIA.
16"	5'
24"	6'
≥30"	8'

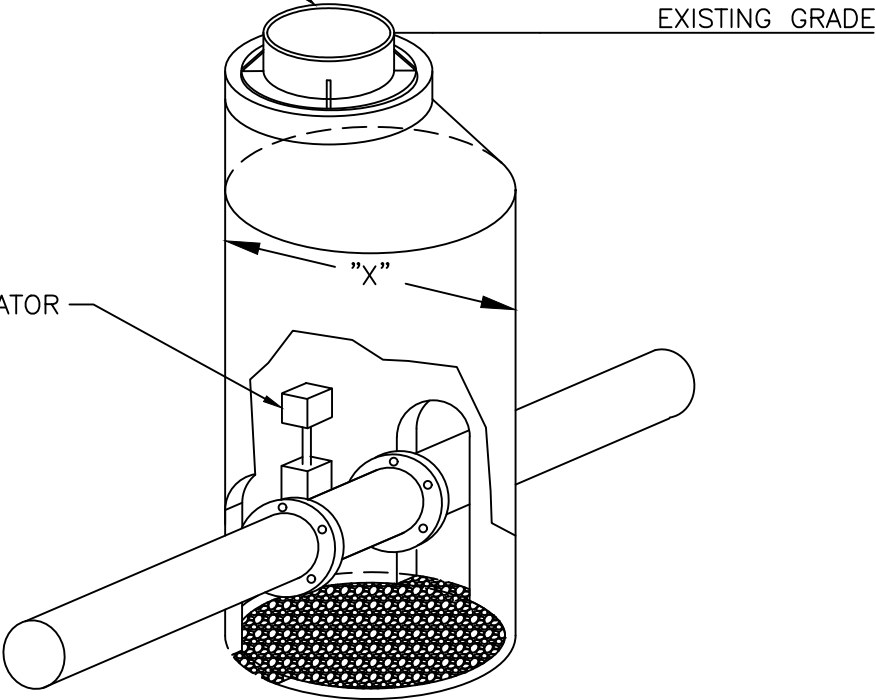
NOTES:

1. USE STANDARD PRECAST ECCENTRIC TOP.
2. BASE SECTION SHALL BE OF "DOG HOUSE" TYPE TO FIT OVER MAIN.
3. PROVIDE A MIN. OF 12" OF #67 STONE FOR POSITIVE DRAINAGE IN BOTTOM OF MANHOLE.
4. GROUT RISER/BASE SECTION AS NECESSARY.
5. MANHOLE LID SHALL SAY "WATER".
6. FLAT TOP MAY BE USED IN NON-PAVED AREAS WHEN NECESSARY TO MATCH GRADE.

ECCENTRIC TOP WITH COVER
OPENING OVER ACTUATOR

EXISTING GRADE

NUT TYPE ACTUATOR

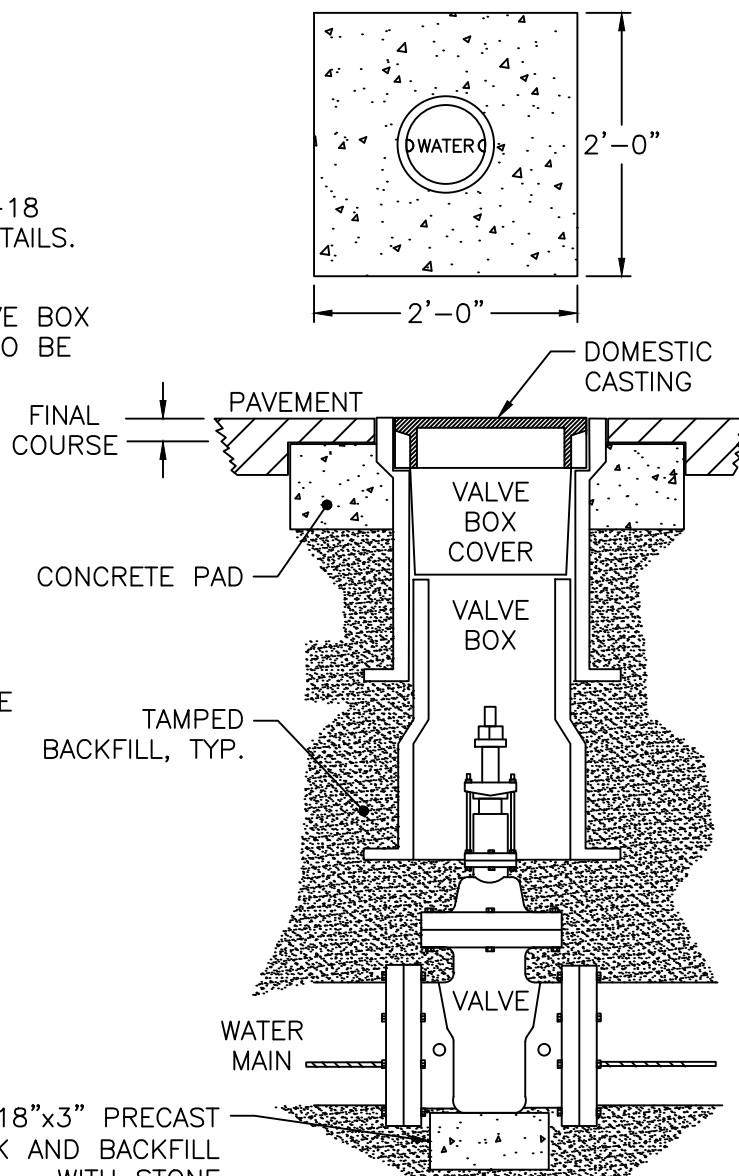
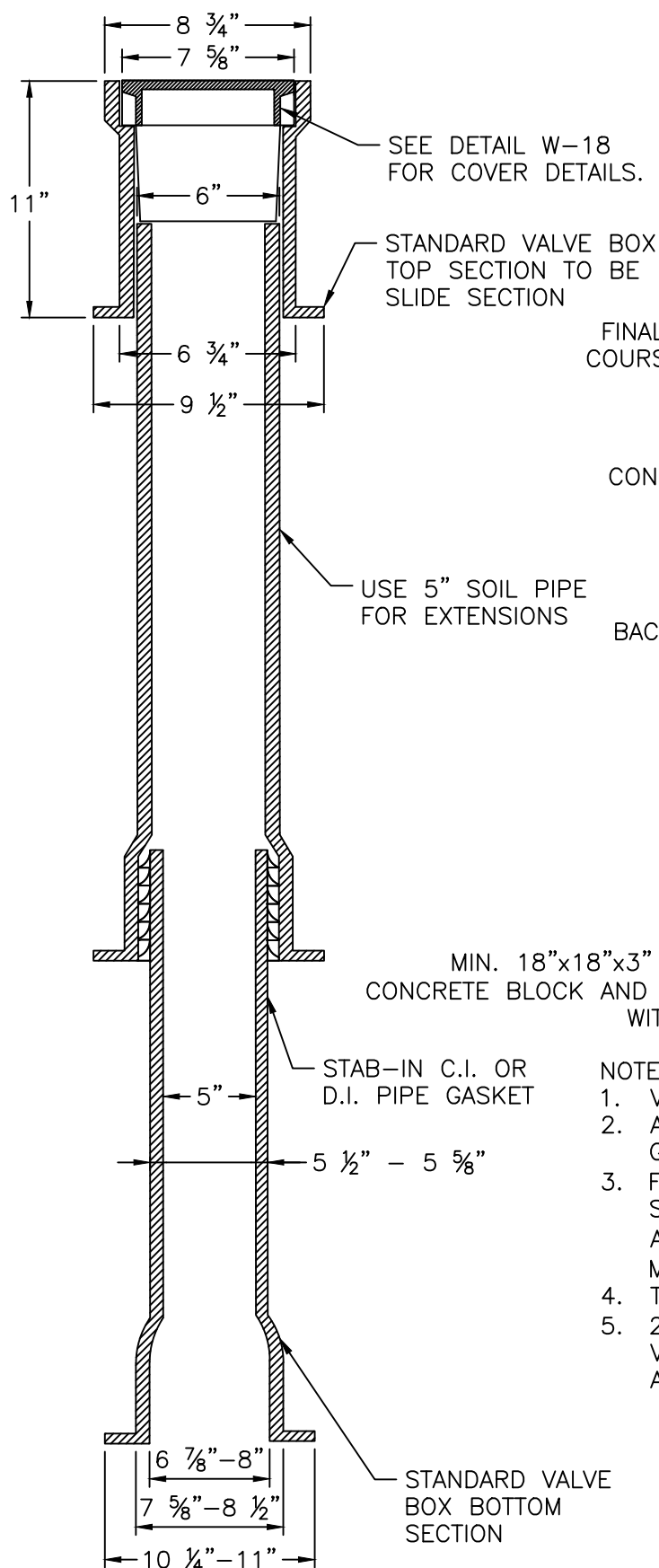


CITY OF RALEIGH
STANDARD DETAIL

REVISIONS DATE: 05/24/2024 NOT TO SCALE

BUTTERFLY VALVE MANHOLE
FOR 16" & LARGER MAINS

W-16

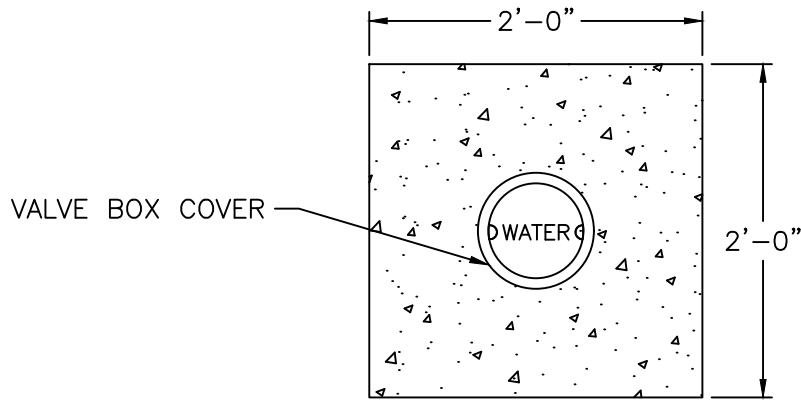


NOTES:

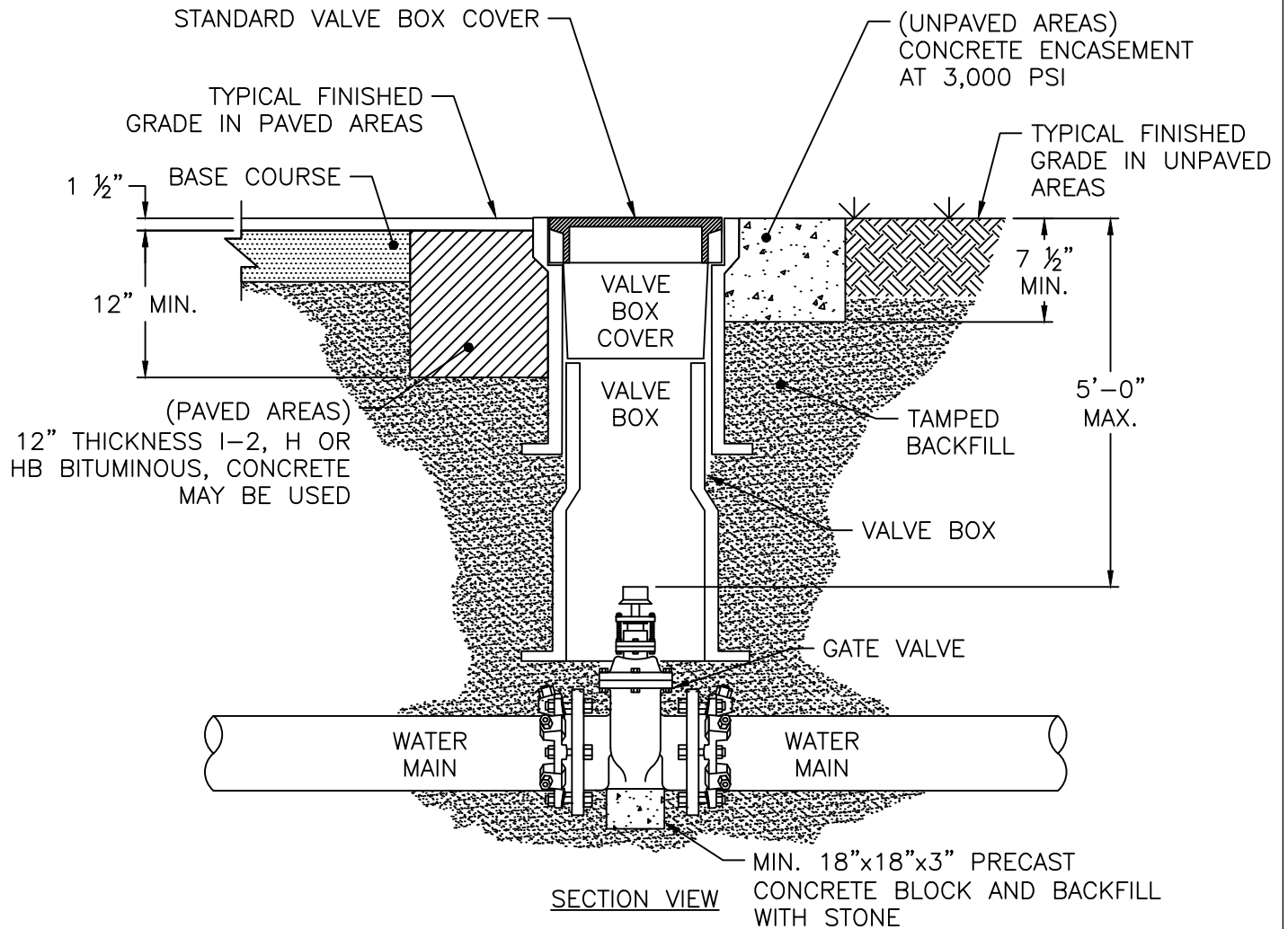
1. VALVE BOX NOT TO CONTACT WATER MAIN
2. ALL TRAFFIC CASTINGS MUST BE CLASS 35 OR GREATER.
3. FOR ALL VALVES OVER 10' DEEP, A VALVE STEM EXTENSION MUST BE USED TO BRING TO A DEPTH OF NO MORE THAN 5', EXTENSION MUST BE A MINIMUM OF 1" SOLID STOCK.
4. TOTAL VALVE BOX WEIGHT: MINIMUM OF 85 LBS.
5. 2'x2'x6" CONCRETE PAD REQUIRED ON ALL VALVES. NO PRECAST CONCRETE DOUGHNUT ALLOWED.

CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	VALVE BOX INSTALLATION AND EXTENSION	
	W-17	



PLAN VIEW



SECTION VIEW

NOTES:

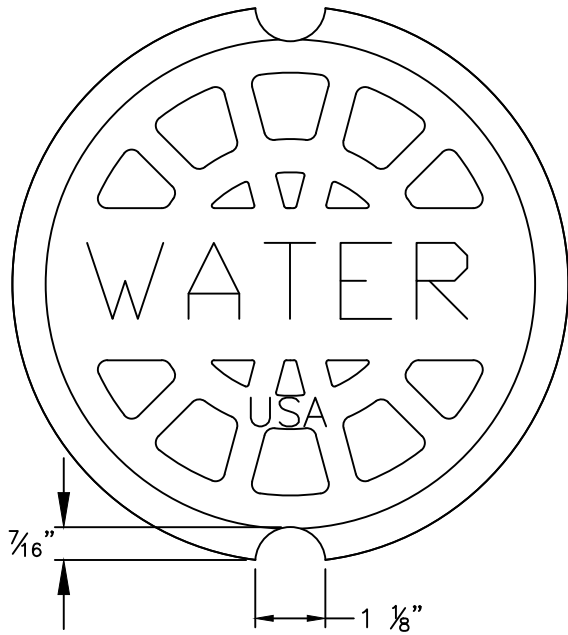
1. ONLY MANUFACTURED VALVE BOX EXTENSIONS SHALL BE ALLOWED.
2. VALVE OPERATING NUT MUST BE EXTENDED SO THAT THE DEPTH IS NO GREATER THAN 5' FROM THE SURFACE USING A MANUFACTURER APPROVED EXTENSION KIT.
3. PRECAST CONCRETE ENCASEMENT IS ALLOWED OUTSIDE OF PAVED AREAS.
4. VALVE BOX SHOULD NOT CONTACT MAIN OR VALVE.

CITY OF RALEIGH
STANDARD DETAIL

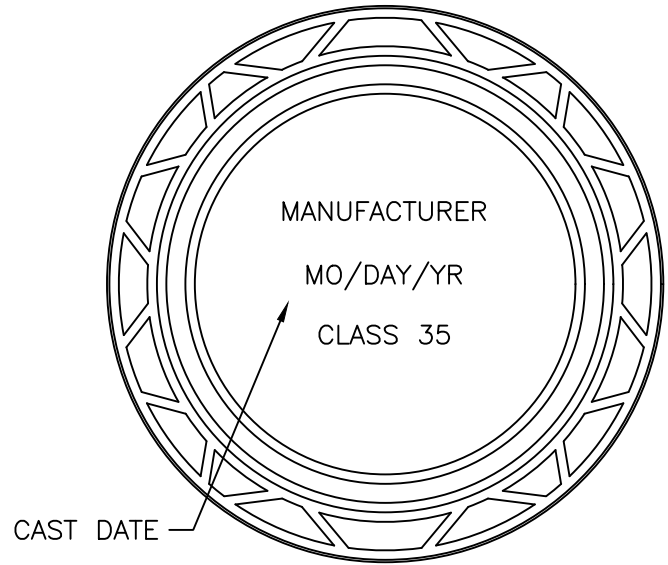
REVISIONS DATE: 05/24/2024 NOT TO SCALE

VALVE AND BOX
INSTALLATION

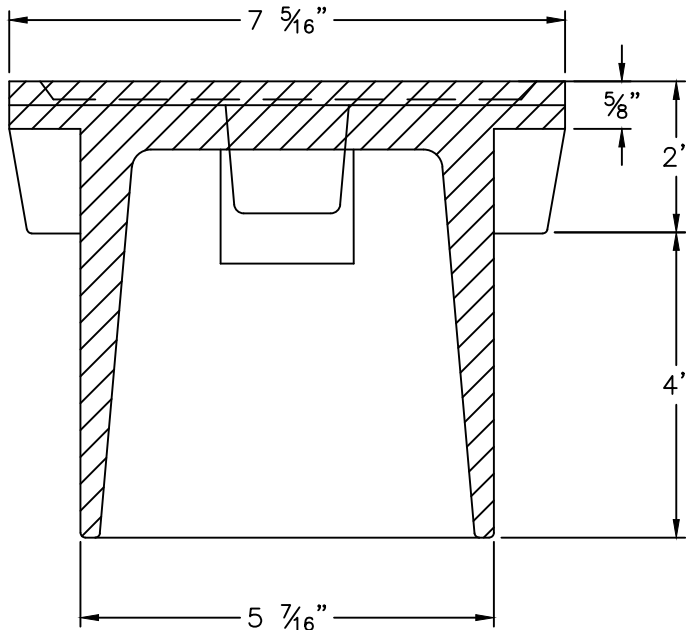
W-17A



PLAN VIEW



BOTTOM VIEW



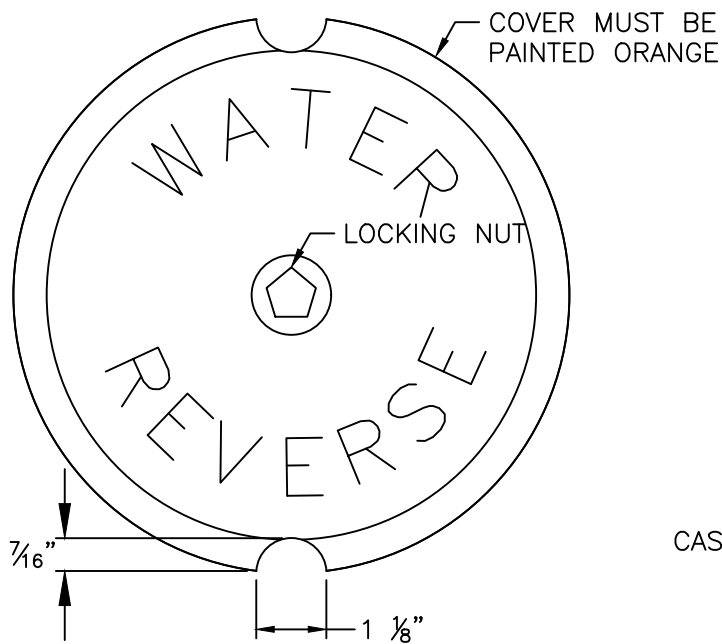
SECTION VIEW

NOTE:

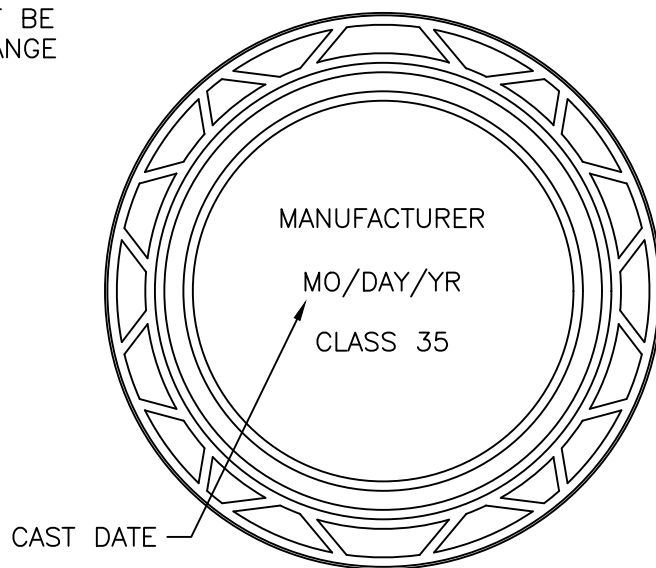
1. "WATER" LETTERING MUST BE 1" RAISED (RECESSED FLUSH).
2. VALVE COVER SHALL BE DOMESTICALLY CAST.
3. COVER MUST HAVE A MINIMUM WEIGHT OF 25 POUNDS.
4. COVER MUST BE CLASS 35 OR GREATER.
5. COVER MUST MEET OR EXCEED AASHTO H-20 LOAD REQUIREMENTS.

**CITY OF RALEIGH
STANDARD DETAIL**

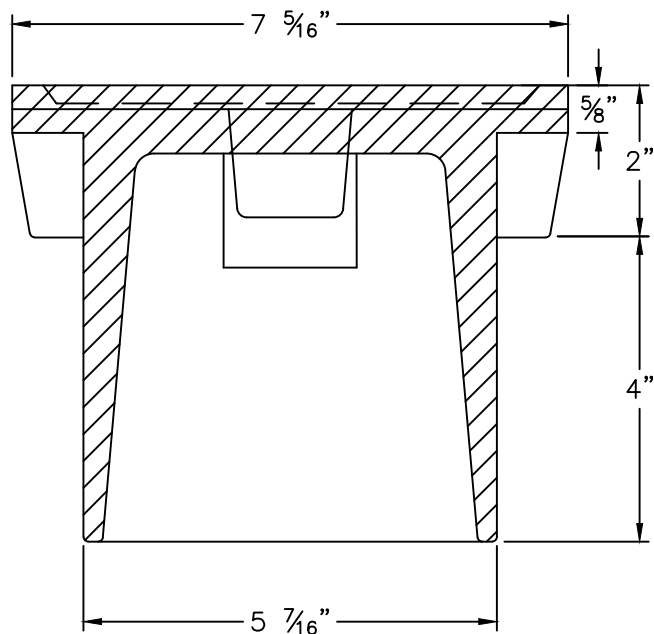
REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	5 1/4" VALVE BOX DROP LID WITH 4" SKIRT	
	W-18	



PLAN VIEW



BOTTOM VIEW



SECTION VIEW

NOTE:

1. "WATER" AND "REVERSE" LETTERING MUST BE 1" RAISED (RECESSED FLUSH).
2. VALVE COVER SHALL BE DOMESTICALLY CAST.
3. COVER MUST HAVE A MINIMUM WEIGHT OF 25 POUNDS.
4. COVER MUST BE CLASS 35 OR GREATER.
5. COVER MUST MEET OR EXCEED AASHTO H-20 LOAD REQUIREMENTS.

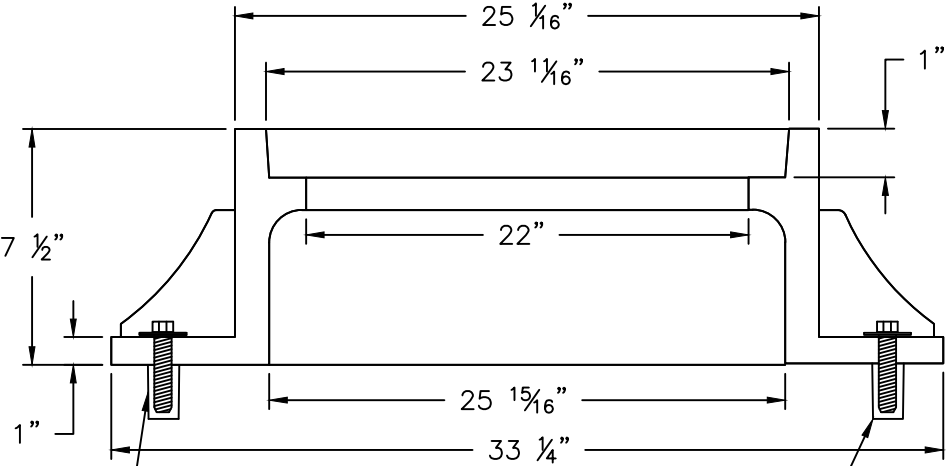
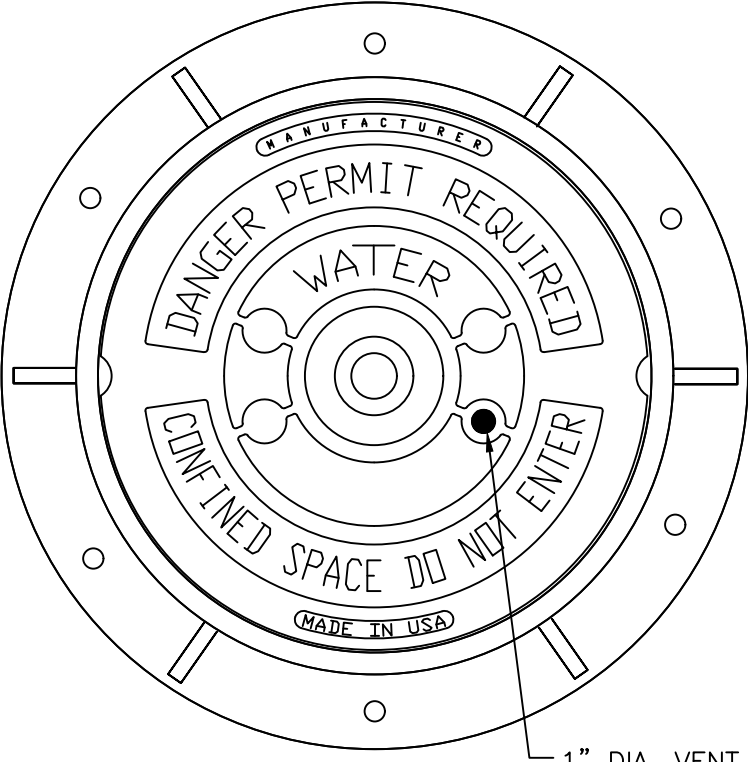
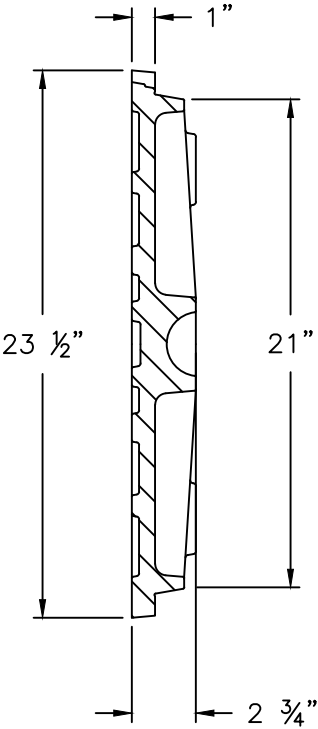
CITY OF RALEIGH
STANDARD DETAIL

REVISIONS DATE: 05/24/2024 NOT TO SCALE

REVERSE TAP $5 \frac{1}{4}$ "
VALVE BOX DROP LID
WITH 4" SKIRT

W-18A

MANHOLE FRAME AND COVER



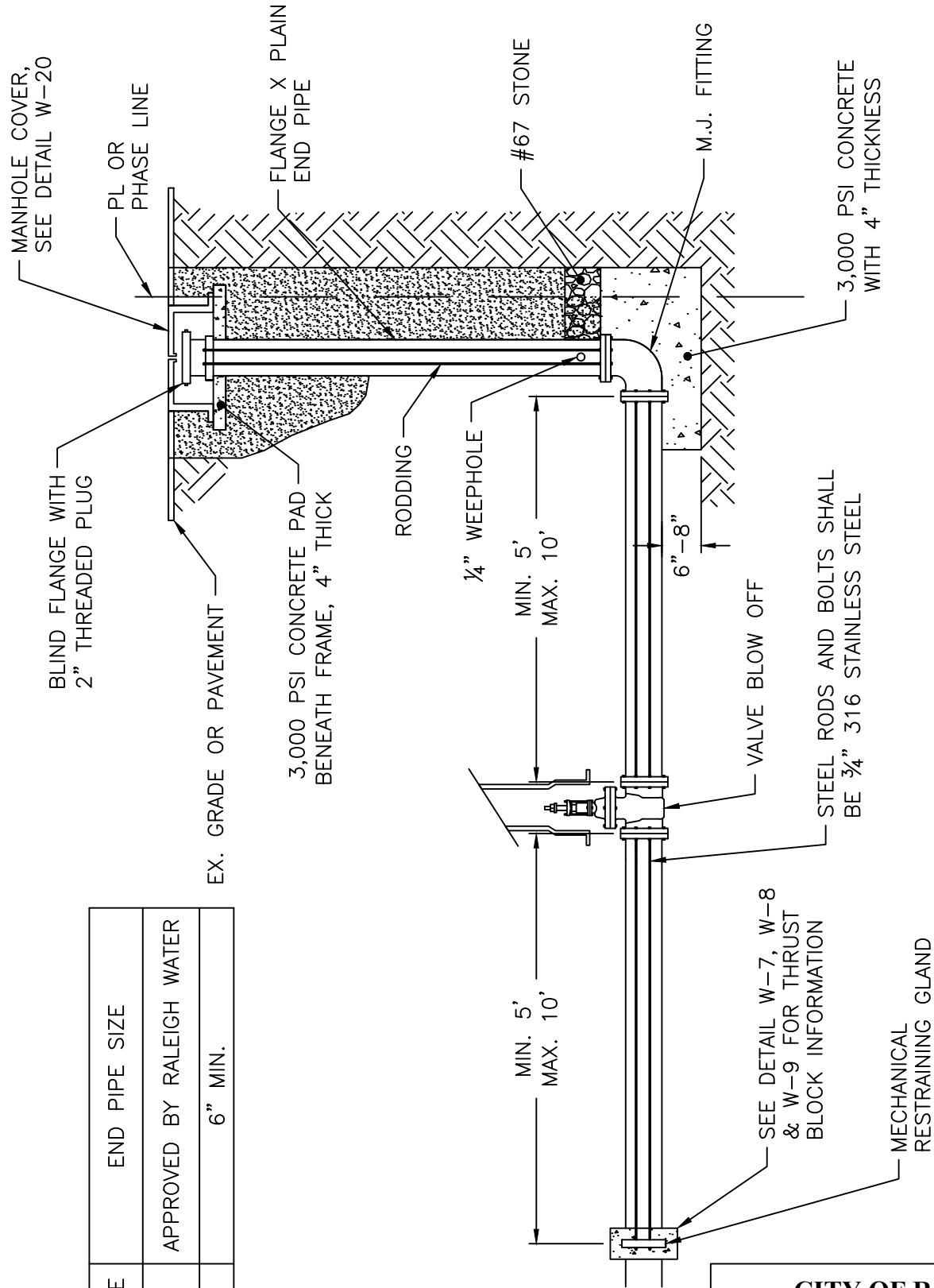
LAGSHIELDS MAY ONLY BE USED
IN ROADWAY APPLICATIONS

5/8"x3" LAGSHIELD IN HOLE DRILLED INTO
CONE OR RING WITH ANCHOR SUNK TO
DESIGN DEPTH, AND 3/8"x3" HOT DIPPED
GALVANIZED LAG BOLT AND WASHER

- NOTES:
1. ALL MANHOLE FRAMES SHALL BE DOMESTICALLY CAST.
 2. FRAME SHALL BE A MINIMUM WEIGHT OF 182 LBS.
 3. COVER SHALL WEIGH A MIN. OF 120 LBS.
 4. MANHOLES WITHIN PAVED SURFACES SHALL BE CONSTRUCTED ACCORDANCE WITH DETAIL S-29.

CITY OF RALEIGH		
STANDARD DETAIL		
REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	STANDARD MANHOLE COVER	
	W-20	

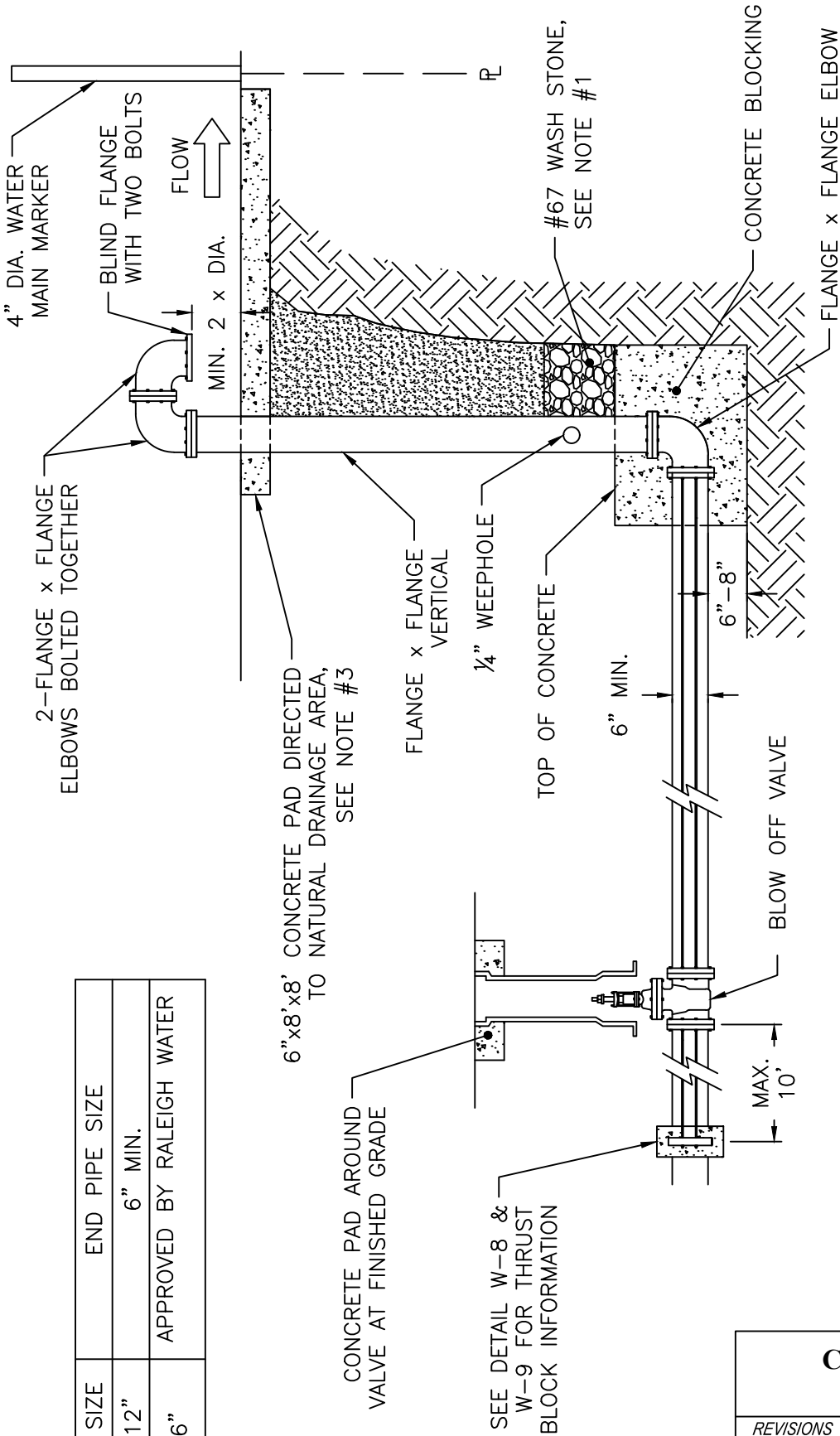
MAIN SIZE	END PIPE SIZE
6"-12"	APPROVED BY RALEIGH WATER
≥16"	6" MIN.



NOTE:
NO ROD COUPLINGS ALLOWED.

CITY OF RALEIGH STANDARD DETAIL		
REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	TEMPORARY WATER MAIN BLOW OFF ASSEMBLY	
	W-21	

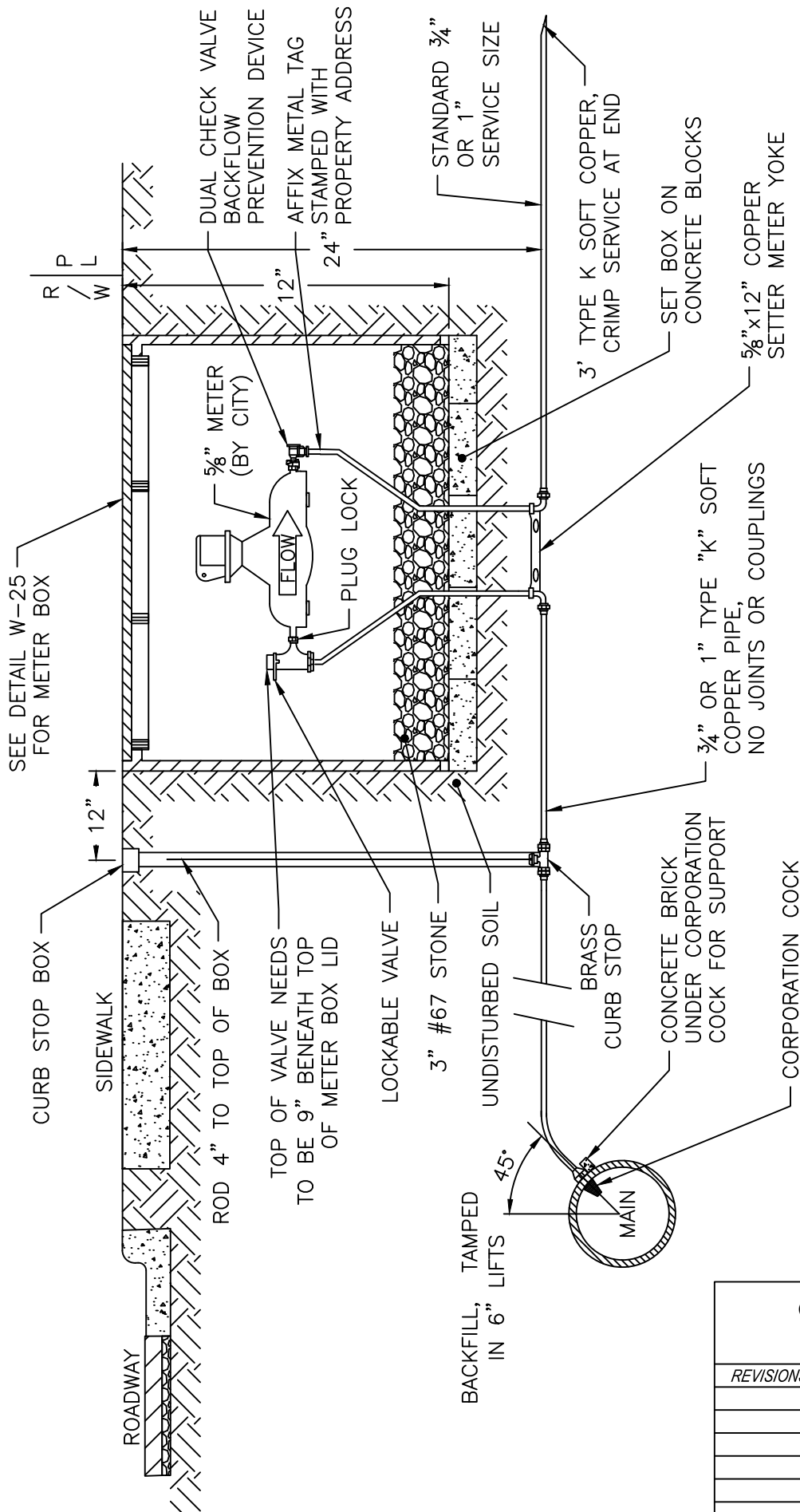
MAIN SIZE	END PIPE SIZE
6"-12"	6" MIN.
≥16"	APPROVED BY RALEIGH WATER



NOTES:

1. DRILL 1/4" WEEP HOLE FOR STACK DRAINAGE INTO STONE.
2. DOUBLE 3/4" BRIDLE RODS ON BOTH SIDES.
3. A RIP-RAP SWALE FROM FROM CONCRETE SPLASH PAD TO POSITIVE DRAINAGE AREA IS REQUIRED.
4. BOTTOM 90° ELBOW SHALL HAVE BLIND FLANGE ATTACHED WITH TWO BOLTS.
5. INSTALL WATER MAIN MARKER AT R/W OR P/L TO LOCATE MAIN.
6. BURIED 3/4" RODS AND BOLTS TO BE 316 STAINLESS STEEL.
7. END PIPE SIZE 6" MIN. OR AS APPROVED BY PUBLIC UTILITIES.

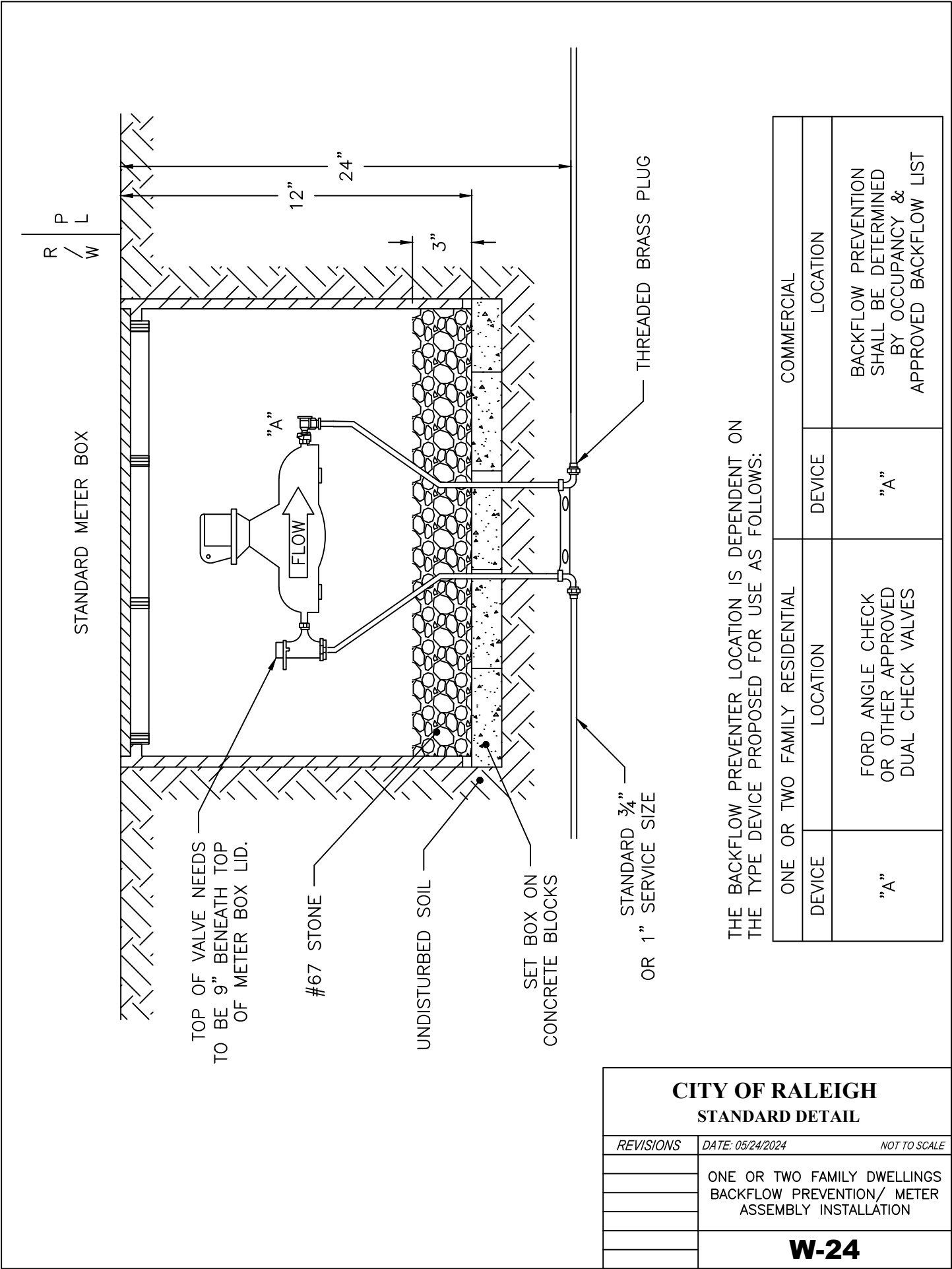
CITY OF RALEIGH		
STANDARD DETAIL		
REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	PERMANENT WATER MAIN BLOW OFF ASSEMBLY	
	W-22	



- NOTES:
1. WATER METER AS MANUFACTURED BY SENSUS, OR SCHLUMBERGER. METER TO BE PROVIDED BY RALEIGH WATER.
 2. DIRECT TAP ALLOWED ON MAINS NO LARGER THAN 16" LINE.
 3. METER BOX TO BE LOCATED IN R/W ADJACENT TO PROPERTY OR IN APPROVED EASEMENT ADJACENT TO R/W.
 4. WHEN THE GRADE CHANGES ON EXISTING SERVICES, A COPPER RESETTER CAN BE USED TO ADJUST TO GRADE. COPPER RESETTERS ARE PROHIBITED ON NEW SERVICES.
 5. CURB STOP BOX SHALL HAVE PLUG STYLE LID WITH PENTAGON BOLT, 1-1/4" STEEL UPPER SECTION, AND ARCH STYLE BASE. STEEL STATIONARY ROD TO BE PROVIDED FOR CURB STOP OPERATION.

CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	STANDARD 3/4" & 1" WATER SERVICE INSTALLATION	
	W-23	



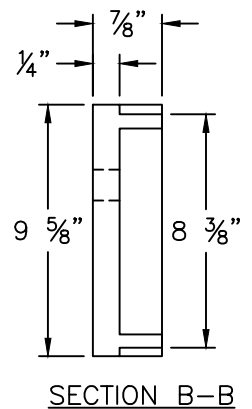
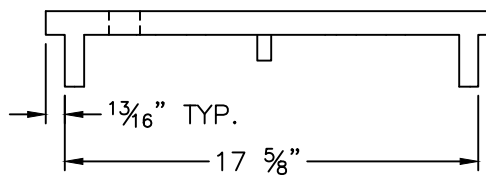
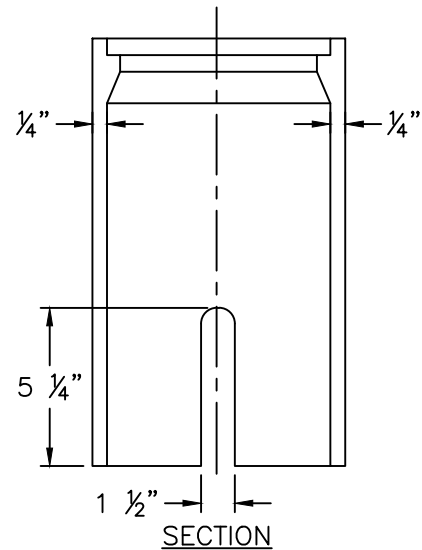
THE BACKFLOW PREVENTER LOCATION IS DEPENDENT ON THE TYPE DEVICE PROPOSED FOR USE AS FOLLOWS:

ONE OR TWO FAMILY RESIDENTIAL		COMMERCIAL	
DEVICE	LOCATION	DEVICE	LOCATION
"A"	FORD ANGLE CHECK OR OTHER APPROVED DUAL CHECK VALVES	"A"	BACKFLOW PREVENTION SHALL BE DETERMINED BY OCCUPANCY & APPROVED BACKFLOW LIST

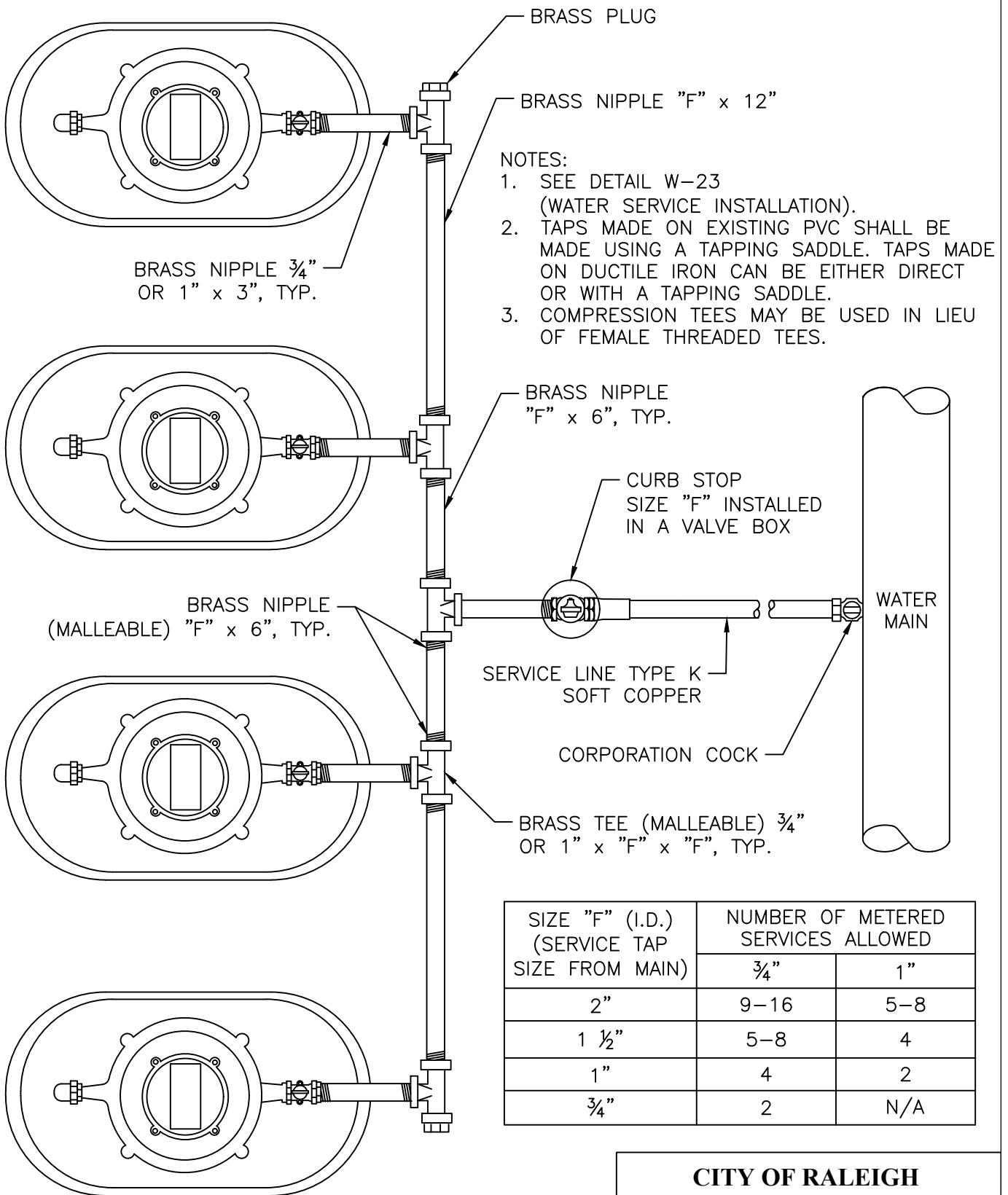
CITY OF RALEIGH		
STANDARD DETAIL		
REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	ONE OR TWO FAMILY DWELLINGS	
	BACKFLOW PREVENTION/ METER	
	ASSEMBLY INSTALLATION	
	W-24	

Diagram illustrating the Plan view of a water meter assembly. The diagram shows a horizontal oval shape representing the meter body. Two circular components are labeled "CITY SEAL" and "AMR". A horizontal line passes through the center, with an arrow pointing to it labeled "PICK UP HOOK". A vertical line also passes through the center. The overall width is dimensioned as 10 $\frac{3}{4}$ " inches. The word "PLAN" is centered below the diagram.

1. COVER WEIGHT: 13 LBS \pm 5%.
2. LIDS TO BE COATED WITH BITUMINOUS COAL TAR COATING.
3. HOLE SHALL BE FITTED WITH A METAL GROMMET.
4. BOXES AND LIDS MUST BE MANUFACTURED FROM THE SAME DOMESTIC FOUNDRY.
5. HEIGHT ADJUSTMENTS ALLOWED BY PRECAST RISERS OR BRICK AND MORTAR. DRY STACKING OF BLOCK IS NOT ALLOWED.



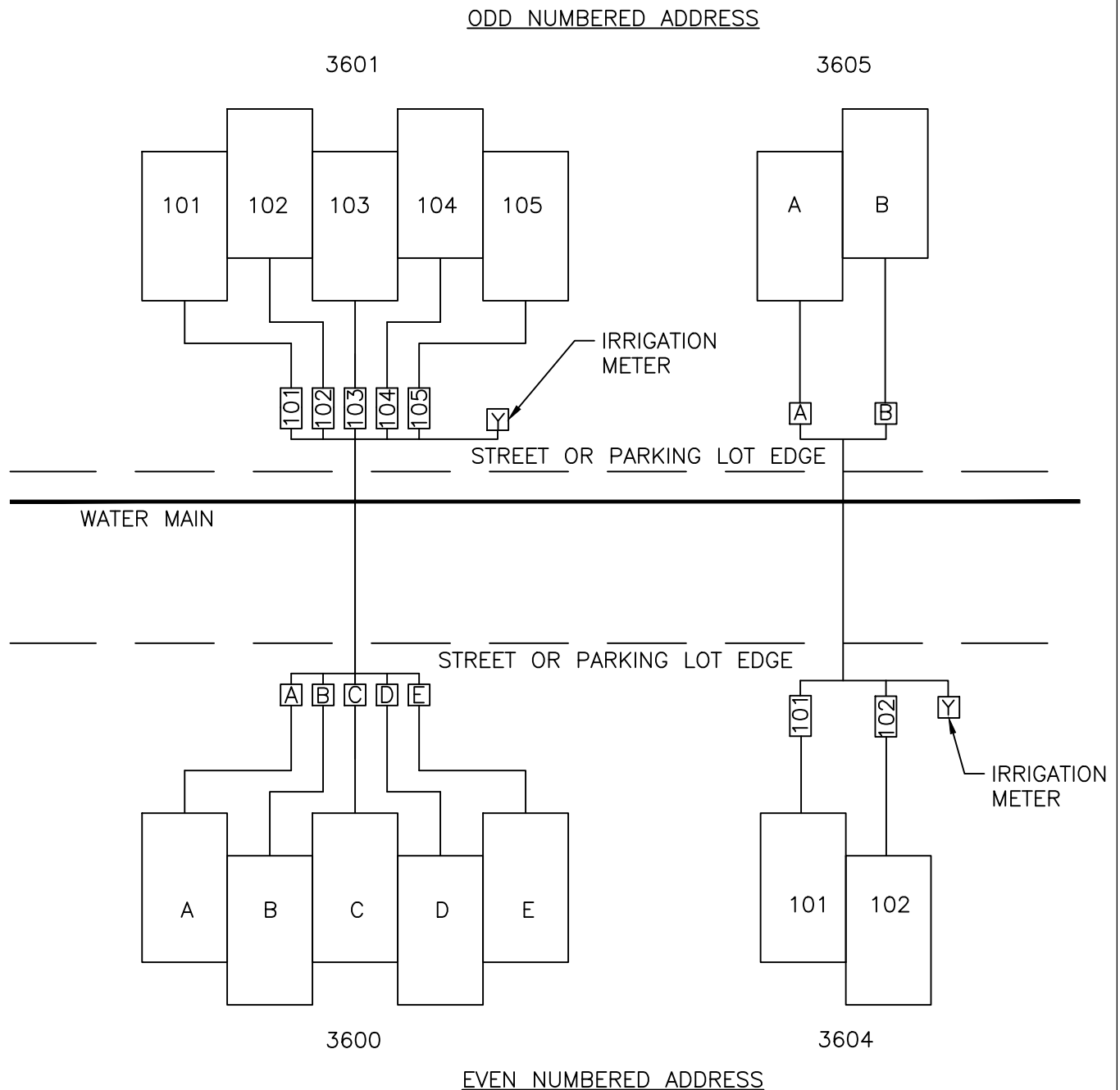
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<i>REVISIONS</i>	<i>DATE: 05/24/2024</i>	<i>NOT TO SCALE</i>
	WATER METER BOX	
	W-25	



SIZE "F" (I.D.) (SERVICE TAP SIZE FROM MAIN)	NUMBER OF METERED SERVICES ALLOWED	
	$\frac{3}{4}$ "	1"
2"	9-16	5-8
1 $\frac{1}{2}$ "	5-8	4
1"	4	2
$\frac{3}{4}$ "	2	N/A

CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	STANDARD GANG METER ASSEMBLY	
	W-26	

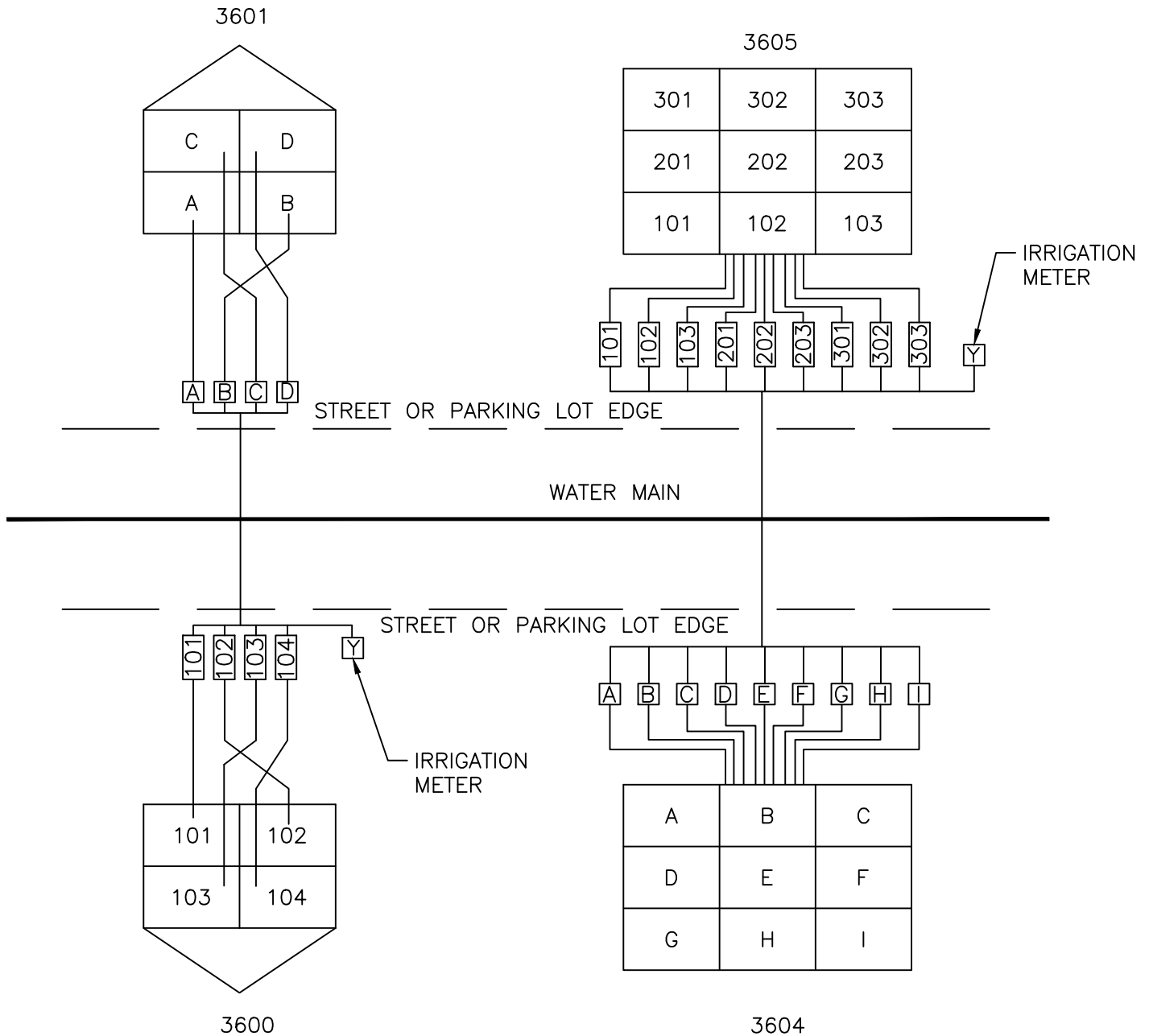


NOTES:

1. EVEN NUMBERED UNITS: METERS SHALL BE SET TO BE READ RIGHT TO LEFT (WHEN FACING BUILDING).
2. ODD NUMBERED UNITS: METERS SHALL BE SET TO BE READ LEFT TO RIGHT (WHEN FACING BUILDING).
3. IF IRRIGATION METER IS INCLUDED, IT SHALL BE THE LAST METER IN NUMBERING SEQUENCE.
4. UNIT 'Y' (FOR YARD METER) SHALL BE USED TO INDICATE IRRIGATION METER.

CITY OF RALEIGH		
STANDARD DETAIL		
REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	GANG METER ADDRESSING SINGLE STORY BUILDING	
	W-27	

ODD NUMBERED ADDRESS



NOTES:

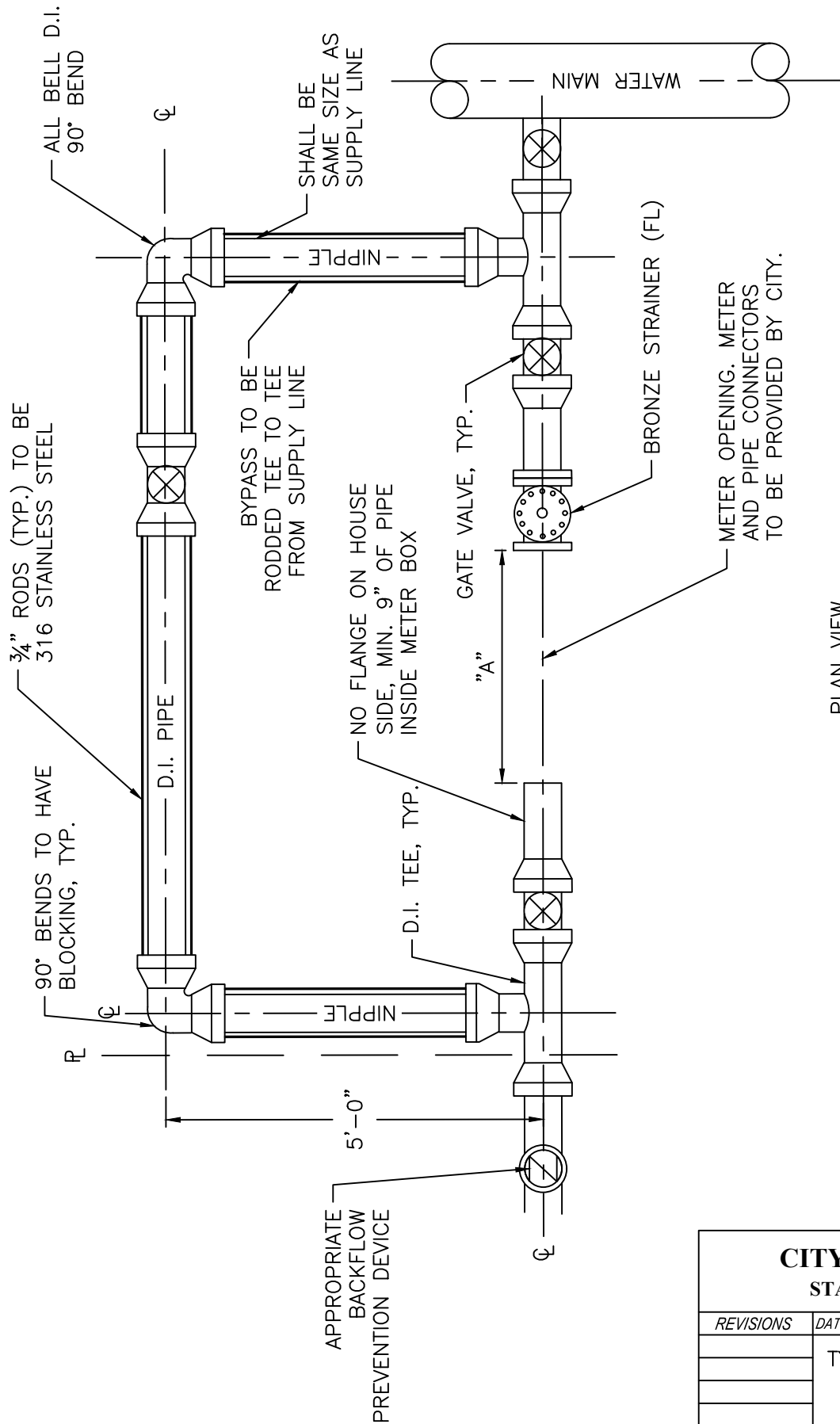
1. EVEN NUMBERED UNITS: METERS SHALL BE SET TO BE READ RIGHT TO LEFT (WHEN FACING BUILDING).
2. ODD NUMBERED UNITS: METERS SHALL BE SET TO BE READ LEFT TO RIGHT (WHEN FACING BUILDING).
3. IF IRRIGATION METER IS INCLUDED, IT SHALL BE THE LAST METER IN NUMBERING SEQUENCE.
4. UNIT 'Y' (FOR YARD METER) SHALL BE USED TO INDICATE IRRIGATION METER.

CITY OF RALEIGH **STANDARD DETAIL**

REVISIONS DATE: 05/24/2024 NOT TO SCALE

GANG METER ADDRESSING
MULTI-STORY BUILDING

W-28



PLAN VIEW

"A"

METER SIZE	METER OPENING
4" METER	28"
6" METER	35"
8" METER	39"

- NOTES:
1. DOMESTIC METERS ONLY.
 2. ALL FITTINGS ARE TO BE MECHANICAL JOINT, U.N.O.
 3. BRONZE STRAINERS SHALL HAVE NON-THREADED BOLT HOLES.

CITY OF RALEIGH
STANDARD DETAIL

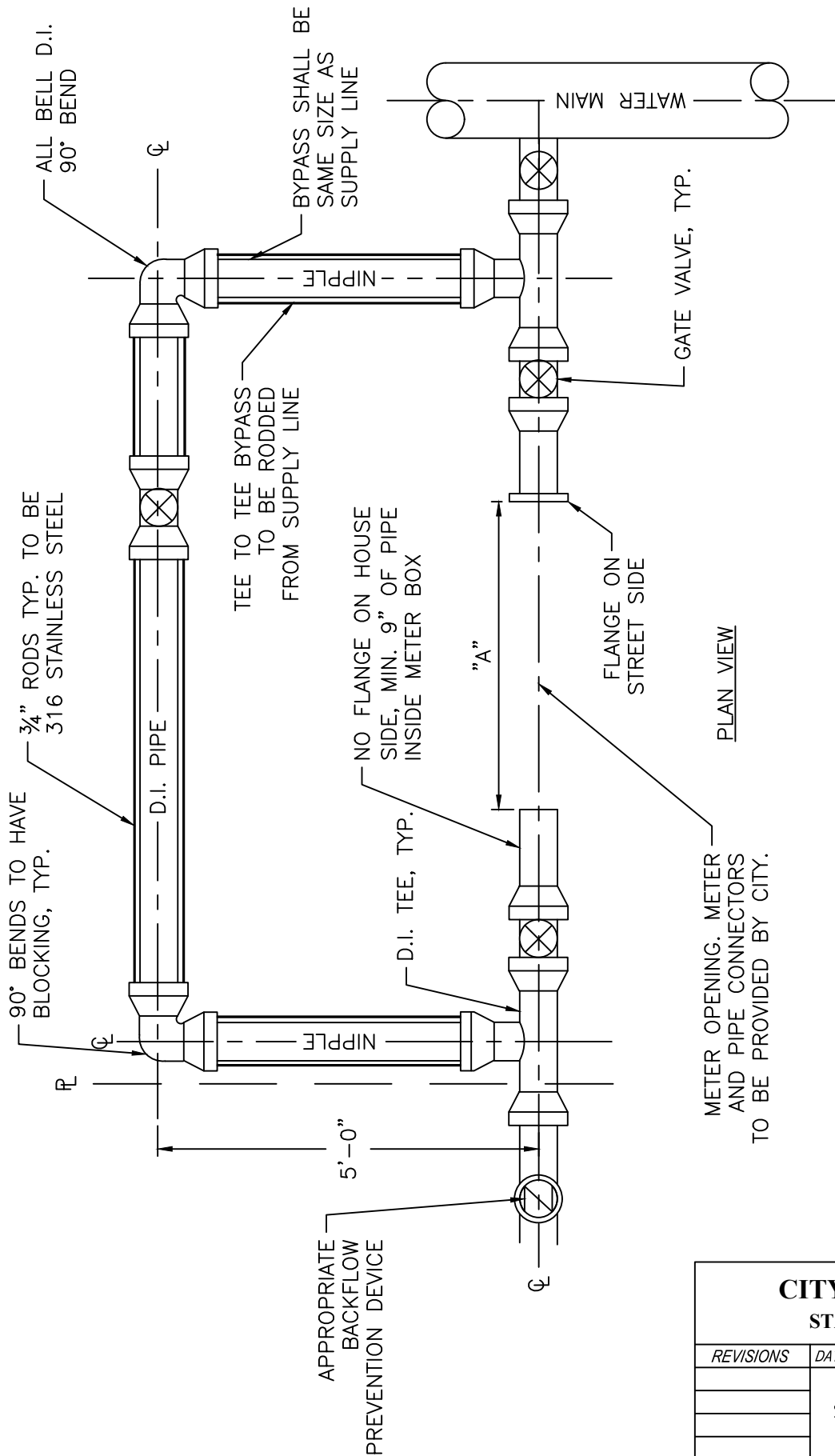
REVISIONS

DATE: 05/24/2024

NOT TO SCALE

TYPICAL 4"-8" DOMESTIC
WATER METER
BYPASS INSTALLATION

W-29

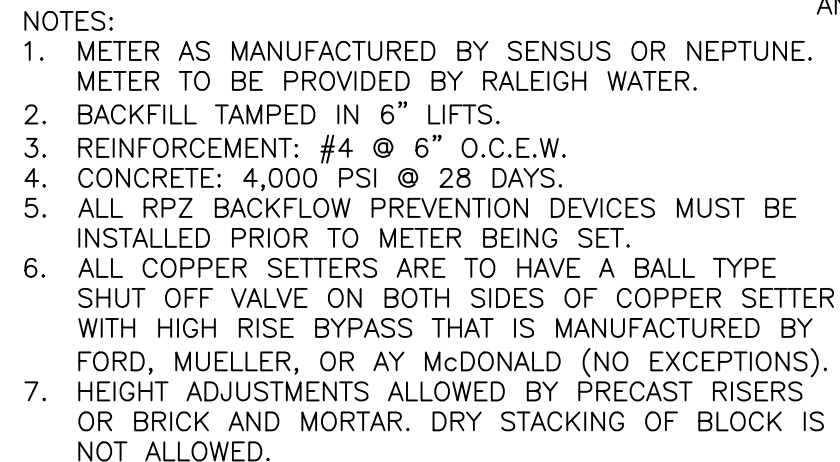


"A"

METER SIZE	METER OPENING
6" METER	46"
8" METER	54"
10" METER	69"

- NOTES:
1. ALL FITTINGS ARE TO BE MECHANICAL JOINT.
 2. SERVICE LINE FOR 10" METER SHALL BE 12".

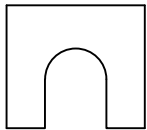
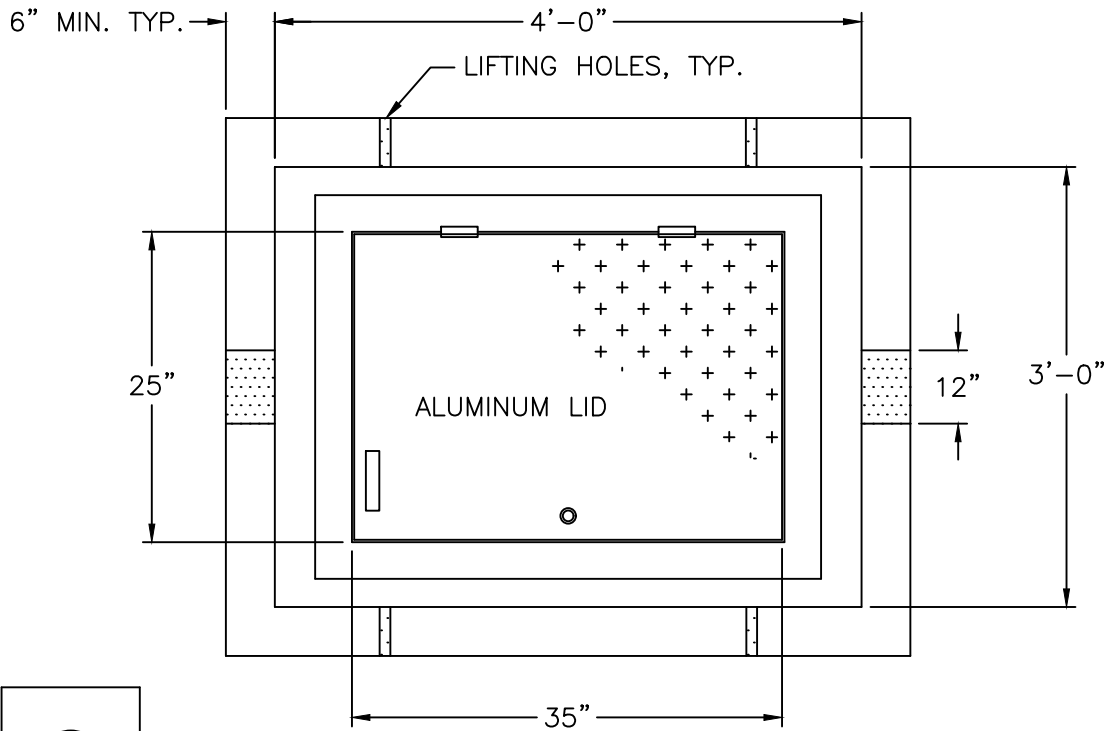
CITY OF RALEIGH	
STANDARD DETAIL	
REVISIONS	DATE: 05/24/2024 NOT TO SCALE
	TYPICAL 6"-10" FIRE SERVICE AND DOMESTIC METER W/ BYPASS
W-30	



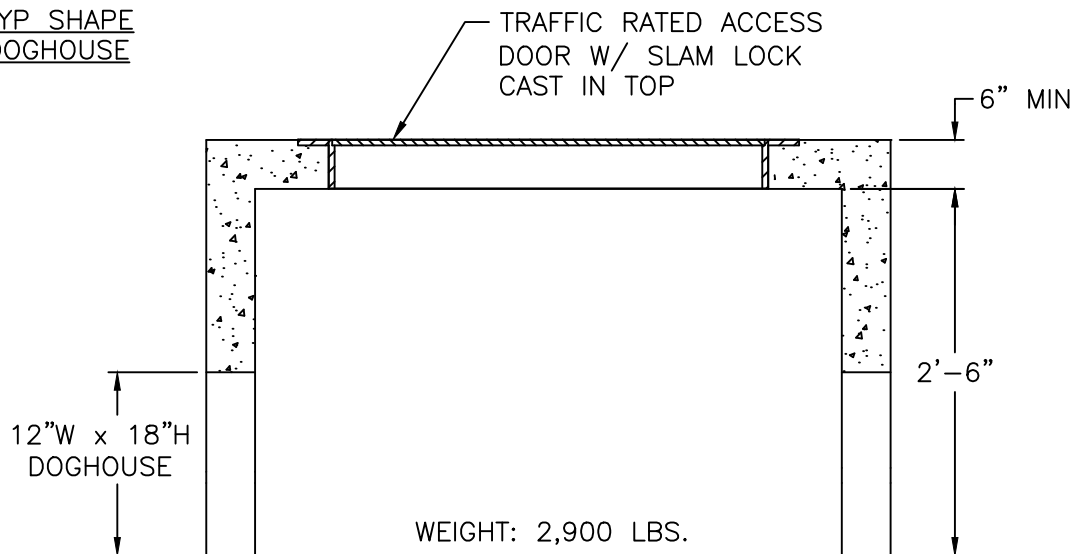
** TRAFFIC RATED
VAULT WALL THICKNESS

CITY OF RALEIGH
STANDARD DETAIL

<i>REVISIONS</i>	<i>DATE: 05/24/2024</i>	<i>NOT TO SCALE</i>
	TYPICAL 1 ½"–2" WATER METER BOX INSTALLATION	
	W-31	



TYP. SHAPE
DOGHOUSE

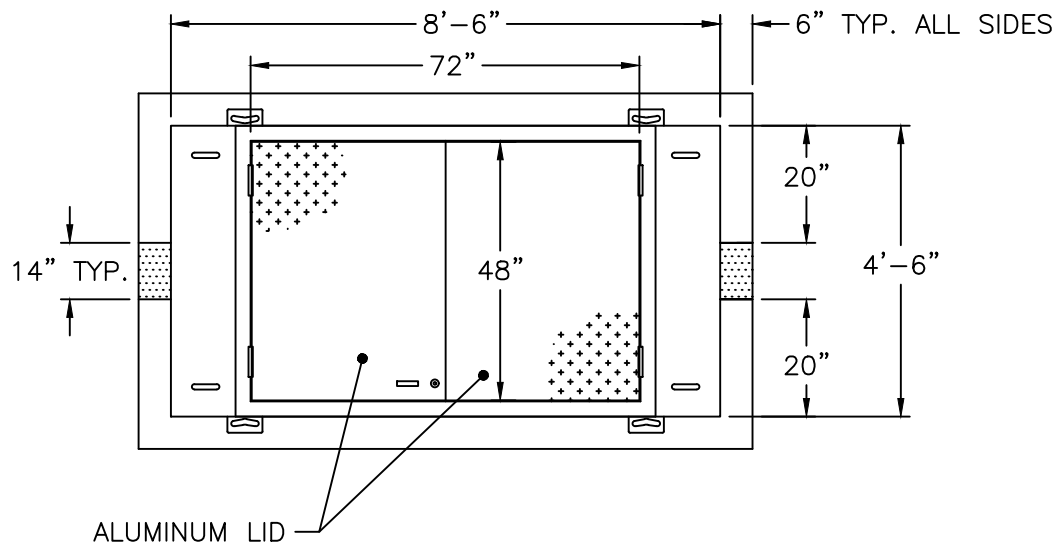


NOTES:

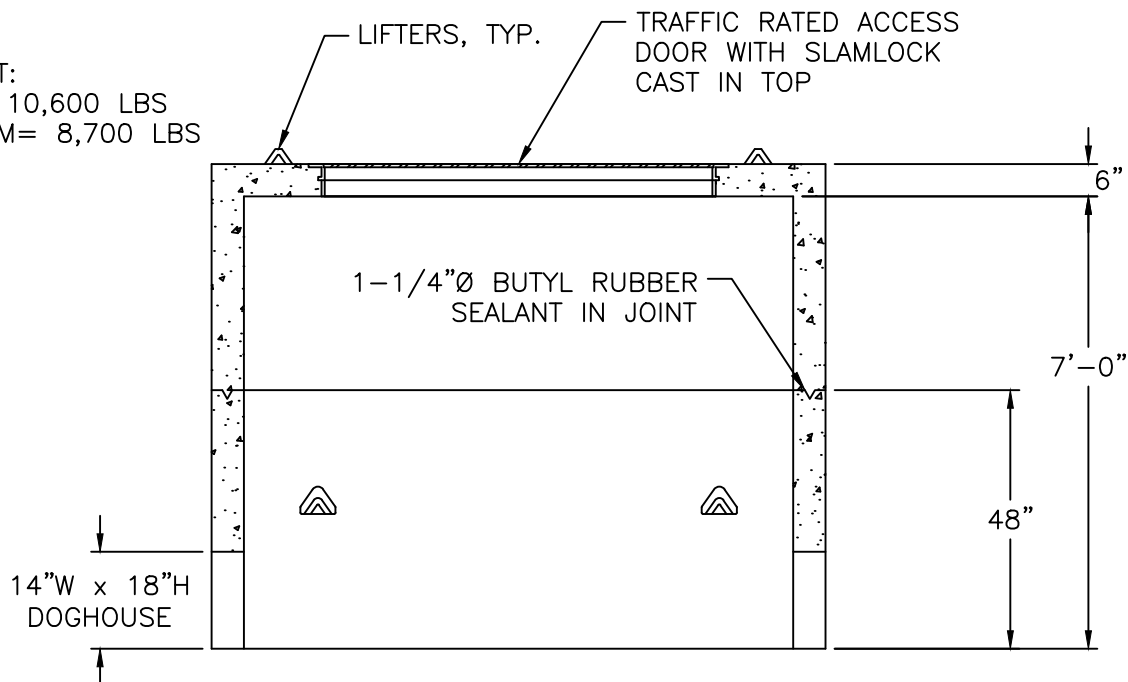
1. REINFORCEMENT: #4 @ 6" O.C.E.W.
2. CONCRETE: 4,000 PSI @ 28 DAYS.
3. 6" OF #67 STONE SHALL BE PLACED IN BOTTOM OF VAULT.
4. METER FLANGE SHALL BE PLACED 42" BELOW FINISHED GRADE.
5. HEIGHT ADJUSTMENTS ALLOWED BY PRECAST RISERS OR BRICK AND MORTAR. DRY STACKING OF BLOCK IS NOT ALLOWED.

CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	TYPICAL 4" WATER METER VAULT	
	W-32	



WEIGHT:
TOP= 10,600 LBS
BOTTOM= 8,700 LBS

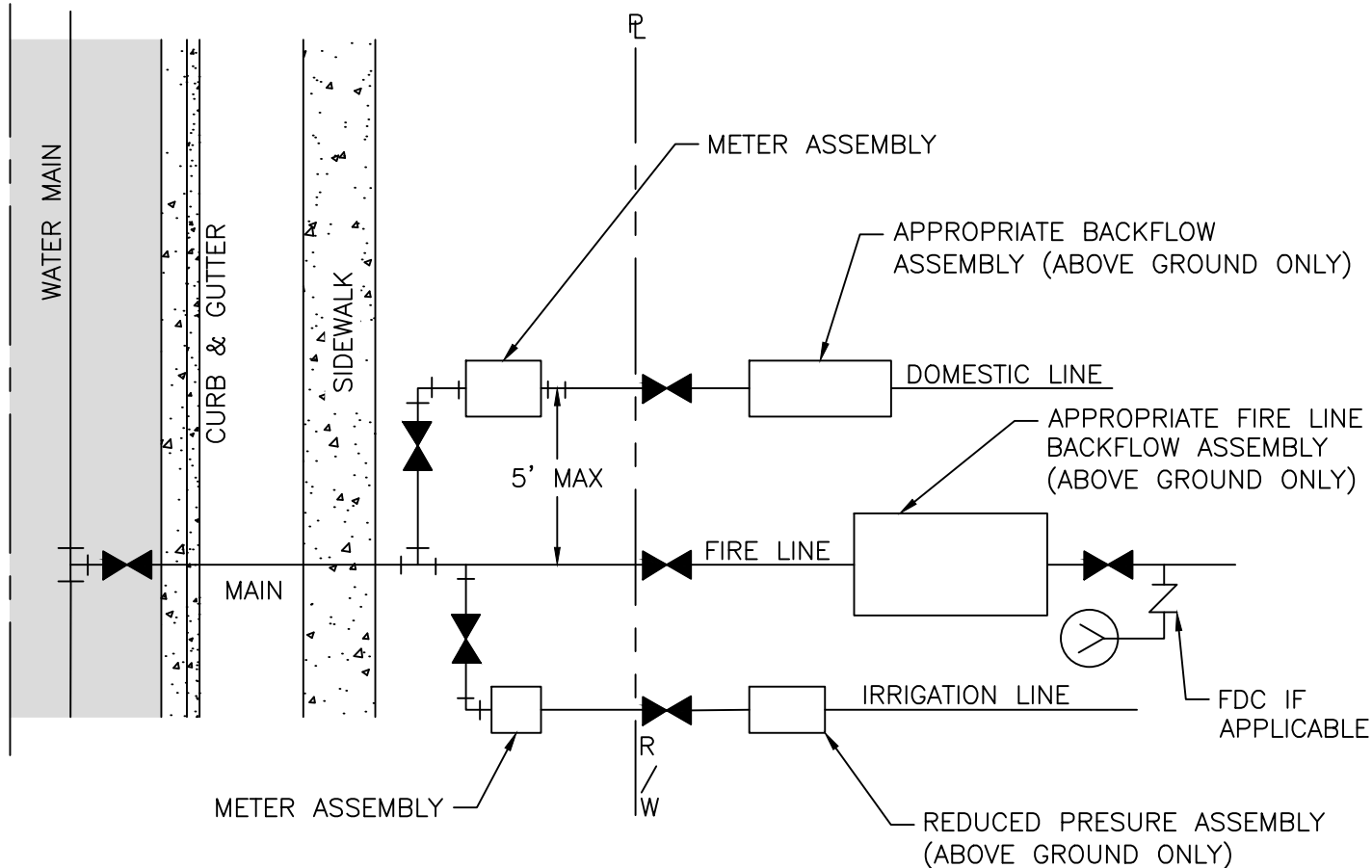


NOTES:

1. REINFORCEMENT: #4 @ 6" O.C.E.W.
2. CONCRETE: 4,000 PSI @ 28 DAYS.
3. 6" OF #67 STONE SHALL BE PLACED IN BOTTOM OF VAULT.
4. METER FLANGE SHALL BE PLACED 49" BELOW FINISHED GRADE.
5. HEIGHT ADJUSTMENTS ALLOWED BY PRECAST RISERS OR BRICK AND MORTAR.
DRY STACKING OF BLOCK IS NOT ALLOWED.

CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	TYPICAL 6" THRU 10" WATER METER VAULT	
	W-33	

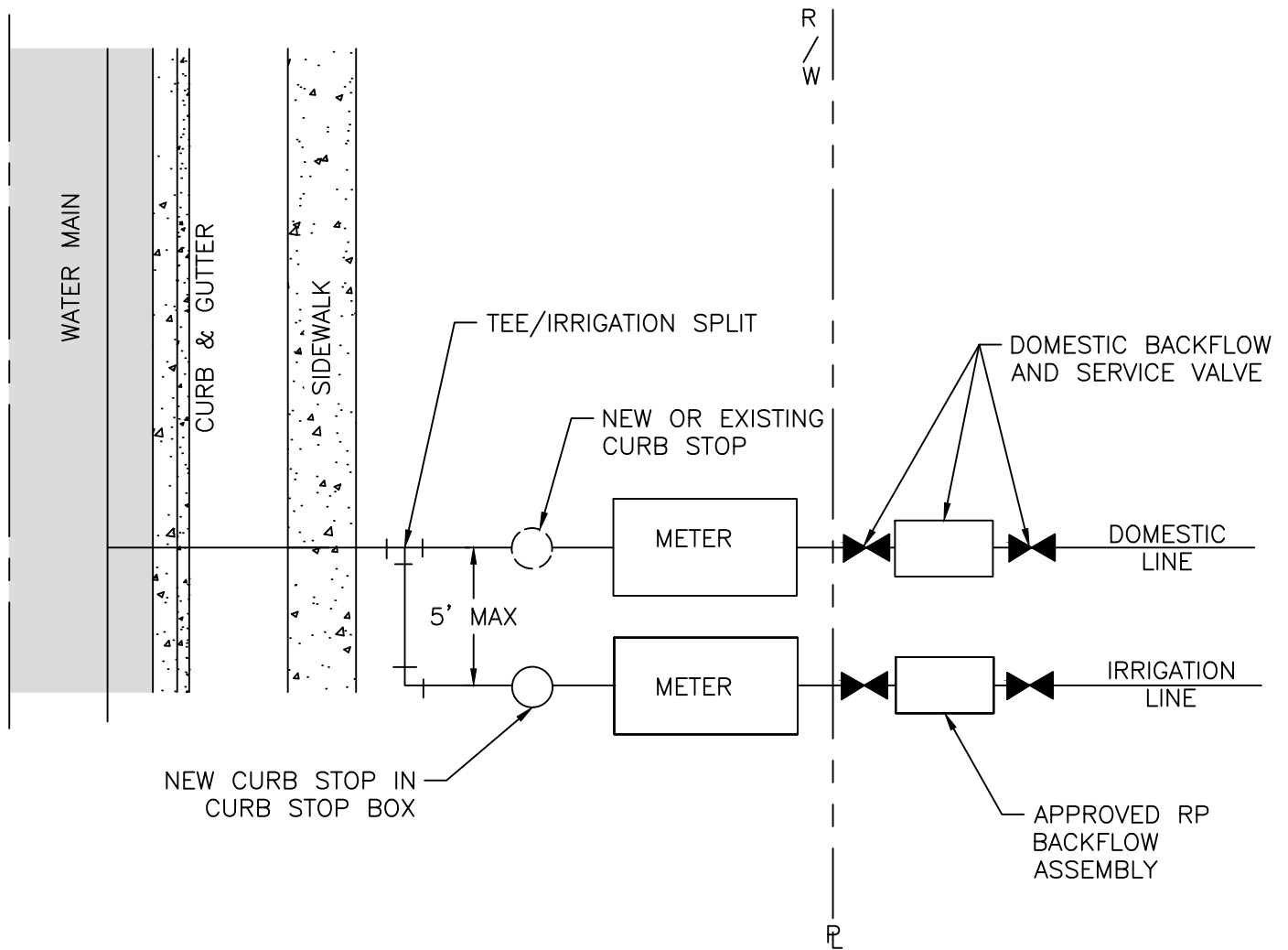


NOTES:

1. SERVICE TAPS FOR 2" AND SMALLER DOMESTIC SERVICES MAY BE BY CORPORATION COCKS. LARGER SERVICES WILL REQUIRE A TEE AND GATE VALVE OR TAPPING SLEEVE AND VALVE ASSEMBLY AND 90° BEND.
2. DOMESTIC SERVICE TAPS SHALL BE ALLOWED ONLY ON 6" OR LARGER FIRE LINES BEFORE THE BACKFLOW ASSEMBLY.
3. ONE DOMESTIC TAP PER FIRE LINE ON STREET SIDE OF BACKFLOW.
4. FIRE LINE SHALL HAVE A FIRE HYDRANT OR BLOW OFF ASSEMBLY AT ITS END TO FACILITATE FLUSHING WHEN NEEDED.
5. IRRIGATION METER SHALL BE LOCATED ON THE SIDE OF DOMESTIC METER WITH INCREASING ADDRESSES.
6. THE CONTAINMENT BACKFLOW ASSEMBLY SHALL BE INSTALLED WITHIN 50 LINEAR PIPING FEET OF THE METER OR RIGHT-OF-WAY FOR FIRE SERVICE LINES.
7. DOMESTIC/IRRIGATION BACKFLOW RISER/STANDPIPE SHALL BE OF APPROVED MATERIALS AS LISTED IN NC PLUMBING CODE.
8. THE RP RELIEF VALVE SHALL BE A MINIMUM OF 12" ABOVE ANY MATERIAL (MULCH INCLUDED) OR GRADE.
9. A SERVICE VALVE IS REQUIRED AFTER THE METER BUT BEFORE THE BACKFLOW ASSEMBLY FOR MAINTENANCE AND REPLACEMENT PURPOSES.
10. THE INSTALLATION MUST ALSO MEET ALL CODE REQUIREMENTS PER THE NC PLUMBING CODE.

CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	FIRE, DOMESTIC & IRRIGATION OPTIONS SCHEMATIC	
	W-34	

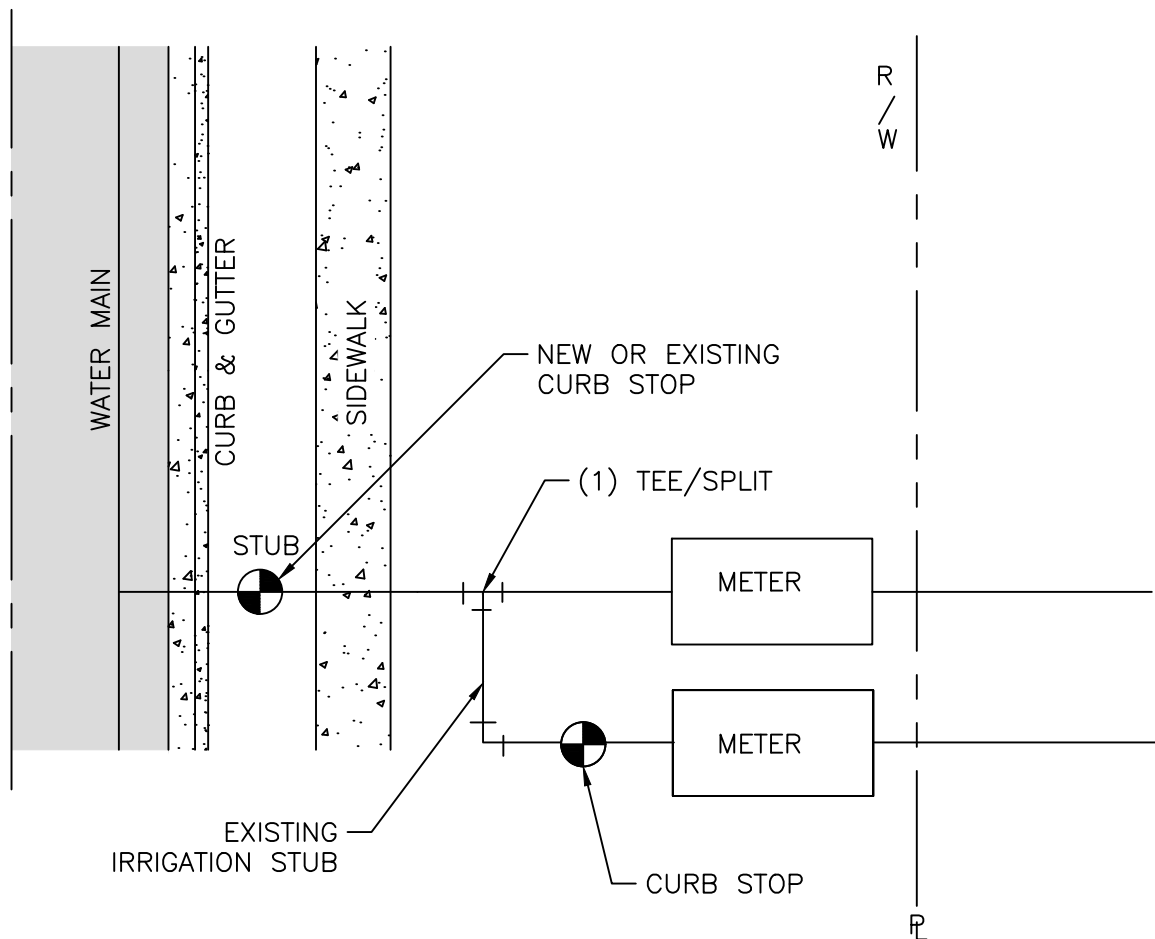


NOTES:

1. IRRIGATION METER SHALL BE LOCATED ON THE SIDE OF DOMESTIC METER WITH INCREASING ADDRESSES.
2. REQUIRED CONTAINMENT BACKFLOWS ARE TO BE INSTALLED WITHIN 50 LINEAR PIPING FEET OF THE METER OR RIGHT-OF-WAY FOR FIRE SERVICE LINES AND MEET INSTALLATION REQUIREMENTS AS LISTED IN APPENDIX A: GUIDELINES AND REQUIREMENTS OF THE CROSS CONNECTION AND HYDRANT METER PROGRAM.
3. BACKFLOW RISER/STANDPIPE SHALL BE OF COPPER OR BRASS.
4. THE RP RELIEF VALVE SHALL BE A MINIMUM OF 12" ABOVE ANY MATERIAL (MULCH INCLUDED) OR GRADE.
5. A SERVICE VALVE IS REQUIRED BEFORE AND AFTER THE BACKFLOW ASSEMBLY FOR MAINTENANCE AND REPLACEMENT PURPOSES.
6. ENCLOSURE MUST BE ASSE 1060 APPROVED AND HAVE ADEQUATE DRAINAGE.

CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	IRRIGATION TAP ON NEW AND EXISTING SERVICES	
	W-35	

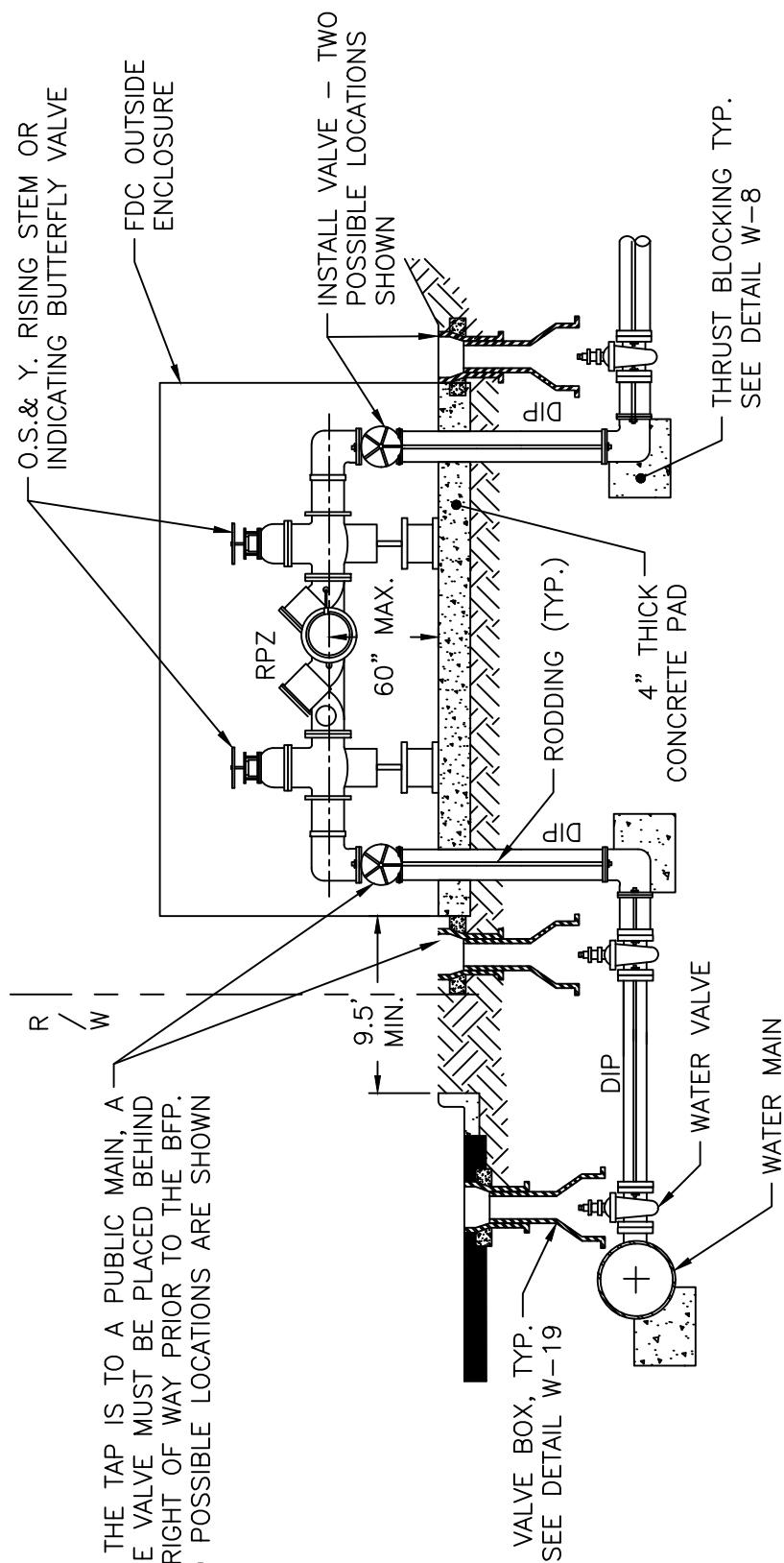


NOTES:

1. REMOVE TEE FITTINGS AND REPAIR STUB WITH CURB STOP & VALVE BOX IF NOT EXISTING.
2. WORK TO BE PERFORMED BY LICENSED UTILITY CONTRACTOR, STUB PERMIT INSPECTION REQUIRED.
3. FOR REPAIR OF EXISTING SERVICE, ONE BRASS COMPRESSION COUPLING AND TYPE K COPPER TO BE USED AS NEEDED FOR REPAIR.
4. REMOVE METER BOX AND PIPING. PRIOR TO TERMINATION THE METER DIVISION/UTILITY BILLING MUST BE CONTACTED FOR METER REMOVAL & ACCOUNT CLOSURE.

**CITY OF RALEIGH
STANDARD DETAIL**

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	IRRIGATION METER TERMINATION	
	W-35A	

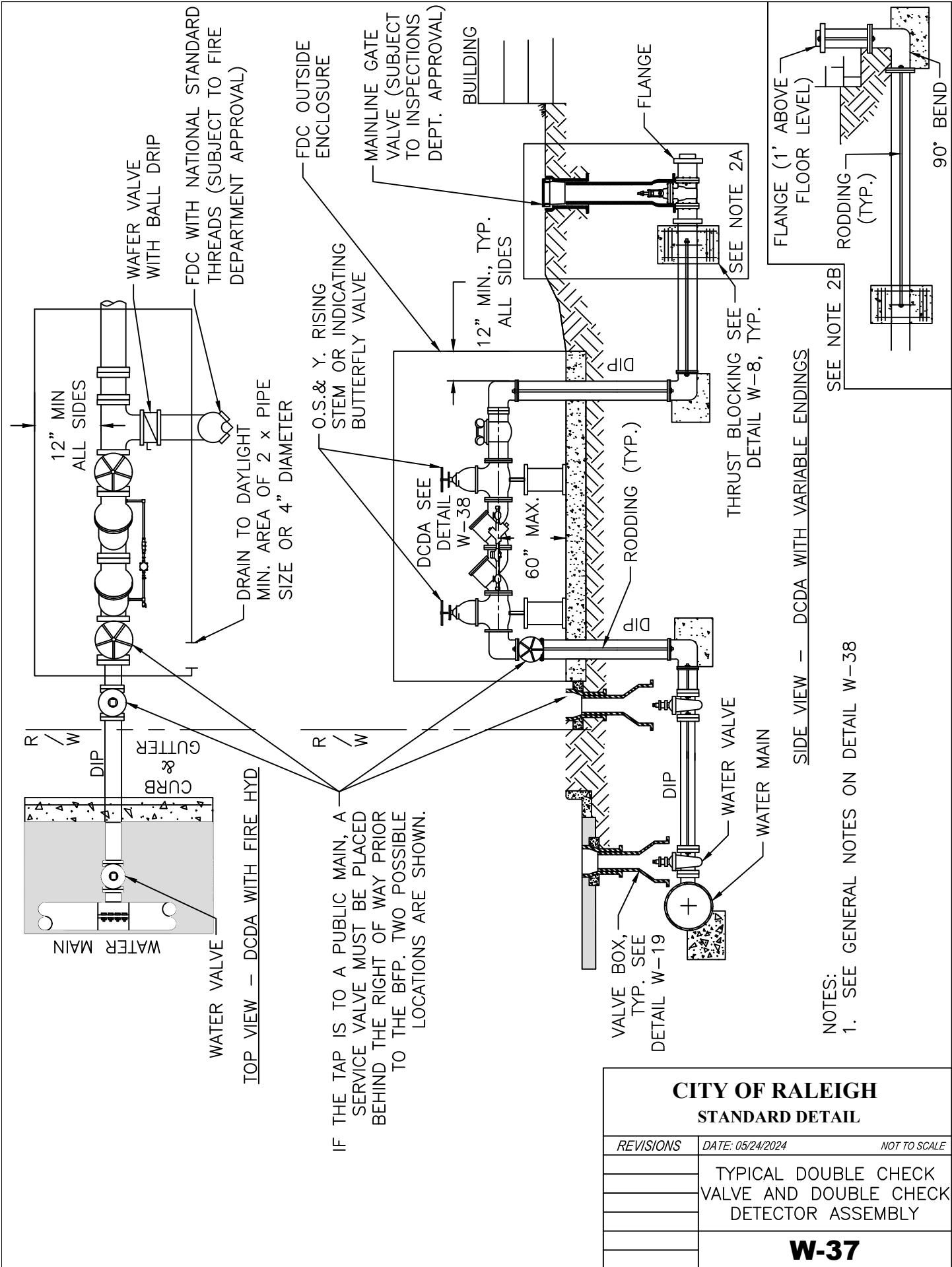


IF THE TAP IS TO A PUBLIC MAIN, A SERVICE VALVE MUST BE PLACED BEHIND THE RIGHT OF WAY PRIOR TO THE BFP. TWO POSSIBLE LOCATIONS ARE SHOWN

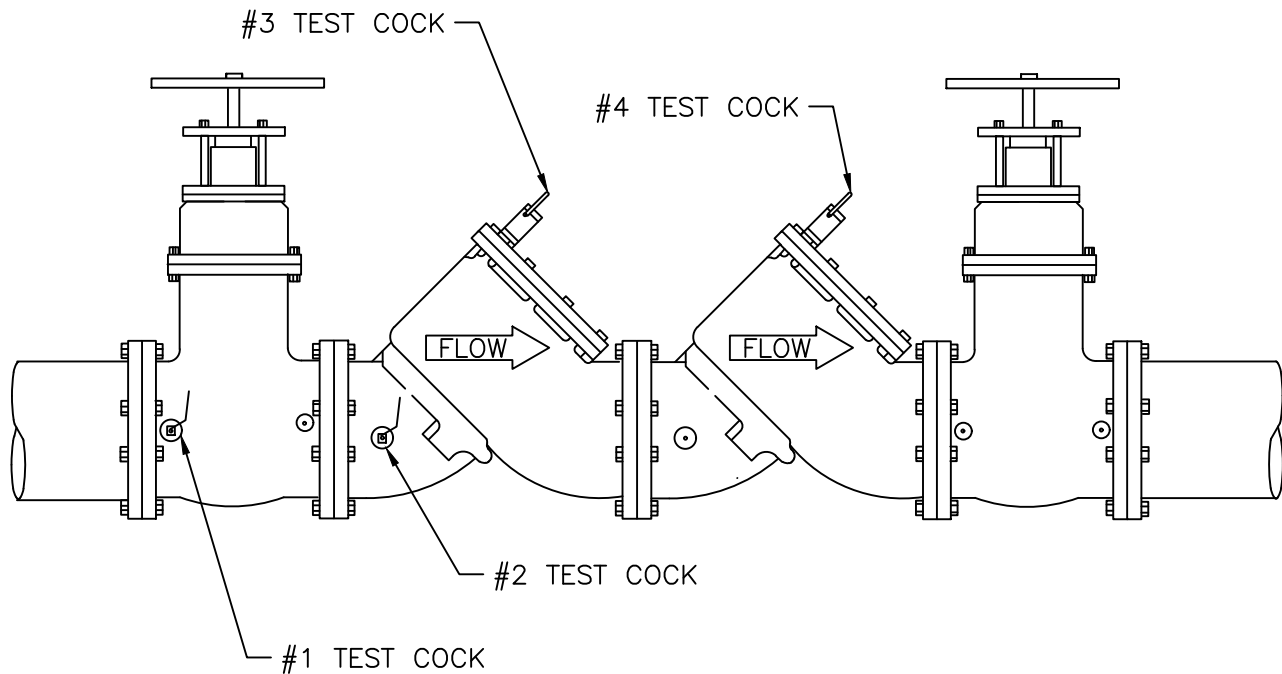
NOTES:

1. ENCLOSURE MUST BE ASSE 1060 APPROVED AND HAVE ADEQUATE DRAINAGE.
2. CONTAINMENT RPZ/RPDA BACKFLOW ASSEMBLIES ARE TO BE INSTALLED WITHIN 50 LINEAR PIPING FEET OF THE METER OR RIGHT-OF-WAY FOR FIRE SERVICE LINES AND MEET INSTALLATION REQUIREMENTS AS LISTED IN APPENDIX A: GUIDELINES AND REQUIREMENTS OF THE CROSS CONNECTION AND HYDRANT METER PROGRAM.
3. NO VALVE IN THE EXISTING SYSTEM SHALL BE OPERATED WITHOUT FOLLOWING THE PROCEDURE OUTLINED IN THE RALEIGH WATER PUBLIC UTILITY DESIGN MANUAL. THE CONTRACTOR SHALL NOTIFY RALEIGH WATER'S DISTRIBUTION DIVISION AT 919-996-3245 TO REQUEST THE OPERATION OF ANY VALVE.
4. RESIDENTIAL LAWN IRRIGATION R.P. ASSEMBLIES THAT ARE REMOVED TO PREVENT FREEZING IN THE WINTER MONTHS MUST BE CAPPED OFF. ALL ABOVE GROUND ASSEMBLIES, EXCEPT RESIDENTIAL LAWN IRRIGATION ASSEMBLIES, MUST BE PROTECTED FROM FROST.
5. ALL CONTAINMENT BACKFLOW ASSEMBLIES MUST BE ASSE AND USC APPROVED.
6. STEEL RODS AND BOLTS SHALL BE $\frac{3}{4}$ " 316 STAINLESS STEEL.

CITY OF RALEIGH		
STANDARD DETAIL		
REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	REDUCED PRESSURE ZONE AND REDUCED PRESSURE DETECTOR ASSEMBLY	
	W-36	



CITY OF RALEIGH STANDARD DETAIL		
REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	TYPICAL DOUBLE CHECK VALVE AND DOUBLE CHECK DETECTOR ASSEMBLY	
	W-37	

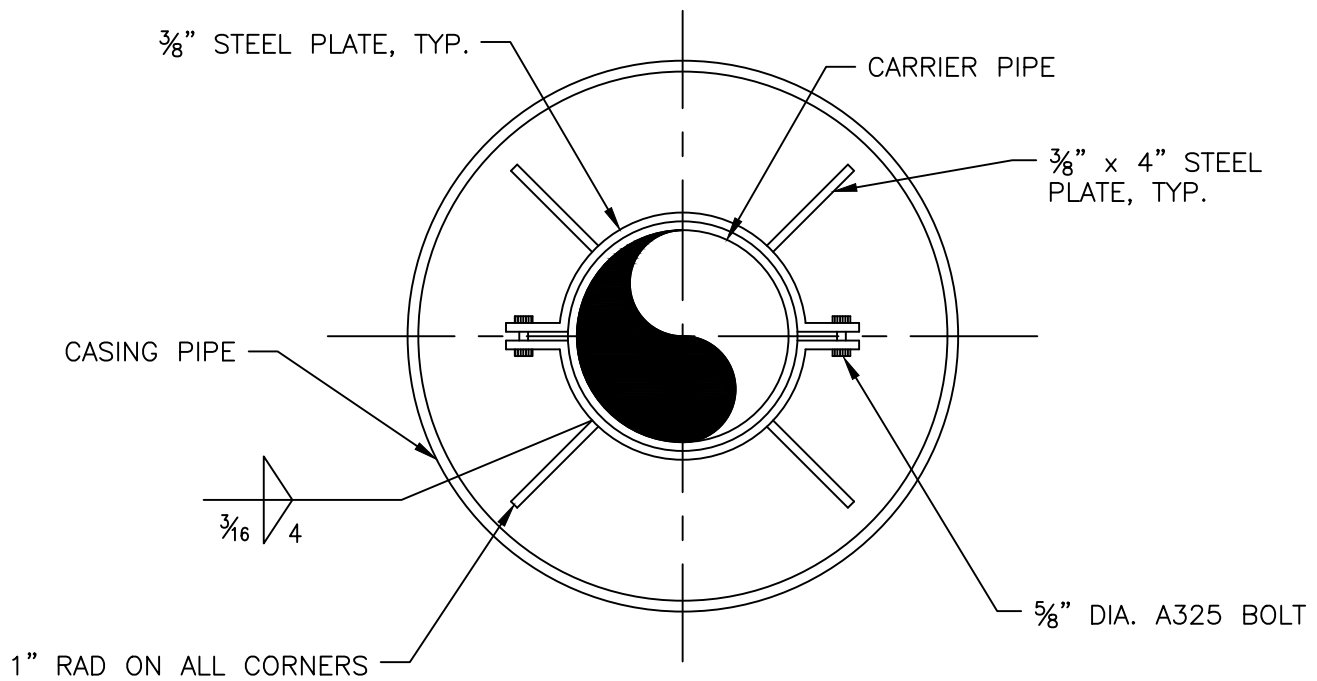


GENERAL NOTES:

1. SHUT-OFF VALVES, CHECK VALVES, AND TEST COCKS SHALL BE STANDARD TO THE APPROVED BACKFLOW ASSEMBLY.
2. ALL LARGE (2 ½"–10") ASSEMBLIES TO BE SUPPORTED BY A CRADLE.
3. ENCLOSURE FOUNDATIONS SHALL BE CONSTRUCTED OF 4" OF CONCRETE OR 6" OF STONE.
4. ASSEMBLIES MUST BE ON CURRENT APPROVAL LIST.
5. 2 ½" AND LARGER ASSEMBLIES SHALL BE FUSION BONDED EPOXY COATED INCLUDING SHUTOFF VALVES.
6. ENCLOSURE MUST BE ASSE 1060 APPROVED AND HAVE ADEQUATE DRAINAGE.
7. CONTAINMENT RPZ/RPDA BACKFLOWS ARE TO BE INSTALLED WITHIN 50 LINEAR PIPING FEET OF THE METER OR RIGHT-OF-WAY FOR FIRE SERVICE LINES AND MEET INSTALLATION REQUIREMENTS AS LISTED IN APPENDIX A: GUIDELINES AND REQUIREMENTS OF THE CROSS CONNECTION AND HYDRANT METER PROGRAM.
8. NO VALVE IN THE EXISTING SYSTEM SHALL BE OPERATED WITHOUT FOLLOWING THE PROCEDURE OUTLINED IN THE RALEIGH WATER PUBLIC UTILITY DESIGN MANUAL. THE CONTRACTOR SHALL NOTIFY RALEIGH WATER'S DISTRIBUTION DIVISION AT 919-996-3245 TO REQUEST THE OPERATION OF ANY VALVE.
9. ALL CONTAINMENT BACKFLOW ASSEMBLIES MUST BE ASSE AND USC APPROVED.
10. STEEL RODS AND BOLTS SHALL BE ¾" 316 STAINLESS STEEL.

CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	STANDARD DOUBLE CHECK VALVE ASSEMBLY	
	W-38	



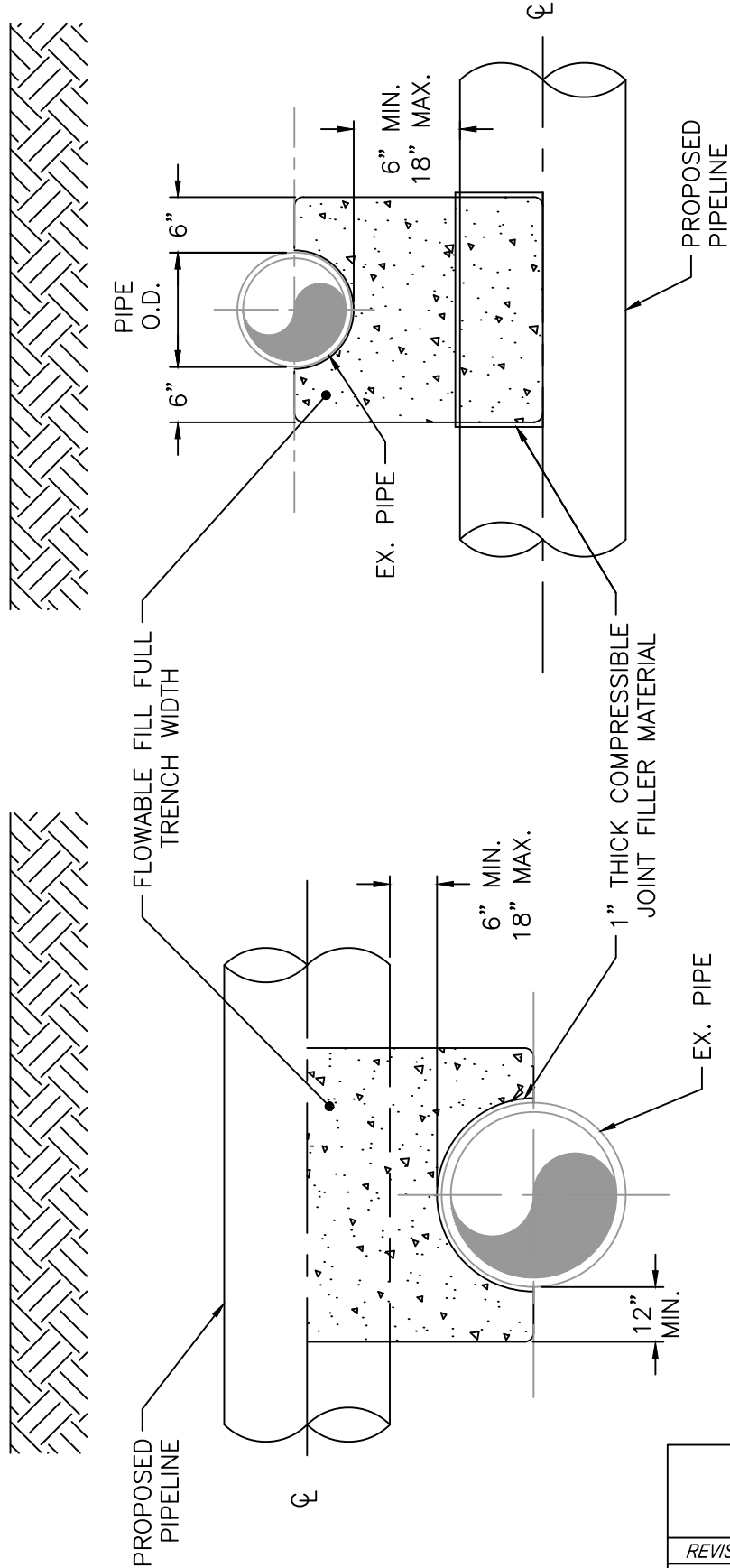
NOTE:
USE A MINIMUM OF TWO SPIDERS PER PIPE JOINT ONE FOURTH OF THE PIPE JOINT LENGTH IN FROM BOTH THE BELL AND SPIGOT ENDS.

CITY OF RALEIGH
STANDARD DETAIL

REVISIONS DATE: 05/24/2024 NOT TO SCALE

PIPE ALIGNMENT GUIDE

W-40



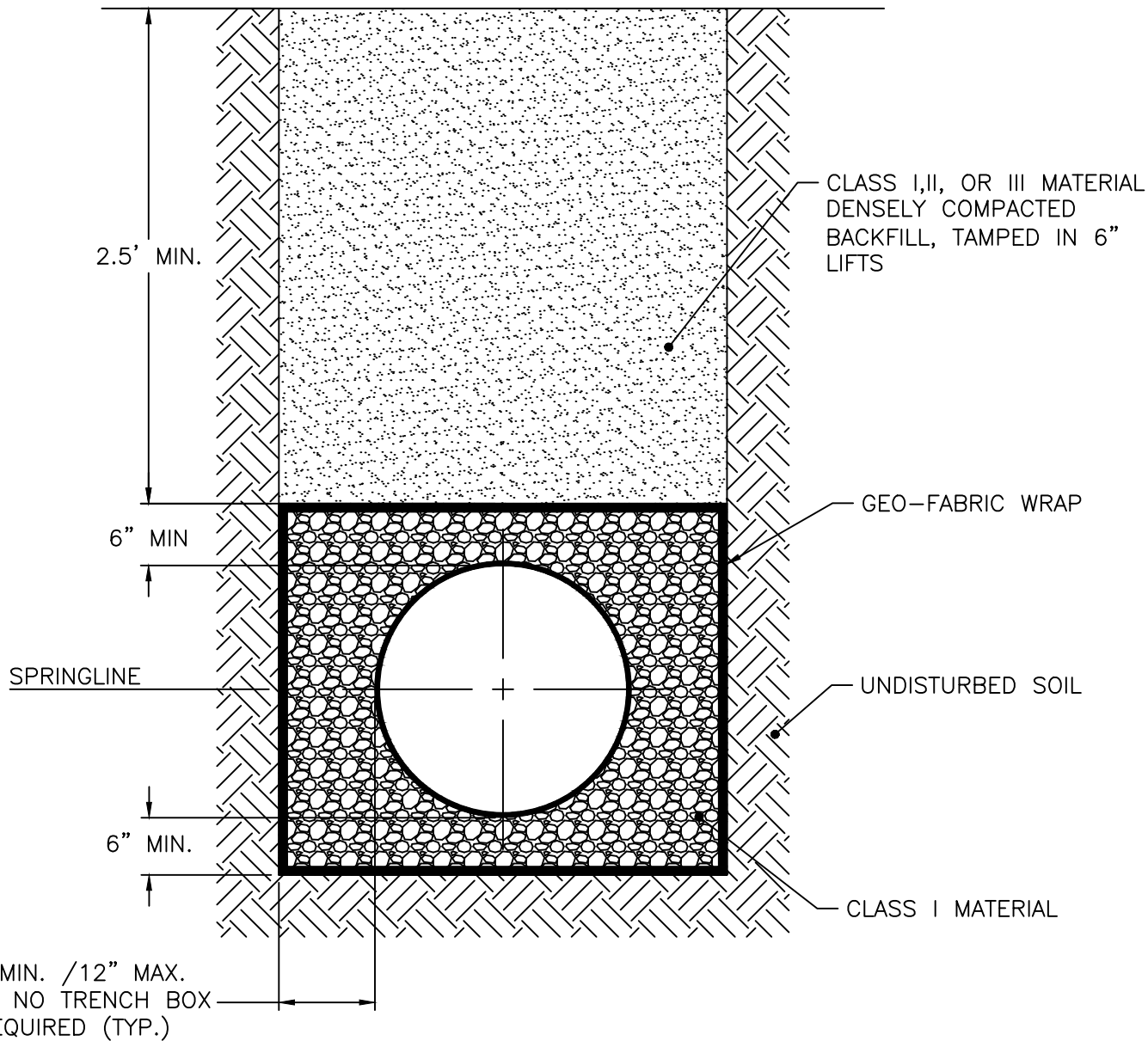
CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	CONCRETE CRADLE PROTECTION FOR WATER LINE CROSSINGS	
	W-41	

PROPOSED PIPELINE UNDER EXISTING PIPE

PROPOSED PIPELINE OVER EXISTING PIPE

NOTE:
 NO ENCASEMENT REQUIRED FOR SPACE
 GREATER THAN 18" FOR WATER LINES.

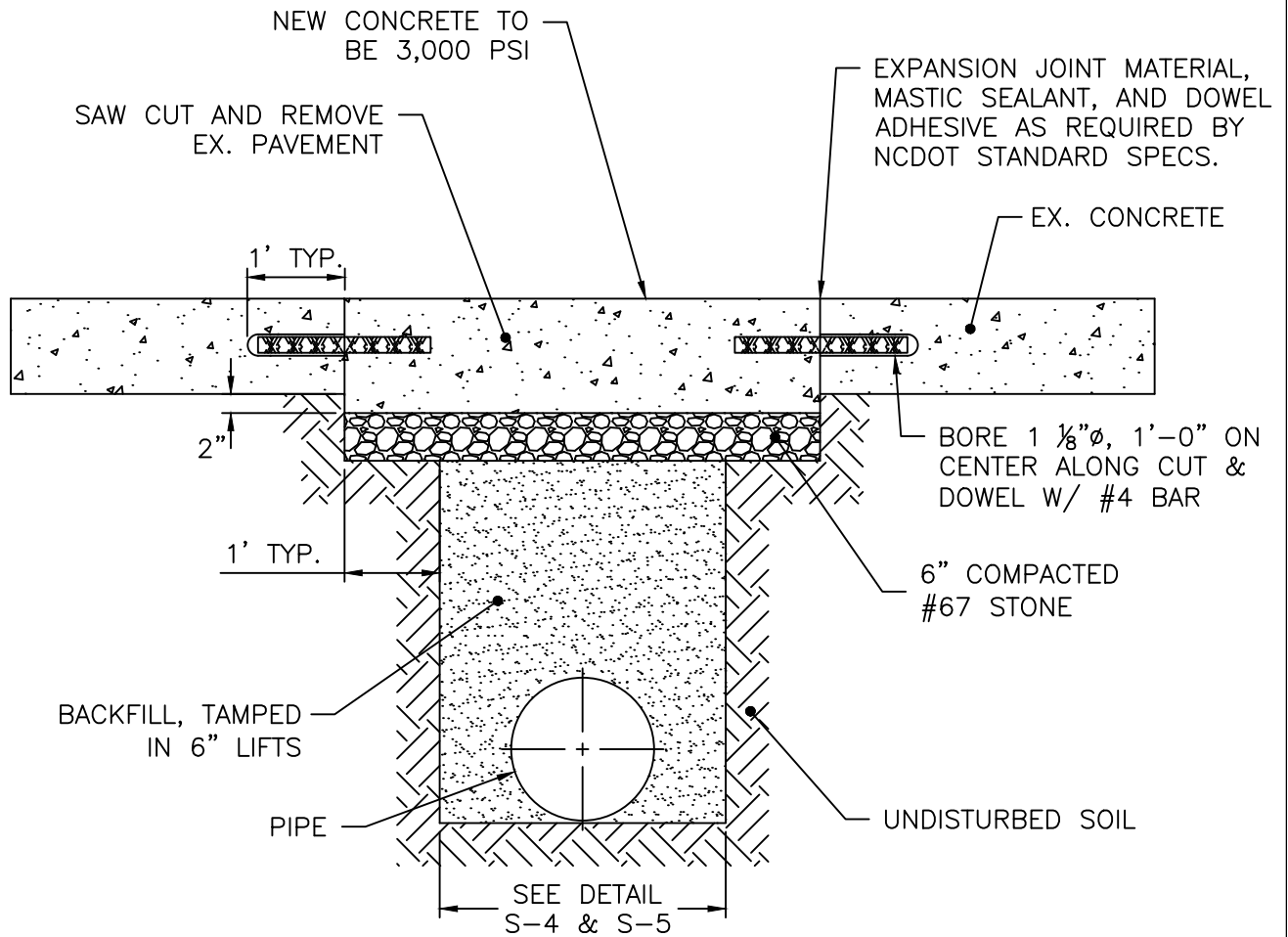


CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
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	STANDARD BEDDING DETAIL FOR CCFRPM PIPES
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S-1



NOTES:

1. SEE DETAIL S-4 & S-5 FOR ADDITIONAL TRENCH AND PIPE BEDDING DETAILS.
2. PAVEMENT CUTS OVER 5'-0" IN WIDTH SHALL BE REINFORCED TO NCDOT OR MERGER COMMUNITY STANDARDS.
3. PAVEMENT CUTS SHALL BE MADE WITH AN APPROPRIATE SAW CUT MACHINE.
4. THE TRENCH SUBGRADE MATERIAL SHALL BE BACKFILLED WITH SUITABLE MATERIAL AND COMPACTED TO AT LEAST 95% OF THE MAXIMUM DRY DENSITY AS DETERMINED BY AASHTO T 99 AS MODIFIED BY NCDOT.
5. THE FINAL 6" OF FILL SHALL CONSIST OF ABC MATERIAL COMPACTED TO AT LEAST 100% OF THE MAXIMUM DRY DENSITY AS DETERMINED BY AASHTO T 180 AS MODIFIED BY NCDOT.

CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	STANDARD CONCRETE PAVEMENT PATCH	
	S-2	

SEE TRANSPORTATION DETAIL
T-10.05.1 FOR ASPHALT REPAIR

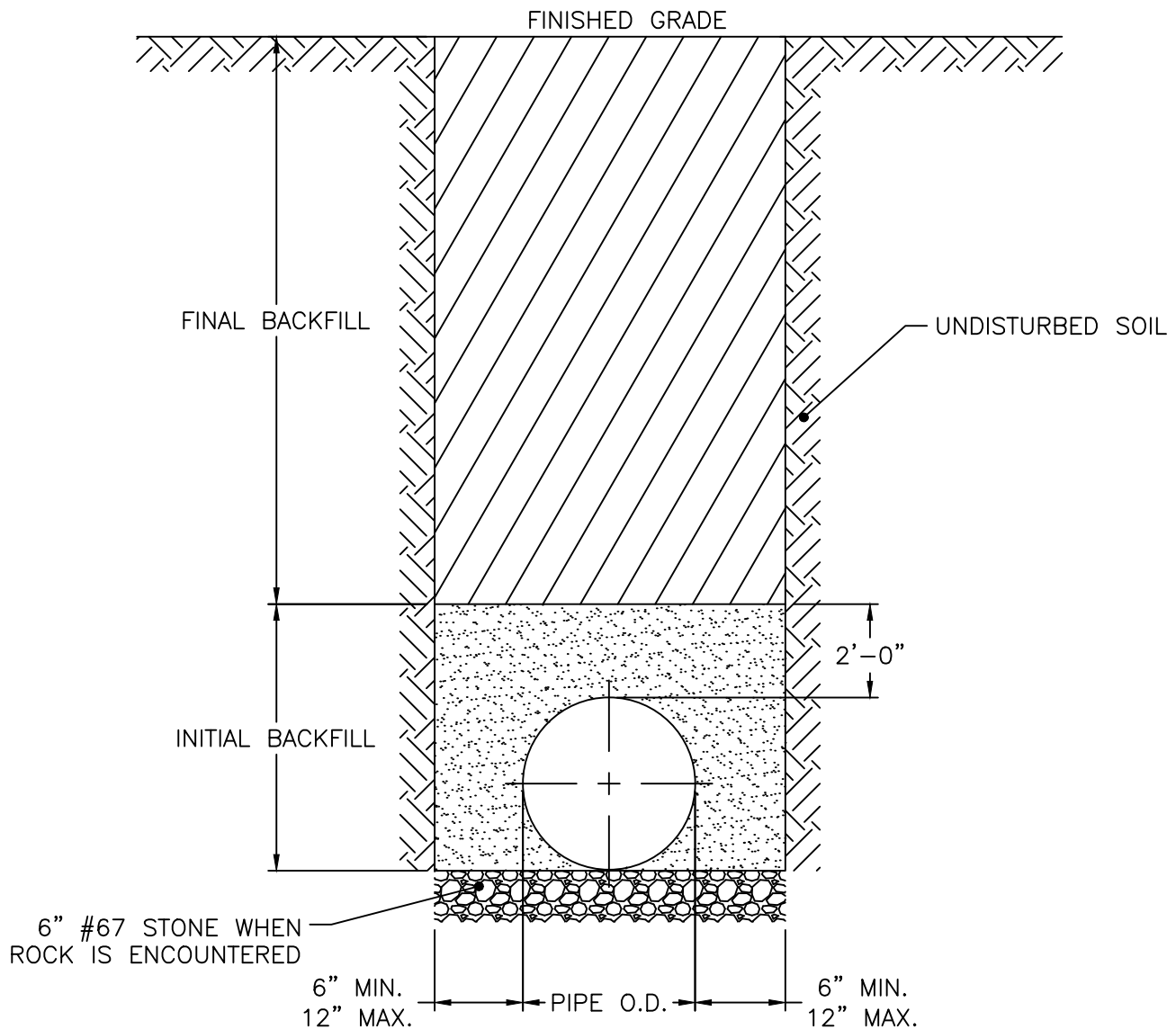
SEE TRANSPORTATION DETAIL
T-10.05.2 FOR ASPHALT REPAIR EXTENTS

CITY OF RALEIGH
STANDARD DETAIL

<i>REVISIONS</i>	<i>DATE: 05/24/2024</i>	<i>NOT TO SCALE</i>
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	STANDARD ASPHALT PAVEMENT PATCH

	S-3
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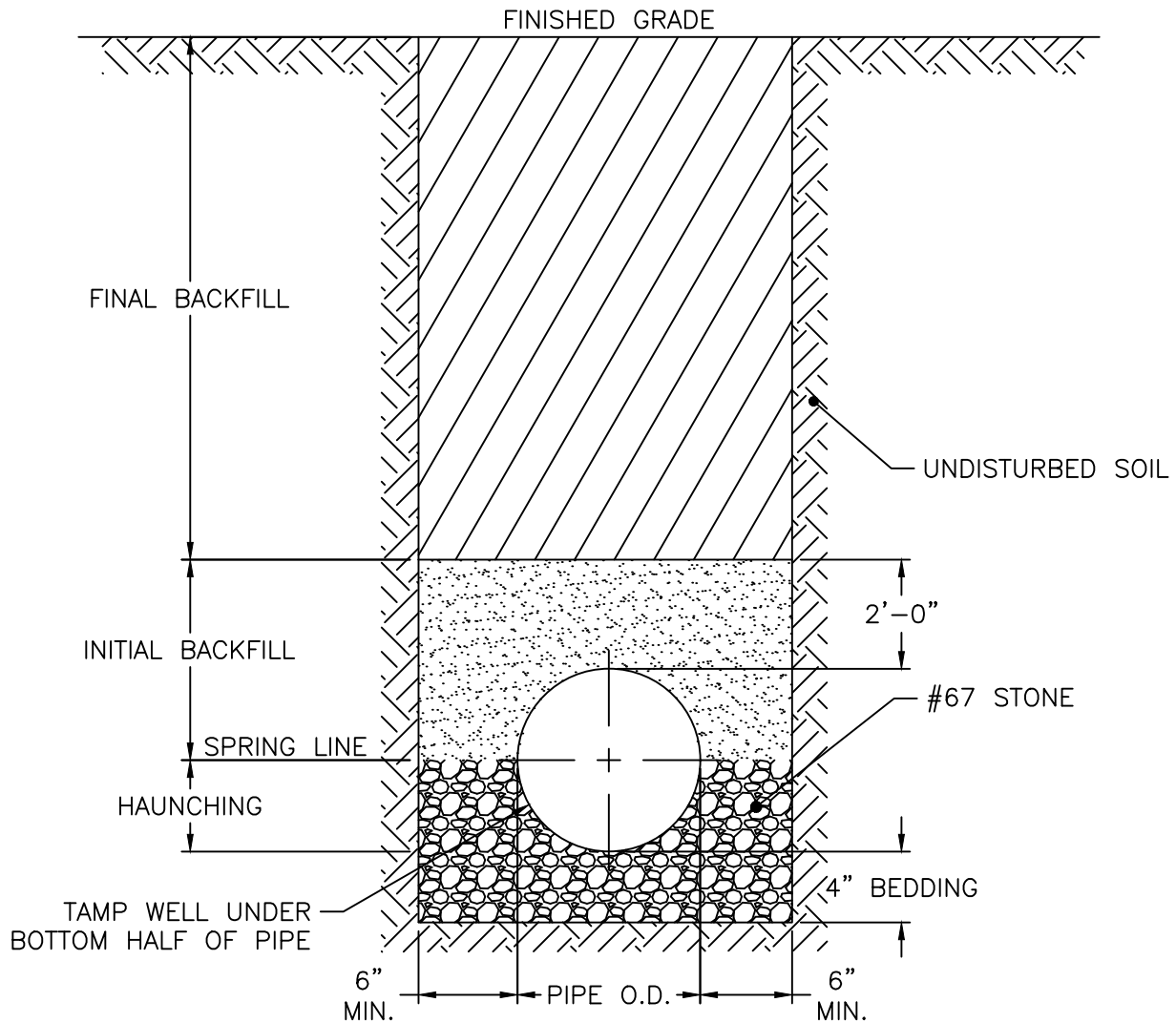


NOTES:

1. FOR TRENCHES REQUIRING SHORING AND BRACING, DIMENSIONS SHALL BE TAKEN FROM THE INSIDE FACE OF THE SHORING AND BRACING.
2. NO ROCKS OR BOULDERS 4" OR LARGER TO BE USED IN INITIAL BACKFILL.
3. ALL BACKFILL MATERIAL SHALL BE SUITABLE NATIVE MATERIAL.
4. BACKFILL SHALL BE TAMPED IN 6" LIFTS IN TRAFFIC AREAS, 12" IN NON-TRAFFIC AREAS.
5. ACHIEVE 80% COMPACTION IN NON-TRAFFIC AREAS, AND 95% COMPACTION IN TRAFFIC AREAS.
6. IF IN EASEMENT, 4" TOPSOIL AND 12" CLEAN SELECT FILL MAY BE REQUIRED.
7. NO BOULDERS 8" IN DIAMETER OR GREATER ALLOWED IN FINAL BACKFILL.

CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	TRENCH BOTTOM DIMENSIONS & BACKFILLING REQUIREMENTS FOR DUCTILE IRON	
	S-4	



TYPICAL TRENCH BOTTOM DIMENSIONS FOR SDR 35 PVC GRAVITY PIPE

NOTES:

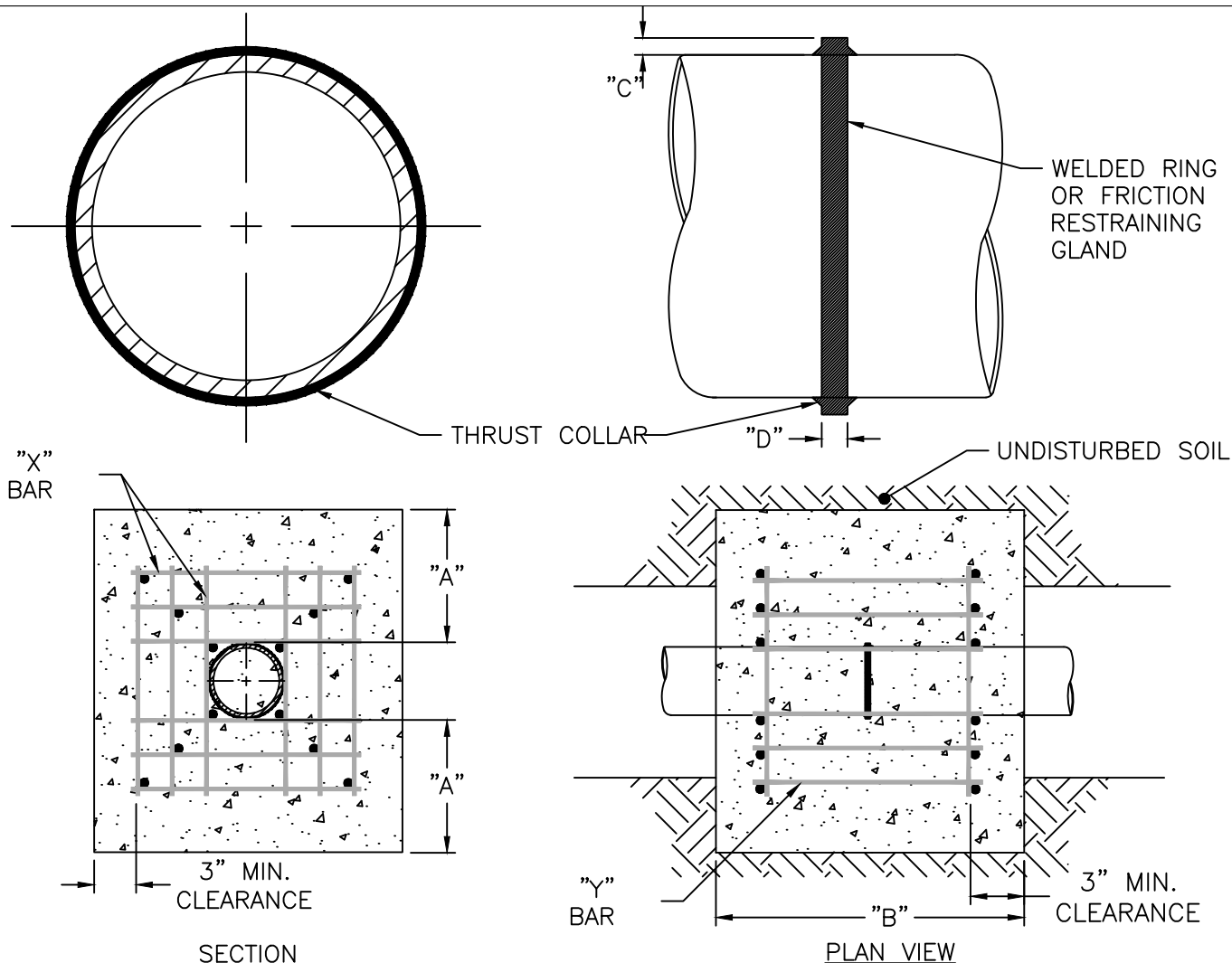
1. FOR TRENCHES REQUIRING SHORING AND BRACING, DIMENSIONS SHALL BE TAKEN FROM THE INSIDE FACE OF THE SHORING AND BRACING.
2. NO ROCKS OR BOULDERS, 4" OR LARGER, TO BE USED IN INITIAL BACKFILL.
3. ALL BACKFILL MATERIAL SHALL BE SUITABLE NATIVE MATERIAL.
4. BACKFILL SHALL BE TAMPED IN 6" LIFTS IN TRAFFIC AREAS, 12" IN NON-TRAFFIC AREAS.

CITY OF RALEIGH
STANDARD DETAIL

REVISIONS DATE: 05/24/2024 NOT TO SCALE

TRENCH BOTTOM DIMENSIONS &
BACKFILLING REQUIREMENTS FOR
PVC GRAVITY SEWER MAIN

S-5



REINFORCING REQUIREMENTS

I.D. PIPE	REBAR SIZE	"X" BAR LENGTH	"X" BAR WEIGHT	"Y" BAR LENGTH	"Y" BAR WEIGHT	NO. REQUIRED
6"-36"	#5	2'-2" + O.D. PIPE	1.043 LBS/FT	1'-1"	1.1 LBS. EACH	X-24 Y-12
≥48"	#6	3'-0" + O.D. PIPE	1.502 LBS/FT	1'-3"	1.9 LBS. EACH	X-24 Y-12

THRUST COLLAR, AND THRUST SCHEDULE

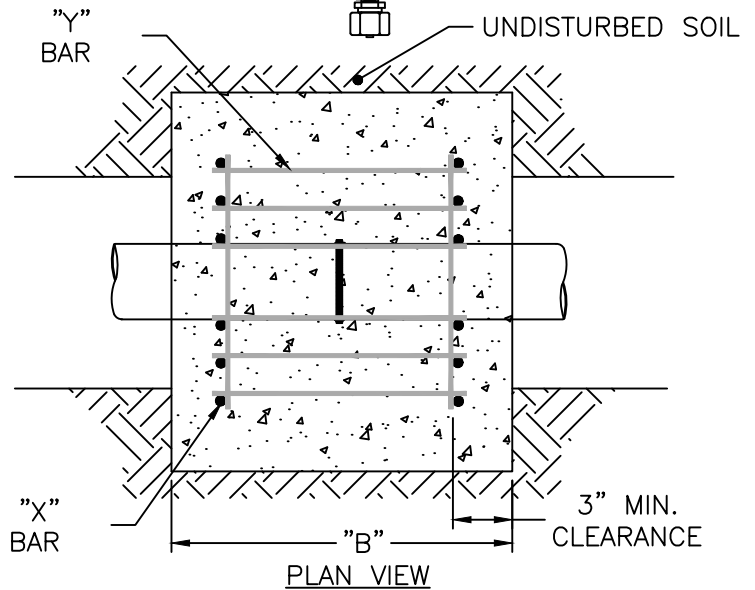
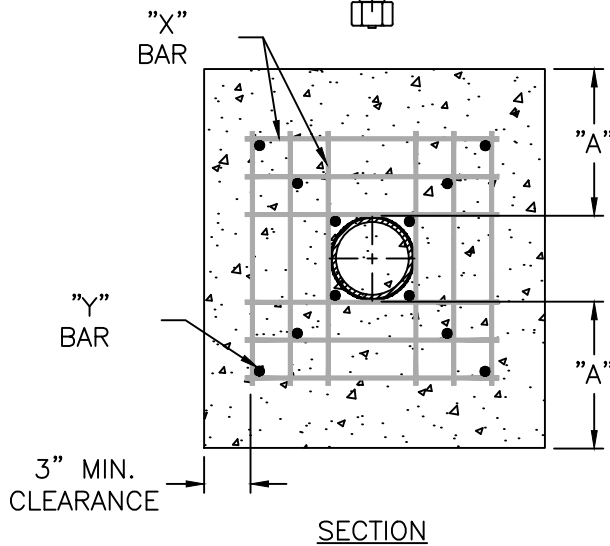
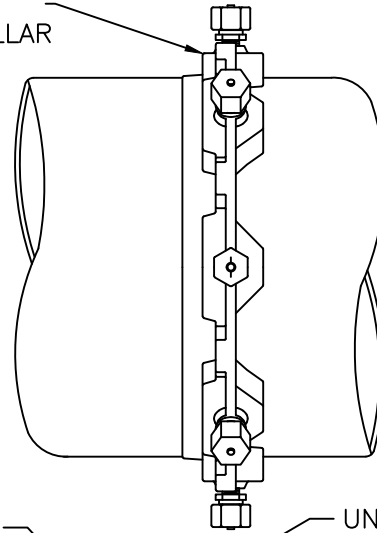
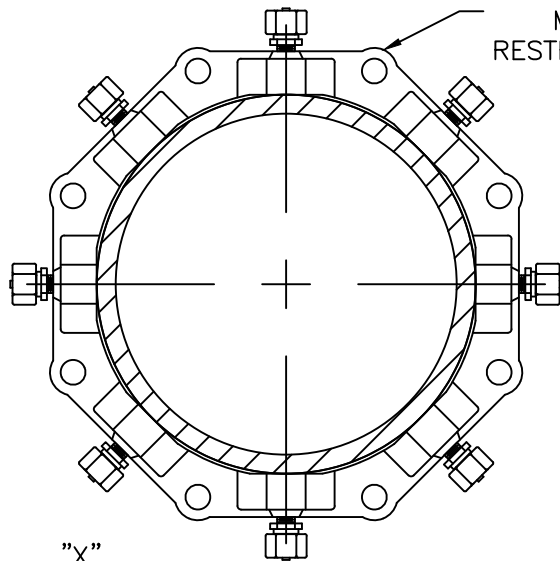
I.D. PIPE	"A"	"B"	"C"	"D"
6"-16"	1'-4"	1'-7"	2"	3/8"
20"-24"	1'-4"	1'-7"	3"	1/2"
30"-36"	1'-4"	1'-7"	4"	5/8"
≥48	1'-8"	1'-9"	6"	7/8"

NOTES:

1. CONCRETE SHALL BE 3,000 PSI AND TRANSIT MIXED.
2. REINFORCING BARS SHALL BE DEFORMED AND TIED TOGETHER.
3. TRENCH BOTTOM WIDTH IN VICINITY OF THRUST BLOCK INSTALLATION SHALL BE THE MINIMUM WIDTH AS SHOWN ON DETAIL S-4 & S-5.
4. BACKFILL TAMPED IN 6" LIFTS, SEE DETAIL S-4 & S-5.
5. THRUST COLLAR MUST BE FACTORY WELDED ON BOTH SIDES ALONG BOTH EDGES OF COLLAR AROUND CIRCUMFERENCE.
6. IN LIEU OF WELDED RING, FRICTION RESTRAINING GLANDS ARE PERMITTED.

CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	RESTRAINING COLLAR DESIGN DATA FOR SEWER FORCE MAIN	
	S-6	



REINFORCING REQUIREMENTS

I.D. PIPE	REBAR SIZE	"X" BAR LENGTH	"X" BAR WEIGHT	"Y" BAR LENGTH	"Y" BAR WEIGHT	NO. REQUIRED
6"-36"	#5	2'-2" + O.D. PIPE	1.043 LBS/FT	1'-1"	1.1 LBS. EACH	X-24 Y-12
≥48"	#6	3'-0" + O.D. PIPE	1.502 LBS/FT	1'-3"	1.9 LBS. EACH	X-24 Y-12

THRUST COLLAR, AND THRUST SCHEDULE

I.D. PIPE	"A"	"B"	"C"	"D"
6"-16"	1'-4"	1'-7"	2"	3/8"
20"-24"	1'-4"	1'-7"	3"	1/2"
30"-36"	1'-4"	1'-7"	4"	5/8"
≥48"	1'-8"	1'-9"	6"	7/8"

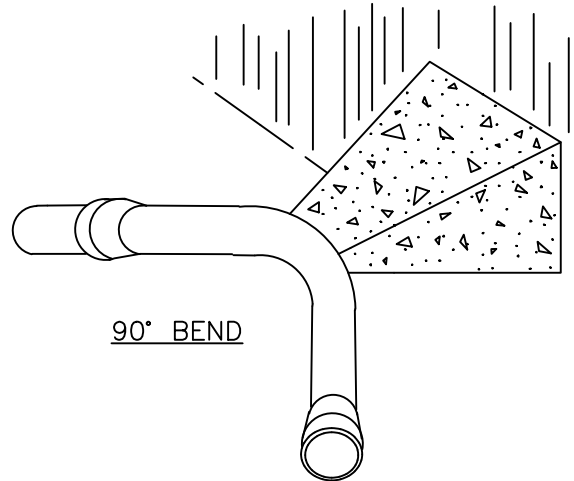
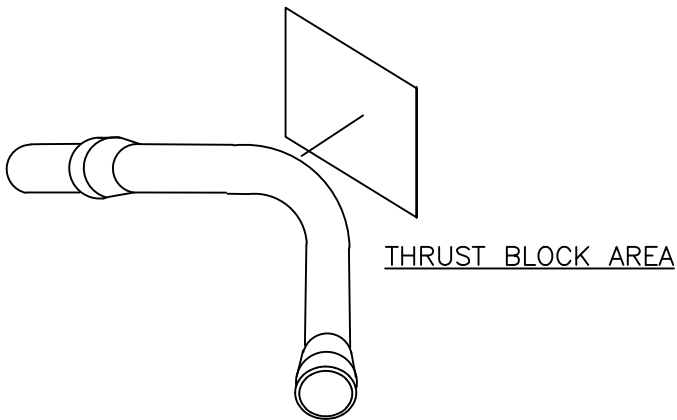
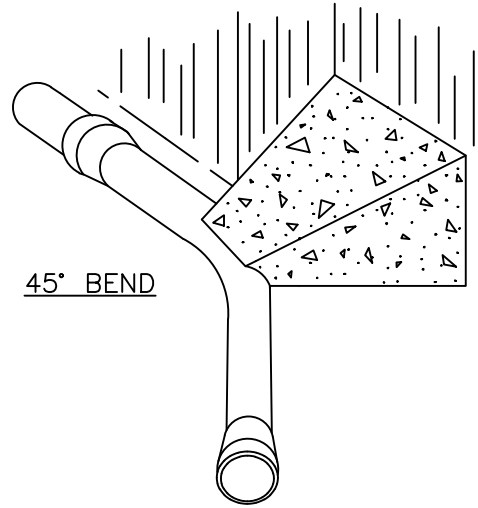
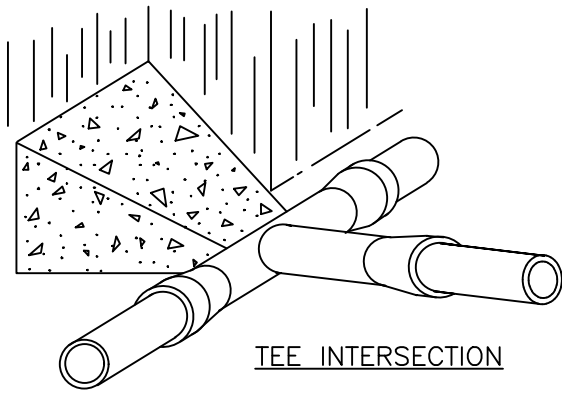
NOTES:

1. CONCRETE SHALL BE 3,000 PSI AND TRANSIT MIXED.
2. REINFORCING BARS SHALL BE DEFORMED AND TIED TOGETHER.
3. TRENCH BOTTOM WIDTH IN VICINITY OF THRUST BLOCK INSTALLATION SHALL BE THE MINIMUM WIDTH AS SHOWN ON DETAIL S-5.
4. BACKFILL TAMPED IN 6" LIFTS, SEE DETAIL S-4 & S-5.
5. MECHANICAL RESTRAINING COLLAR SHALL BE AS MANUFACTURED BY MEGA-LUG OR EQUAL.

CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	RESTRAINING COLLAR DESIGN DATA FOR PVC FORCE MAINS	
	S-6A	

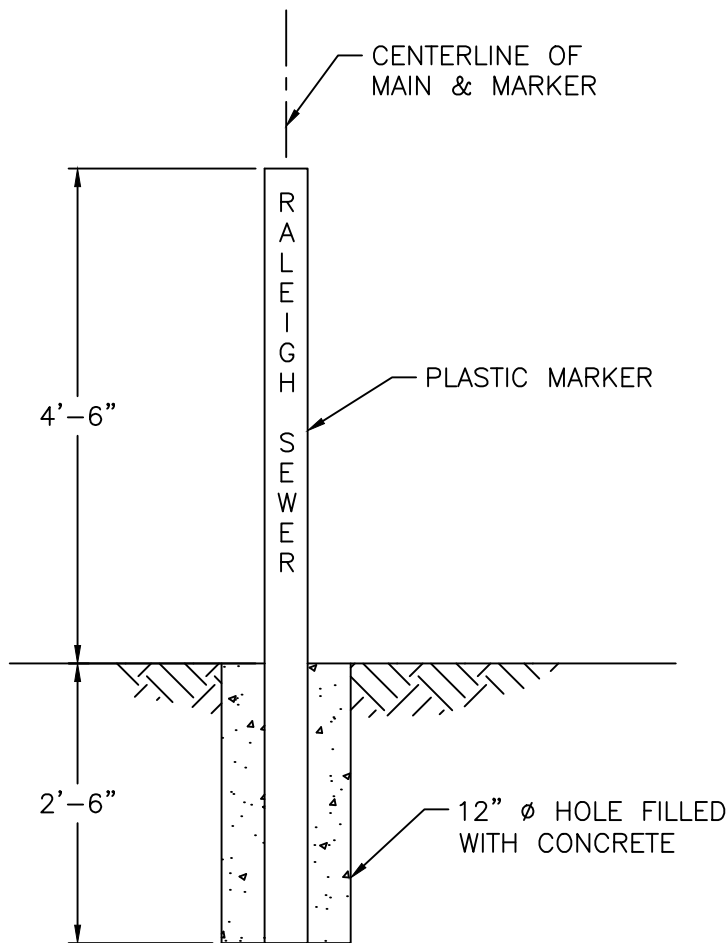
THRUST BLOCKING



NOTES:

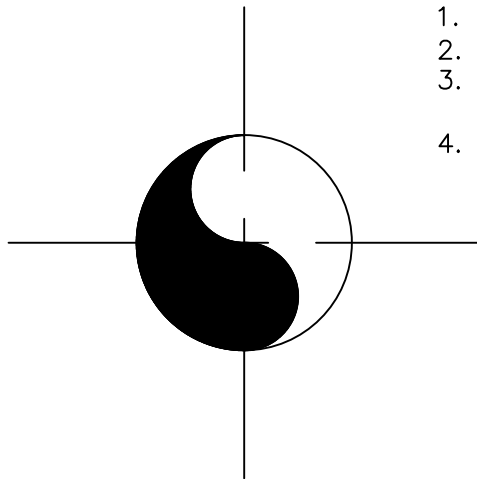
1. CONCRETE SHALL BE 3,000 PSI.
2. CONCRETE SHALL NOT CONTACT BOLTS OR ENDS OF MECHANICAL JOINT FITTINGS.
3. TRENCHES SHALL CONFORM TO DETAIL S-4 & S-5.
4. SEE DETAIL W-10 & W-11 (THRUST BLOCK TABLES) FOR AREA OF CONCRETE REQUIRED.
5. ALL BENDS AND INTERSECTIONS SHALL HAVE CONCRETE THRUST BLOCKING.

<h1 style="text-align: center;">CITY OF RALEIGH</h1> <h2 style="text-align: center;">STANDARD DETAIL</h2>		
REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	<h1 style="text-align: center;">THRUST BLOCKING VIEWS</h1>	
	<h1 style="text-align: center;">S-7</h1>	



NOTES:

1. PLASTIC MARKER SHALL BE GREEN IN COLOR.
2. MARKERS SHALL BE LABELED "RALEIGH SEWER".
3. TO BE SPACED EVERY 300 FEET ON EACH SIDE OF ANY ROADWAY OR JUNCTION.
4. MARKERS SHALL BE ROUND, 4" IN DIAMETER.



SEWER FORCE MAIN

CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	MAIN MARKER FOR SEWER FORCE MAINS IN EASEMENTS	
	S-8	

AERIAL PIPE CROSSING GENERAL NOTES:

1. ALL MATERIALS UTILIZED ON THESE DETAIL SHEETS SHALL CONFORM TO THE APPROPRIATE SECTIONS OF THE CITY OF RALEIGH PUBLIC UTILITIES HANDBOOK UNLESS NOTED OTHERWISE HEREIN.

2. RESTRAINED JOINT PIPE AND FITTINGS SHALL CONSIST OF BOLTED RETAINER RINGS AND WELDED RETAINER BARS OR BOLTLESS TYPE WHICH INCLUDE DUCTILE IRON LOCKING SEGMENTS AND RUBBER RETAINERS. BOLTS FOR RESTRAINED JOINTS (IF APPLICABLE) SHALL CONFORM TO ANSI B18.2. RESTRAINED PIPE AND FITTINGS SHALL BE FLEX-RING OR LOK-RING TYPE JOINTS AS MANUFACTURED BY AMERICAN CAST IRON PIPE CO.; TR FLEX AS MANUFACTURED BY US PIPE, SUPER-LOCK AS MANUFACTURED BY CLOW, BOLT-LOK OR SNAP-LOK AS MANUFACTURED BY GRIFFIN PIPE PRODUCTS, OR EQUAL.

3. CONCRETE PROPERTIES SHALL BE AS FOLLOWS:

A. CONCRETE COMPRESSIVE STRENGTH = 4,000 PSI

B. NOMINAL SLUMP = 4 INCHES

C. WATER/CEMENTITIOUS MATERIALS RATIO = 0.45 (MAX)

D. AIR CONTENT = 6% * 1.5%

CONCRETE SHALL BE COMPOSED OF CEMENT, WATER, COARSE AGGREGATES, FINE AGGREGATES AND AIR. CEMENT SHALL BE TYPE I/II OR II IN ACCORDANCE WITH ASTM C-150. MATERIAL REQUIREMENTS FOR ALL FINE AND COARSE AGGREGATES SHALL CONFORM TO ASTM C-33. COARSE AGGREGATE SHALL BE SIZE No. 57 OR 67. AN APPROVED CLASS 'F' FLYASH MAY BE SUBSTITUTED FOR AN EQUAL AMOUNT OF CEMENT BY WEIGHT UP TO 25%.

4. ALL EXPOSED CONCRETE CORNERS SHALL BE CHAMFERED $\frac{3}{4}$ ".

5. CONVENTIONAL REINFORCING STEEL SHALL CONFORM TO ASTM A615 GRADE 60 AND SHALL BE PLACED IN ACCORDANCE WITH "RECOMMENDED PRACTICE FOR PLACING REINFORCING BARS" (LATEST EDITION) AS PUBLISHED BY THE CONCRETE REINFORCING INSTITUTE. SPLICES SHALL BE CLASS 'B' CONFORMING TO THE PROVISIONS OF ACI 318 - "BUILDING CODE REQUIREMENTS FOR STRUCTURAL CONCRETE".

6. NEOPRENE BEARING PADS SHALL BE FORMED FROM PREVIOUSLY UNVULCANIZED, 100% VIRGIN NEOPRENE, WITH DUROMETER HARDNESS = 50.

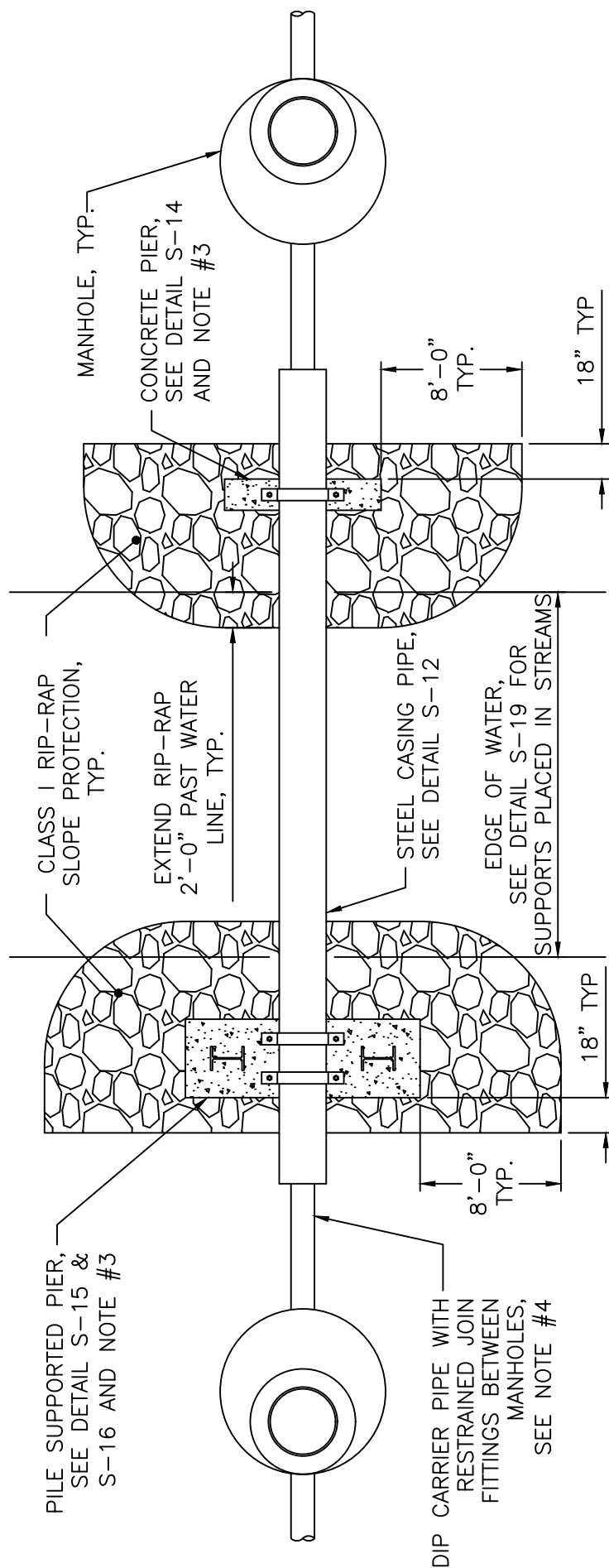
7. PILES SHALL BE STRUCTURAL STEEL HP12x53 PILES AND SHALL CONFORM TO THE REQUIREMENTS OF ASTM A36. PILES SHALL BE DRIVEN TO DEPTHS REQUIRED TO OBTAIN AN ULTIMATE BEARING CAPACITY OF NOT LESS THAN TWO TIMES THE DESIGN LOADING OF 30 TONS. PILES SHALL PENETRATE A MINIMUM OF FIFTEEN FEET INTO UNDISTURBED SOIL. IN DRIVING PILES, A METHOD APPROVED BY THE ENGINEER SHALL BE USED WHEREBY THE HEAD OF THE PILE IS NOT DAMAGED. IF REQUESTED BY THE ENGINEER, PILES SHALL BE TESTED TO DETERMINE THE ULTIMATE CAPACITY OF THE PILES. THE METHOD OF LOAD TESTING SHALL CONFORM TO ASTM D1143 AND THE NORTH CAROLINA STATE BUILDING CODE. WHERE PILES ARE EXPOSED, PILES SHALL BE PAINTED AND/OR COATED IN ACCORDANCE WITH THE CITY SPECIFICATIONS.

CITY OF RALEIGH
STANDARD DETAIL

REVISIONS DATE: 05/24/2024 NOT TO SCALE

AERIAL PIPE CROSSING
GENERAL NOTES

S-10

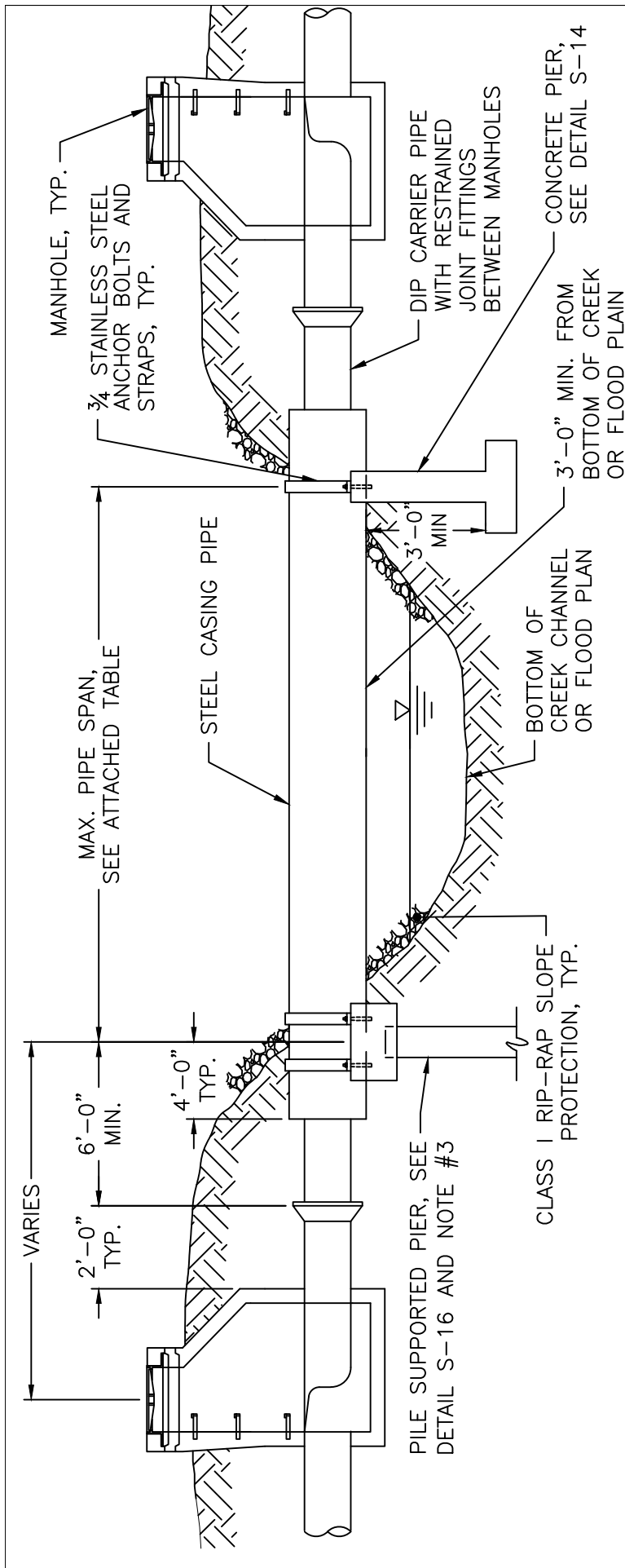


NOTES:

1. RIP-RAP FOR SLOPE PROTECTION SHALL BE CLASS I RIP-RAP IN ACCORDANCE WITH SECTION 876 OF THE NORTH CAROLINA DEPARTMENT OF TRANSPORTATION'S "STANDARD SPECIFICATIONS FOR ROADS AND STRUCTURES".
2. RIP-RAP SHALL BE PLACED IN ACCORDANCE WITH DRAWING 876.01 OF THE NORTH CAROLINA DEPARTMENT OF TRANSPORTATION'S "ROADWAY STANDARD DRAWINGS".
3. SUPPORT TYPE FOR PIERS SHALL BE DETERMINED BY ENGINEER BASED ON SUBGRADE CONDITIONS AT SITE. SEE DETAIL S-14 FOR SUBGRADE PARAMETERS FOR EACH TYPE OF FOUNDATION.
4. WHERE DUCTILE IRON PIPE IS USED FOR CARRIER PIPE, DUCTILE IRON CARRIER PIPE SHALL BE INSTALLED UTILIZING 2 PIPE ALIGNMENT GUIDES PER JOINT ONE FOURTH OF THE PIPE JOINT LENGTH IN FROM BOTH THE BELL AND SPIGOT ENDS.

CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	AERIAL PIPE CROSSING TYPICAL PLAN	
	S-11	



ALLOWABLE SPANS FOR STEEL CASING PIPE

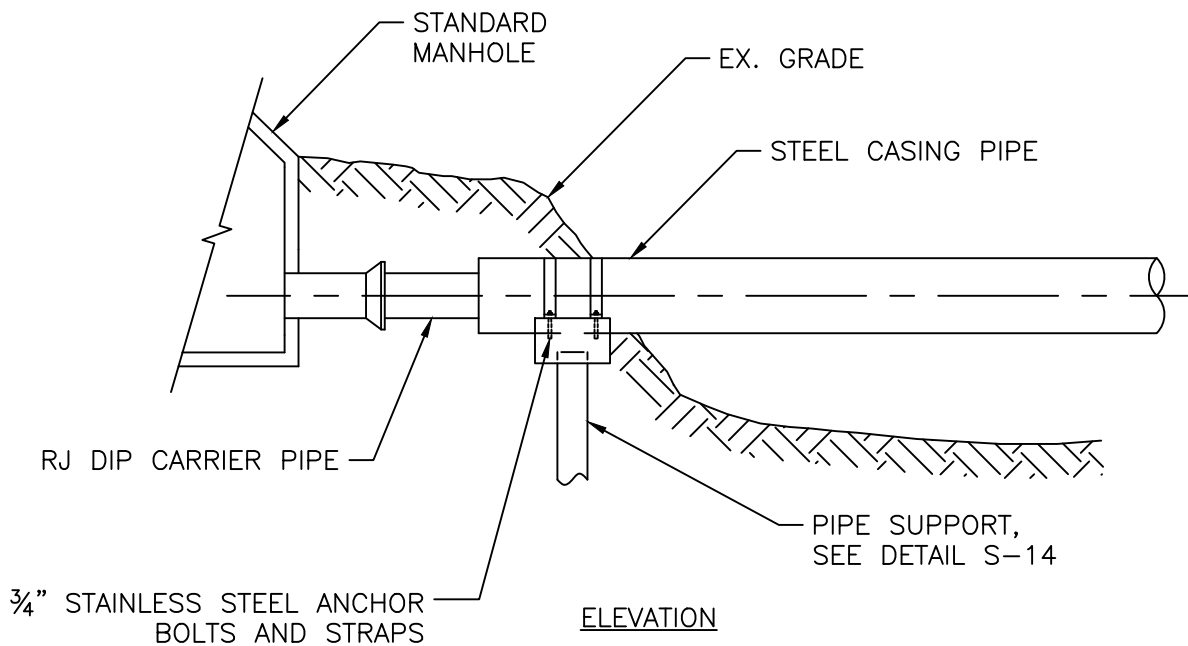
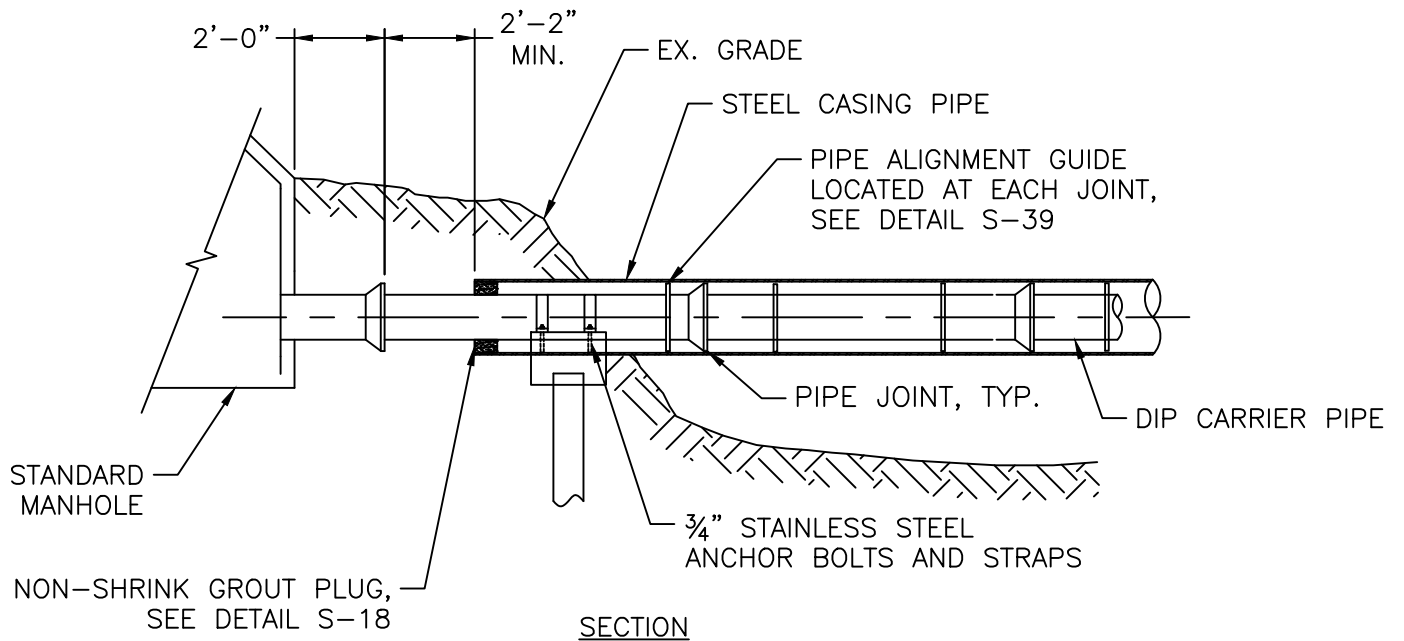
CARRIER PIPE, DIP DIAMETER (IN.)	CASING PIPE, STEEL DIAMETER (IN.)	MIN. CASING PIPE WALL THICKNESS (IN.)	ALLOWABLE SPAN (FT.)
6	14	0.3750	40
8	16	0.3750	45
10	18	0.3750	50
12	20	0.3750	50
14	24	0.3750	55
16	26	0.3750	55
18	30	0.3750	60
20	32	0.3750	60
24	36	0.4375	65
30	42	0.4375	65
36	48	0.5000	65
42	56	0.5000	65

NOTES:

- STEEL PIPE SHALL BE EITHER SPIRAL WELDED OR SMOOTH WALL SEAMLESS WITH A MINIMUM YIELD STRENGTH OF 35,000 PSI. PAINTING AND LINING SHALL BE AS REQUIRED BY THE CITY OF RALEIGH PUBLIC UTILITIES HANDBOOK.
- DUCTILE IRON PIPE SHALL BE SUPPORTED WITH TWO SPIDERS AT EVERY JOINT WITHIN THE CASING PIPE USING APPROVED PIPE ALIGNMENT GUIDE. SEE DETAIL S-39. ALL JOINTS SHALL BE RESTRAINED JOINT. SEE NOTE #2 ON DETAIL S-10.
- SUPPORT TYPE FOR PIERS SHALL BE DETERMINED BY ENGINEER BASED ON SUBGRADE CONDITIONS AT SITE. SEE DETAIL S-14 FOR SUBGRADE PARAMETERS FOR EACH TYPE OF FOUNDATION. SEE DETAIL S-19 FOR SUPPORTS PLACED WITHIN STREAM.
- BOTTOM OF PIPE TO BE AT A MINIMUM OF 1' ABOVE THE 25 YEAR FLOOD ELEVATION.

CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	AERIAL PIPE CROSSING STEEL CASING PIPE ELEVATION	
	S-12	

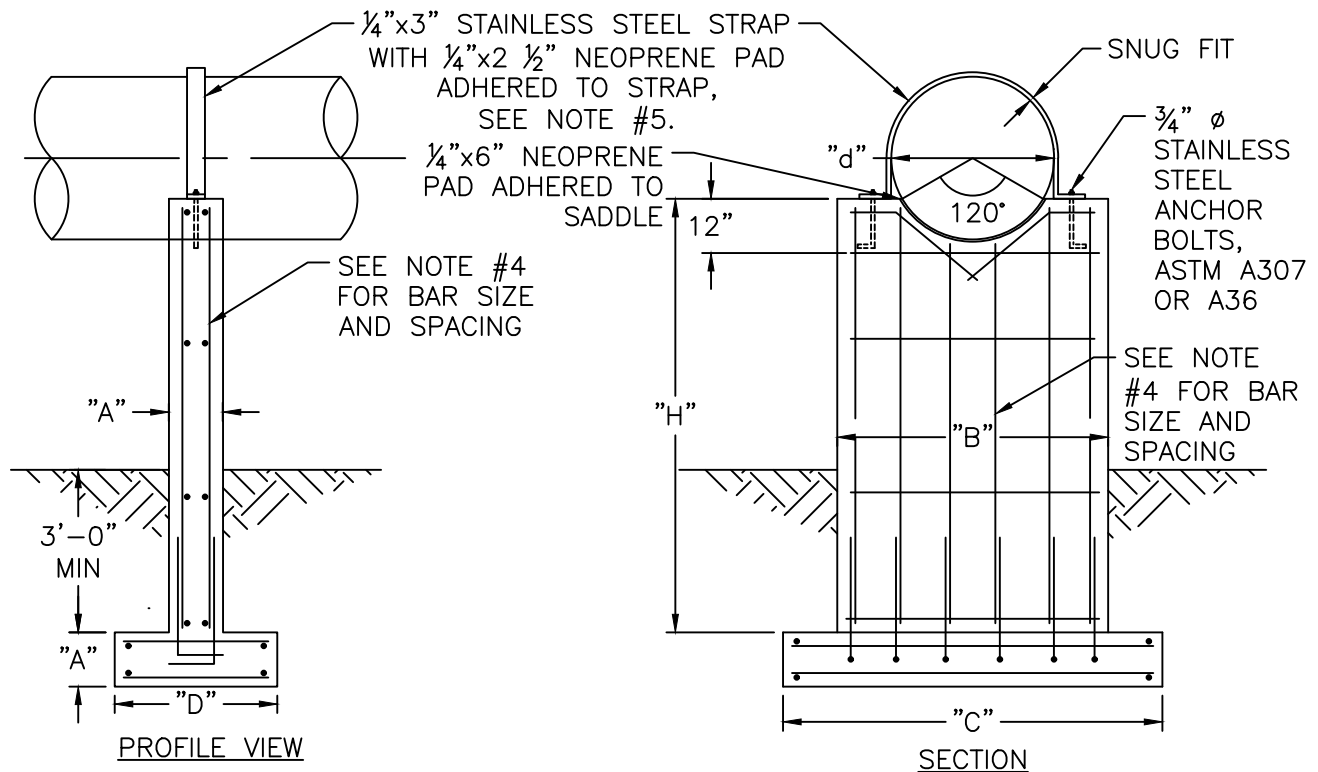


CITY OF RALEIGH
STANDARD DETAIL

REVISIONS DATE: 05/24/2024 NOT TO SCALE

AERIAL PIPE CROSSING
TYPICAL PIPE SECTION
AND ELEVATION

S-13



CASING PIPE DIA. "d" (IN.)	"H" (FT.)	THICKNESS "A" (IN.)	PIER WIDTH "B"	FOOTING LENGTH "C"	FOOTING WIDTH "D"
6-12	≤ 6	12	2'-4"	5'-6"	3'-0"
	8	12		6'-3"	
	10	12		6'-8"	
	12	12		7'-2"	
	12	12		7'-2"	
14-20	≤ 6	12	3'-0"	8'-0"	3'-0"
	8	12		9'-0"	
	10	12		9'-10"	
	12	14		10'-6"	
22-28	≤ 6	14	3'-8"	8'-9"	4'-0"
	8	14		10'-0"	
	10	14		11'-0"	
	12	14		11'-10"	
30-36	≤ 6	18	4'-4"	9'-0"	4'-0"
	8	18		10'-6"	
	10	18		11'-6"	
	12	18		12'-4"	
38-48	≤ 6	18	5'-4"	9'-6"	5'-0"
	8	18		11'-0"	
	10	18		12'-0"	
	12	18		12'-10"	
51-56	≤ 6	18	6'-4"	9'-10"	5'-0"
	8	18		11'-4"	
	10	18		12'-4"	
	12	18		13'-2"	

NOTES:

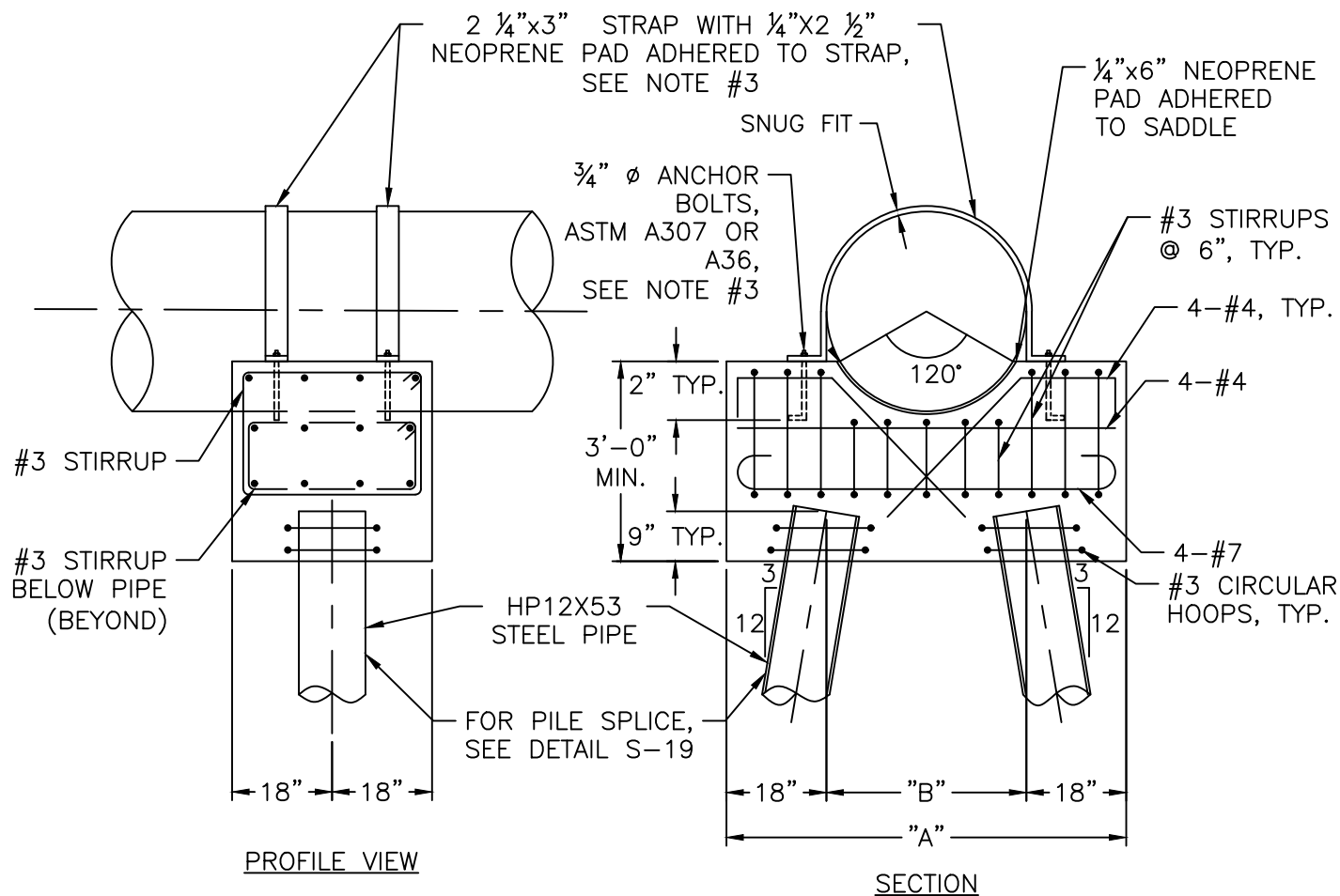
- SHALLOW FOUNDATION DESIGN SHOWN THIS DETAIL IS BASED ON THE FOLLOWING PARAMETERS:
 - ALLOWABLE SOIL BEARING CAPACITY = 2,000 PSF
 - CONCRETE COMPRESSIVE STRENGTH = 4,000 PSI
 - GRADE 60 REINFORCING STEEL
 - MAX. STREAM VELOCITY = 10 FT/SEC
 - MAX. SUPPORT HEIGHT (H) = 12'-0"
 IF FIELD CONDITIONS REQUIRE ANY DEVIATION FROM THESE PARAMETERS, THE FOUNDATION DESIGN SHALL BE REVIEWED BY THE ENGINEER.
- IF SUBGRADE AT LOCATION OF SUPPORTS IS DEEMED UNABLE TO WITHSTAND 2,000 PSF BEARING PRESSURE, A PILE SUPPORTED FOUNDATION SHALL BE UTILIZED AS PER DETAIL S-15.
- IF BEDROCK IS ENCOUNTERED WHICH WILL PREVENT 3- FEET MIN. COVER OVER FOOTING, DOWELS SHALL BE DRILLED INTO BEDROCK PRIOR TO PLACING FOUNDATION, SEE DETAIL S-17.
- TWELVE-INCH AND FOURTEEN-INCH THICK PIERS AND FOOTINGS SHALL BE REINFORCED WITH #5 BARS AT 12 INCHES O.C. IN EACH DIRECTION ON EACH FACE. EIGHTEEN-INCH WIDE PIERS AND FOOTINGS SHALL BE REINFORCED WITH #7 BARS AT 12 INCHES O.C. IN EACH DIRECTION ON EACH FACE.
- EIGHTEEN-INCH THICK PIERS SHALL REQUIRE TWO STRAPS OVER THE PIPE INSTEAD OF ONE (AS SHOWN).
- WHEN CONCRETE SUPPORTS ARE REQUIRED TO BE LOCATED WITHIN A STREAM AND ARE NOT COVERED WITH BLACKFILL, SEE DETAIL S-19 FOR MODIFICATIONS TO UPSTREAM FACE SUPPORT.

CITY OF RALEIGH STANDARD DETAIL

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
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AERIAL PIPE CROSSING
CONCRETE PIER DETAIL

S-14



WIDTH OF PILE CAP

CASING PIPE DIAMETER (IN.)	TOTAL WIDTH "A"	PILE SPACING "B"
≤ 36	6'-0"	3'-0"
38-42	6'-6"	3'-6"
45-51	7'-3"	4'-3"
54-60	8'-0"	5'-0"

NOTES:

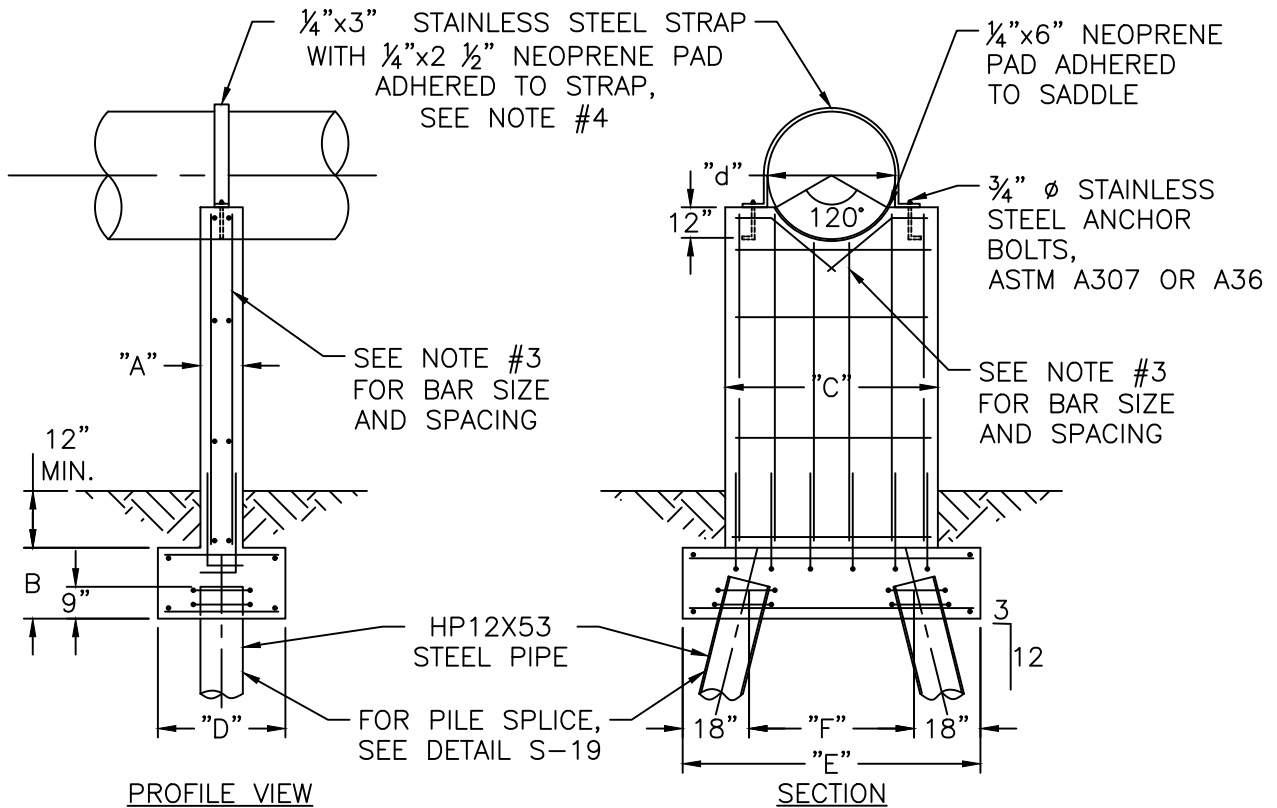
- PILE SUPPORTED FOUNDATION DESIGN SHOWN ON THIS DETAIL IS BASED UPON THE FOLLOWING PARAMETERS:
 - MINIMUM CAPACITY OF HP12x53 PILE = 30 TONS
 - CONCRETE COMPRESSIVE STRENGTH = 4,000 PSI
 - GRADE 60 REINFORCING STEEL
 - MAXIMUM STREAM VELOCITY = 10 FT/SEC
 IF FIELD CONDITIONS REQUIRE ANY DEVIATION FROM THESE PARAMETERS, FOUNDATION DESIGN SHALL BE REVIEWED BY THE PROJECT ENGINEER.
- LENGTH OF PILES SHALL BE AS REQUIRED TO DEVELOP 30 TON CAPACITY BY EITHER END BEARING, FRICTION, OR A COMBINATION OF END BEARING AND FRICTION. AS A MINIMUM, PILES SHALL BE DRIVEN AT LEAST 15 FEET INTO UNDISTURBED SOIL.
- ANCHOR BOLTS AND STRAPS SHALL BE STAINLESS STEEL.

CITY OF RALEIGH
STANDARD DETAIL

REVISIONS DATE: 05/24/2024 NOT TO SCALE

AERIAL PIPE CROSSING
PIPE CAP DETAIL

S-15



CASING PIPE DIA. "d" (IN.)	PIER THICKNESS "A" (IN.)	FOOTING THICKNESS "B" (IN.)	PIER WIDTH "C"	FOOTING WIDTH "D"	FOOTING LENGTH "E"	PILE SPACING "F"
6-12	12	20	2'-4"	3'-0"	6'-0"	3'-0"
14-20	12	20	3'-0"	3'-0"	8'-0"	5'-0"
22-28	18	26	3'-8"	4'-0"	8'-9"	5'-9"
30-36	18	26	4'-4"	4'-0"	9'-0"	6'-0"
38-48	18	26	5'-4"	5'-0"	9'-6"	6'-6"
51-60	18	26	6'-4"	5'-0"	9'-10"	6'-10"

NOTES:

- PILE SUPPORTED PIER FOUNDATION DESIGN SHOWN ON THIS DETAIL IS BASED ON THE FOLLOWING PARAMETERS:

- MINIMUM CAPACITY OF HP12x53 PILE = 30 TONS
- CONCRETE COMPRESSIVE STRENGTH = 4,000 PSI
- GRADE 60 REINFORCING STEEL
- MAXIMUM STREAM VELOCITY = 10 FT/SEC

IF FIELD CONDITIONS REQUIRE ANY DEVIATION FROM THESE PARAMETERS, THE FOUNDATION DESIGN SHALL BE REVIEWED BY THE ENGINEER.

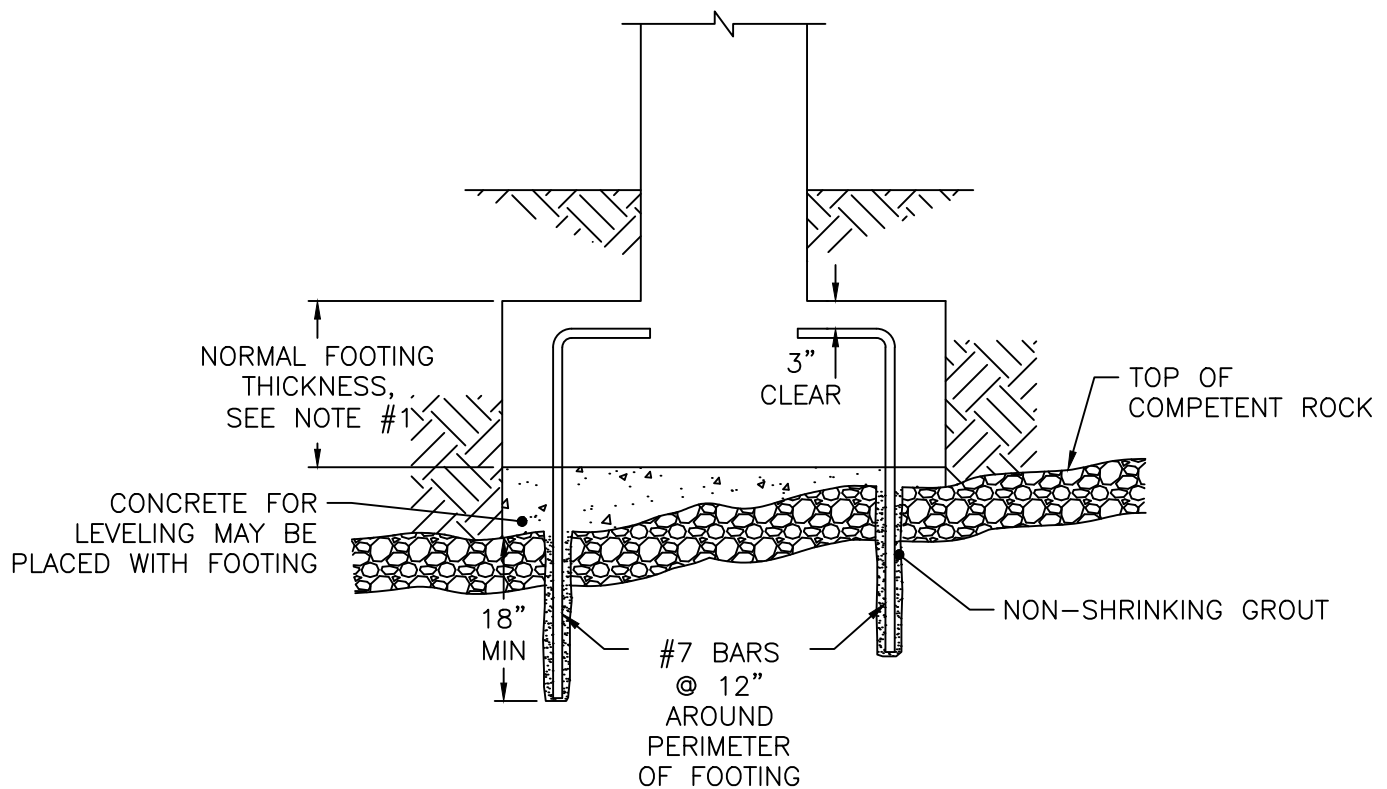
- LENGTH OF PILES SHALL BE AS REQUIRED TO DEVELOP 30 TON CAPACITY BY EITHER END BEARING, FRICTION OR A COMBINATION OF END BEARING AND FRICTION. AS A MINIMUM, PILES SHALL BE DRIVEN AT LEAST 15 FEET INTO UNDISTURBED SOIL.
- TWELVE-INCH AND FOURTEEN-INCH WIDE PIERS SHALL BE REINFORCED WITH #5 BARS AT 12 INCHES O.C. IN EACH DIRECTION ON EACH FACE. EIGHTEEN-INCH WIDE PIERS SHALL BE REINFORCED WITH #7 BARS AT 12 INCHES O.C. IN EACH DIRECTION ON EACH FACE. FOOTINGS SHALL BE REINFORCED TYPICALLY TO PIERS.
- EIGHTEEN-INCH WIDE PIERS SHALL REQUIRE TWO STRAPS OVER THE PIPE INSTEAD OF ONE (AS SHOWN).
- WHEN CONCRETE SUPPORTS ARE REQUIRED TO BE LOCATED WITHIN A STREAM AND ARE NOT COVERED WITH BACKFILL, SEE DETAIL S-19 FOR MODIFICATIONS TO UPSTREAM FACE OF SUPPORT.

CITY OF RALEIGH STANDARD DETAIL

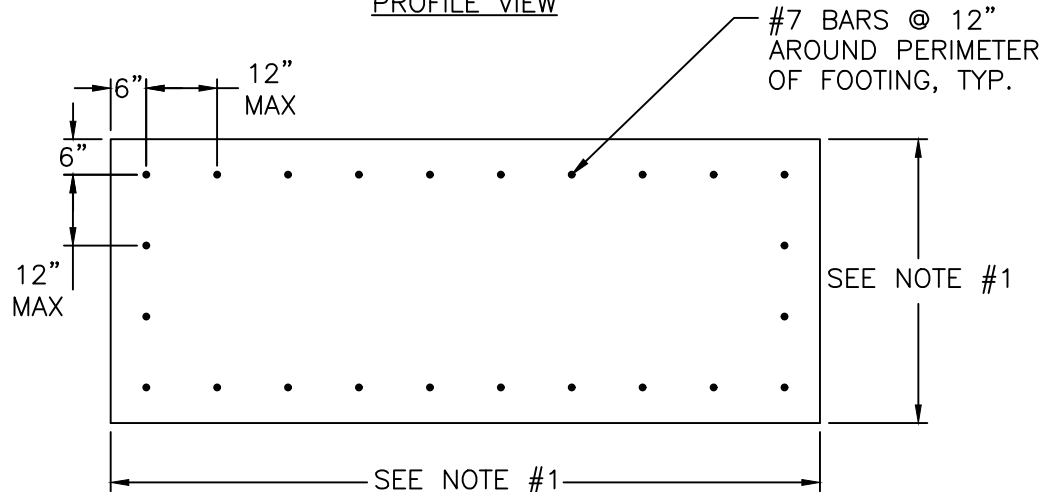
REVISIONS DATE: 05/24/2024 NOT TO SCALE

AERIAL PIPE CROSSING
PILE SUPPORTED
PIER DETAIL

S-16



PROFILE VIEW



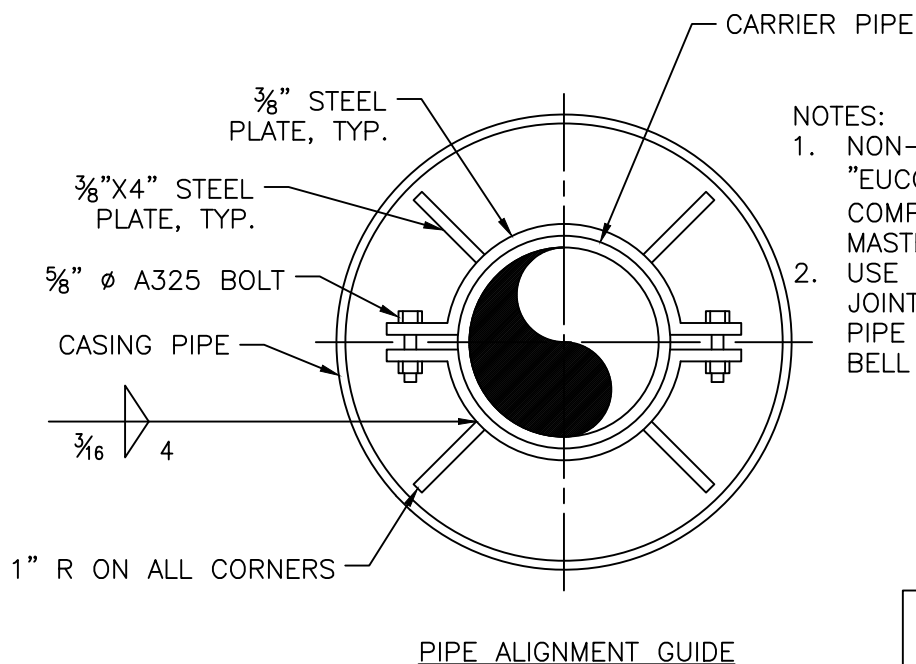
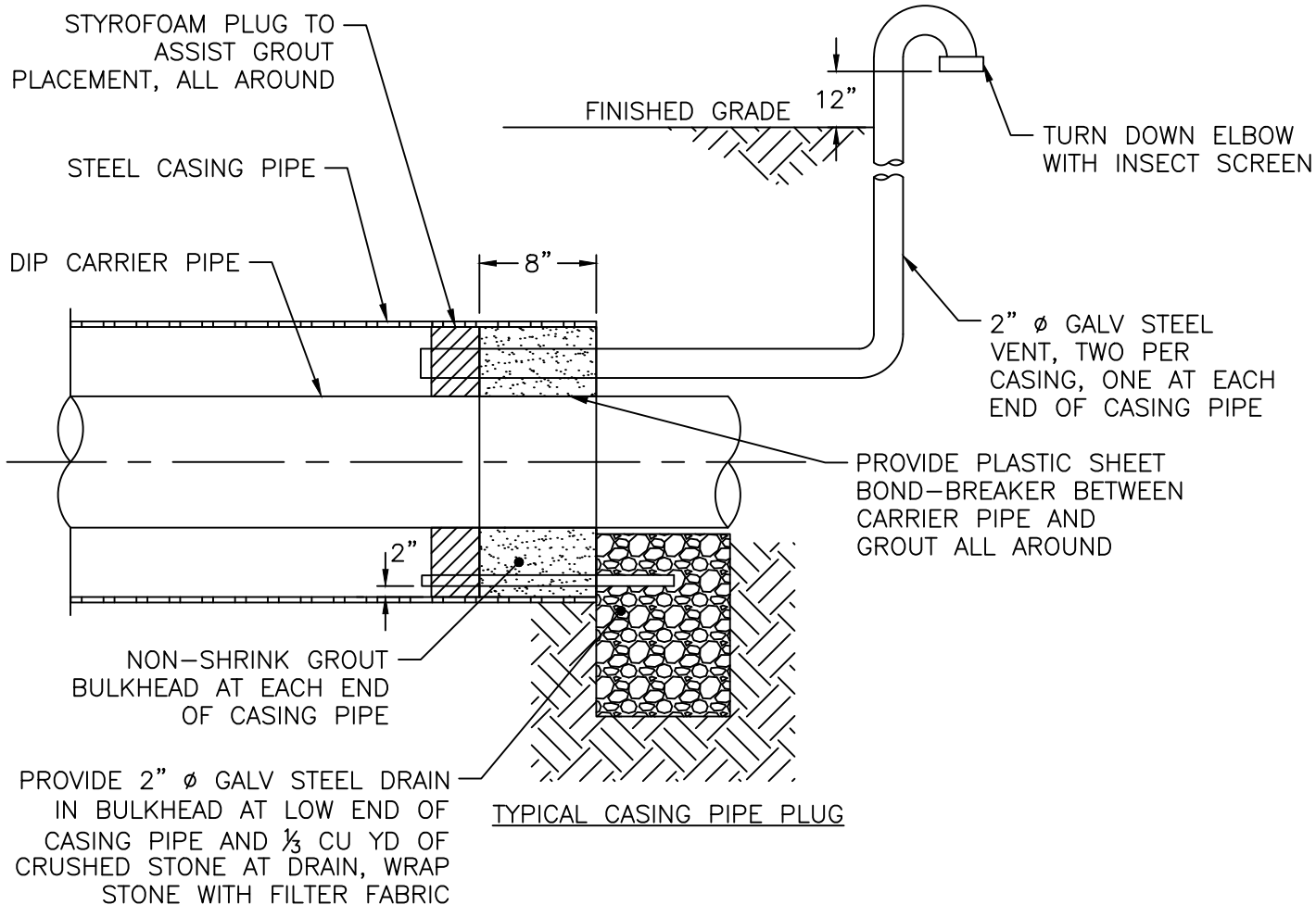
PLAN VIEW

NOTES:

1. GEOMETRY OF FOOTING SHALL MATCH GEOMETRY OF CONCRETE PIERS WITH HEIGHT OF 6 FEET OR LESS AS PER DETAIL S-14.
2. NON-SHRINK GROUT SHALL BE "EUCO-N-S" BY THE EUCLID CHEMICAL COMPANY; "MASTERFLOW 713" BY MASTER BULDERS, OR EQUAL.

CITY OF RALEIGH
STANDARD DETAIL

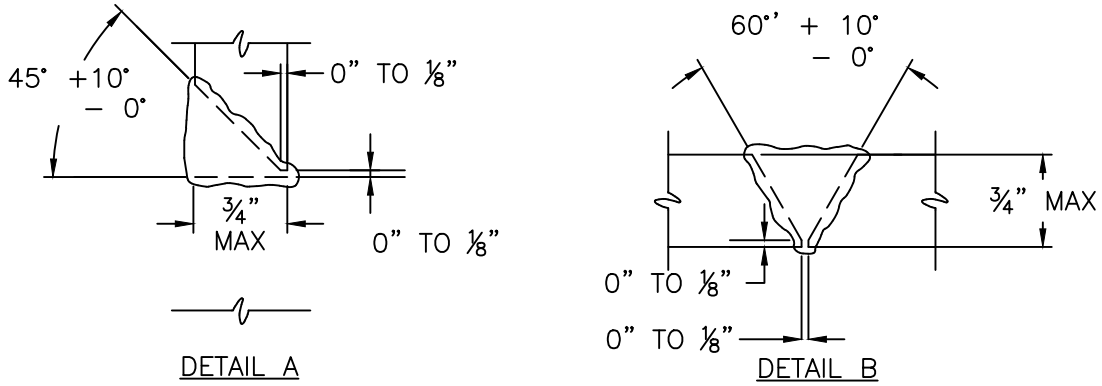
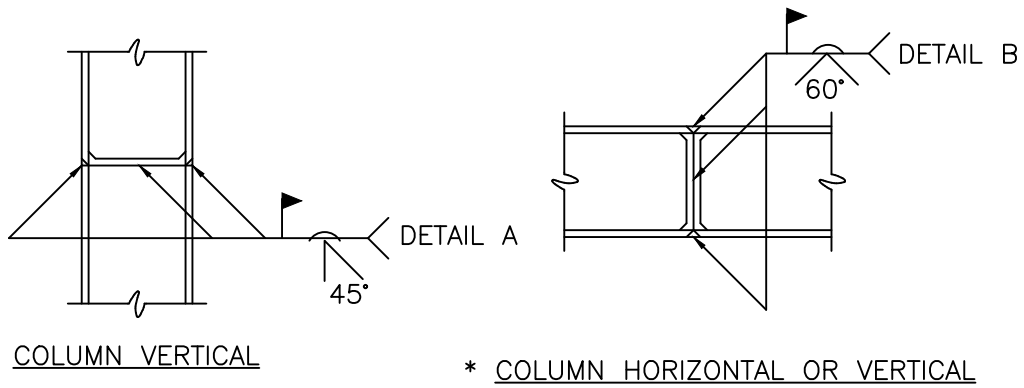
REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	AERIAL PIPE CROSSING CONCRETE PIER ON BEDROCK	
	S-17	



- NOTES:
1. NON-SHRINK GROUT SHALL BE "EUCO-N-S" BY THE EUCLID CHEMICAL COMPANY; "MASTERFLOW 713" BY MASTER BUILDERS, OR EQUAL.
 2. USE A MINIMUM OF 2 SPIDERS PER JOINT PLACED ONE FOURTH OF THE PIPE JOINT LENGTH IN FROM BOTH THE BELL AND SPIGOT.

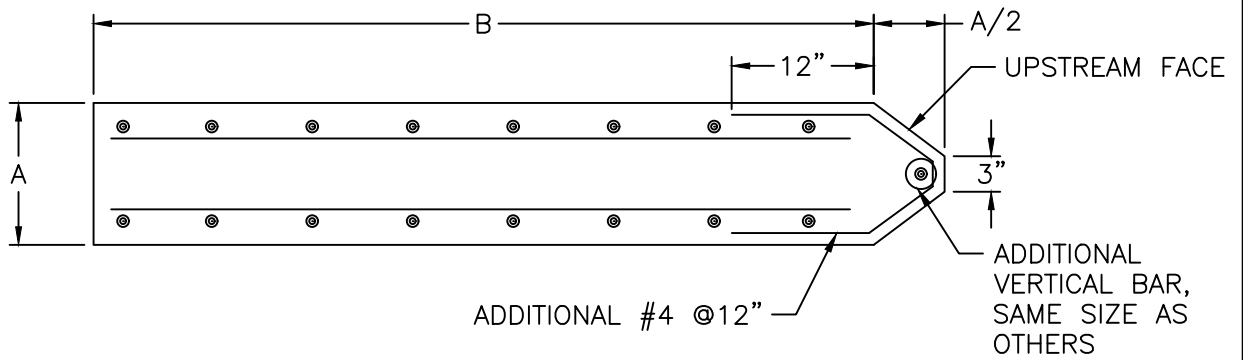
CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	AERIAL PIPE CROSSING CASING PIPE DETAILS	
	S-18	



* POSITION OF COLUMN DURING WELDING

STEEL PILE SPlice



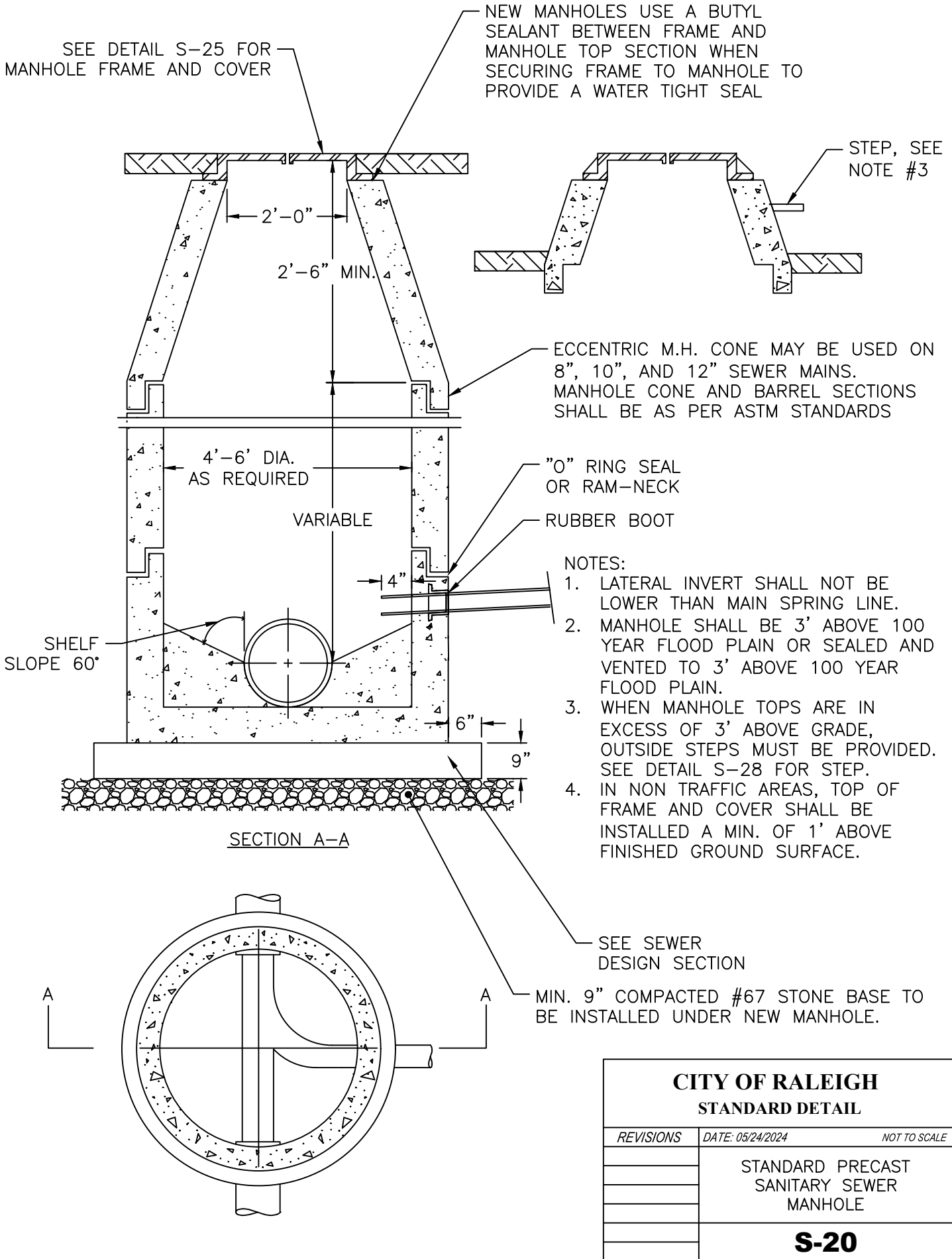
PLAN - CONCRETE SUPPORT NOSING
(WHEN EXPOSED TO STREAM FLOW)

CITY OF RALEIGH STANDARD DETAIL

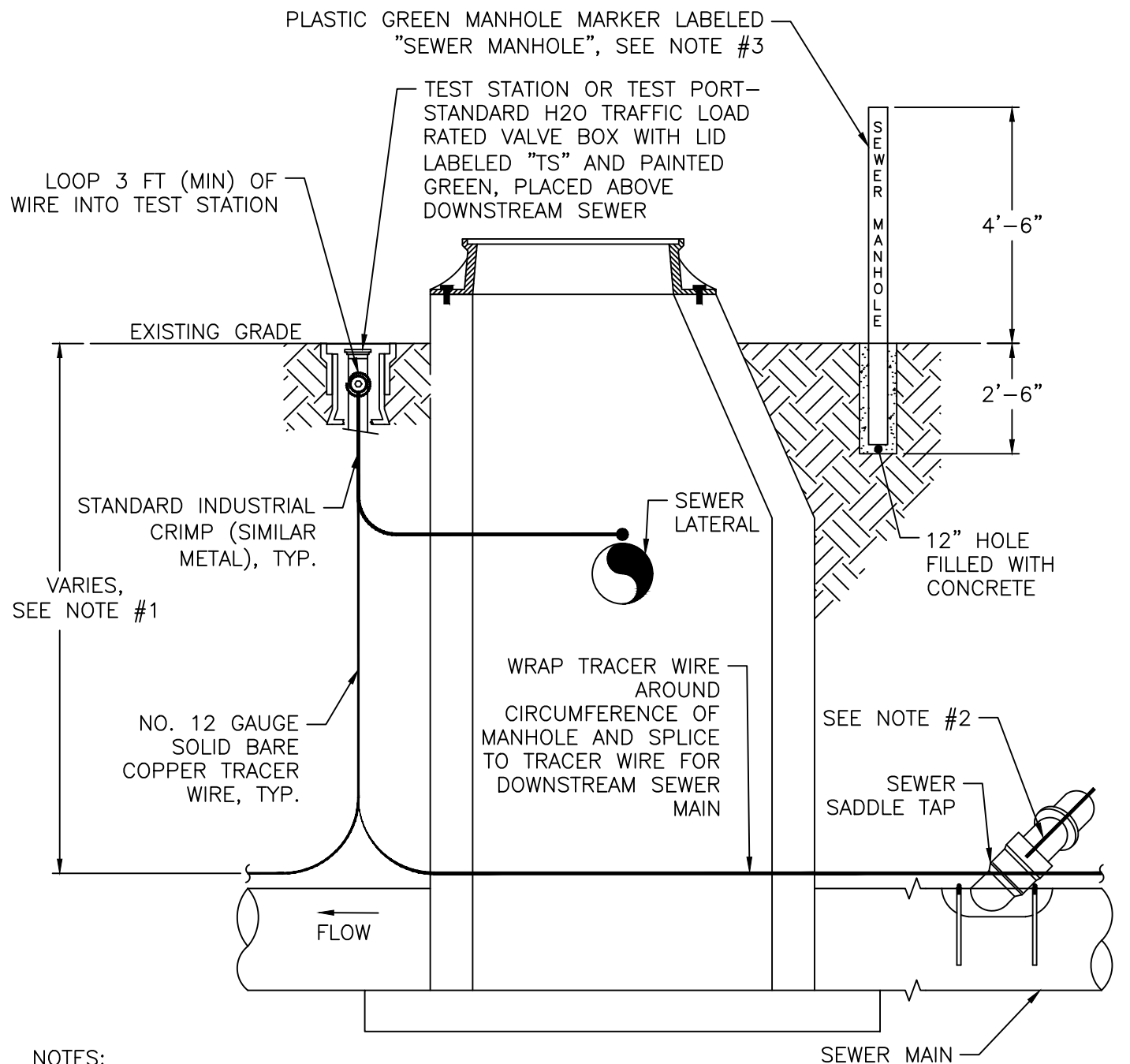
REVISIONS DATE: 05/24/2024 NOT TO SCALE

AERIAL PIPE
CROSSING CONCRETE
SUPPORT DETAILS

S-19



CITY OF RALEIGH		
STANDARD DETAIL		
REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	STANDARD PRECAST SANITARY SEWER MANHOLE	
	S-20	

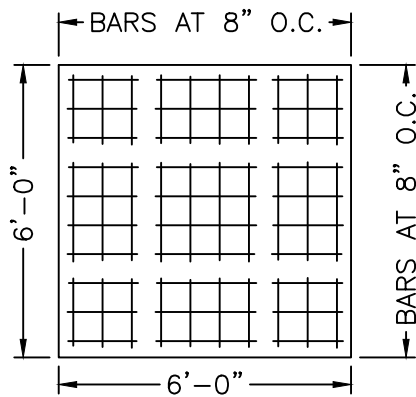


NOTES:

1. THE TRACER WIRE SHALL BE CONTINUOUS TO THE GREATEST EXTENT POSSIBLE. FOR GRAVITY MAIN AND OR LATERAL INSTALLATIONS LESS THAN 8 FT, THE TRACING WIRE SHALL BE ATTACHED TO THE PIPE. TRACER WIRE SHALL BE LAID FLAT AND SECURELY AFFIXED TO THE PIPE AT 10 FOOT INTERVALS. FOR GRAVITY MAIN AND OR LATERAL INSTALLATION DEEPER THAN 8 FT, THE TRACING WIRE SHALL BE INSTALLED AT A DEPTH OF 7-8 FT. THE WIRE SHALL BE PROTECTED FROM DAMAGE DURING THE EXECUTION OF THE WORK. NO BREAKS OF CUTS IN THE TRACER WIRE SHALL BE PERMITTED.
2. WHERE LATERAL TAPS ARE MADE BY SERVICE SADDLES, THE TRACER WIRE SHALL NOT BE ALLOWED TO TO BE PLACED BETWEEN THE SADDLE AND MAIN.
3. MANHOLE MARKERS SHALL BE PLACED ADJACENT TO MANHOLES AT THE DISCRETION OF OWNER OR OWNER'S REPRESENTATIVE.

CITY OF RALEIGH
STANDARD DETAIL

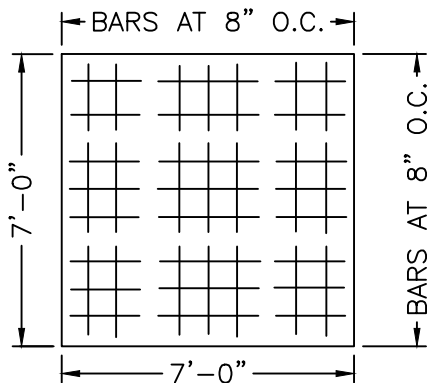
REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	GRAVITY SEWER MAIN TRACER WIRE AND MANHOLE MARKER	
	S-20A	



REINFORCED CONC. FOOTING
FOR 4' PRECAST MANHOLE

BILL OF MATERIAL FOR 4' MANHOLE BASE

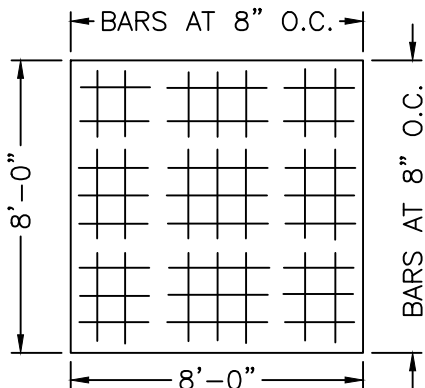
BAR SIZE	BAR LENGTH	NO. OF BARS	BAR WT. (LBS.)
#5	5'-6"	18	103
CL. "A" CONCRETE TOTAL CU. YDS.			1.0



REINFORCED CONC. FOOTING
FOR 5' PRECAST MANHOLE

BILL OF MATERIAL FOR 5' MANHOLE BASE

BAR SIZE	BAR LENGTH	NO. OF BARS	BAR WT. (LBS.)
#5	6'-6"	20	136
CL. "A" CONCRETE TOTAL CU. YDS.			1.4



REINFORCED CONC. FOOTING
FOR 6' PRECAST MANHOLE

BILL OF MATERIAL FOR 6' MANHOLE BASE

BAR SIZE	BAR LENGTH	NO. OF BARS	BAR WT. (LBS.)
#5	7'-6"	24	165
CL. "A" CONCRETE TOTAL CU. YDS.			1.8

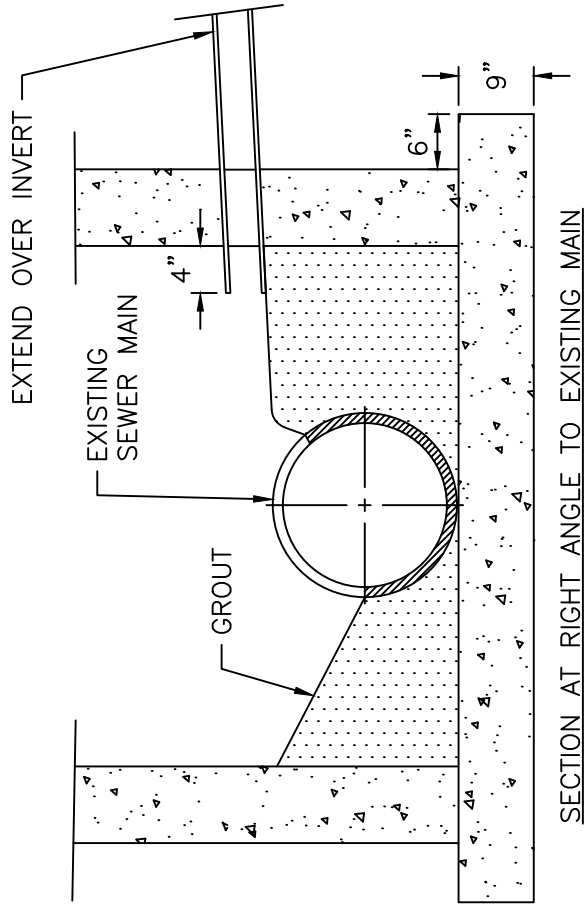
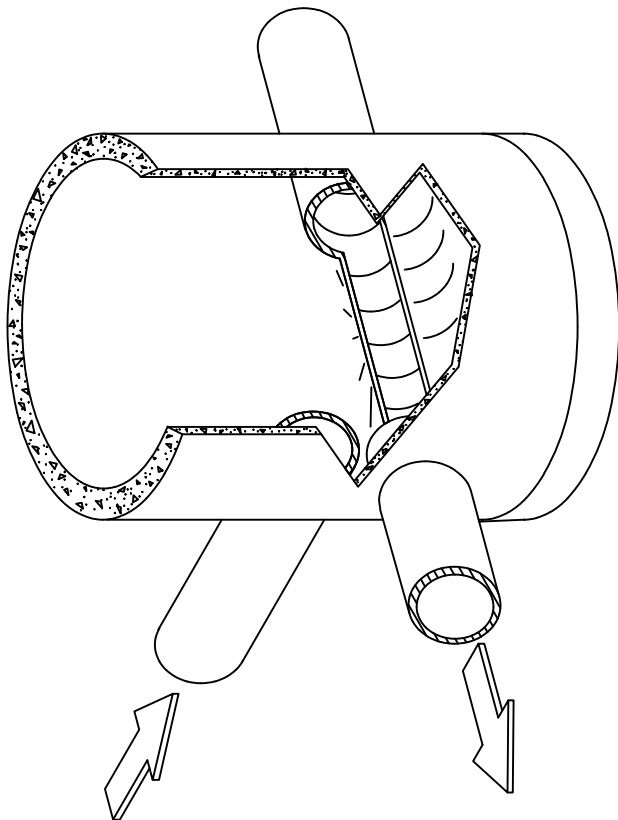
* ALL BASES ARE MINIMUM 9" THICK

CITY OF RALEIGH
STANDARD DETAIL

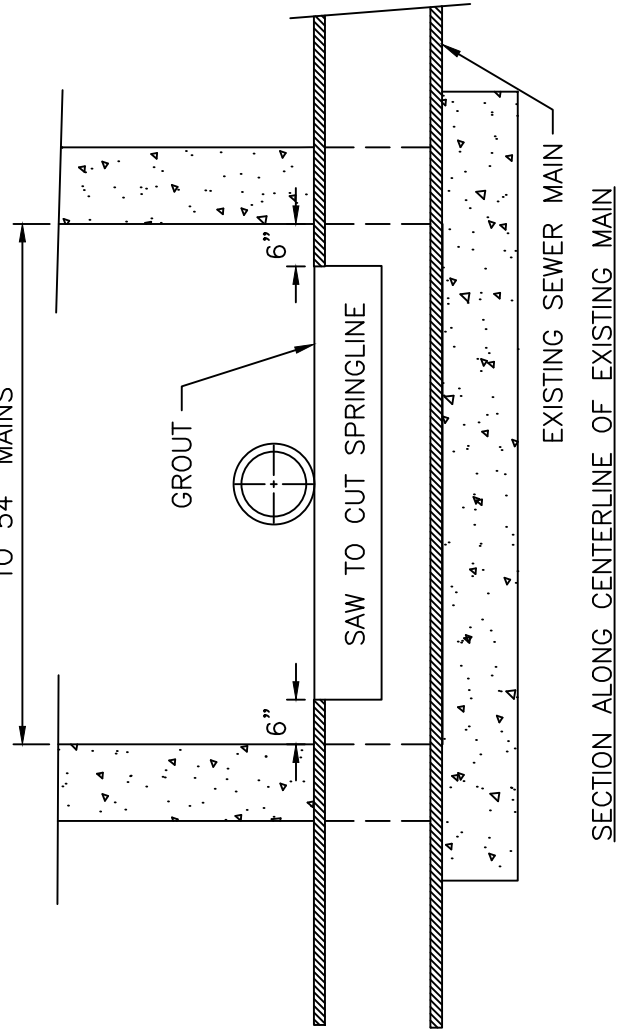
REVISIONS DATE: 05/24/2024 NOT TO SCALE

EXTENDED BASE OR
CAST-IN-PLACE REINFORCED
CONCRETE BASE

S-21



4'-0" FOR 8" TO 12"
MANS 5'-0" FOR 15" TO
30" MANS 6'-0" FOR 36"
TO 54" MANS



NOTES:

1. FLOW SHALL BE MAINTAINED DURING CONSTRUCTION.
2. THIS DETAIL TO BE USED WHEN A 6" OR LARGER LATERAL NECESSITATES CONSTRUCTION OF A NEW MANHOLE.
3. SEE DETAIL S-20 FOR PRECAST MANHOLES.
4. THE CONTRACTOR SHALL PROVIDE A MINIMUM 9" COMPACTED #67 STONE BASE.
5. FOR USE ON DIP, CONCRETE, AND PVC ONLY.
6. (NOT ALLOWED ON VCP) SEE DETAIL S-21 FOR REINFORCING OF POURED IN-PLACE BASE.

CITY OF RALEIGH STANDARD DETAIL

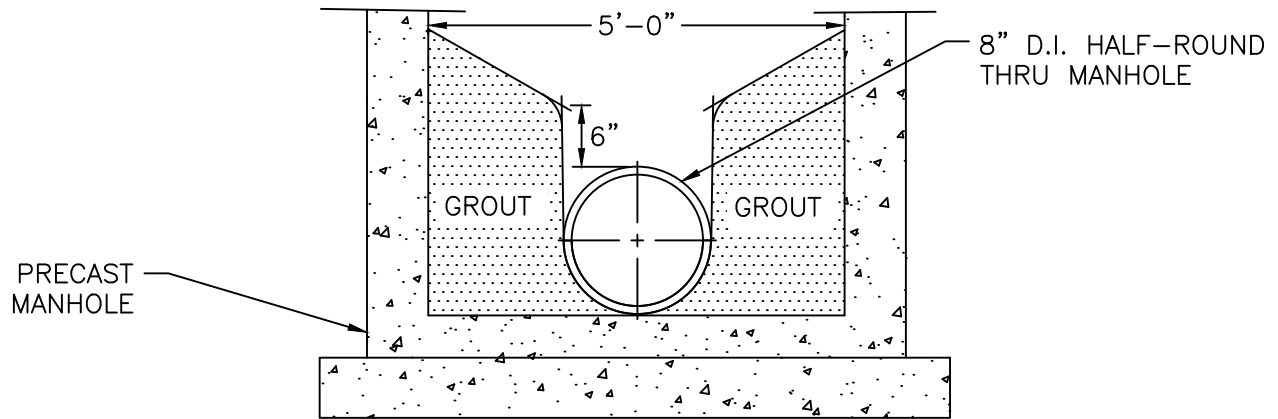
REVISIONS

DATE: 05/24/2024

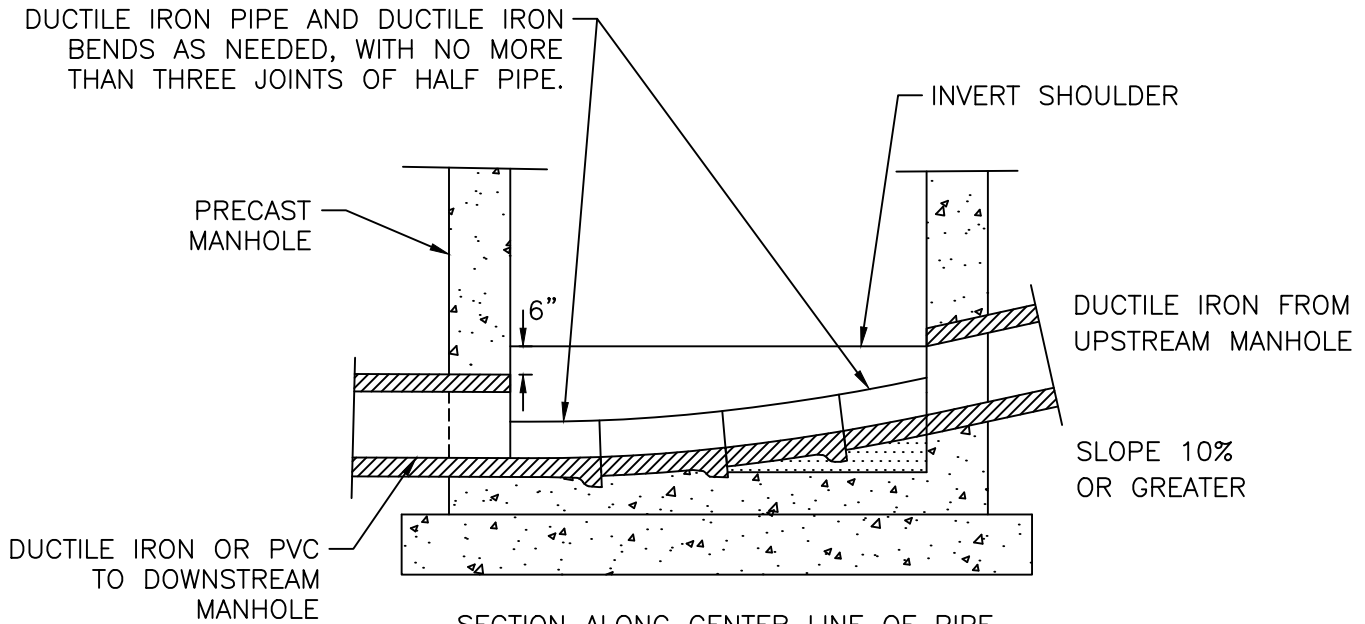
NOT TO SCALE

STANDARD MANHOLE
INSTALLATION OVER
EXISTING SEWER MAIN

S-22



SECTION AT RIGHT ANGLE TO CENTER LINE OF PIPE



SECTION ALONG CENTER LINE OF PIPE

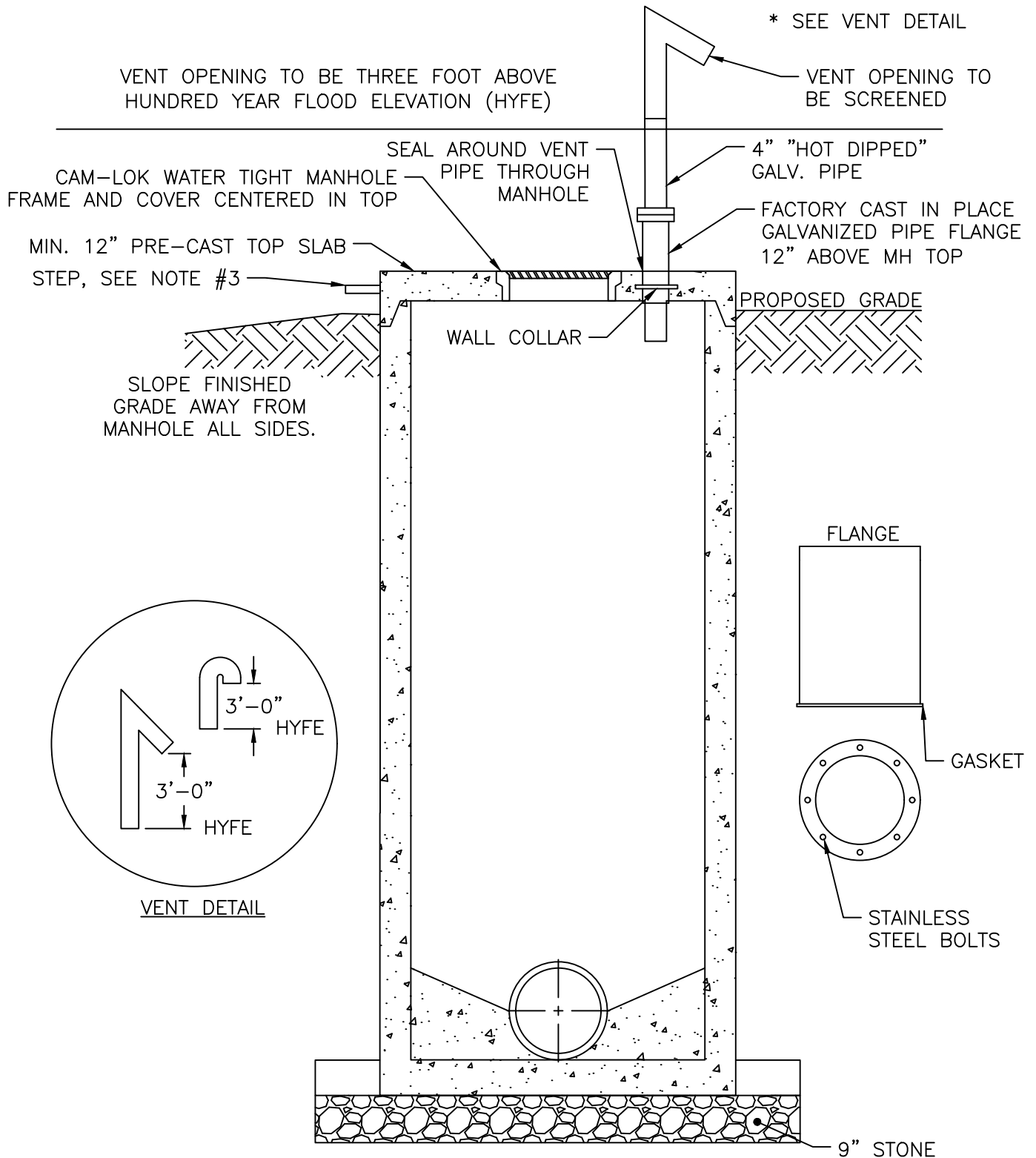
NOTE:
NO HORIZONTAL ALIGNMENT CHANGE
CAN BE MADE WITHIN THIS MANHOLE
TYPE. USE ON GRADES 10% OR GREATER.

CITY OF RALEIGH
STANDARD DETAIL

REVISIONS DATE: 05/24/2024 NOT TO SCALE

STANDARD HIGH VELOCITY
MANHOLE INVERT

S-23



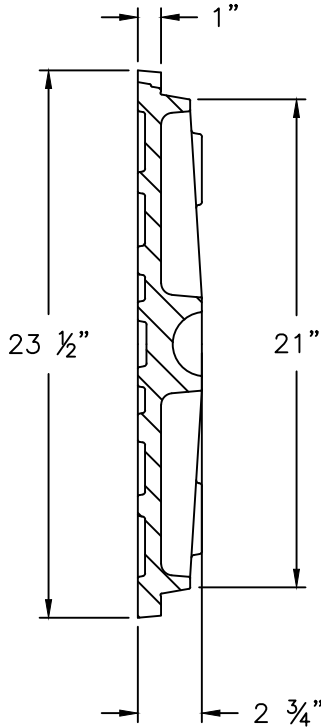
NOTES:

1. VENT MUST BE FACTORY WELDED, FABRICATED, AND "HOT DIPPED" GALVANIZED.
2. HYFE- HUNDRED YEAR FLOOD ELEVATION.
3. WHEN MANHOLE TOPS ARE IN EXCESS OF 3' ABOVE GRADE, OUTSIDE STEPS MUST BE PROVIDED. SEE DETAIL S-28 FOR STEP.

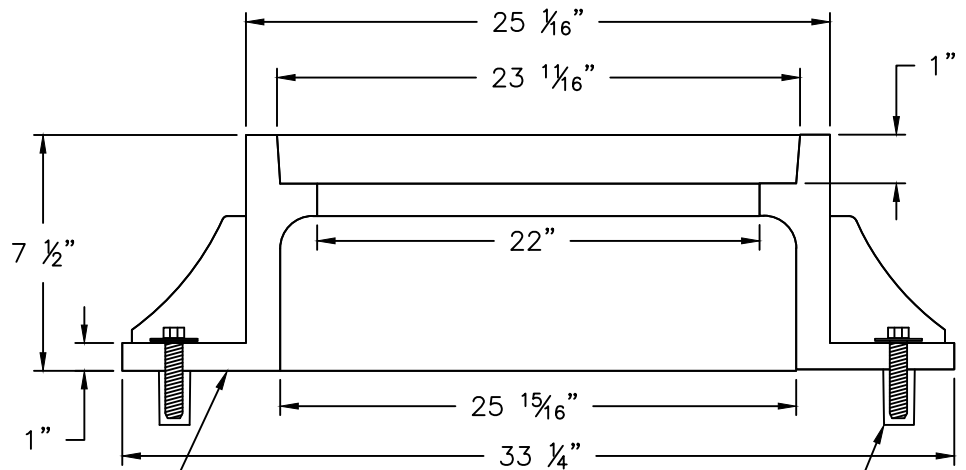
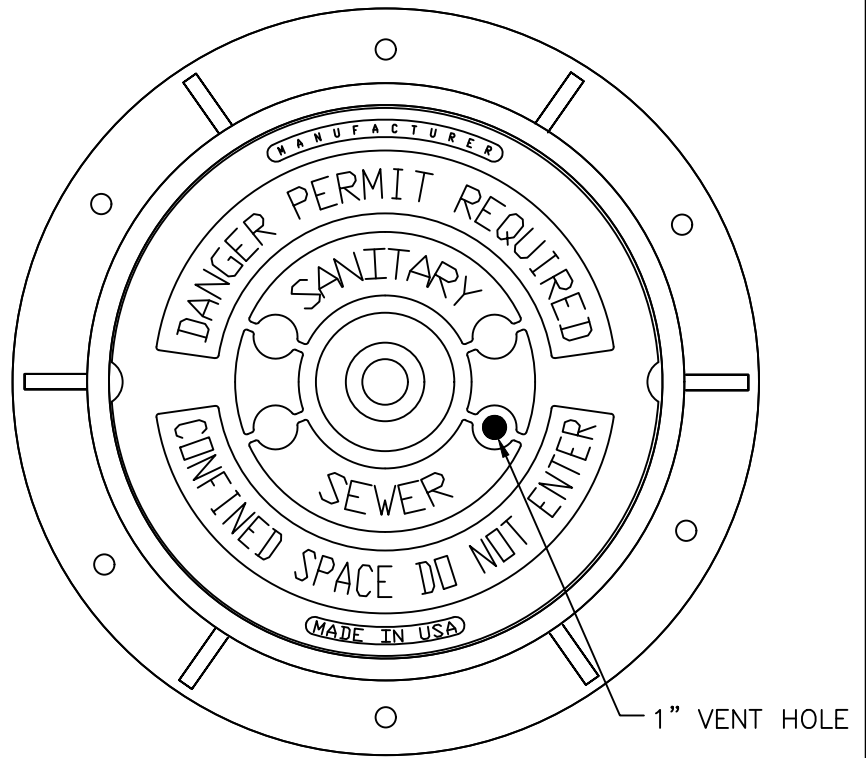
CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	STANDARD SEAL TIGHT MANHOLE WITH VENTED STACK	
	S-24	

MANHOLE FRAME AND COVER



COVER 120 LBS. MINIMUM



BUTYL-NEK OR APPROVED SEALANT
BETWEEN FRAME AND COVER

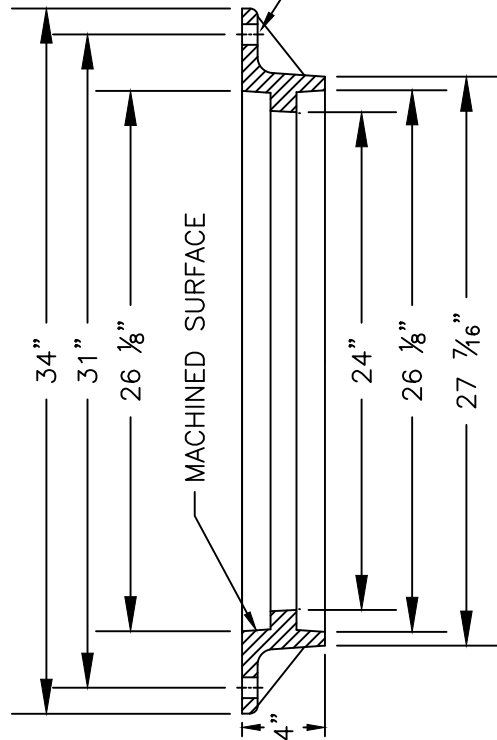
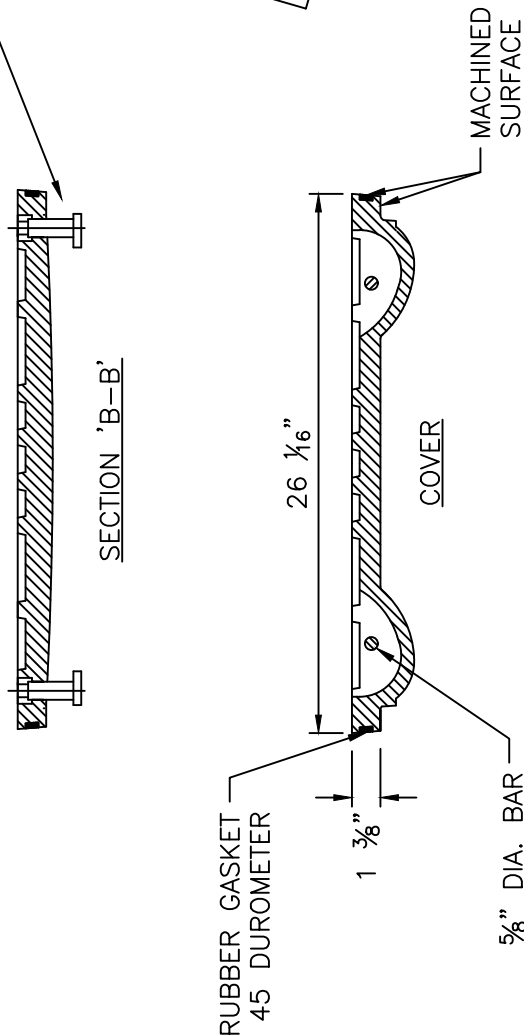
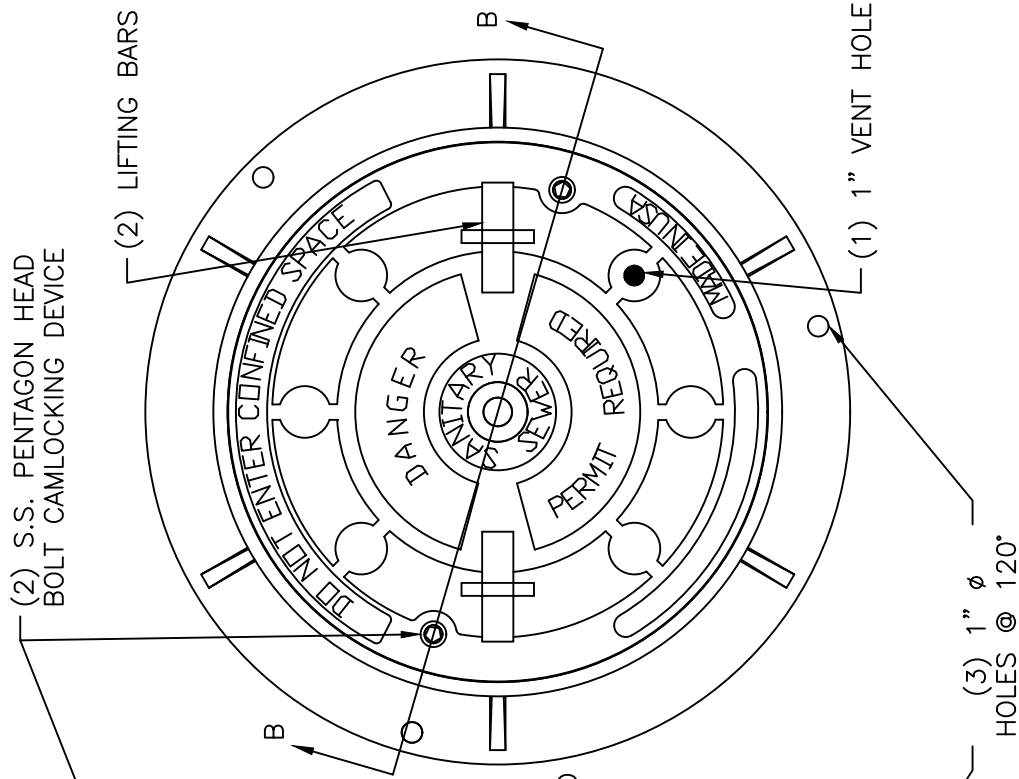
5/8"x3" LAGSHIELD IN HOLE DRILLED INTO
CONE OR RING WITH ANCHOR SUNK TO
DESIGN DEPTH, AND 3/8"x3" HOT DIPPED
GALVANIZED LAG BOLT AND WASHER

NOTES:

1. ALL MANHOLE FRAMES SHALL BE DOMESTICALLY CAST.
2. FRAME SHALL BE A MINIMUM WEIGHT OF 182 LBS. WITHIN PUBLIC ROW AND 160 LBS. WITHIN EASEMENTS.
3. COVER SHALL WEIGH A MIN. OF 120 LBS.
4. ALL MANHOLE FRAMES OUTSIDE OF PAVED SURFACES SHALL BE BOLTED TO THE CONE SECTION OR RING WITH A MINIMUM OF 4 BOLTS PER FRAME.

CITY OF RALEIGH STANDARD DETAIL

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	STANDARD MANHOLE COVER	
	S-25	



NOTE: SOLID COVER REQUIRED WHEN WATER TIGHT MANHOLE SPECIFIED.

CITY OF RALEIGH STANDARD DETAIL

REVISIONS DATE: 05/24/2024 NOT TO SCALE

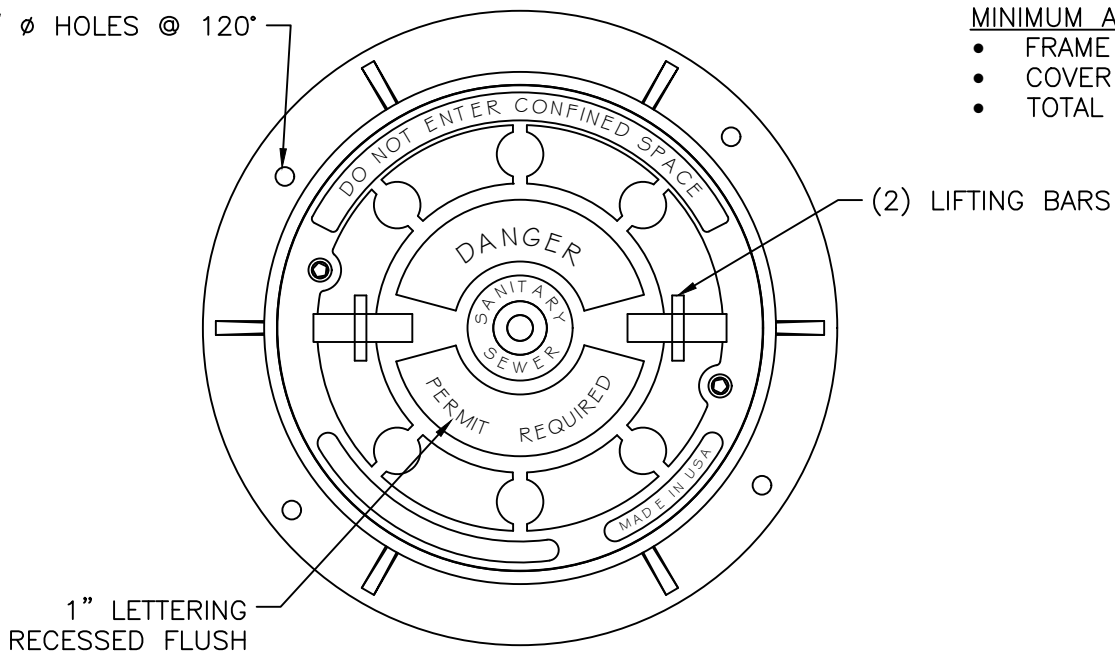
FLAT MANHOLE COVER

S-25A

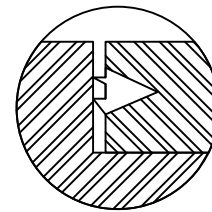
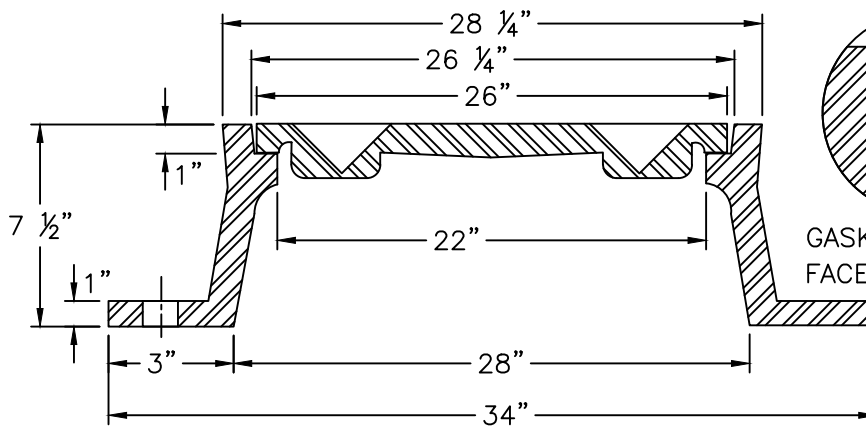
(4) 1" Ø HOLES @ 120°

MINIMUM AVG. WEIGHT:

- FRAME 182 LBS
- COVER 160 LBS
- TOTAL 342 LBS

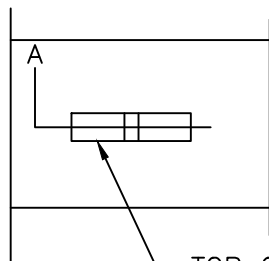


PLAN

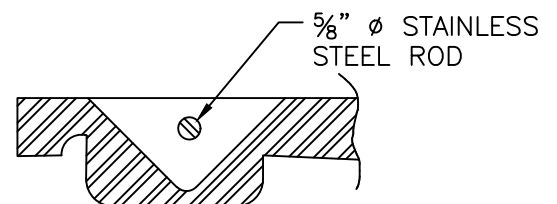


GASKET IN VERTICAL FACE OF COVER

FRAME MUST BE ANCHORED IN ACCORDANCE WITH DETAIL S-25



TOP OF COVER

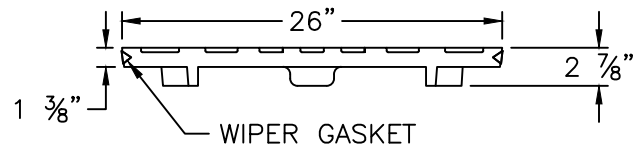
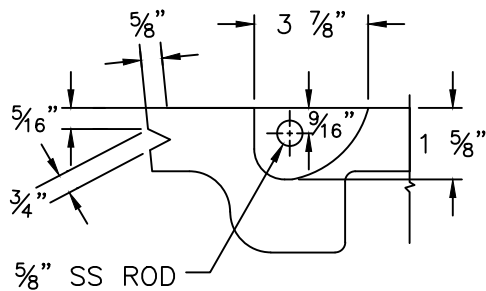
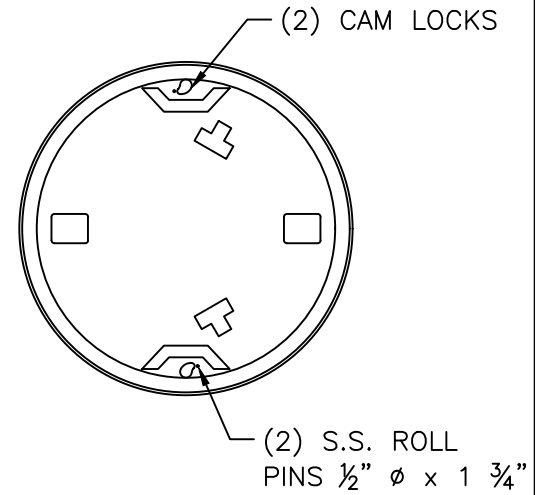
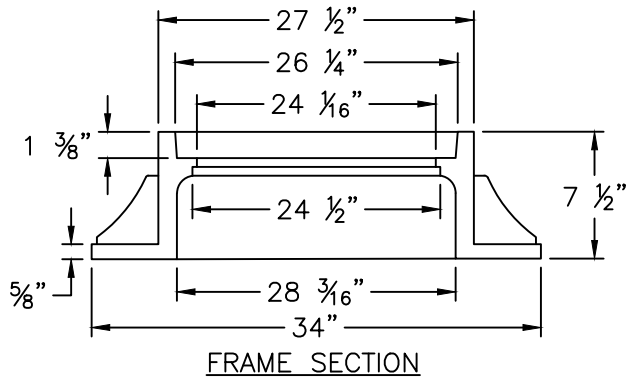


SECTION A

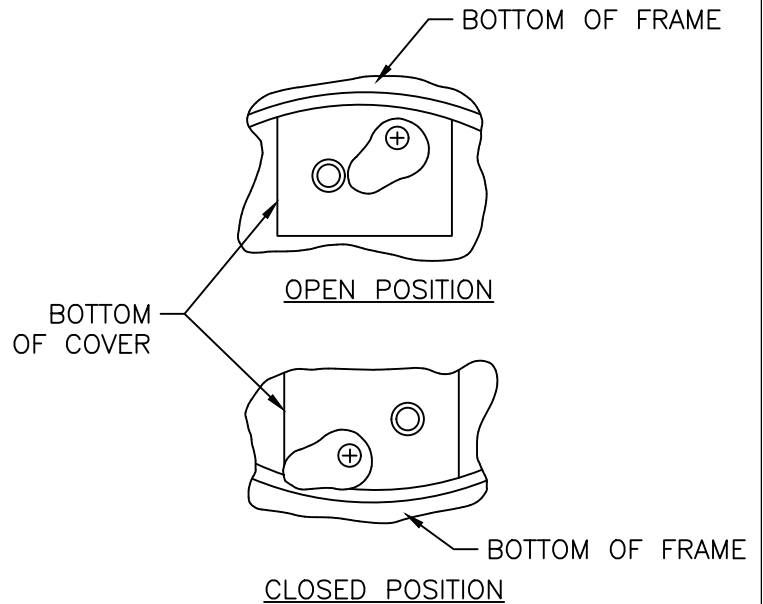
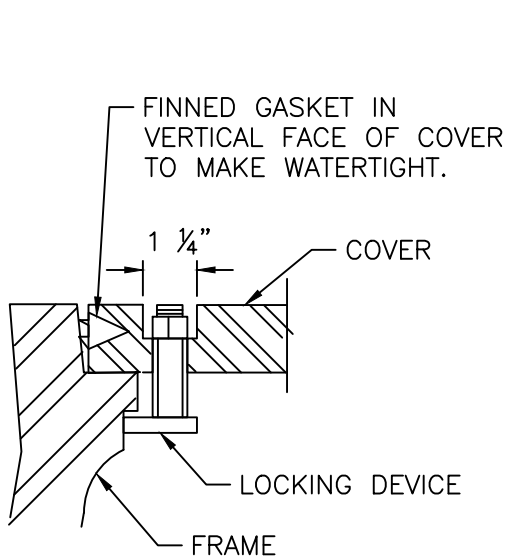
TYPICAL LIFTING DEVICE

CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	MANHOLE FRAME AND WATERTIGHT COVER	
	S-26	



TYPICAL CAM LOCK MANHOLE



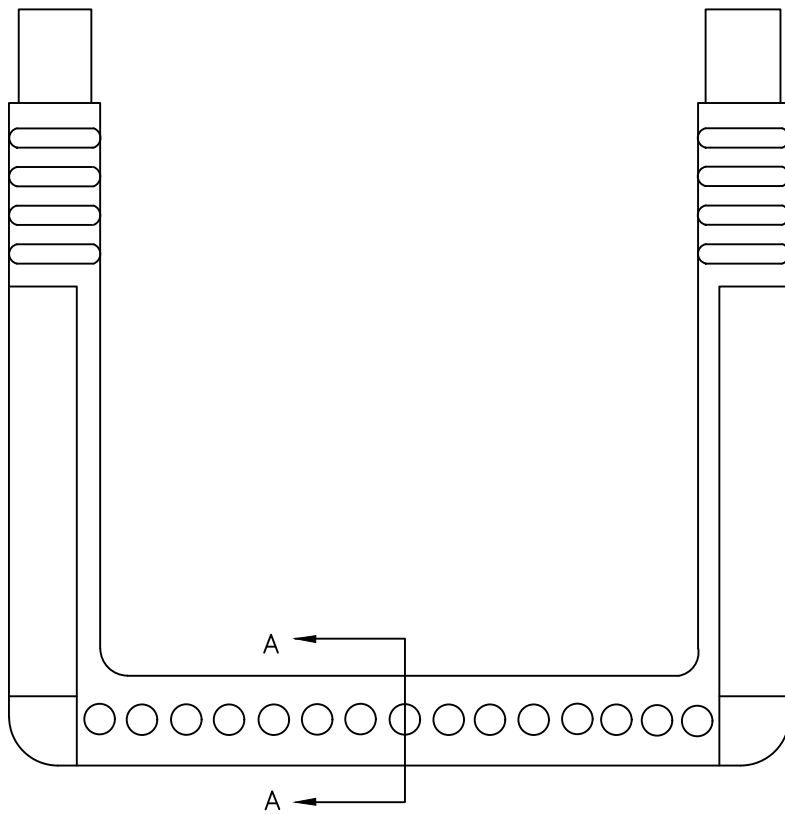
TYPICAL LOCKING DEVICE

NOTE:

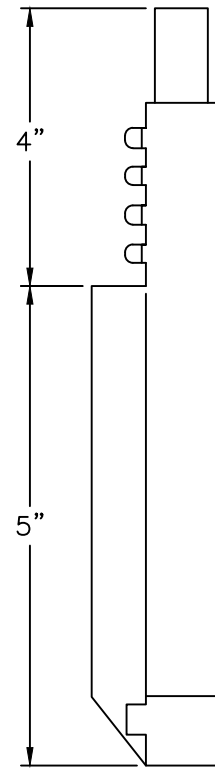
1. WHEN WATERTIGHT NOT SPECIFIED, TOP SHALL HAVE ONE 1" VENT HOLE.
2. STANDARD: PENTAGON HEAD S.S.
OPTIONAL: S.S. HEX HEAD BOLT.
3. RING MUST BE ANCHORED IN ACCORDANCE WITH DETAIL S-25.

CITY OF RALEIGH
STANDARD DETAIL

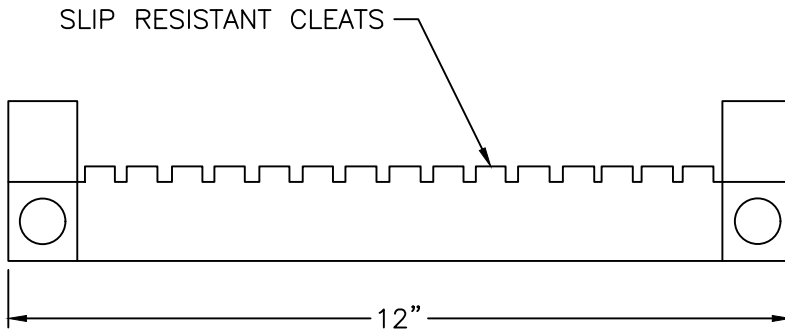
REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	WATERTIGHT MANHOLE FRAME WITH CAM LOCK COVER	
	S-27	



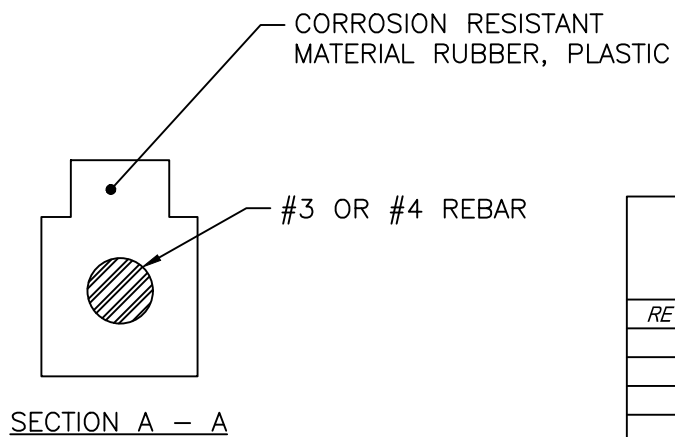
PLAN



SIDE ELEVATION

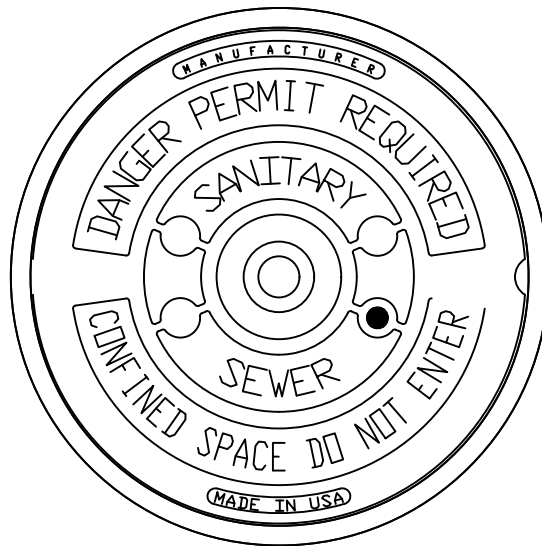


ELEVATION

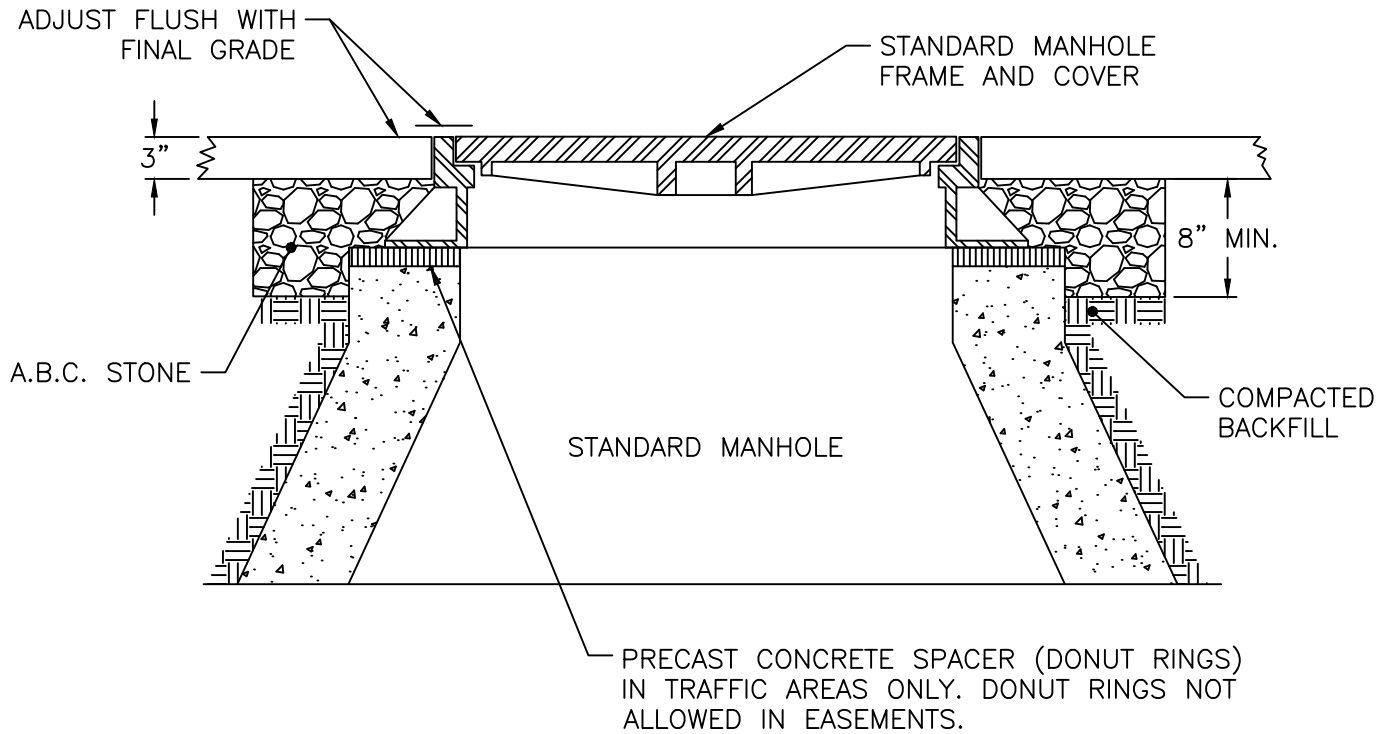


CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	STANDARD SLIP RESISTANT MANHOLE STEP DETAIL	
	S-28	



PLAN



SECTION

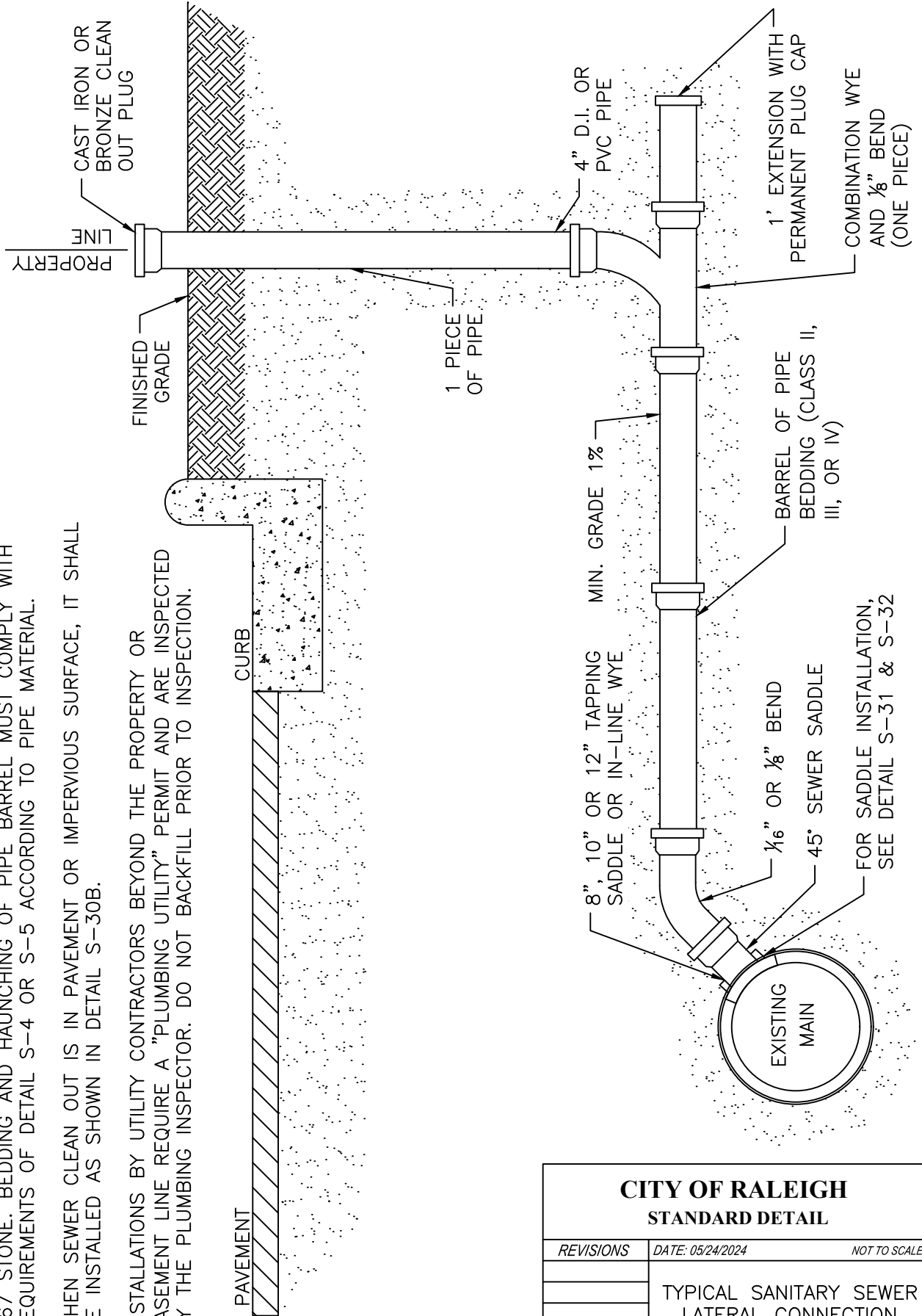
CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	STANDARD MANHOLE FRAME AND COVER DETAIL WITHIN FRAME SURFACE	
	S-29	

NOTES:

1. THE FULL LENGTH OF THE SERVICE DITCH SHALL BE COMPACTED IN 6" LIFTS WITH MECHANICAL TAMP. ALL TAPS WILL BE MADE USING MECHANICAL TAPPING MACHINE. FOR PVC INSTALLATIONS, SADDLE AND BEND MUST BE BEDDED IN #67 STONE. BEDDING AND HAUNCHING OF PIPE BARREL MUST COMPLY WITH REQUIREMENTS OF DETAIL S-4 OR S-5 ACCORDING TO PIPE MATERIAL.
2. WHEN SEWER CLEAN OUT IS IN PAVEMENT OR IMPERVIOUS SURFACE, IT SHALL BE INSTALLED AS SHOWN IN DETAIL S-30B.
3. INSTALLATIONS BY UTILITY CONTRACTORS BEYOND THE PROPERTY OR EASEMENT LINE REQUIRE A "PLUMBING UTILITY" PERMIT AND ARE INSPECTED BY THE PLUMBING INSPECTOR. DO NOT BACKFILL PRIOR TO INSPECTION.

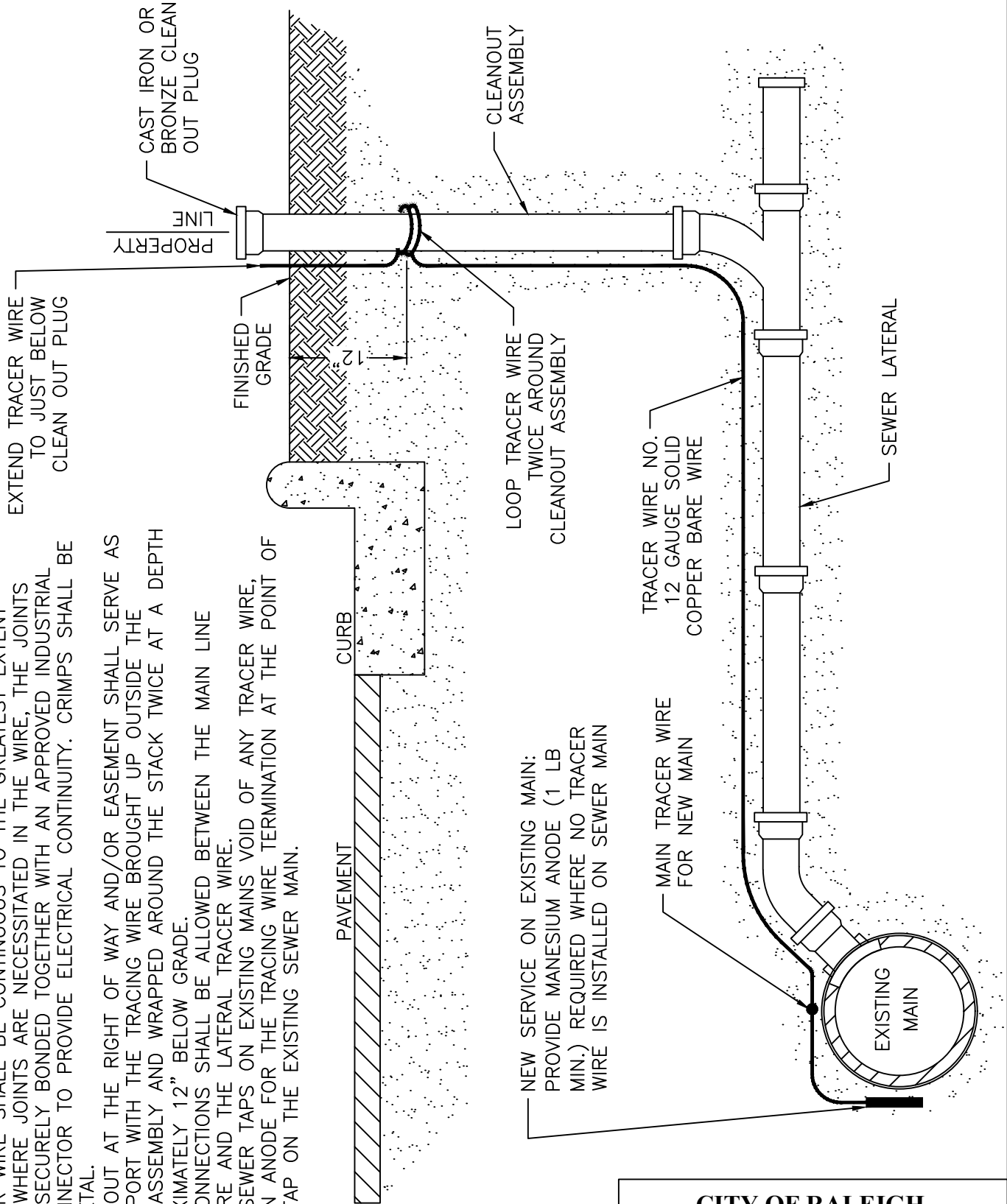
* SERVICE LATERAL MATERIAL AS REQUIRED



CITY OF RALEIGH	
STANDARD DETAIL	
REVISIONS	DATE: 05/24/2024 NOT TO SCALE
	TYPICAL SANITARY SEWER LATERAL CONNECTION
	S-30

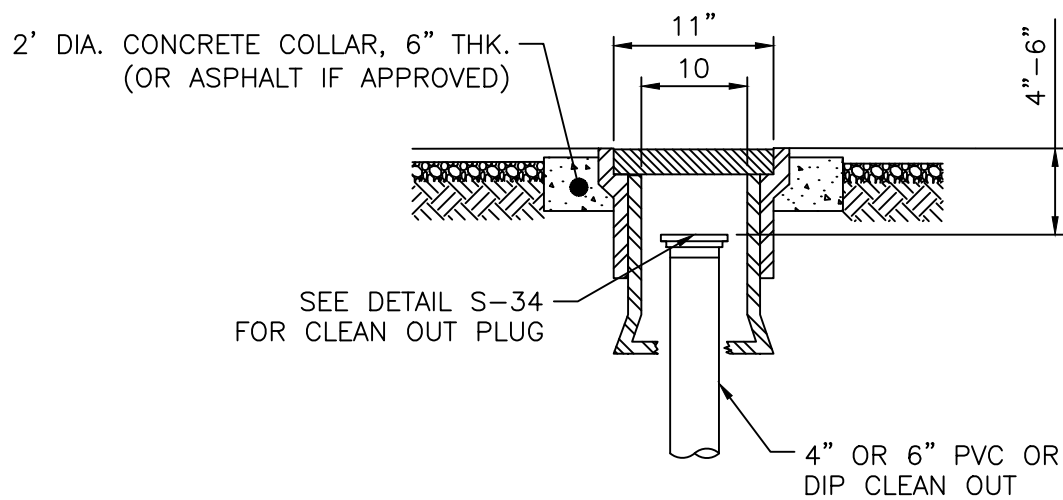
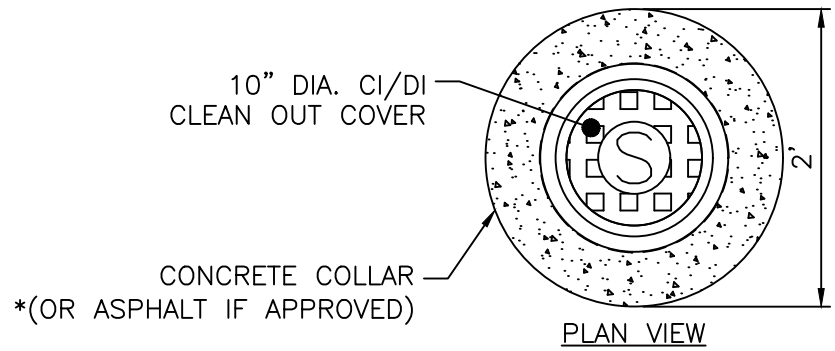
NOTES:

1. THE TRACER WIRE SHALL BE CONTINUOUS TO THE GREATEST EXTENT POSSIBLE. WHERE JOINTS ARE NECESSITATED IN THE WIRE, THE JOINTS SHALL BE SECURELY BONDED TOGETHER WITH AN APPROVED INDUSTRIAL CRIMP CONNECTOR TO PROVIDE ELECTRICAL CONTINUITY. CRIMPS SHALL BE SIMILAR METAL.
2. THE CLEANOUT AT THE RIGHT OF WAY AND/OR EASEMENT SHALL SERVE AS THE TEST PORT WITH THE TRACING WIRE BROUGHT UP OUTSIDE THE CLEANOUT ASSEMBLY AND WRAPPED AROUND THE STACK TWICE AT A DEPTH OF APPROXIMATELY 12" BELOW GRADE.
3. SPliced CONNECTIONS SHALL BE ALLOWED BETWEEN THE MAIN LINE TRACER WIRE AND THE LATERAL TRACER WIRE.
4. FOR NEW SEWER TAPS ON EXISTING MAINS VOID OF ANY TRACER WIRE, PROVIDE AN ANODE FOR THE TRACING WIRE TERMINATION AT THE POINT OF THE NEW TAP ON THE EXISTING SEWER MAIN.



**CITY OF RALEIGH
STANDARD DETAIL**

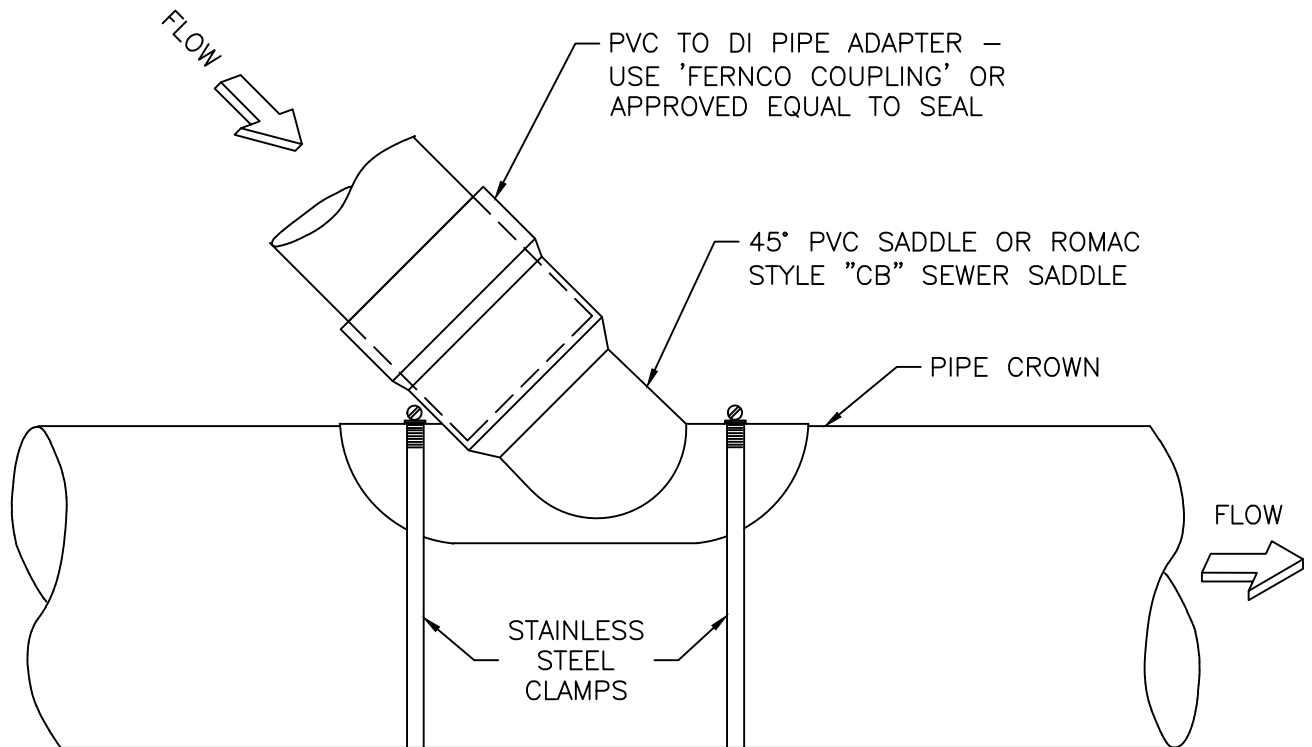
REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	TYPICAL SANITARY SEWER LATERAL TRACER WIRE	
	S-30A	



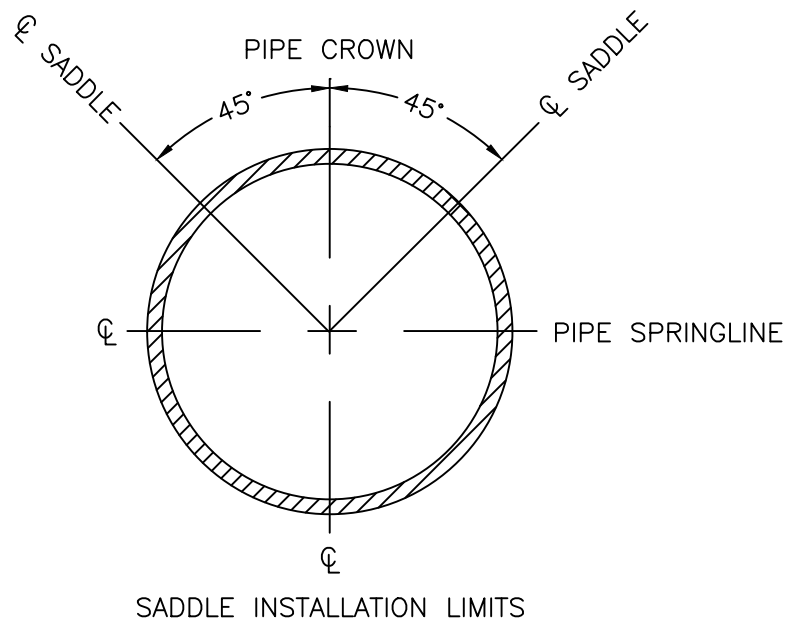
SECTION VIEW

CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	TRAFFIC RATED CLEAN OUT STRUCTURE	
	S-30B	

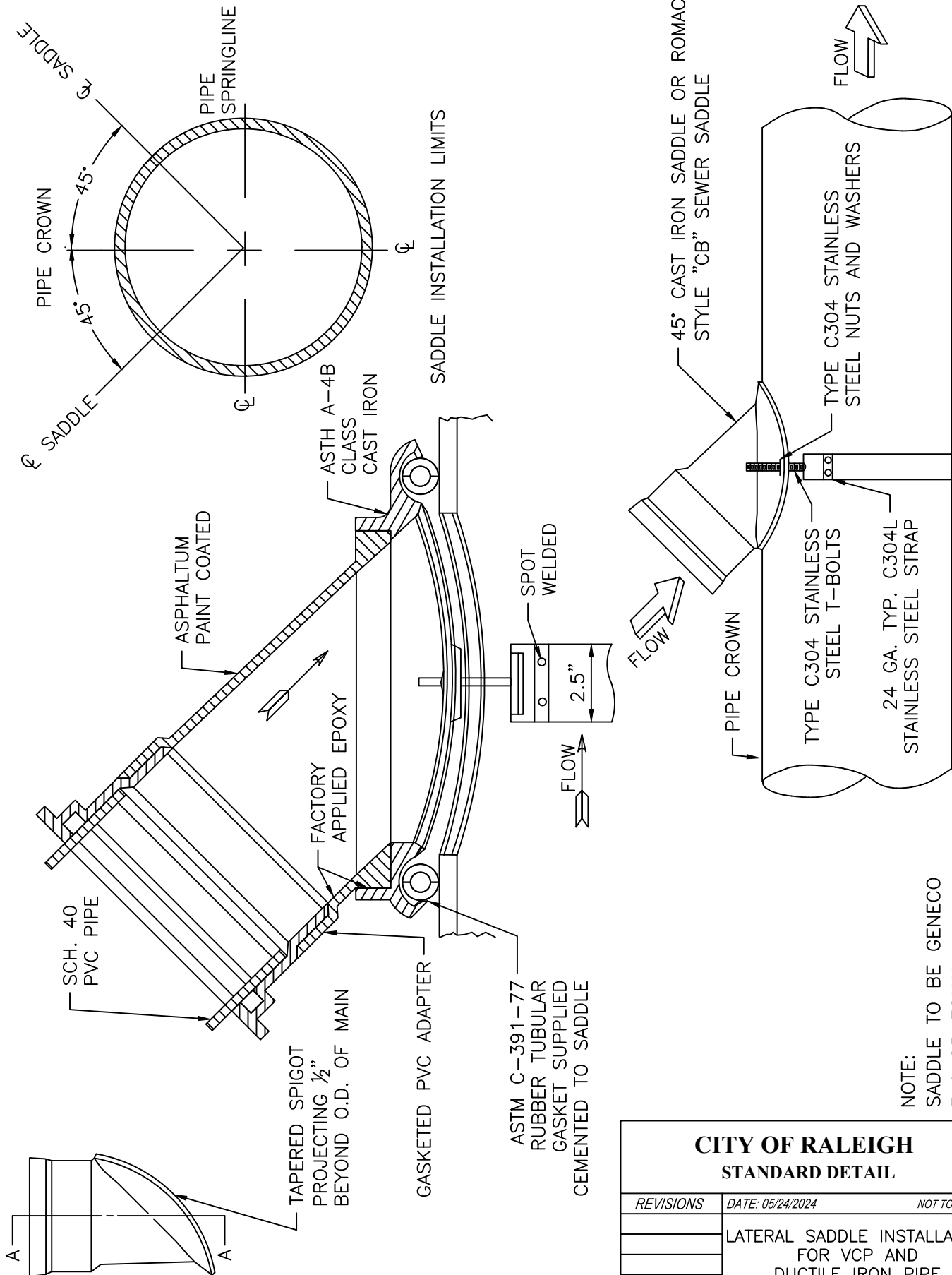


BACKFILL UNDER PVC SADDLE, ADAPTOR, AND CAST IRON BEND WITH #67 STONE AS SHOWN ON DETAIL S-4.



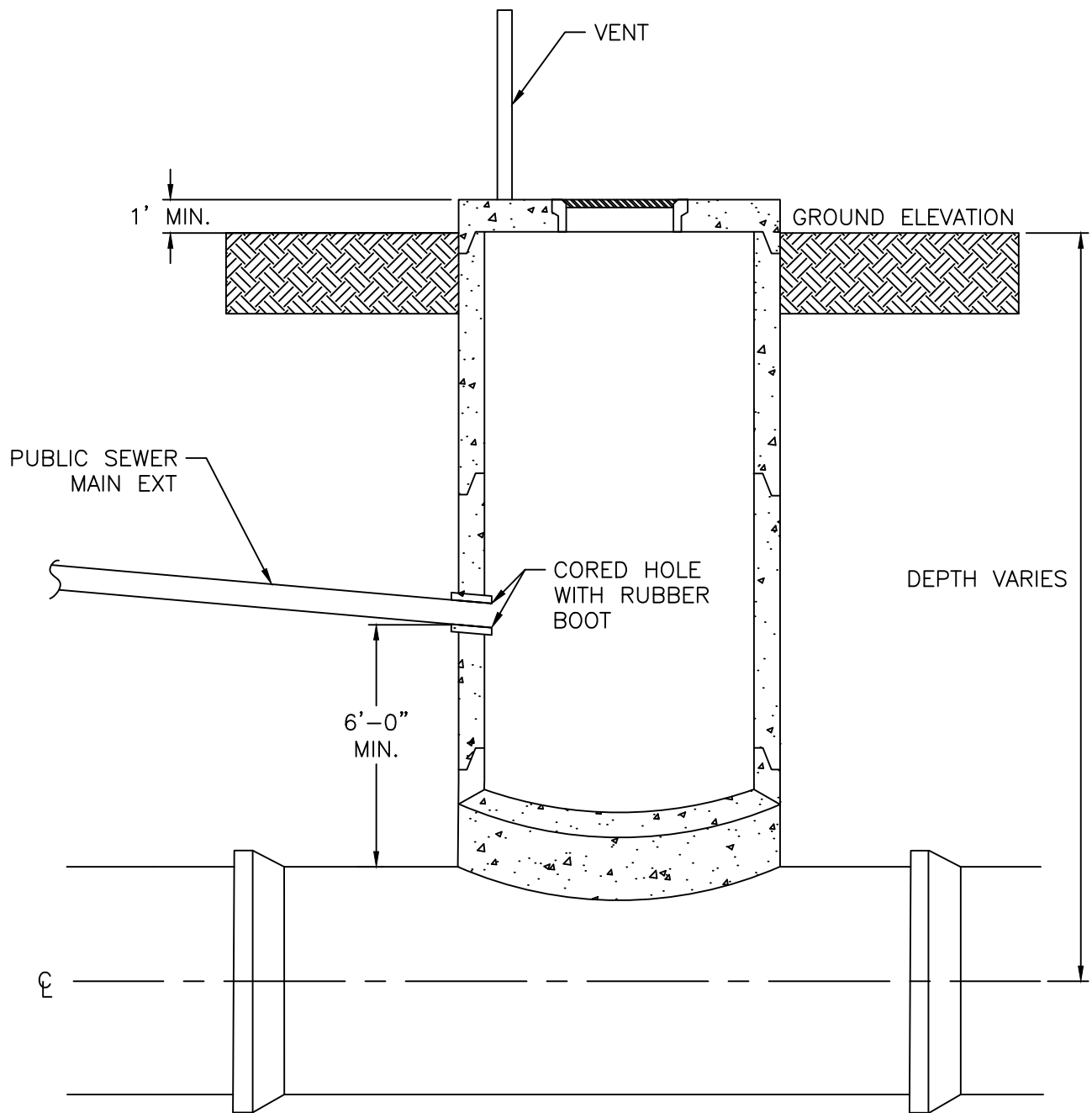
CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	LATERAL SADDLE INSTALLATION DETAIL FOR PVC PIPE	
	S-31	



NOTE:
SADDLE TO BE GENECO
E40 OR EQUAL.

CITY OF RALEIGH		
STANDARD DETAIL		
REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	LATERAL SADDLE INSTALLATION FOR VCP AND DUCTILE IRON PIPE	
	S-32	

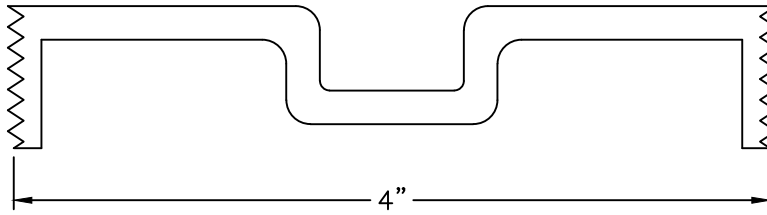


NOTES:

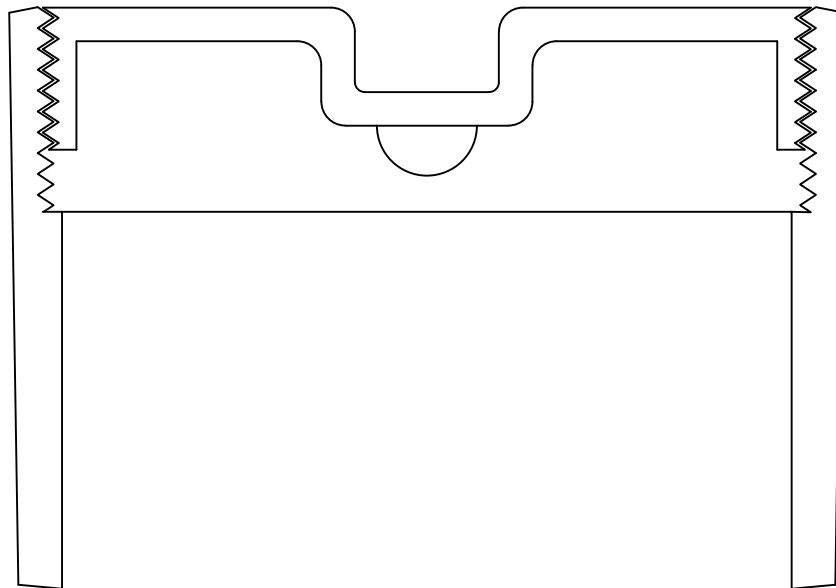
1. HOLE SHALL BE CORED IN RISER SECTION FOR PUBLIC SERVICE MAIN EXTENSION.
2. RUBBER BOOT SHALL BE UTILIZED ON ALL CORES.
3. CORES SHALL BE IN CENTER OF RISER SECTION.
4. CONNECTION TO TEE MANHOLE MUST BE MADE BY CONTRACTOR APPROVED BY CITY OF RALEIGH PUBLIC UTILITIES DEPARTMENT.

**CITY OF RALEIGH
STANDARD DETAIL**

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	MAIN EXTENSION TO TIE INTO TEE MANHOLE	
	S-33	



STANDARD 4" BRONZE CLEANOUT PLUG



CLEANOUT FERRULE WITH PLUG

STYLES ACCEPTED:
 INVERTED NUT
 RAISED NUT

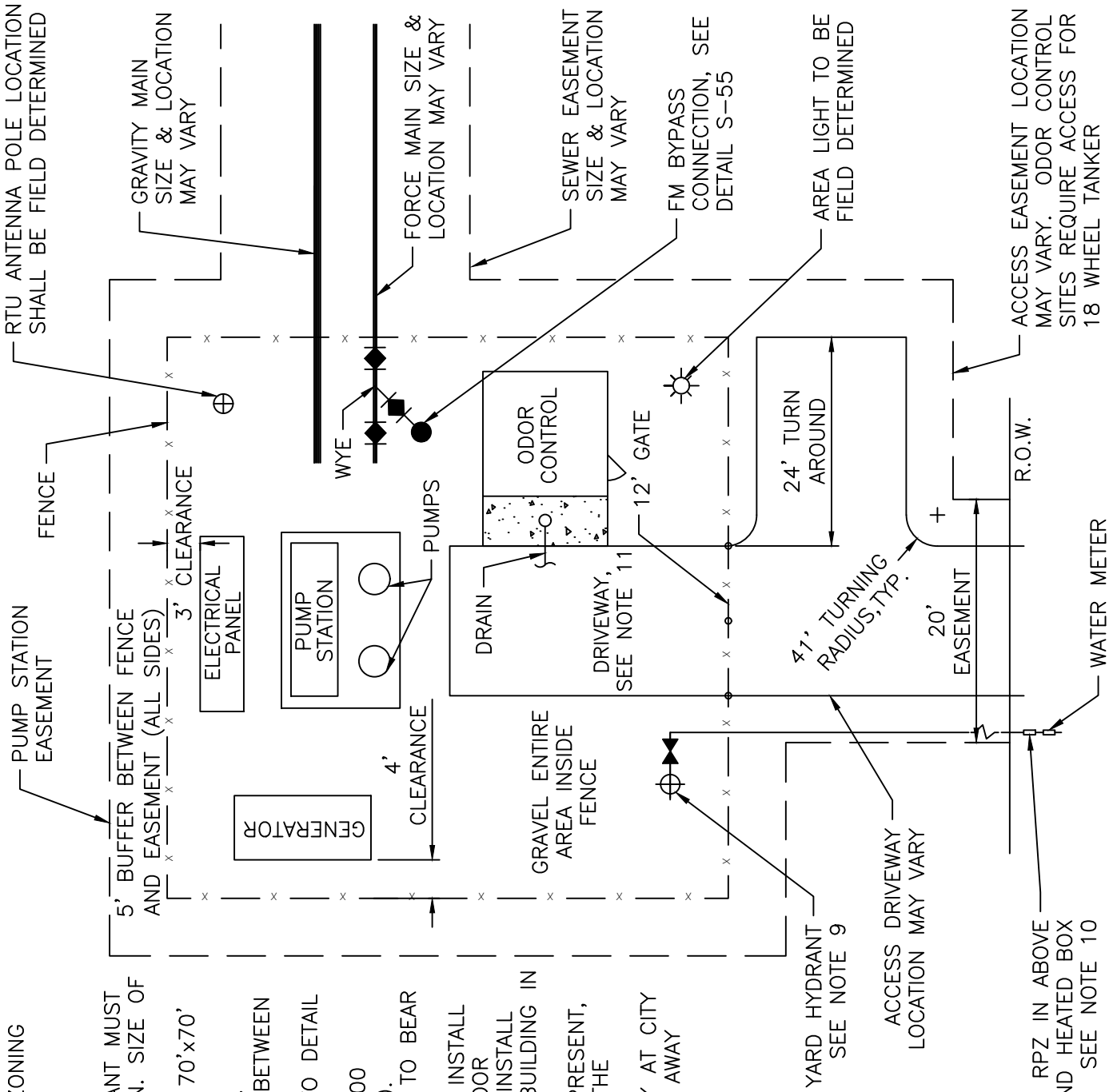
CITY OF RALEIGH STANDARD DETAIL		
REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	4" CLEANOUT PLUG	
		S-34

NOTES:

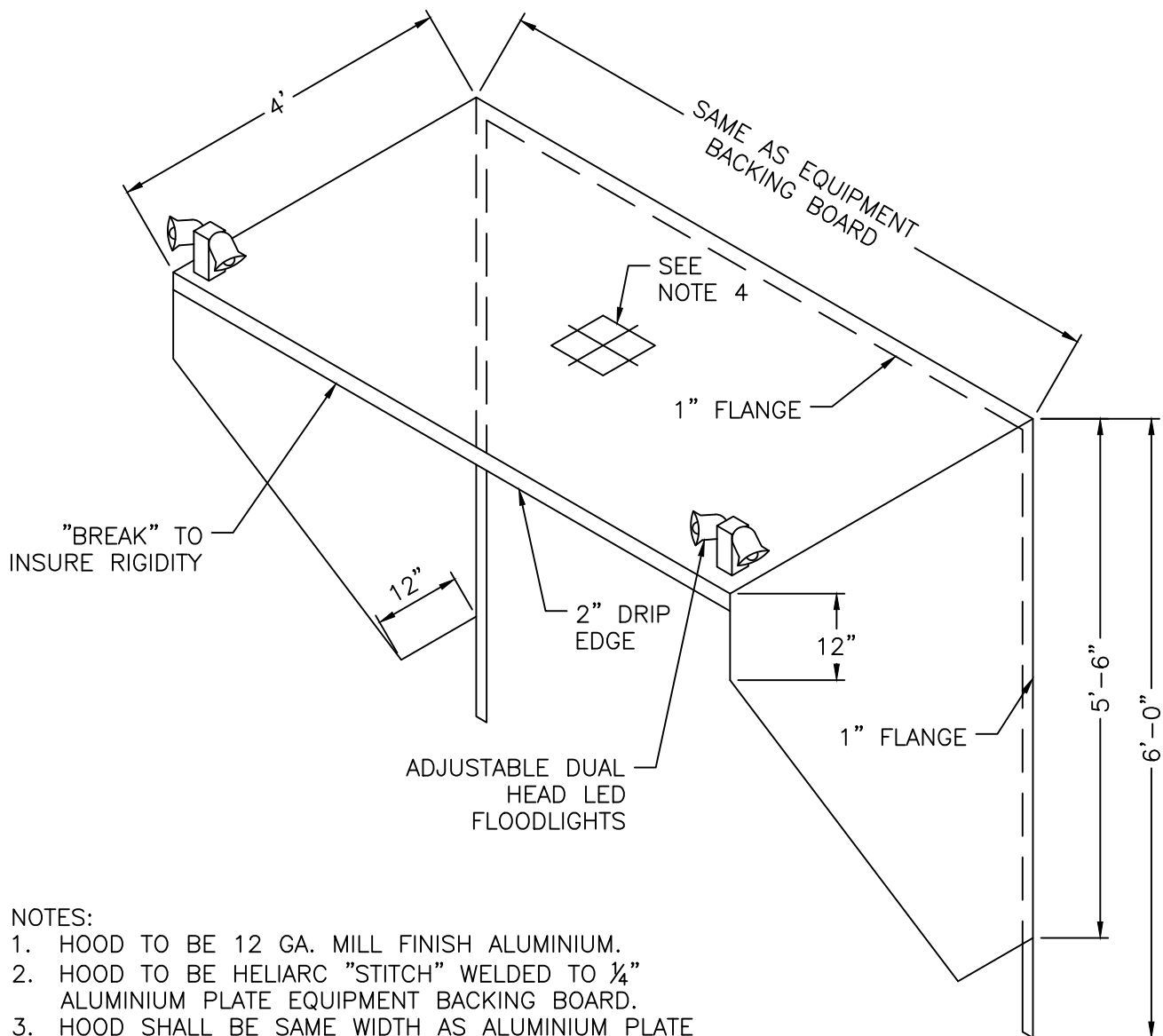
1. PUMP STATION MUST MEET ALL ZONING SET-BACK REQUIREMENTS.
2. PUMP STATION MUST MEET ALL LANDSCAPING REQUIREMENTS.
3. WATER SERVICE FOR YARD HYDRANT MUST HAVE RPZ BACKFLOW PROTECTION. SIZE OF SERVICE MAY VARY.
4. PUMP STATION EASEMENT TO BE 70'x70' MINIMUM.
5. EQUIPMENT LOCATIONS MAY VARY.
6. 5' BUFFER SHALL BE REQUIRED BETWEEN FENCE AND EASEMENT LINE.
7. FOR ELECTRICAL PANEL, REFER TO DETAIL S-36 & S-37.
8. SEE CITY SPECIFICATION 32-10-00 (PAVEMENT AND APPURTENANCES). PAVEMENT SHALL HAVE CAPACITY TO BEAR 88K G.V.W.
9. IF NO ODOR CONTROL BUILDING, INSTALL YARD HYDRANT AS SHOWN. IF ODOR CONTROL BUILDING IS PRESENT, INSTALL HOSE BIBB ON ODOR CONTROL BUILDING IN LIEU OF YARD HYDRANT.
10. IF ODOR CONTROL BUILDING IS PRESENT, RPZ SHALL BE LOCATED INSIDE THE BUILDING.
11. ASPHALT OR CONCRETE DRIVEWAY AT CITY DISCRETION. DIVERT STORMWATER AWAY FROM PUMP STATION

CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
MINIMUM REQUIREMENTS FOR PUMP STATIONS		
S-35		



REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	PUMP STATION ELECTRICAL PANEL	
	S-36	



NOTES:

1. HOOD TO BE 12 GA. MILL FINISH ALUMINIUM.
2. HOOD TO BE HELIARC "STITCH" WELDED TO $\frac{1}{4}$ " ALUMINIUM PLATE EQUIPMENT BACKING BOARD.
3. HOOD SHALL BE SAME WIDTH AS ALUMINIUM PLATE EQUIPMENT BACKING BOARD.
4. PROVIDE MOUNTING TABS FOR WORK LIGHT BOX.

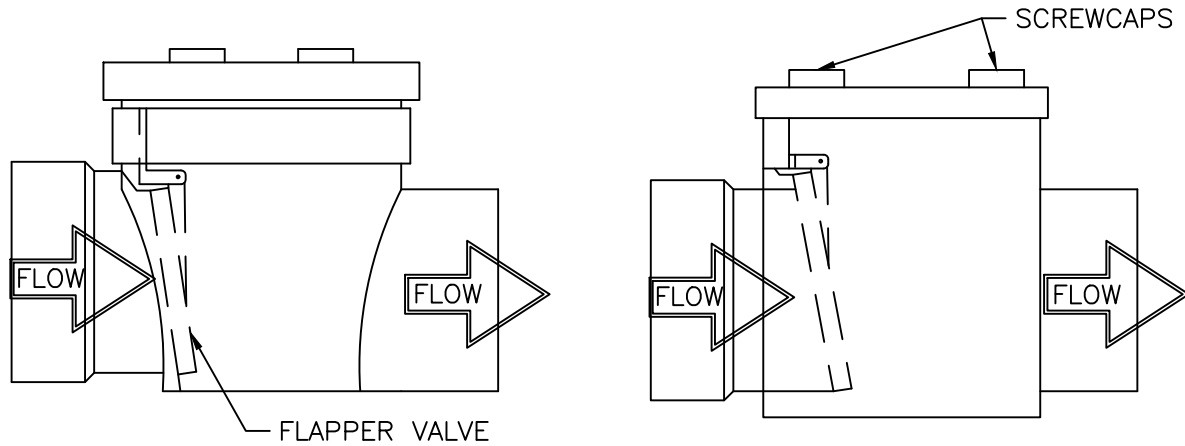
CITY OF RALEIGH
STANDARD DETAIL

REVISIONS DATE: 05/24/2024 NOT TO SCALE

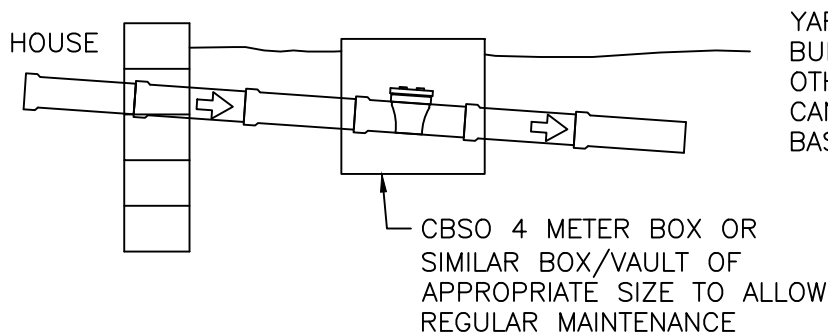
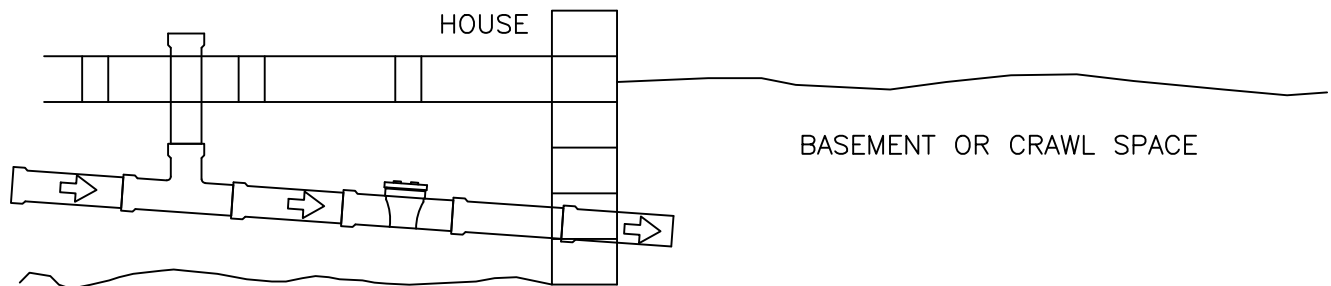
WEATHER HOOD FOR
ELECTRICAL EQUIPMENT

S-37

TYPICAL SANITARY SEWER SERVICE BACKWATER VALVE STYLES:



TYPICAL BACKWATER VALVE INSTALLATIONS:



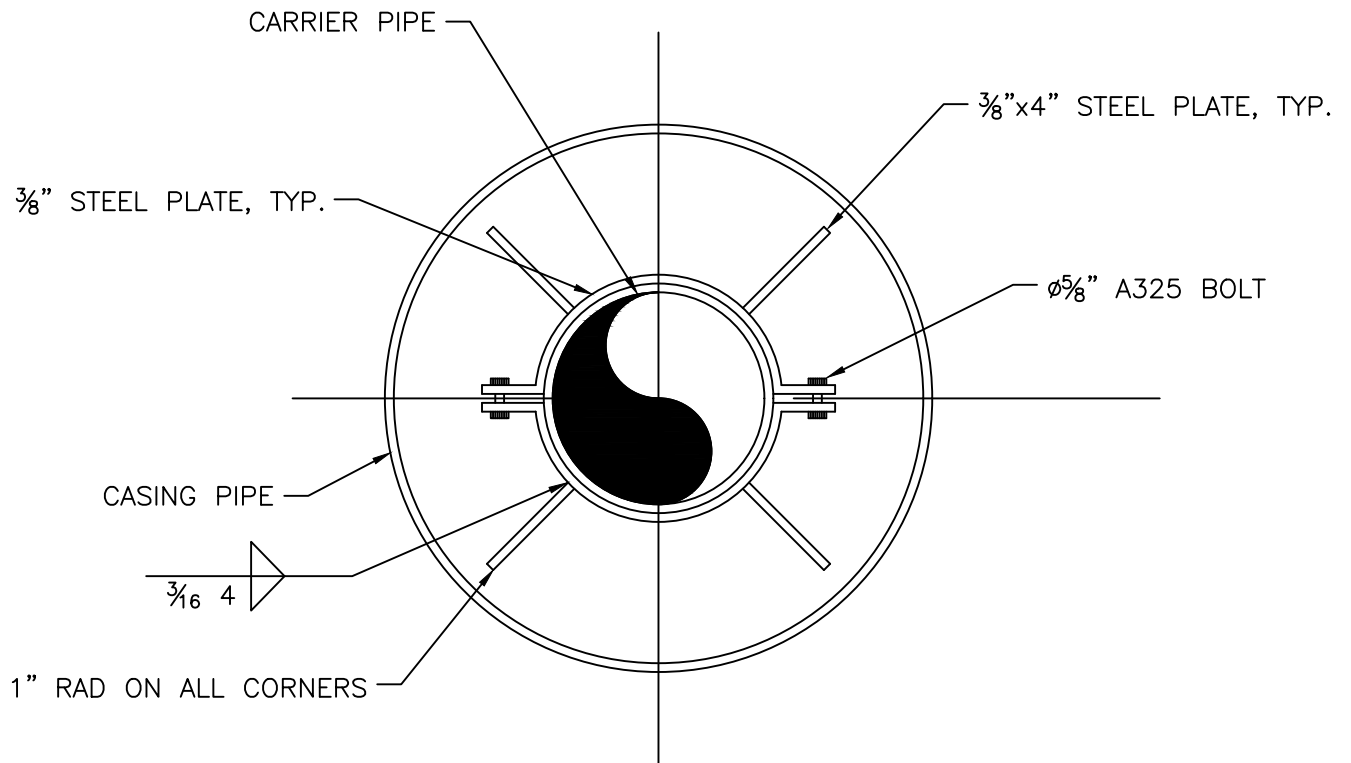
YARD/VAULT INSTALLATION FOR
BUILDINGS BUILT ON SLAB AND
OTHER LOCATIONS WHERE VALVE
CANNOT BE INSTALLED IN
BASEMENT OR CRAWL SPACE.

NOTES:

1. INSTALLATIONS OF GREATER THAN 4' IN DEPTH MAY REQUIRE MANHOLE.
2. VALVES MUST BE INSTALLED IN A LOCATION AT WHICH THEY CAN BE CLEANED AND SERVICED REGULARLY.

**CITY OF RALEIGH
STANDARD DETAIL**

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	TYPICAL SANITARY SEWER SERVICE BACKWATER VALVE INSTALLATION	
	S-38	



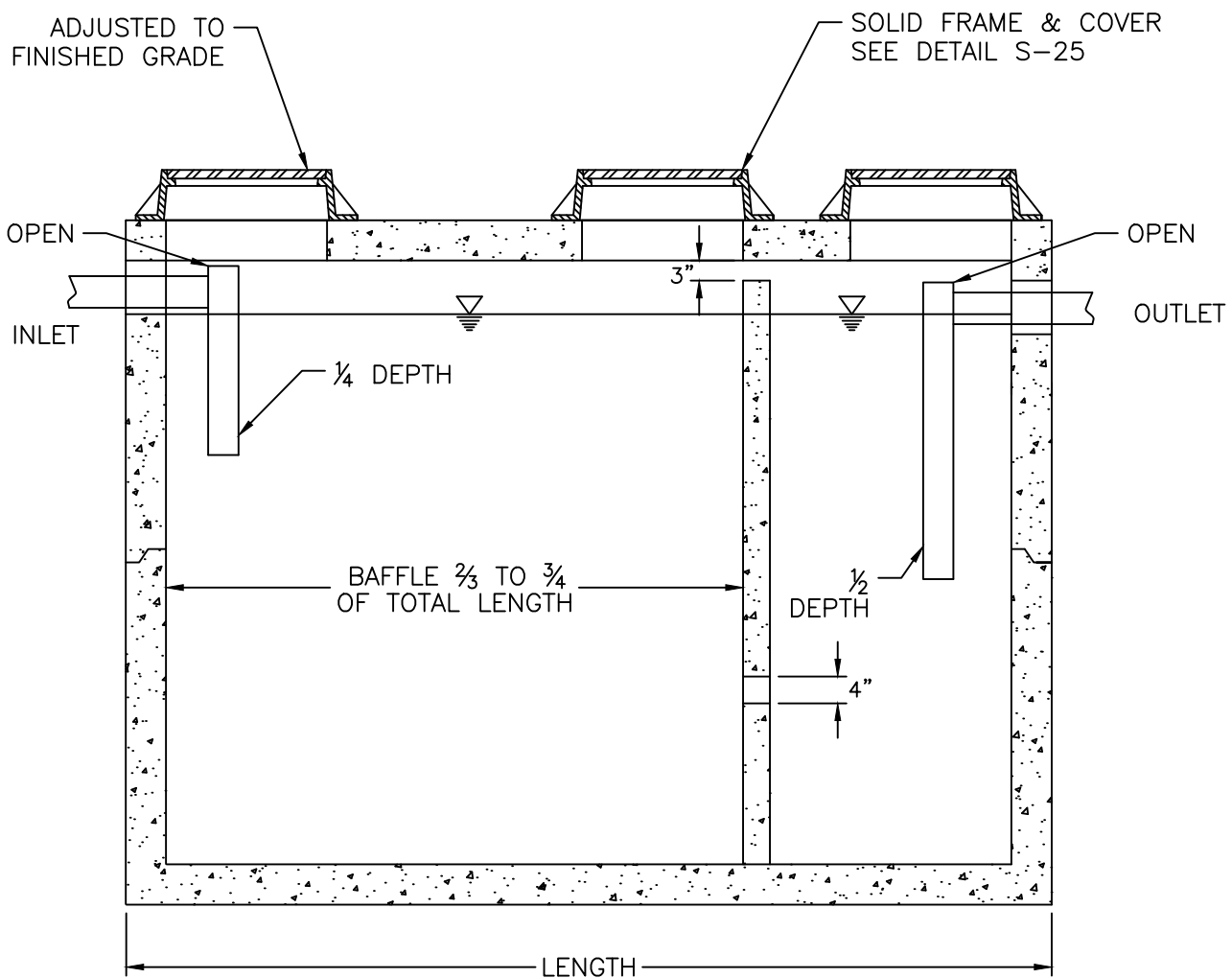
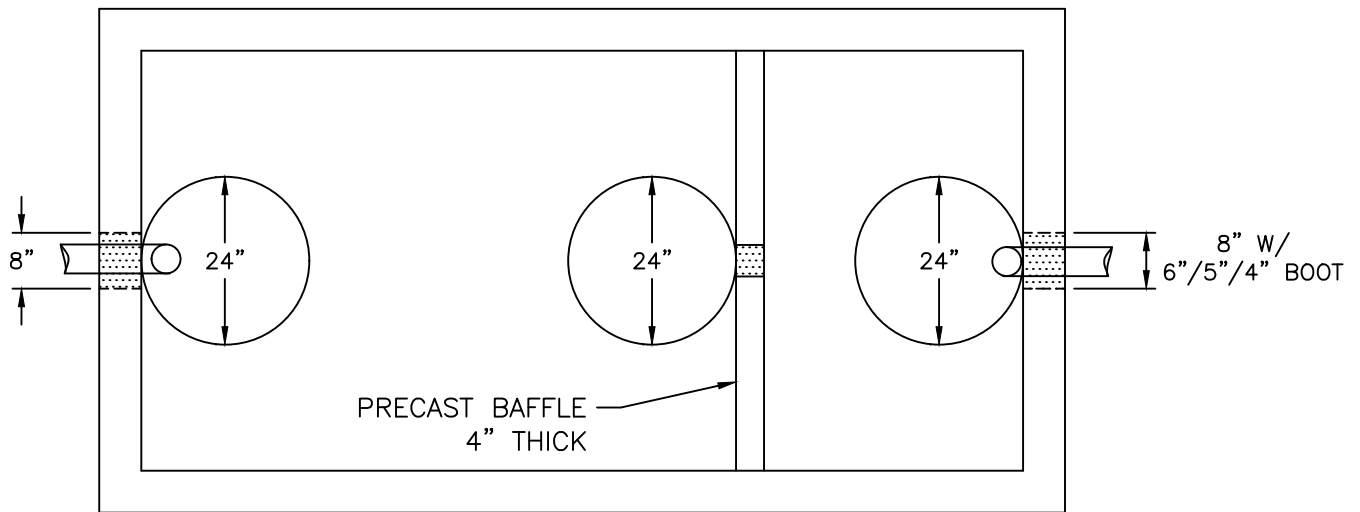
NOTE:
USE A MINIMUM OF TWO SPIDERS PER PIPE JOINT ONE FOURTH OF THE
PIPE JOINT LENGTH IN FROM BOTH THE BELL AND SPIGOT ENDS.

CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
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PIPE ALIGNMENT GUIDE

S-39

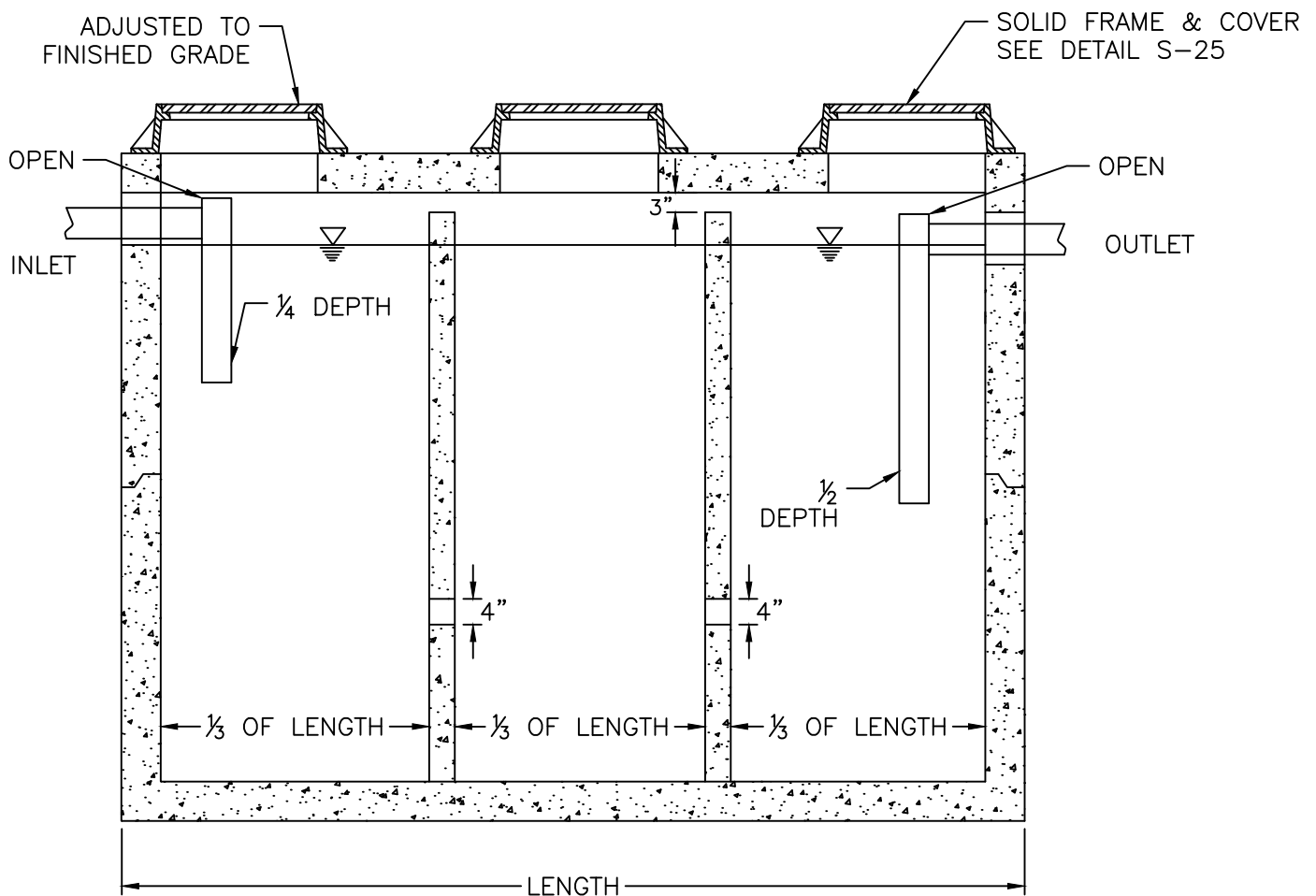
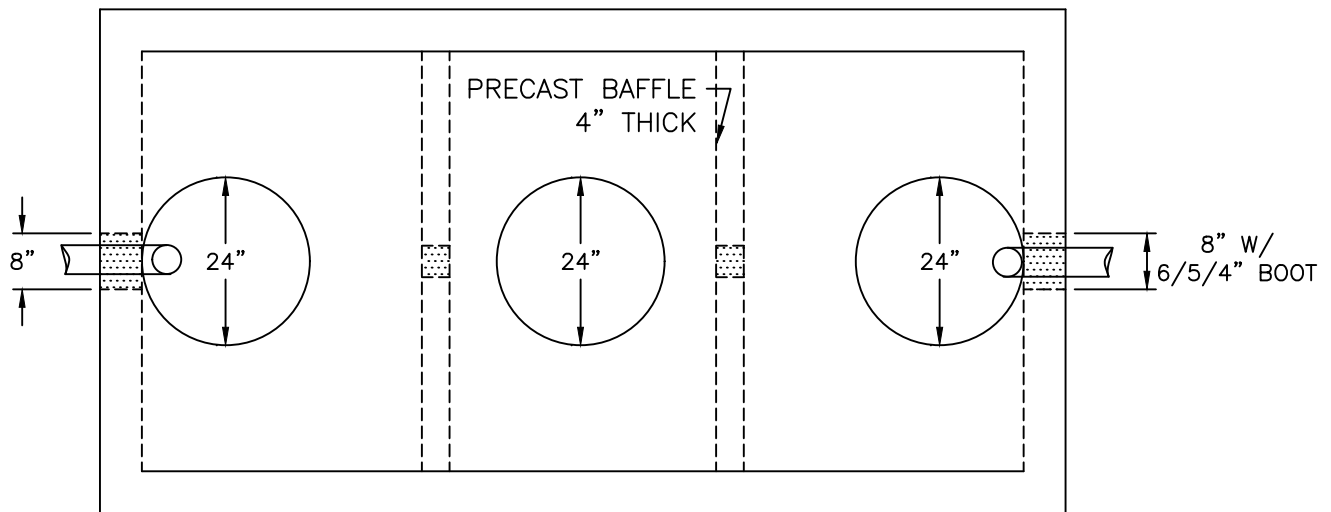


NOTES:

1. REINFORCEMENT: H-20 BRIDGE LOADING (TRAFFIC RATED).
2. CONCRETE: 4,000 PSI @ 28 DAYS.
3. EARTHCOVER: 0' TO 5' MAX.
4. HDPE ALLOWED IN LIEU OF CONCRETE. MEET SAME LOADING REQUIREMENTS.

**CITY OF RALEIGH
STANDARD DETAIL**

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	1,000 GALLON GREASE INTERCEPTOR	
	S-40	



NOTES:

1. REINFORCEMENT: H-20 BRIDGE LOADING (TRAFFIC RATED).
2. CONCRETE: 4,000 PSI @ 28 DAYS.
3. EARTHCOVER: 0' TO 5' MAX.
4. HDPE ALLOWED IN LIEU OF CONCRETE. MEET SAME LOADING REQUIREMENTS.

CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	1,000 GALLON OIL-WATER-SAND SEPARATOR	
	S-40A	

LOCALLY AVAILABLE SIZES	
INTERCEPTORS CAPACITY (GAL.)	SEPARATORS CAPACITY (GAL.)
300	1,000
550	1,200
750	1,600
1,000	
1,200	
1,500	
2,000	
2,500	
3,000	
4,000	
5,000	
6,000	
8,000	

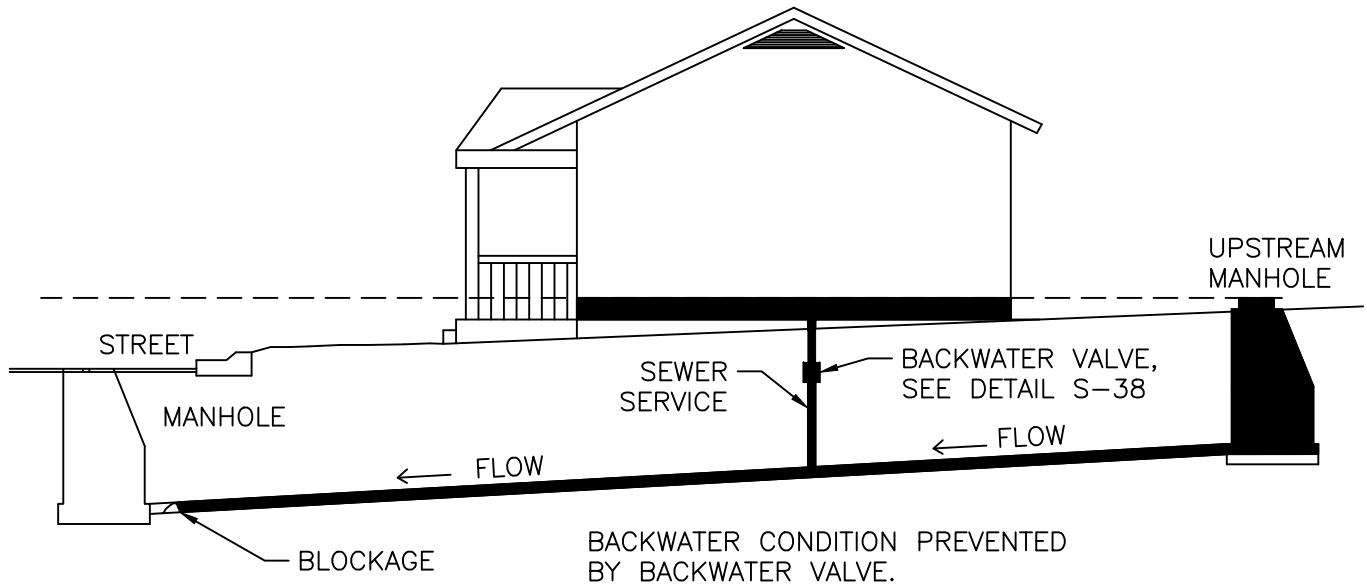
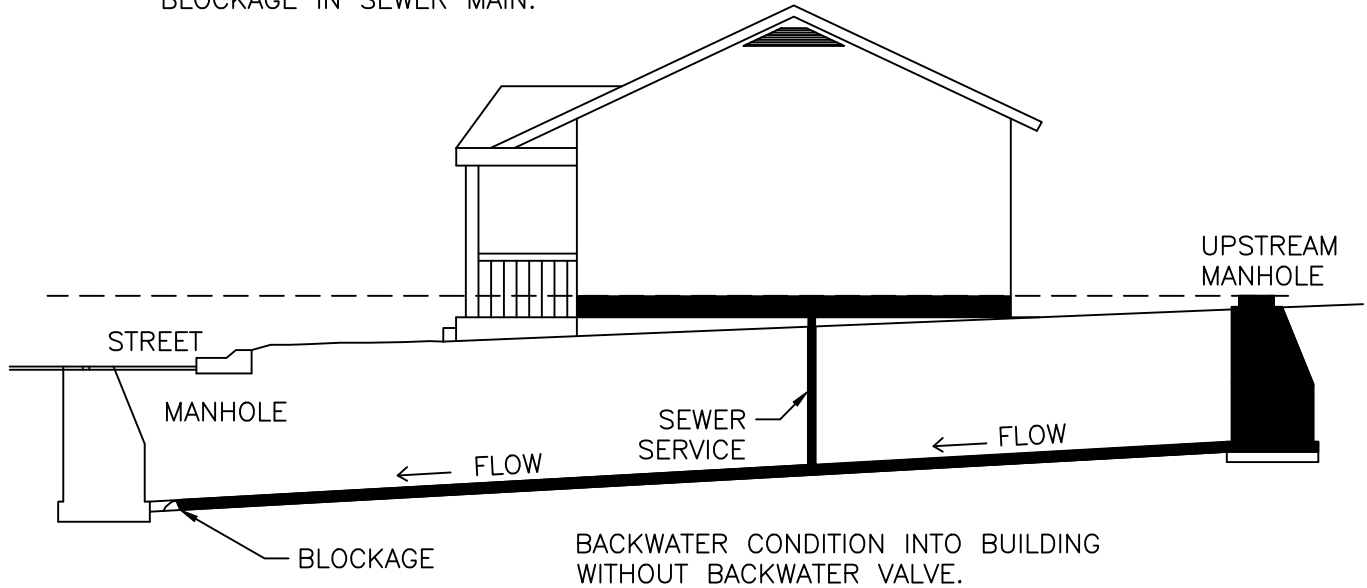
NOTES:

1. BAFFLE WALLS LOCATED AT A DISTANCE FROM INLET WALL $\frac{2}{3}$ TO $\frac{3}{4}$ OF THE TOTAL LENGTH OF THE INTERCEPTOR OR SEPARATOR AS SHOWN ON DETAIL S-40. BAFFLE WALLS LOCATED AT A DISTANCE APPROXIMATELY OF $\frac{1}{3}$ OF THE TOTAL LENGTH OF THE SEPARATOR AS SHOWN ON DETAIL S-40A.
2. EACH INTERCEPTOR OR SEPARATOR SHALL HAVE INLET AND OUTLET TEES. THE OUTLET TEE SHALL EXTEND 50% INTO THE LIQUID DEPTH. THE INLET TEE SHALL EXTEND 25% INTO THE LIQUID DEPTH. INLET AND OUTLET TEES MUST BE OPEN TO ALLOW THE COLLECTION OF F.O.G. SAMPLE.
3. ACCESS OPENINGS OVER EACH COMPARTMENT WITHIN THE INTERCEPTOR OR SEPARATOR SHALL BE 24 INCHES IN DIAMETER AND CONTAIN PICK HOLES. ALL COVERS SHALL BE CONSTRUCTED OF CAST IRON OR EQUIVALENT TRAFFIC BEARING MATERIAL. MANHOLE COVERS MUST EXTEND TO FINISH GRADE AND BE INSTALLED TO EXCLUDE THE ENTRANCE OF STORMWATER INTO THE INTERCEPTOR OR SEPARATOR.
4. FULL SIZE DUAL SWEEP CLEANOUTS SHALL BE INSTALLED ON THE INLET AND OUTLET SIDES OF THE INTERCEPTOR OR SEPARATOR.
5. INTERCEPTORS AND SEPARATORS MUST BE VENTED IN ACCORDANCE WITH THE NC STATE PLUMBING CODE.
6. CONCRETE: 4,000 PSI @ 28 DAYS.
7. DESIGN: ACI 318 BUILDING CODE
ASTM C1613-06 FOR GREASE INTERCEPTORS
ASTM C913-02 FOR WATER AND WASTEWATER STRUCTURES
ASTM C890-06 FOR MINIMAL STRUCTURAL DESIGN LOADING
8. INTERCEPTORS AND SEPARATORS SHALL BE DESIGNED TO WITHSTAND AN H-20 WHEEL LOAD.
9. INTERCEPTORS OR SEPARATORS MADE OF POLYETHYLENE OR FIBERGLASS SHALL INCLUDE A MINIMUM 12,000 PSI TENSILE STRENGTH, 19,000 PSI FLEXURAL STRENGTH, AND 800,000 PSI FLEXURAL MODULUS.
10. ALL INTERCEPTORS AND SEPARATORS SHALL BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURERS SPECIFICATIONS.

CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	DIMENSIONS: GREASE INTERCEPTORS & OIL-WATER SAND SEPARATORS	
	S-41	

BUILDING WITH NEXT UPSTREAM MANHOLE
HIGHER THAN THE LOWEST DRAIN AND
BLOCKAGE IN SEWER MAIN.



CITY OF RALEIGH
STANDARD DETAIL

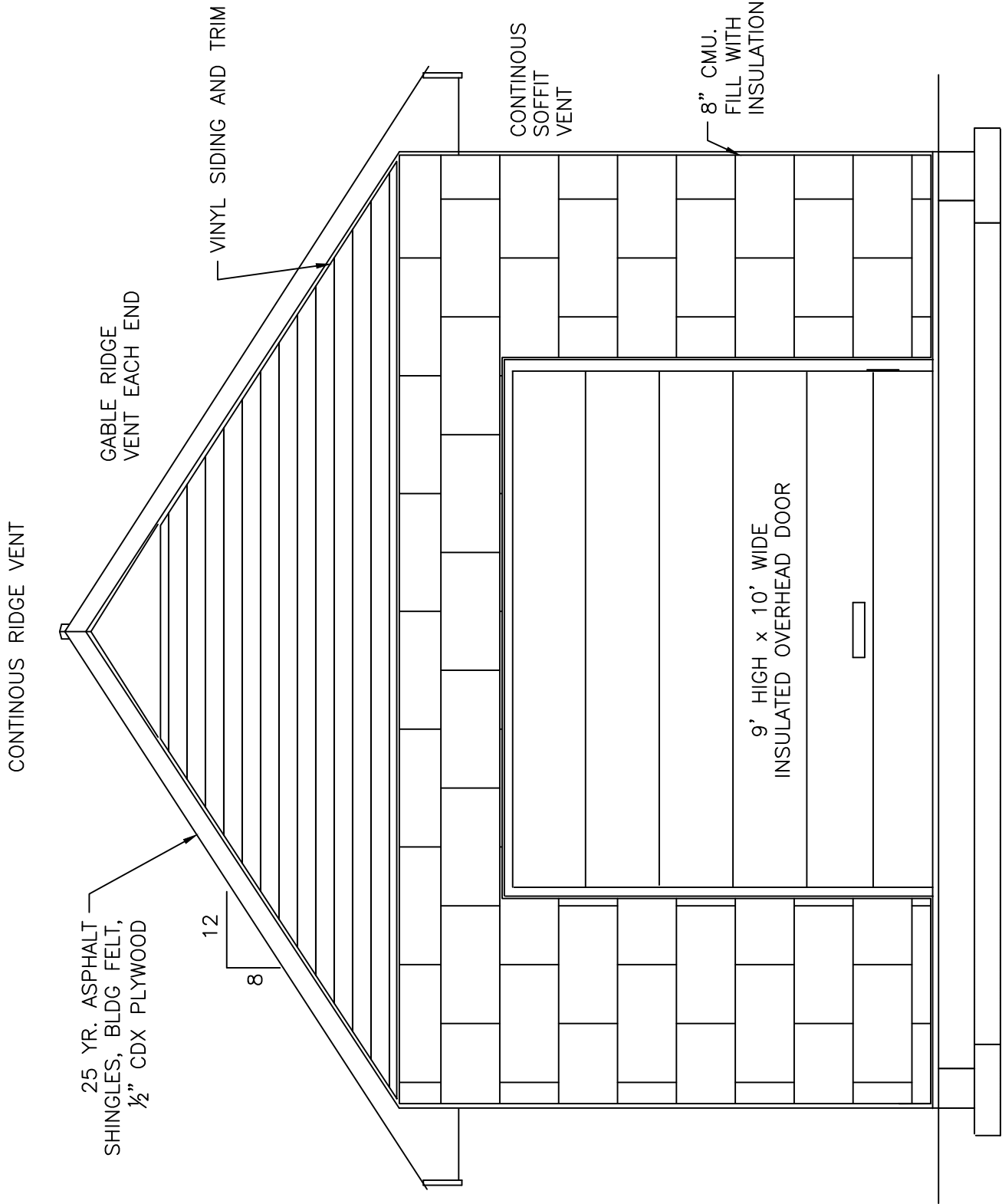
REVISIONS	DATE: 05/24/2024	NOT TO SCALE
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	TYPICAL SEWER SERVICE REQUIRING BACKWATER VALVE
--	---

S-42

NOT USED

CITY OF RALEIGH		
STANDARD DETAIL		
REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	NOT USED	
	S-43	



NOTES:

1. NOT TO SCALE.
2. THIS IS A RENDERING ONLY. BUILDING PLANS MUST BE APPROVED.

CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	STANDARD ODOR CONTROL BLDG. FRONT ELEVATION	
	S-44	

CONTINUOUS RIDGE VENT

25 YR. ASPHALT
SHINGLES, BLDG FELT,
½" CDX PLYWOOD

8" CMU.
FILL WITH
INSULATION

3'x7' 18GA.
INS. STEEL
DOOR

CITY OF RALEIGH
STANDARD DETAIL

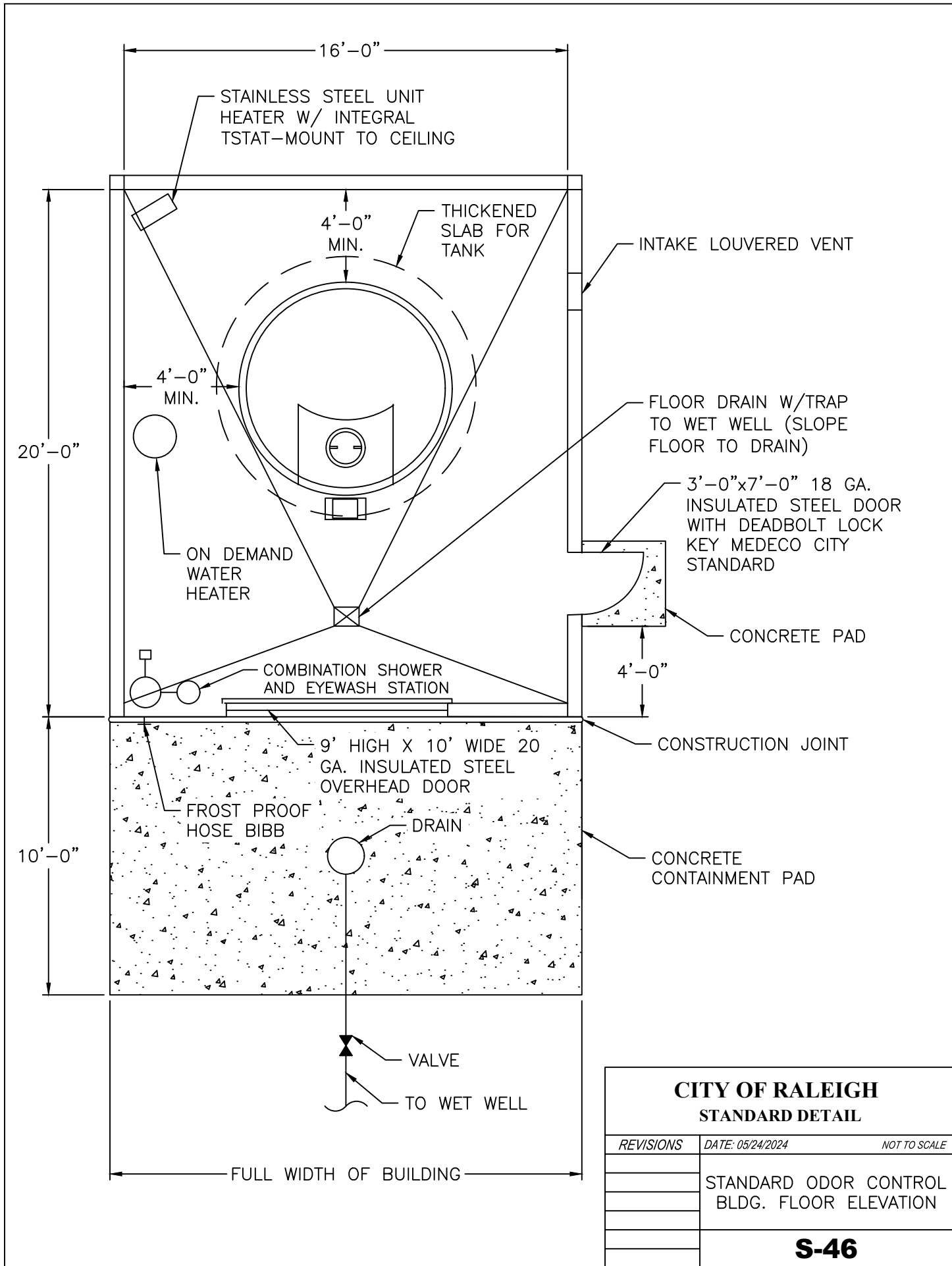
REVISIONS

DATE: 05/24/2024

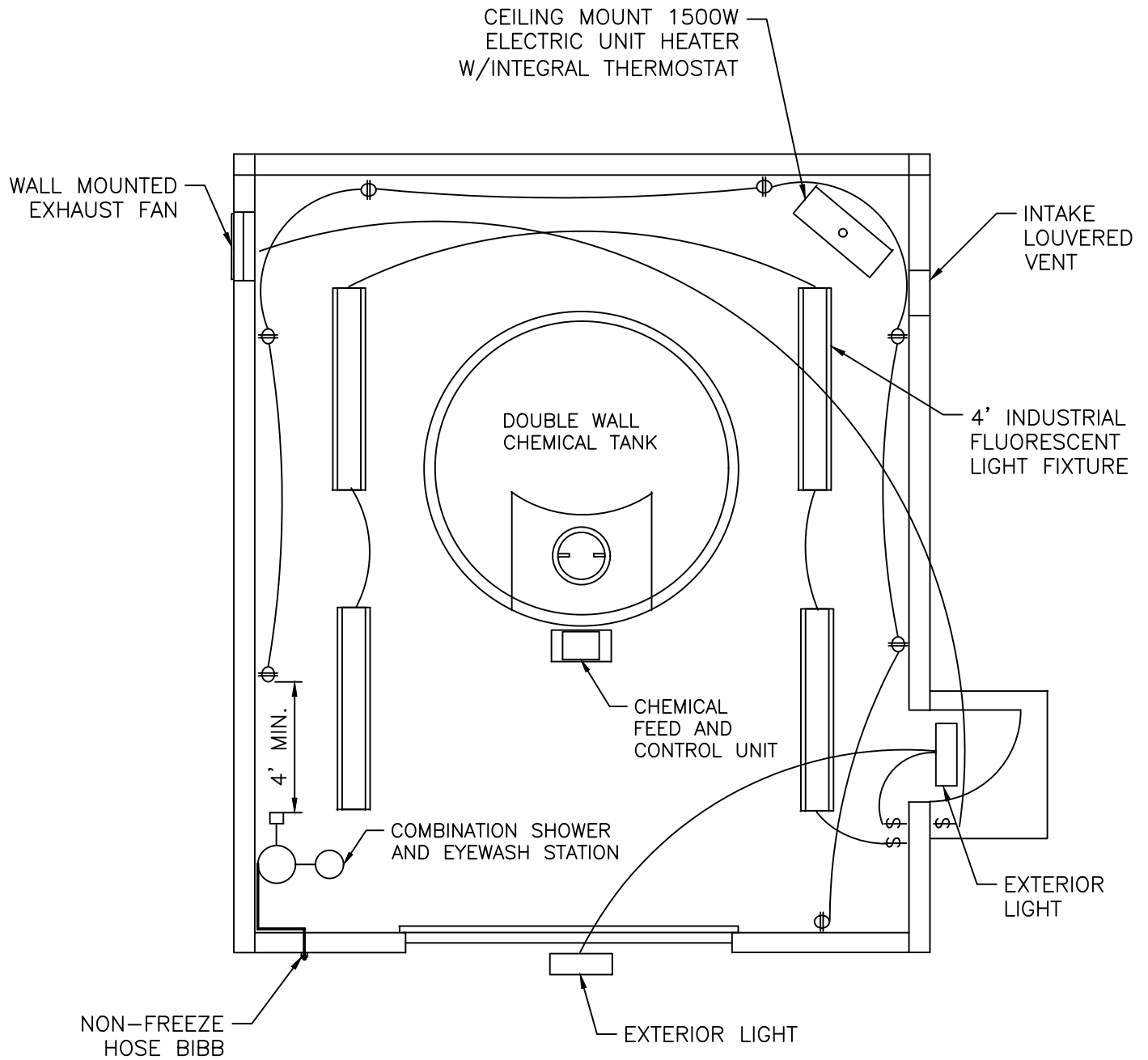
NOT TO SCALE

STANDARD ODOR CONTROL
BLDG. SIDE ELEVATION

S-45

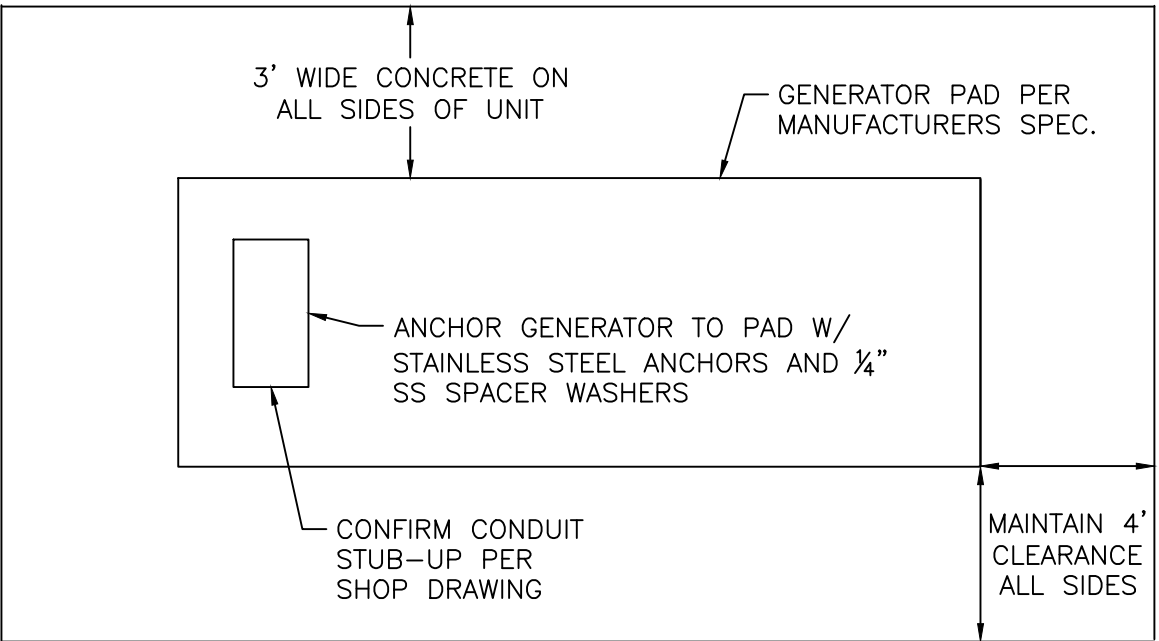
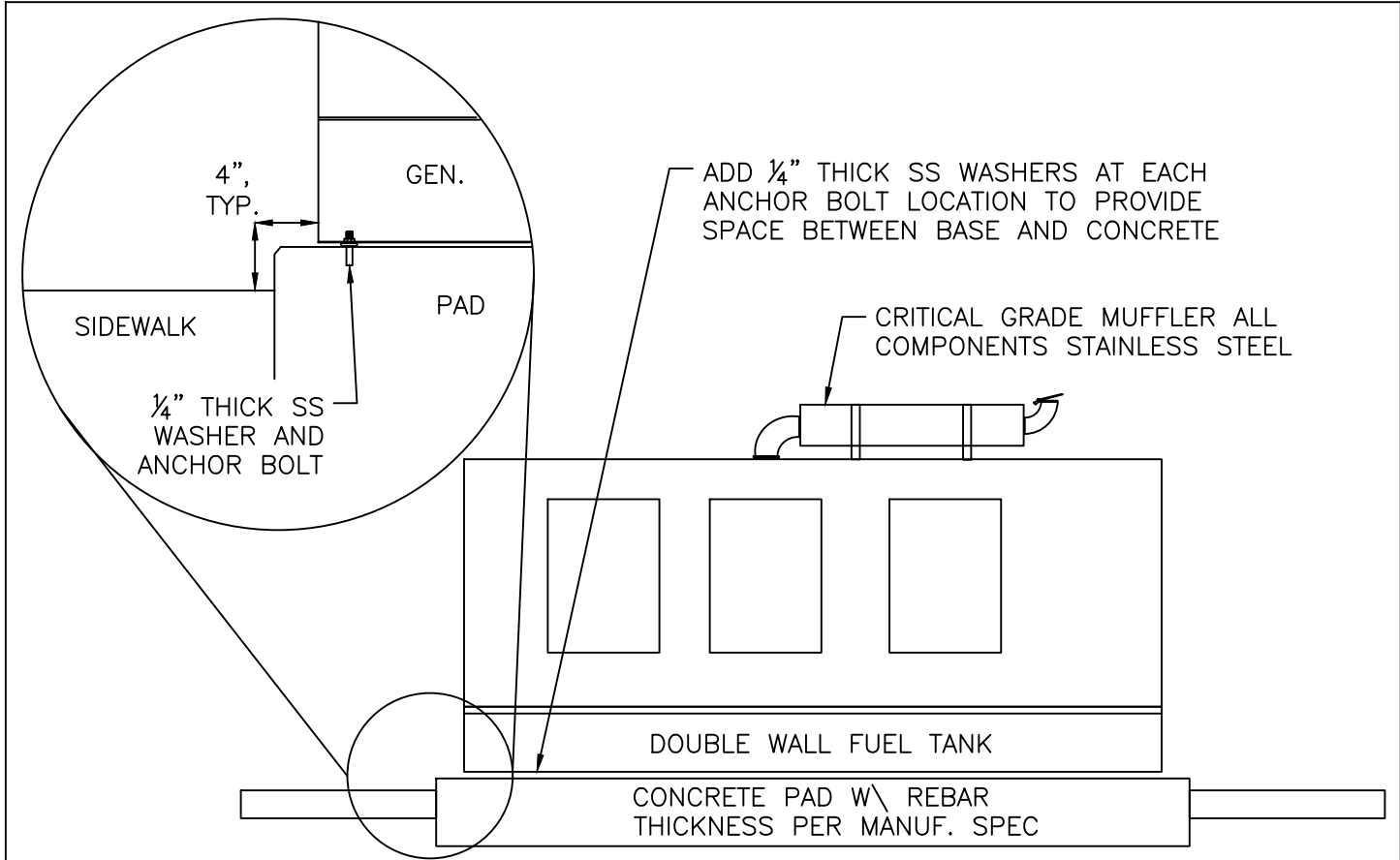


CITY OF RALEIGH STANDARD DETAIL		
REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	STANDARD ODOR CONTROL BLDG. FLOOR ELEVATION	
	S-46	



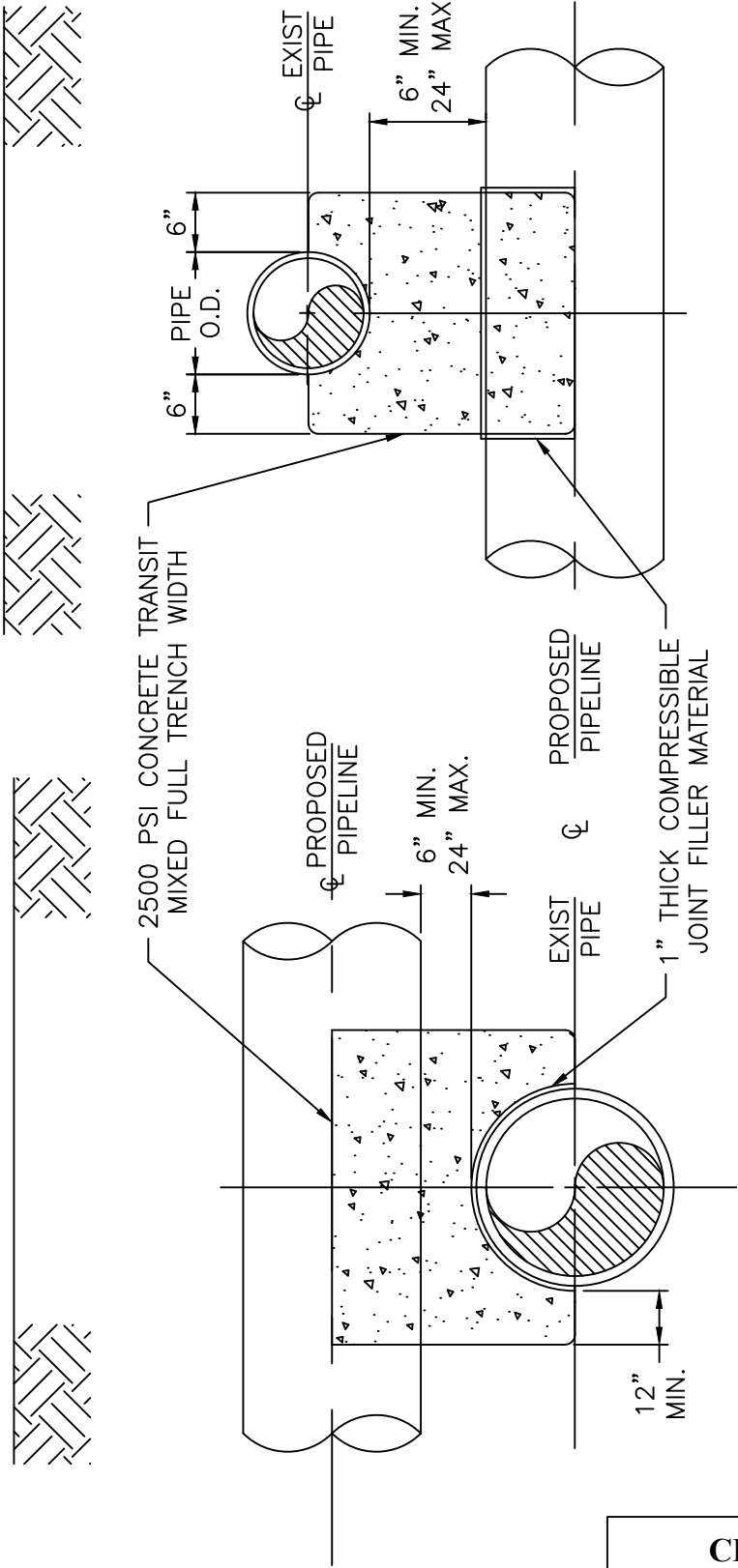
CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	STANDARD ODOR CONTROL BLDG. MECHANICAL & ELECTRICAL	
	S-47	



CITY OF RALEIGH STANDARD DETAIL		
REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	GENERATOR PAD	
		S-48

NOTE:
NO ENCASEMENT REQUIRED FOR SPACE
GREATER THAN 24" FOR SEWER LINES.



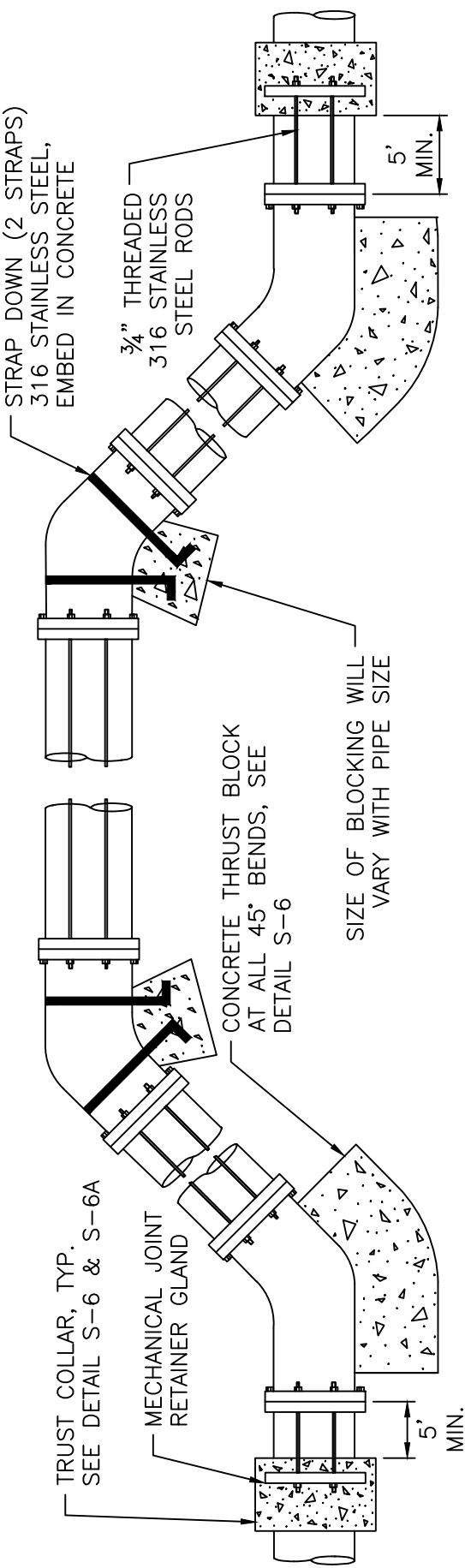
PROPOSED PIPELINE
UNDER EXISTING PIPE

PROPOSED PIPELINE OVER
EXISTING PIPE

CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	CONCRETE CRADLE PROTECTION FOR SEWER LINE CROSSINGS	
	S-49	

TOP OF GROUND



ROD REQUIREMENTS

SIZE OF 45° BEND	STATIC TRUST IN POUNDS	NO. OF RODS REQUIRED
6"	4,328	2
8"	7,694	4
12"	17,312	4
16"	30,779	8
24"	69,252	8

STRAP REQUIREMENTS

STRAP WIDTH	STRAP THICKNESS
1"	3/16"
1.5"	3/16"
2"	1/4"
2"	1/2"
4"	1/2"

RESTRAINT REQUIREMENTS

PIPE DIA	RODDING	RJ GLANDS	THRUST COLLAR	THRUST BLOCKING
<12"	X	X	X	
≥12"	X	X	X	X

"X" DENOTES REQUIRED RESTRAINT.

NOTES:

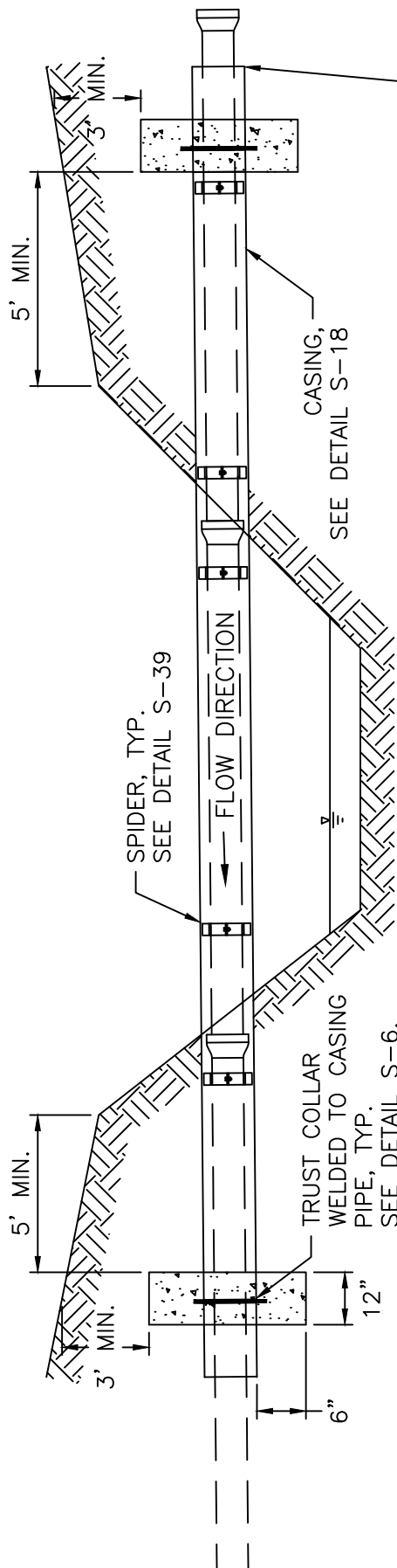
- STEEL RODS AND BOLTS SHALL BE 3/4" 316 STAINLESS STEEL.
- CONCRETE SHALL NOT CONTACT BOLTS OR ENDS OF MECHANICAL JOINT BENDS.
- RESTRAINED MECHANICAL GLANDS TO BE USED AT ALL FITTINGS.
- MUST USE DUCTILE IRON EYE BOLTS WHERE NECESSARY.
- 3' MINIMUM COVER MUST BE MAINTAINED.
- EXTERNAL RESTRAINT REQUIRED. INTEGRAL BELL RESTRAINT REQUIRES DIRECTOR'S APPROVAL.

CITY OF RALEIGH
STANDARD DETAIL

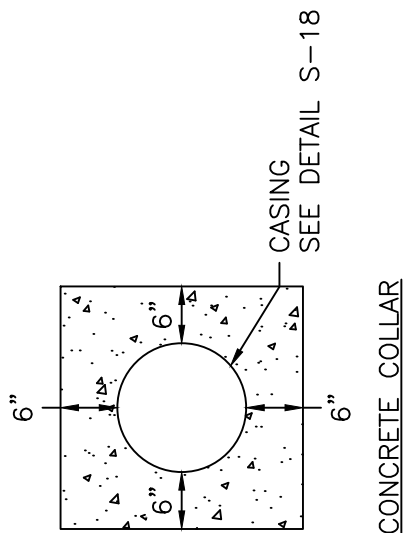
REVISIONS DATE: 05/24/2024 NOT TO SCALE

STANDARD VERTICAL BEND

S-50



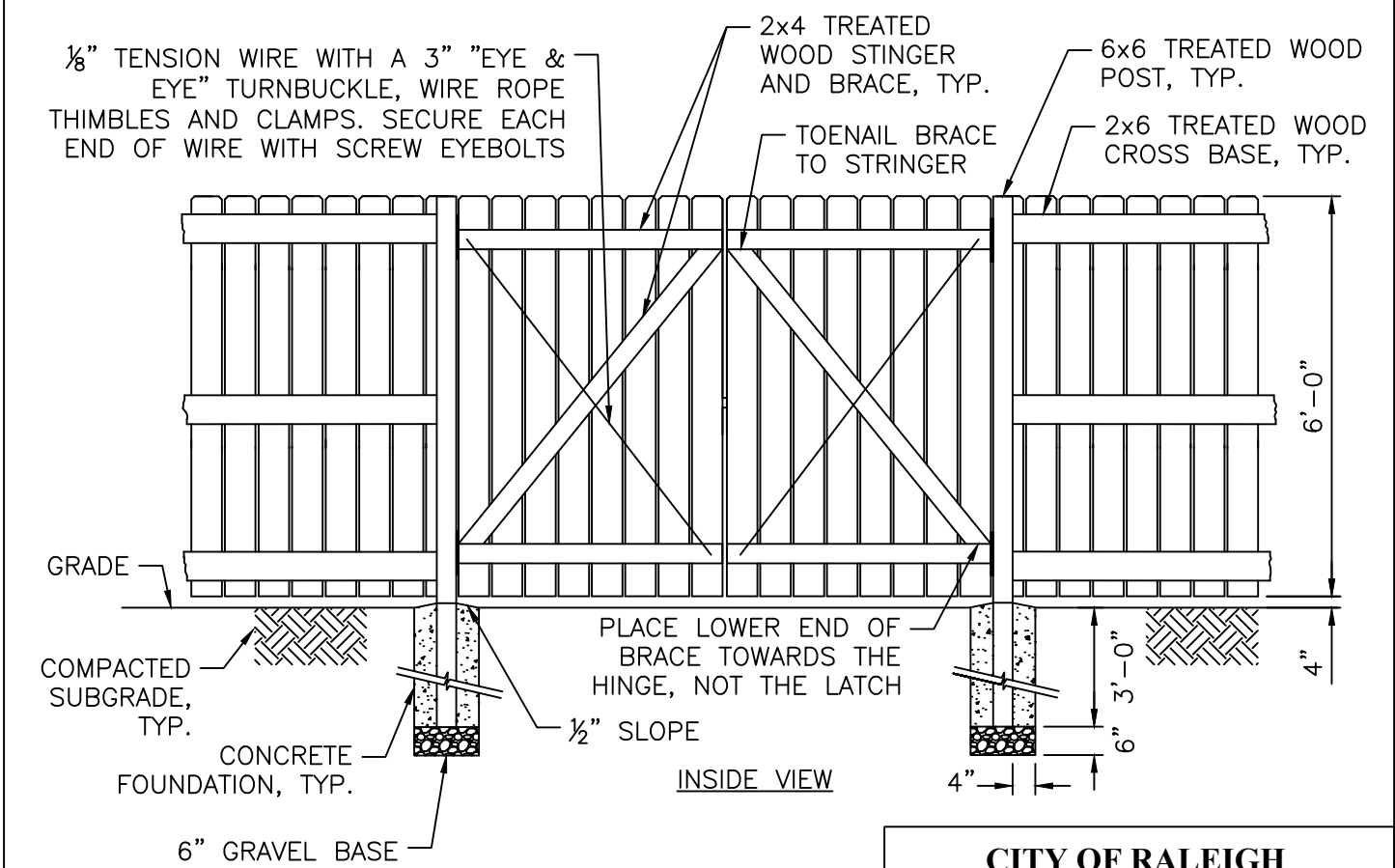
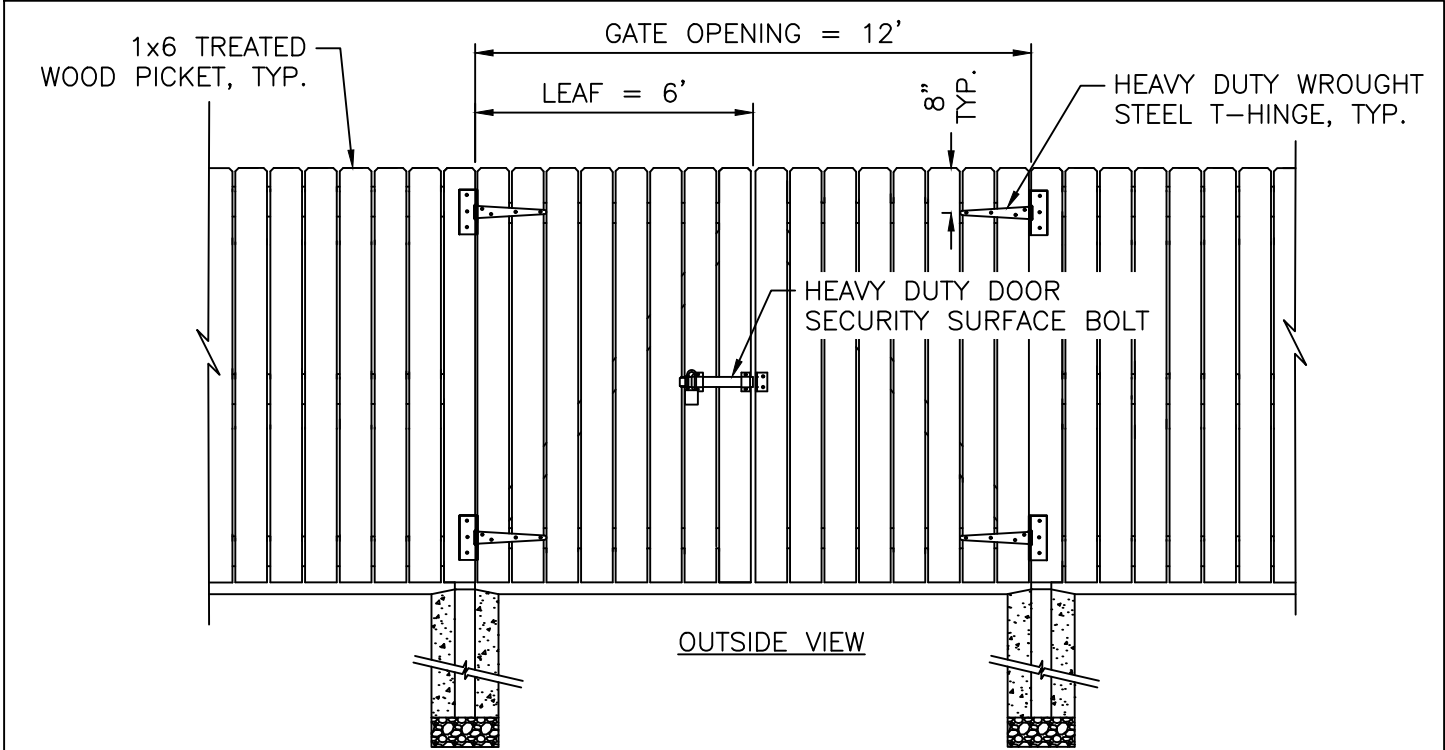
PROFILE VIEW



NOTES:

1. FOR CROSSINGS OF LESS THAN 10' NO CASING IS REQUIRED IF THE JOINT OF PIPE IS CENTERED ON THE CROSSING.
2. THRUST COLLAR MAY BE FIELD WELDED ON STEEL CASING PIPE. IF NO CASING IS REQUIRED THE THRUST COLLAR MUST BE FACTORY WELDED ON DIP CARRIER PIPE.

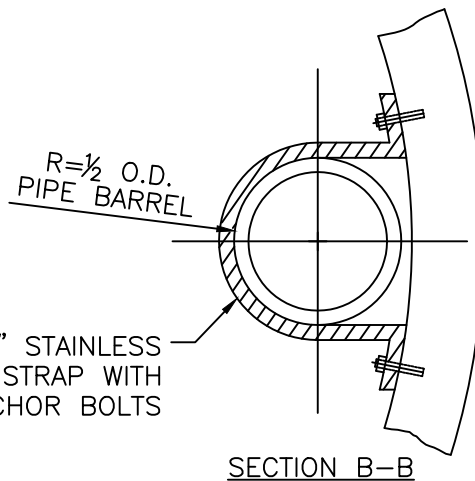
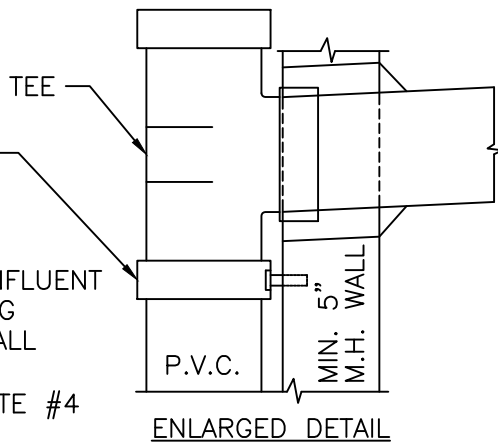
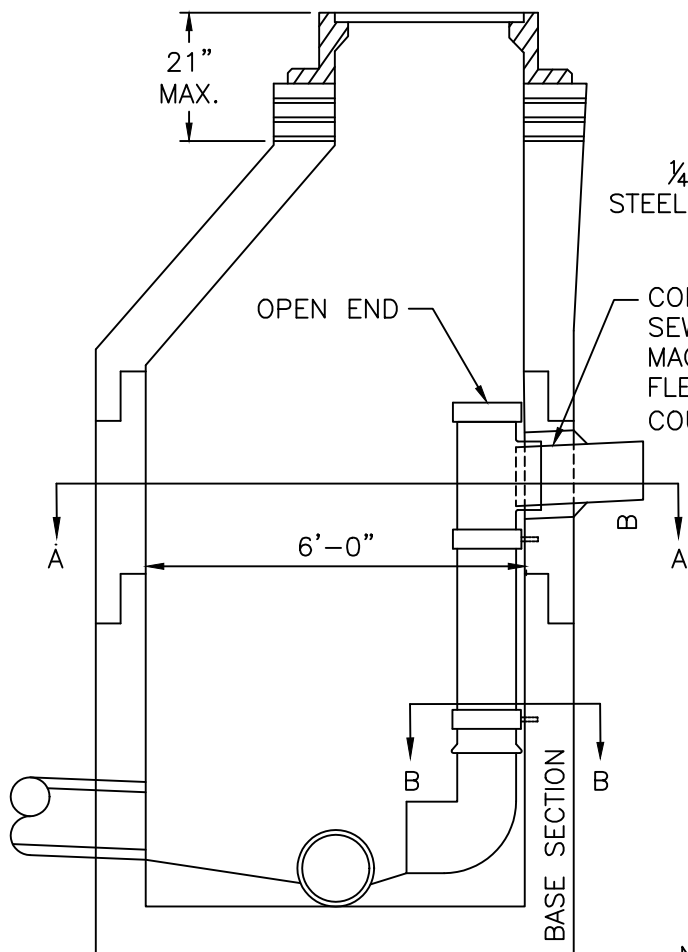
CITY OF RALEIGH STANDARD DETAIL		
REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	AERIAL SEWER SERVICE	
	S-51	



- NOTES:
1. INSTALL 1x6 BOARDS VERTICALLY.
 2. 2x6'S MAY SLOPE OR BE HORIZONTAL TO ACCOUNT FOR GRADE CHANGES.
 3. SPACE 1x6 BOARDS EQUALLY (3/8" MAX).

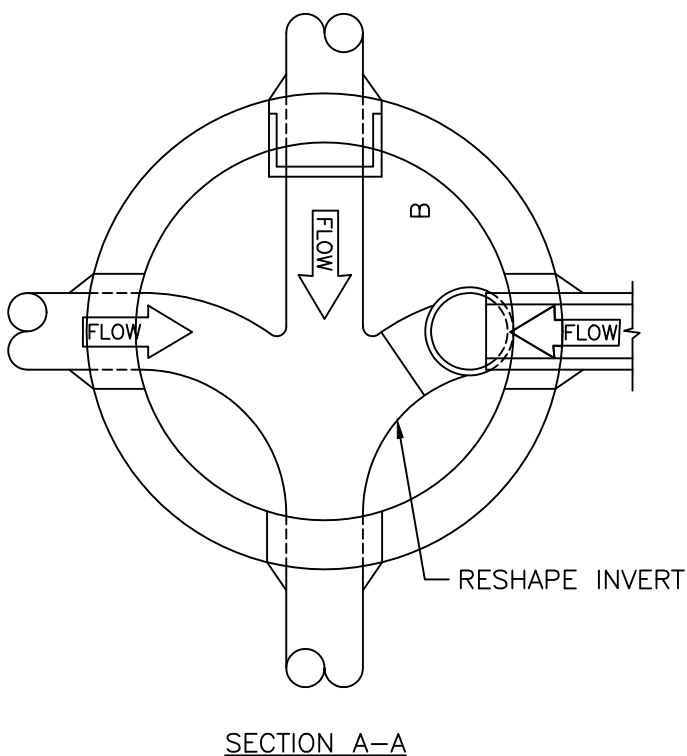
CITY OF RALEIGH STANDARD DETAIL		
REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	WOODEN FENCE GATE	
	S-52	

4" MIN. VERTICAL CLEARANCE
FROM MANHOLE WALL JOINT



NOTES:

1. PIPE FOR INSIDE DROP SHALL BE SDR 35 PVC CONFORMING TO ASTM SPECIFICATION D3034.
2. BOTTOM BEND TO BE 90° SHORT BEND, BELL SPIGOT, OF SDR 35 PVC. SPIGOT OF BEND TO REST DIRECTLY ON EXISTING SHELF. CONSTRUCT MASONRY TROUGH FROM DROP EFFLUENT TO MAIN CHANNEL.
3. LOCATE STRAPS AT TEE AND ABOVE BELL OF 90° BEND AS SHOWN. ADD EXTRA STRAPS AS NECESSARY TO MAINTAIN MAXIMUM SPACING OF TEN FEET.
4. HOLE IN MANHOLE WALL TO BE MADE WITH A CORING MACHINE. INSTALL FLEXIBLE RUBBER COUPLING.
5. CORE HOLE SHALL NOT ENTER CONE SECTION.

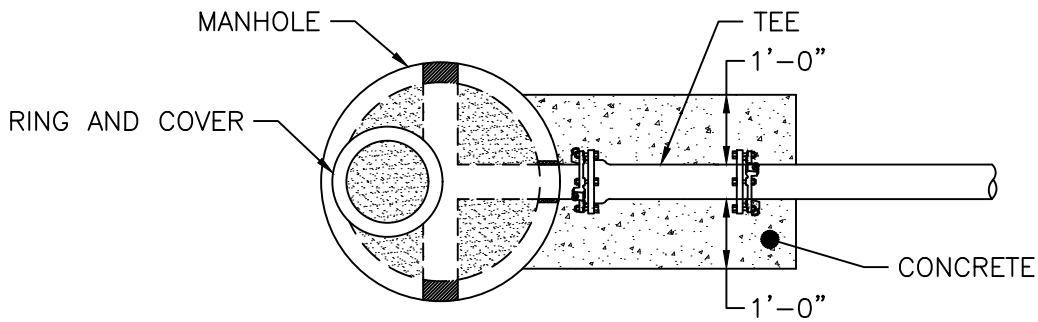


CITY OF RALEIGH
STANDARD DETAIL

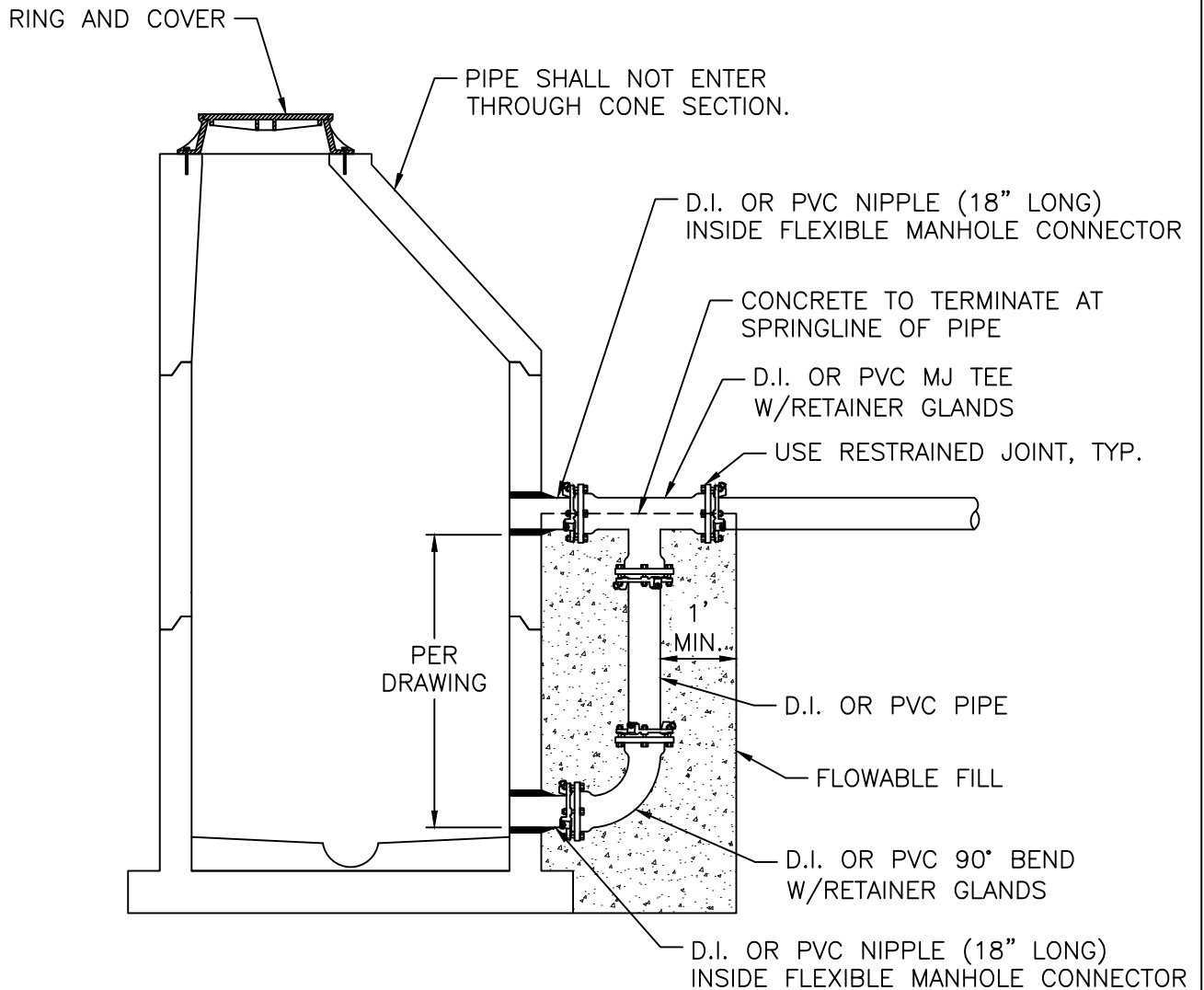
REVISIONS DATE: 05/24/2024 NOT TO SCALE

INSIDE DROP MANHOLE

S-53



PLAN VIEW



SECTION VIEW

NOTES:

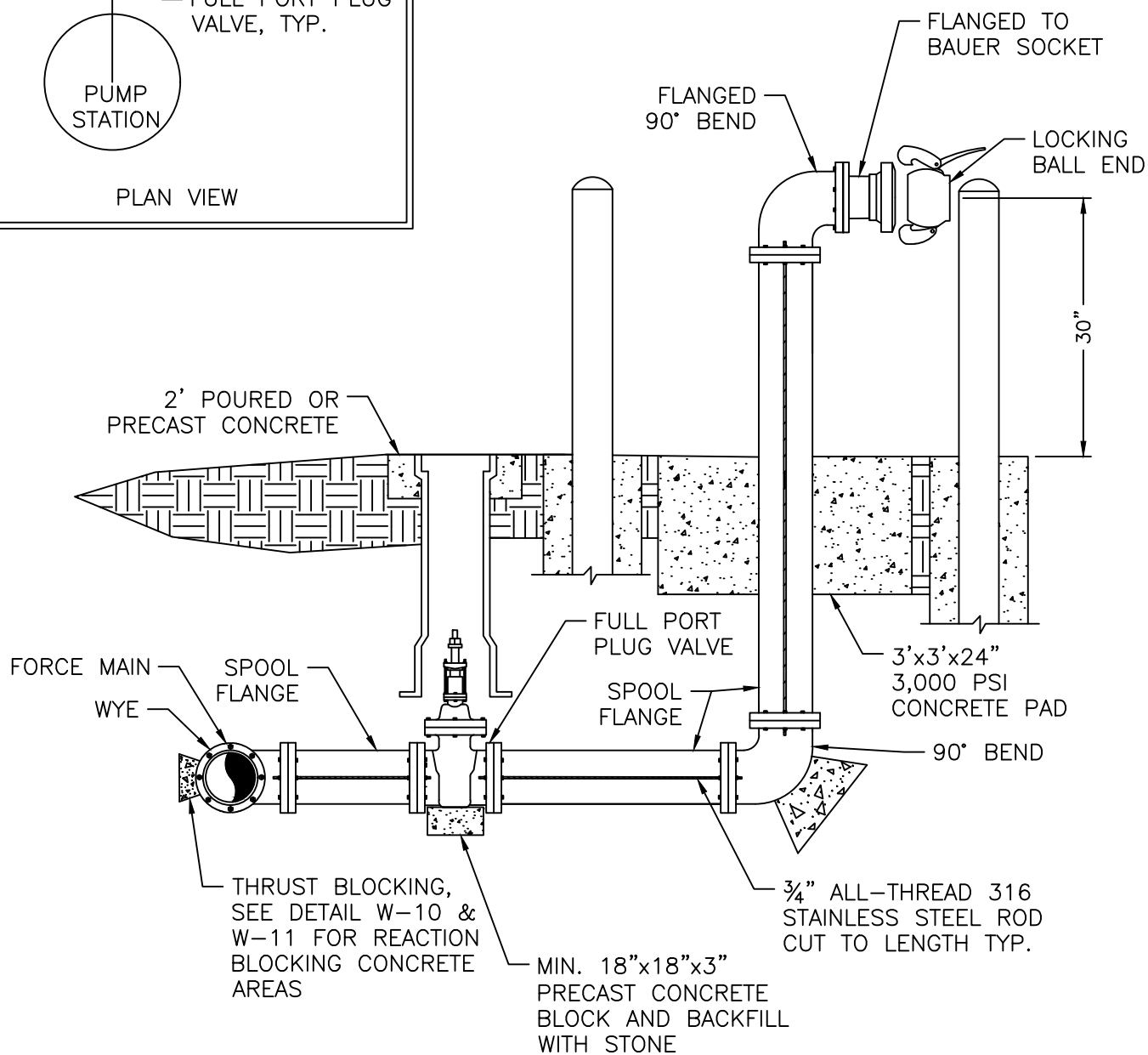
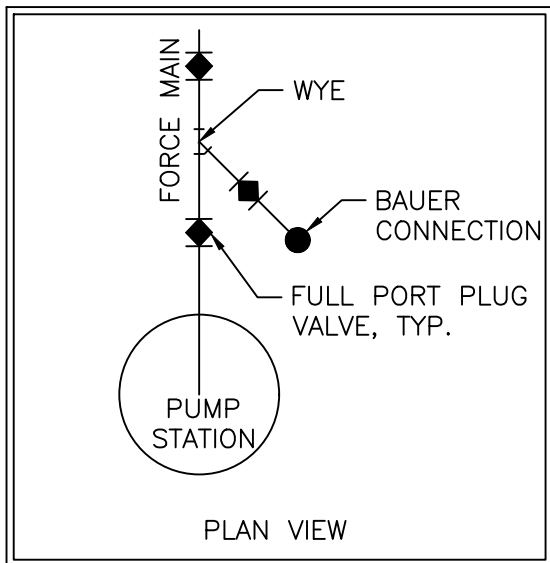
1. ENCASE ENTIRE DROP ASSEMBLY IN CONCRETE. 1' MINIMUM CONC. COVER ON EACH SIDE AND BOTTOM.

**CITY OF RALEIGH
STANDARD DETAIL**

REVISIONS DATE: 05/24/2024 NOT TO SCALE

OUTSIDE DROP MANHOLE

S-54

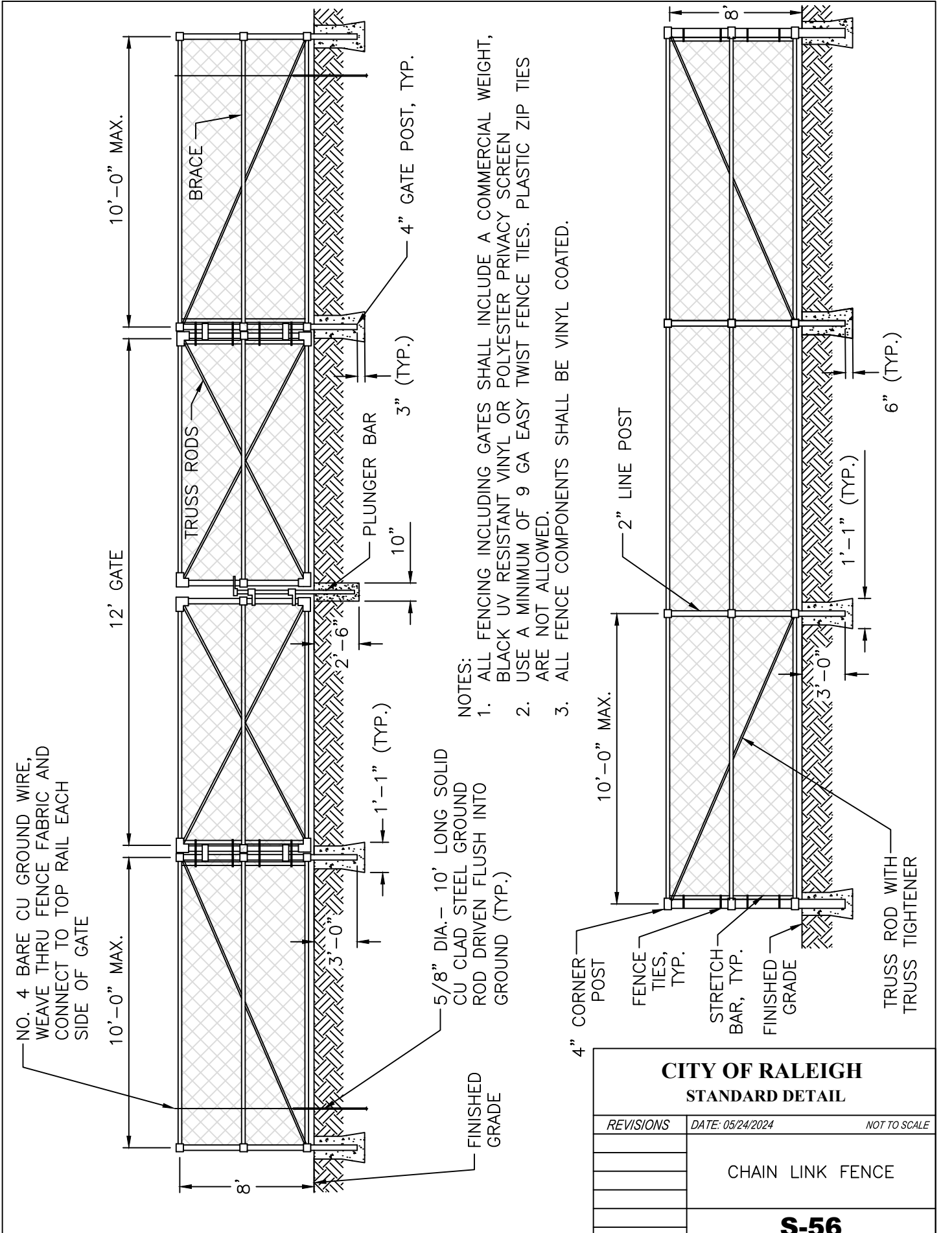


NOTES:

1. BYPASS DIAMETER SHALL MATCH FM DIAMETER UNLESS APPROVED BY RALEIGH WATER.
2. THE DESIGN ENGINEER SHALL LAYOUT BYPASS CONNECTION RISER TO PREVENT MAINTENANCE ACCESS CONFLICTS WITH THE PUMP STATION.

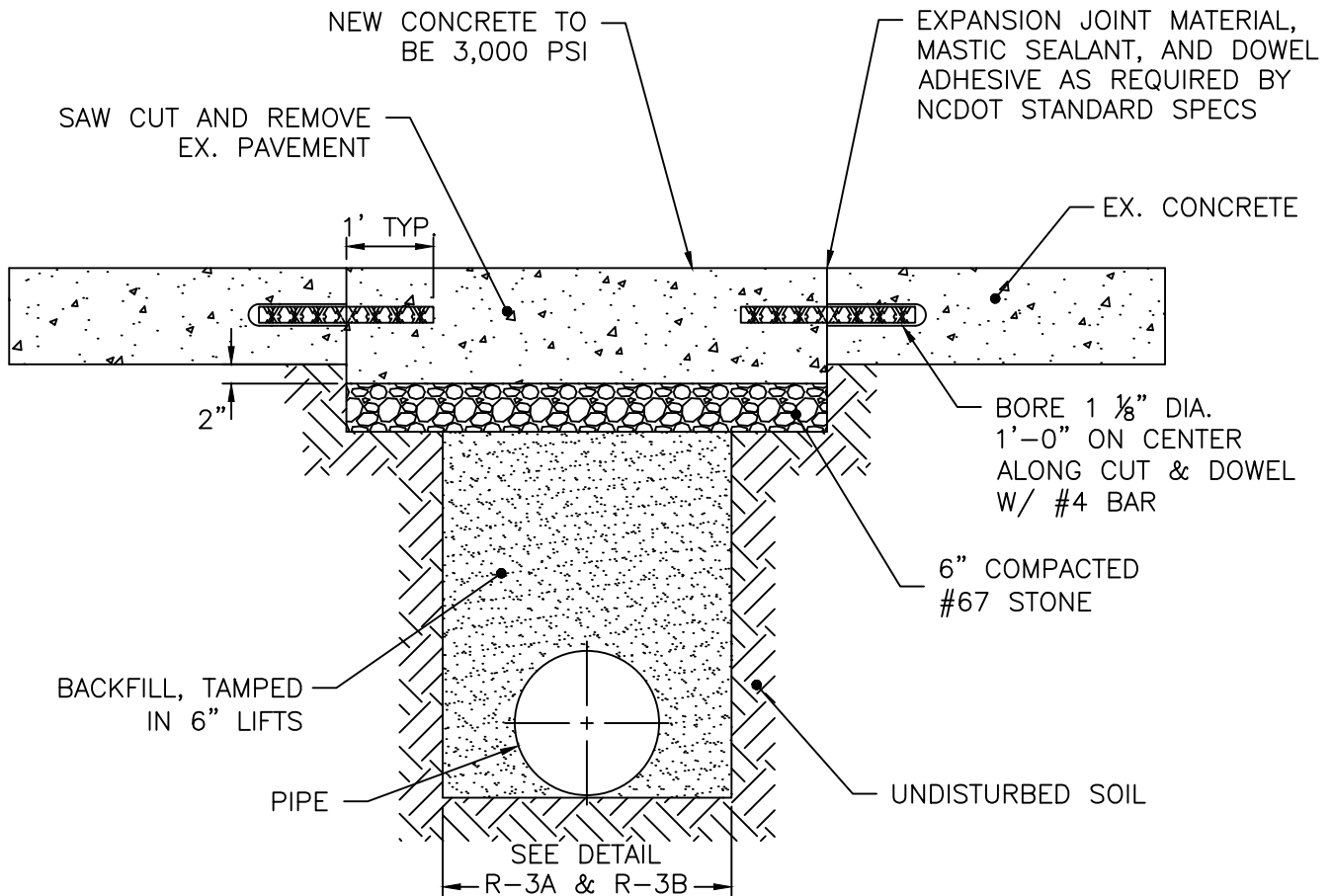
CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	BYPASS CONNECTION FOR PUMP STATIONS AND FORCE MAINS	
	S-55	



- NOTES:
1. ALL FENCING INCLUDING GATES SHALL INCLUDE A COMMERCIAL WEIGHT, BLACK UV RESISTANT VINYL OR POLYESTER PRIVACY SCREEN
 2. USE A MINIMUM OF 9 GA EASY TWIST FENCE TIES. PLASTIC ZIP TIES ARE NOT ALLOWED.
 3. ALL FENCE COMPONENTS SHALL BE VINYL COATED.

CITY OF RALEIGH		
STANDARD DETAIL		
REVISIONS	DATE: 05/24/2024	NOT TO SCALE
	CHAIN LINK FENCE	
	S-56	



NOTES:

1. SEE DETAIL R-3A & R-3B FOR ADDITIONAL TRENCH AND PIPE BEDDING DETAILS.
2. PAVEMENT CUTS WITHIN NCDOT ROW SHALL CONFORM TO THE APPROVED ON SITE ENCROACHMENT PERMIT.
3. THE PAVEMENT CUT SHALL BE DEFINED BY A STRAIGHT EDGE AND CUT WITH AN APPROVED SAW CUT MACHINE.
4. THE TRENCH SUBGRADE MATERIAL SHALL BE BACKFILLED WITH SUITABLE MATERIAL AND COMPACTED TO AT LEAST 95% OF THE MAXIMUM DRY DENSITY AS DETERMINED BY AASHTO T 99 AS MODIFIED BY NCDOT.
5. THE FINAL 6" OF FILL SHALL CONSIST OF ABC MATERIAL COMPACTED TO AT LEAST 100% OF THE MAXIMUM DRY DENSITY AS DETERMINED BY AASHTO T 180 AS MODIFIED BY NCDOT.

CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 01/18/2025	NOT TO SCALE
	STANDARD CONCRETE PAVEMENT PATCH	
	R-1	

SEE TRANSPORTATION DETAIL
T-10.05.1 FOR ASPHALT REPAIR

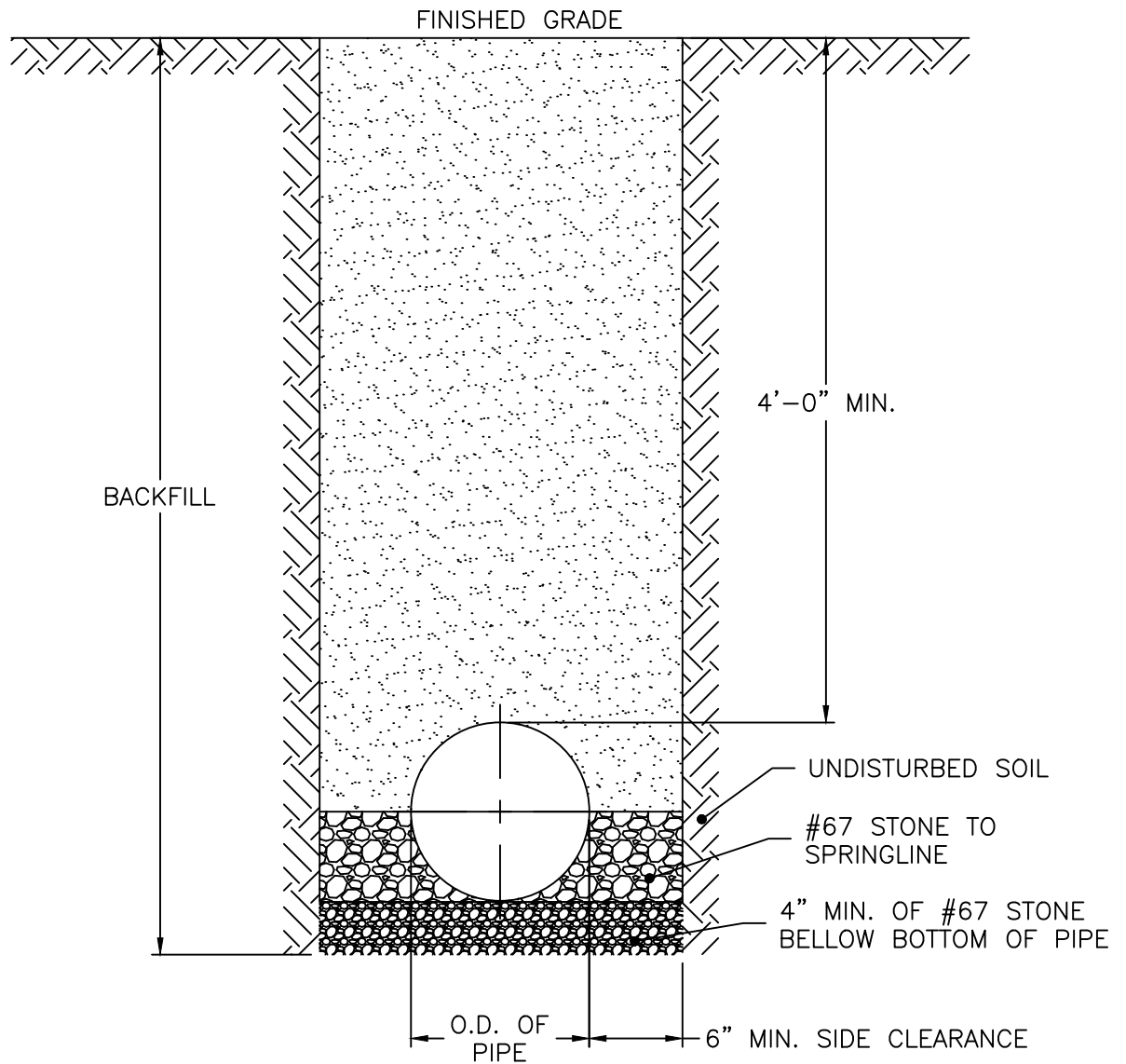
SEE TRANSPORTATION DETAIL
T-10.05.2 FOR ASPHALT REPAIR EXTENTS

CITY OF RALEIGH
STANDARD DETAIL

<i>REVISIONS</i>	<i>DATE: 01/18/2025</i>	<i>NOT TO SCALE</i>
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	STANDARD ASPHALT PAVEMENT PATCH

	R-2
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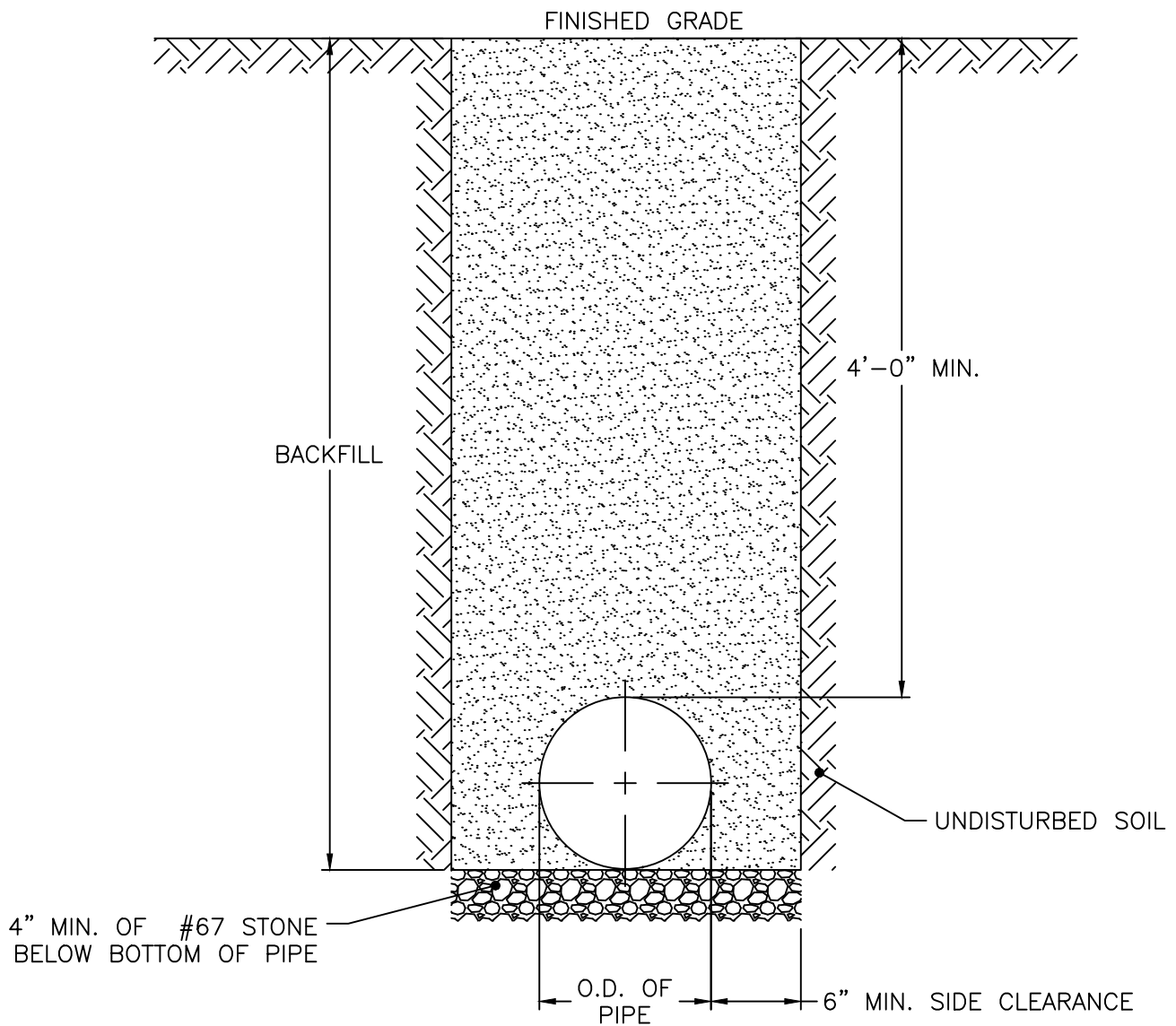


NOTES:

1. TRENCHES REQUIRING SHORING AND BRACING, DIMENSIONS SHALL BE TAKEN FROM THE INSIDE FACE OF THE SHORING AND BRACING.
2. NO ROCKS OR BOULDERS 4" OR LARGER TO BE USED IN BACKFILL.
3. ALL BACKFILL MATERIAL SHALL BE SUITABLE NATIVE MATERIAL.
4. BACKFILL SHALL BE TAMPED IN 6" LIFTS.
5. ACHIEVE 95% COMPACTION IN BACKFILL.

**CITY OF RALEIGH
STANDARD DETAIL**

REVISIONS	DATE: 01/18/2025	NOT TO SCALE
	TRENCH BOTTOM DIMENSIONS AND BACKFILLING REQUIREMENTS FOR PVC REUSE MAINS	
	R-3A	

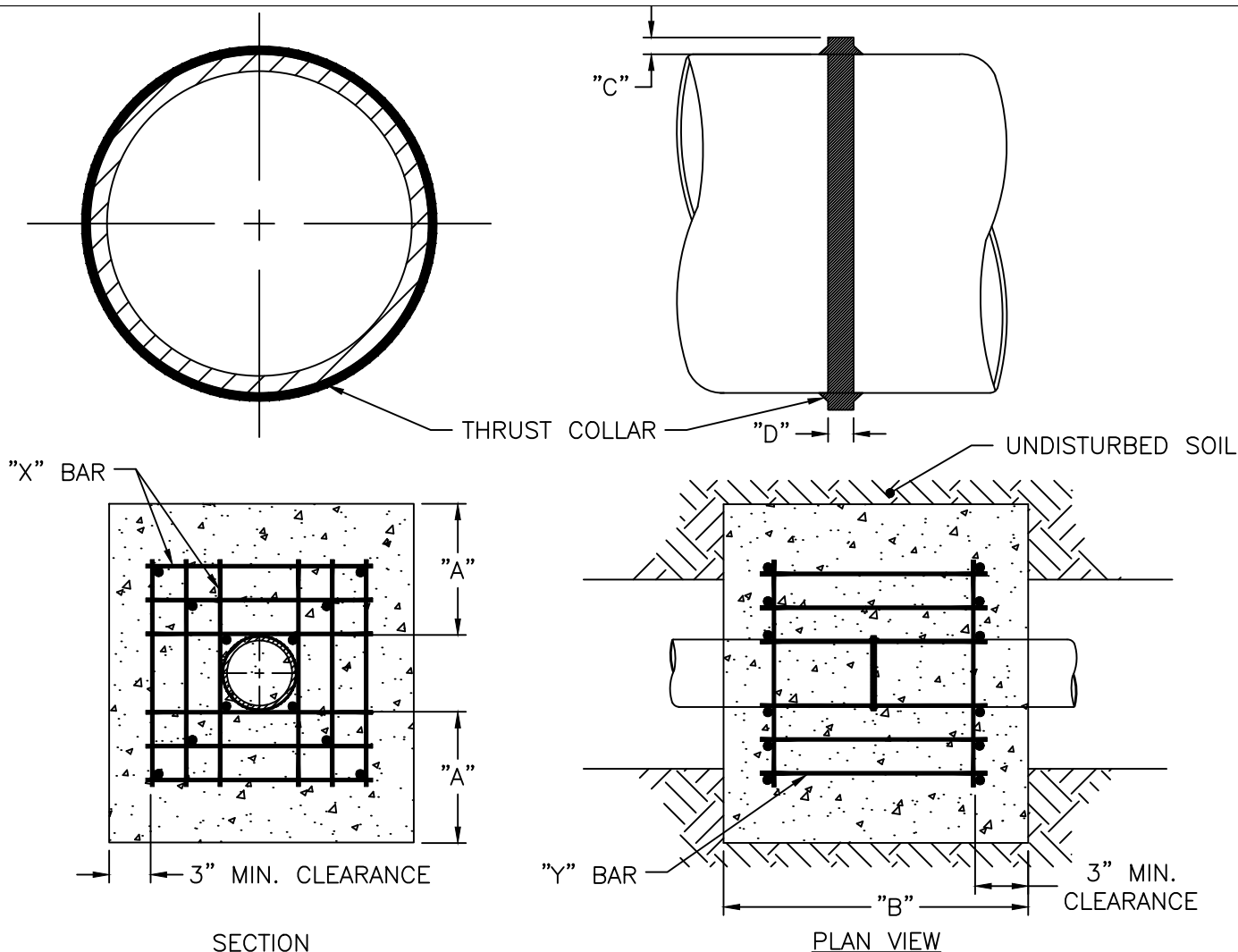


NOTES:

1. TRENCHES REQUIRING SHORING AND BRACING, DIMENSIONS SHALL BE TAKEN FROM THE INSIDE FACE OF THE SHORING AND BRACING.
2. NO ROCKS OR BOULDERS 4" OR LARGER TO BE USED IN BACKFILL.
3. ALL BACKFILL MATERIAL SHALL BE SUITABLE NATIVE MATERIAL.
4. BACKFILL SHALL BE TAMPED IN 6" LIFTS.
5. ACHIEVE 95% COMPACTION IN BACKFILL.

CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 01/18/2025	NOT TO SCALE
	TRENCH BOTTOM DIMENSIONS AND BACKFILLING REQUIREMENTS FOR DI REUSE MAINS	
	R-3B	



REINFORCING REQUIREMENTS

I.D. PIPE	REBAR SIZE	"X" BAR LENGTH	"X" BAR WEIGHT	"Y" BAR LENGTH	"Y" BAR WEIGHT	NO. REQUIRED
6"-36"	#5	2'-2"+ O.D. PIPE	1.043 LBS/FT	1'-1"	1.1 LBS. EACH	X-24 Y-12
≥48"	#6	3'-0"+ O.D. PIPE	1.502 LBS/FT	1'-3"	1.9 LBS. EACH	X-24 Y-12

THRUST COLLAR AND THRUST SCHEDULE

I.D. PIPE	"A"	"B"	"C"	"D"
6"-16"	1'-4"	1'-7"	2"	$\frac{3}{8}$ "
20"-24"	1'-4"	1'-7"	3"	$\frac{1}{2}$ "
30"-36"	1'-4"	1'-7"	4"	$\frac{5}{8}$ "
≥48"	1'-8"	1'-9"	6"	$\frac{7}{8}$ "

NOTES:

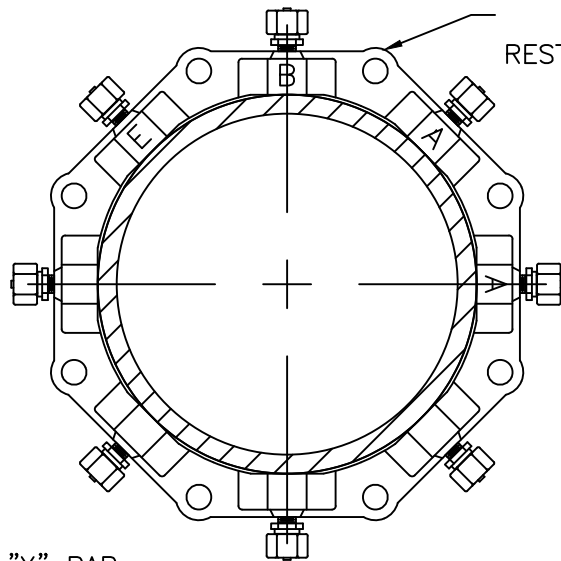
1. SEE DETAIL R-6 FOR THRUST BLOCK LOCATIONS.
2. CONCRETE SHALL BE 3,000 PSI AND TRANSIT MIXED.
3. REINFORCING BARS SHALL BE DEFORMED AND TIED TOGETHER.
4. TRENCH BOTTOM WIDTH IN VICINITY OF THRUST BLOCK INSTALLATION SHALL BE THE MINIMUM WIDTH AS SHOWN ON DETAIL R-3A.
5. BACKFILL TAMPED IN 6" LIFTS, SEE DETAIL R-3A.
6. THRUST COLLAR MUST BE FACTORY WELDED ON BOTH SIDES ALONG BOTH EDGES OF COLLAR AROUND CIRCUMFERENCE.

CITY OF RALEIGH
STANDARD DETAIL

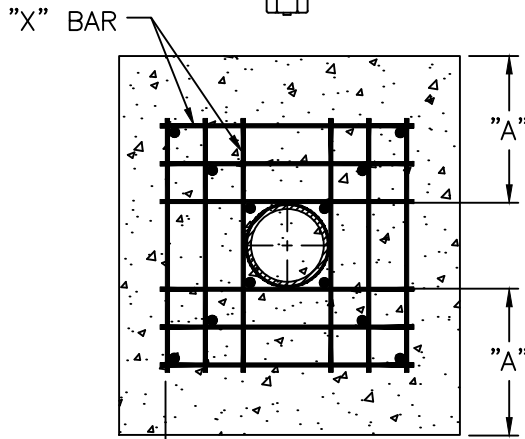
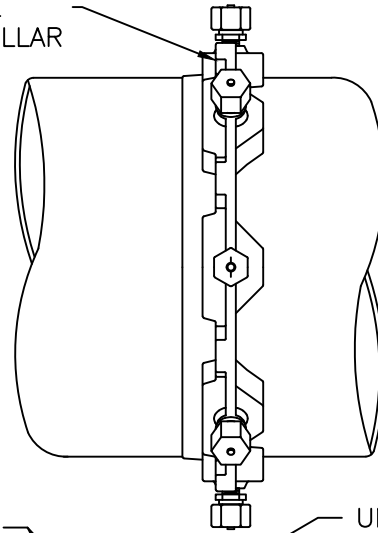
REVISIONS DATE: 01/18/2025 NOT TO SCALE

THRUST BLOCKING DESIGN
DATA FOR DI REUSE MAINS

R-4A

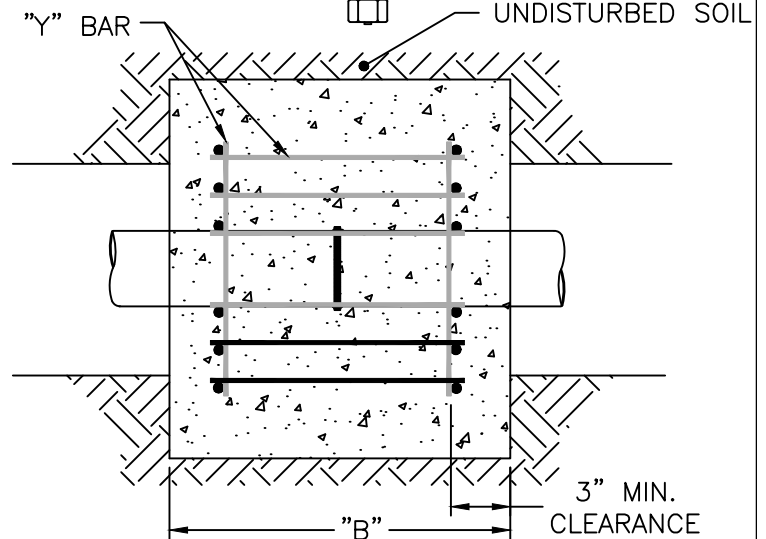


MECHANICAL
RESTRAINING COLLAR



3" MIN.
CLEARANCE

SECTION



PLAN VIEW

REINFORCING REQUIREMENTS

I.D. PIPE	REBAR SIZE	"X" BAR LENGTH	"X" BAR WEIGHT	"Y" BAR LENGTH	"Y" BAR WEIGHT	NO. REQUIRED
6"-36"	#5	2'-2"+ O.D. PIPE	1.043 LBS/FT	1'-1"	1.1 LBS. EACH	X-24 Y-12
≥48"	#6	3'-0"+ O.D. PIPE	1.502 LBS/FT	1'-3"	1.9 LBS. EACH	X-24 Y-12

THRUST COLLAR AND
THRUST SCHEDULE

I.D. PIPE	"A"	"B"
6"-16"	1'-4"	1'-7"
20"-24"	1'-4"	1'-7"
30"-36"	1'-4"	1'-7"
≥48"	1'-8"	1'-9"

NOTES:

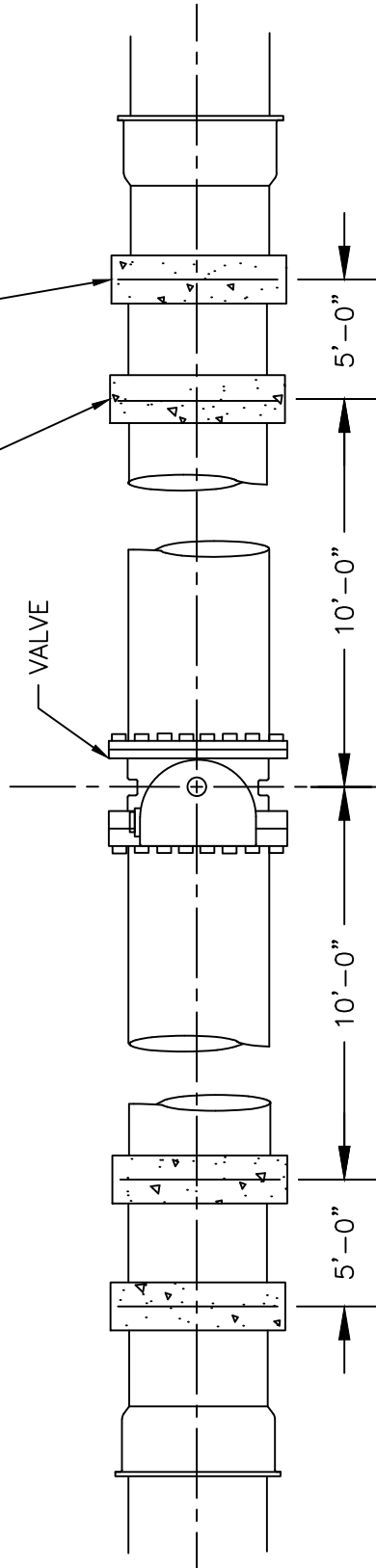
- SEE DETAIL R-6 FOR THRUST BLOCK LOCATIONS.
- CONCRETE SHALL BE 3,000 PSI AND TRANSIT MIXED.
- REINFORCING BARS SHALL BE DEFORMED AND TIED TOGETHER.
- TRENCH BOTTOM WIDTH IN VICINITY OF THRUST BLOCK INSTALLATION SHALL BE THE MINIMUM WIDTH AS SHOWN ON DETAIL R-3B.
- BACKFILL TAMPED IN 6" LIFTS, SEE DETAIL R-3B.
- MECHANICAL RESTRAINING COLLAR SHALL BE AS MANUFACTURED BY MEGA-LUG OR EQUAL.

CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 01/18/2025	NOT TO SCALE
	THRUST BLOCKING DESIGN DATA FOR PVC REUSE MAINS	
	R-4B	

16" MAIN - 1 THRUST BLOCK
REQUIRED, ON MAINS GREATER THAN
16" 2 THRUST BLOCKS REQUIRED.

STANDARD THRUST BLOCK,
SEE DETAIL R-4A OR R-4B

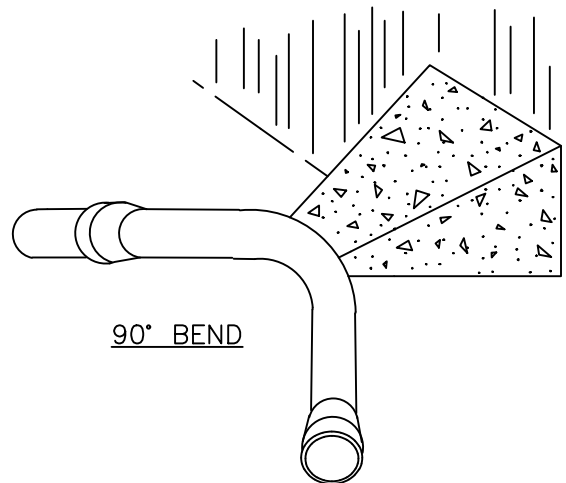
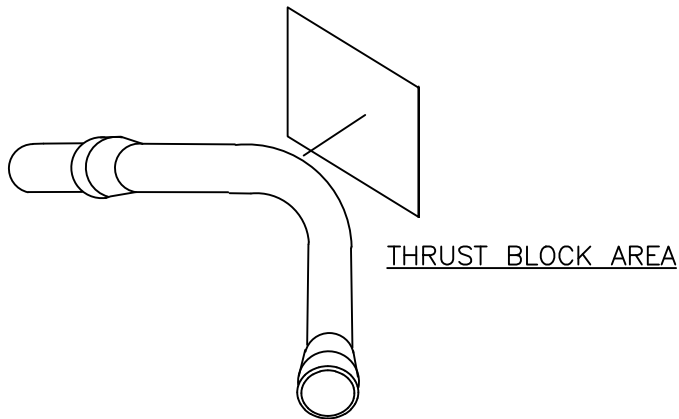
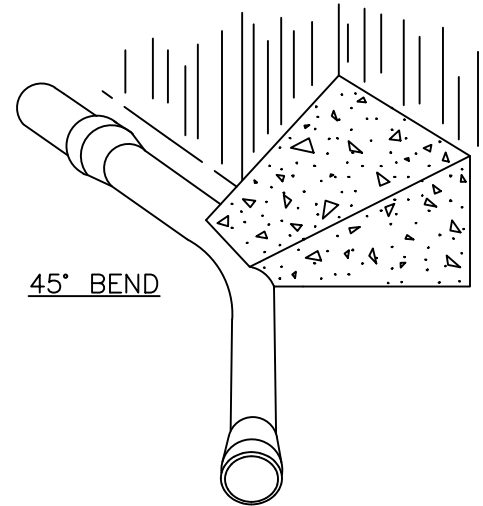
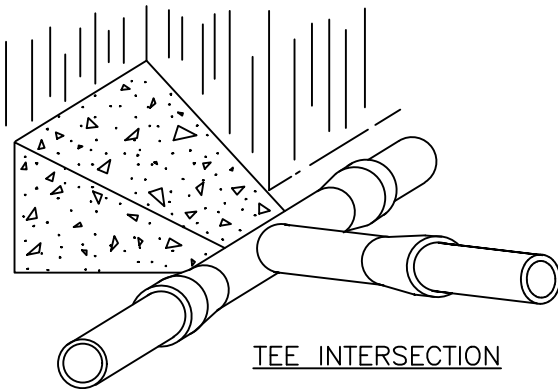


THRUST BLOCKING AT VALVES 16" AND LARGER

CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 01/18/2025	NOT TO SCALE
	THRUST BLOCK INSTALLATION FOR 16" AND LARGER VALVES AND DEAD END REUSE MAINS	
	R-5	

THRUST BLOCKING



NOTES:

1. CONCRETE SHALL BE 3,000 PSI.
2. CONCRETE SHALL NOT CONTACT BOLTS OR ENDS OF MECHANICAL JOINT FITTINGS.
3. TRENCHES SHALL CONFORM TO DETAIL R-3A & R-3B.
4. SEE DETAIL R-7 & R-8 (THRUST BLOCK TABLES), FOR AREA OF CONCRETE REQUIRED.
5. ALL BENDS AND INTERSECTIONS SHALL HAVE CONCRETE THRUST BLOCKING.

CITY OF RALEIGH STANDARD DETAIL

REVISIONS	DATE: 01/18/2025	NOT TO SCALE
	THRUST BLOCKING VIEWS	
		R-6

REACTION BEARING AREAS FOR HORIZONTAL WATER PIPE BENDS
BASED ON TEST PRESSURE OF 200 PSI

ALL AREAS GIVEN IN SQUARE FEET

SIZE OF BEND	DEGREE OF BEND	STATIC THRUST IN POUNDS	MODERATELY DRY CLAY 4,000 LBS/FT ²	SOFT CLAY 2,000 LBS/FT ²	1,600 LBS/FT ² GRAVEL/COARSE SAND	8,000 LBS/FT ² DRY CLAY (ALWAYS DRY)	SAND, COMPACT FIRM 8,000 LBS/FT ²	SAND—CLEAN DRY 4,000 LBS/FT ²	SOIL 1,000 LBS/FT ² QUICKSAND (VERY POOR)	ROCK—POOR 10,000 LBS/FT ²
6"	11 ¼°	1,108	1	1	1	1	1	1	2	1
	22 ½°	2,207	1	2	2	1	1	1	3	1
	45°	4,328	2	3	3	1	1	2	5	1
	90°	7,996	2	4	5	1	1	2	8	1
	PLUG	5,655	2	3	4	1	1	2	6	1
8"	11 ¼°	1,970	1	1	2	1	1	1	2	1
	22 ½°	3,922	1	2	3	1	1	1	4	1
	45°	7,694	2	4	5	1	1	2	8	1
	90°	14,215	4	8	9	2	2	4	15	2
	PLUG	10,053	3	5	6	2	2	3	10	1
12"	11 ¼°	4,433	2	3	3	1	1	2	5	1
	22 ½°	8,826	3	5	6	2	2	3	9	1
	45°	17,312	5	9	11	3	3	5	18	2
	90°	31,983	8	16	19	4	4	8	32	4
	PLUG	22,619	6	12	14	3	3	6	23	3
16"	11 ¼°	7,881	2	4	5	1	1	2	8	1
	22 ½°	15,691	4	8	10	2	2	4	16	2
	45°	30,779	8	16	19	4	4	8	31	4
	90°	56,861	15	29	35	8	8	15	57	6
	PLUG	40,213	10	21	25	5	5	10	41	5

NOTES:

- REACTION BEARING AREAS ARE IN SQUARE FEET MEASURED IN A VERTICAL PLANE IN THE TRENCH SIDE AT AN ANGLE OF 90° TO THE THRUST VECTOR.
- USE 6" 90° BEND VALUE FOR HYDRANTS FOR ADDITIONAL SAFETY FACTOR.

CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 01/18/2025	NOT TO SCALE
	THRUST BLOCKING DESIGN QUANTITY TABLE	
	R-7	

REACTION BEARING AREAS FOR HORIZONTAL WATER PIPE BENDS
BASED ON TEST PRESSURE OF 200 PSI

ALL AREAS GIVEN IN SQUARE FEET

SIZE OF BEND	DEGREE OF BEND	STATIC THRUST IN POUNDS	MODERATELY DRY CLAY 4,000 LBS/FT ²	SOFT CLAY 2,000 LBS/FT ²	1,600 LBS/FT ² GRAVEL/COARSE SAND	8,000 LBS/FT ² DRY CLAY (ALWAYS DRY)	SAND, COMPACT FIRM 8,000 LBS/FT ²	SAND—CLEAN DRY 4,000 LBS/FT ²	SOIL 1,000 LBS/FT ² QUICKSAND (VERY POOR)	ROCK—POOR 10,000 LBS/FT ²
24"	11 ¼°	17,734	5	9	11	3	3	5	18	2
	22 ½°	35,305	9	18	22	5	5	9	36	4
	45°	69,252	18	35	42	9	9	18	70	7
	90°	127,936	32	64	77	16	16	32	128	113
	PLUG	90,478	23	46	55	12	12	23	91	10
30"	11 ¼°	27,709	7	14	17	4	4	7	2	3
	22 ½°	55,163	14	28	34	7	7	14	56	6
	45°	108,206	28	55	65	14	14	28	109	11
	90°	199,900	50	100	120	25	25	50	200	20
	PLUG	141,372	36	71	85	18	18	36	142	15
36"	11 ¼°	39,901	10	20	24	5	5	10	40	4
	22 ½°	79,439	20	40	48	10	10	20	30	8
	45°	155,816	39	78	94	20	20	39	156	16
	90°	287,855	72	144	172	36	36	72	288	29
	PLUG	203,575	51	102	122	26	26	51	204	21
48"	11 ¼°	70,935	18	36	43	9	9	18	71	8
	22 ½°	141,218	36	71	85	18	18	36	142	15
	45°	277,007	70	139	166	35	35	70	277	28
	90°	511,742	128	256	320	64	64	128	512	52
	PLUG	361,911	91	181	217	46	46	91	362	37

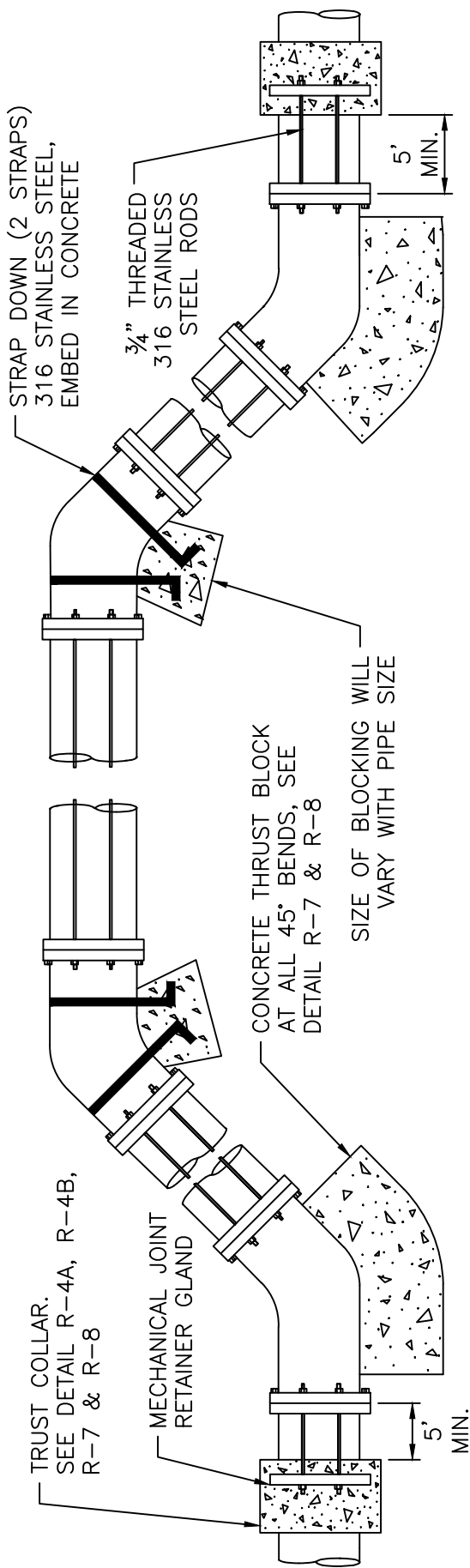
NOTES:

- REACTION BEARING AREAS ARE IN SQUARE FEET MEASURED IN A VERTICAL PLANE IN THE TRENCH SIDE AT AN ANGLE OF 90° TO THE THRUST VECTOR.
- USE 6" 90° BEND VALUE FOR HYDRANTS FOR ADDITIONAL SAFETY FACTOR.

CITY OF RALEIGH
STANDARD DETAIL

REVISIONS	DATE: 01/18/2025	NOT TO SCALE
	THRUST BLOCKING DESIGN QUANTITY TABLE	
	R-8	

TOP OF GROUND



ROD REQUIREMENTS			STRAP REQUIREMENTS	
SIZE OF 45° BEND	STATIC TRUST IN POUNDS	NO. OF RODS REQUIRED	STRAP WIDTH	STRAP THICKNESS
6"	4,328	2	1"	3/16"
8"	7,694	4	1.5"	3/16"
12"	17,312	4	2"	1/4"
16"	30,779	8	2"	1/2"
24"	69,252	8	4"	1/2"

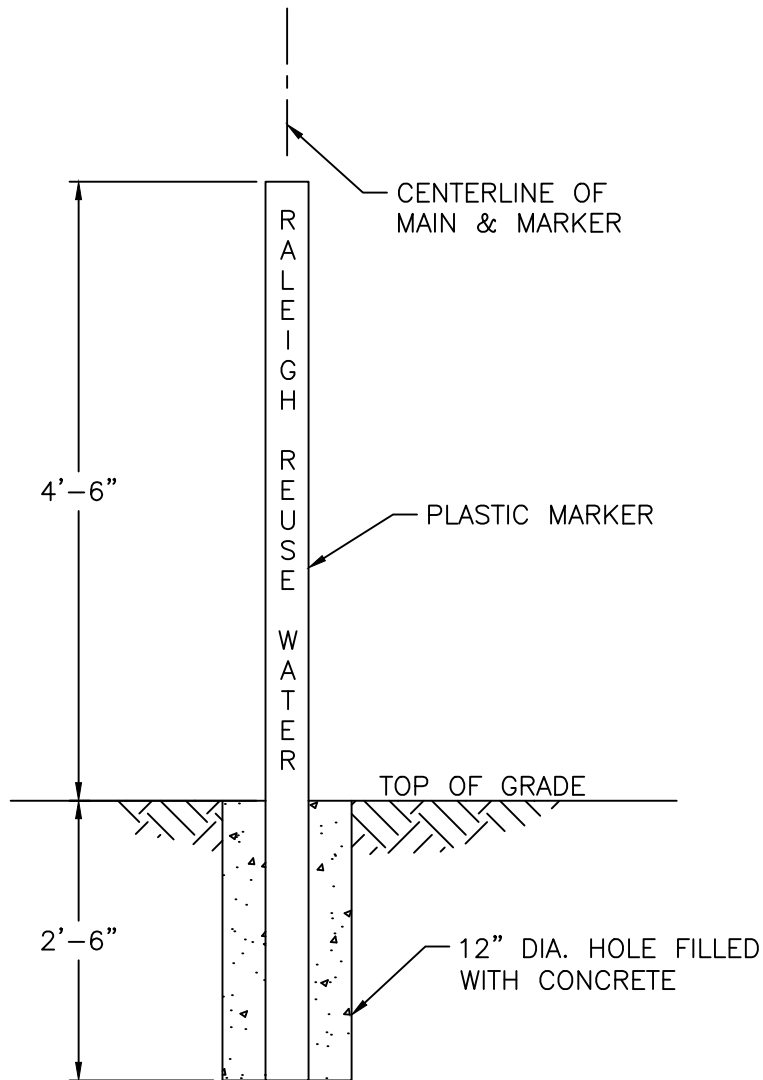
RESTRAINT REQUIREMENTS				
PIPE DIA	RODDING	RJ GLANDS	THRUST COLLAR	THRUST BLOCKING
<12"	X	X	X	
≥12"	X	X	X	X

"X" DENOTES REQUIRED RESTRAINT.

NOTES:

1. STEEL RODS AND BOLTS SHALL BE 3/4" 316 STAINLESS STEEL.
2. CONCRETE SHALL NOT CONTACT BOLTS OR ENDS OF MECHANICAL JOINT BENDS.
3. RESTRAINED MECHANICAL GLANDS TO BE USED AT ALL FITTINGS.
4. MUST USE DUCTILE IRON EYE BOLTS WHERE NECESSARY.
5. 3' MINIMUM COVER MUST BE MAINTAINED.
6. EXTERNAL RESTRAINT REQUIRED. INTEGRAL BELL RESTRAINT REQUIRES DIRECTOR'S APPROVAL.

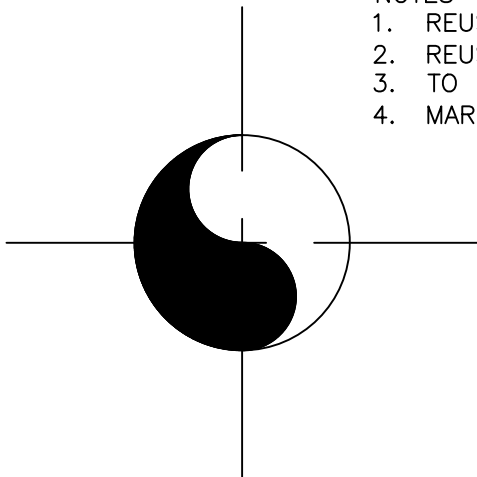
CITY OF RALEIGH		
STANDARD DETAIL		
REVISIONS	DATE: 01/18/2025	NOT TO SCALE
	STANDARD VERTICAL BEND	
	R-9	



REUSE WATER

NOTES

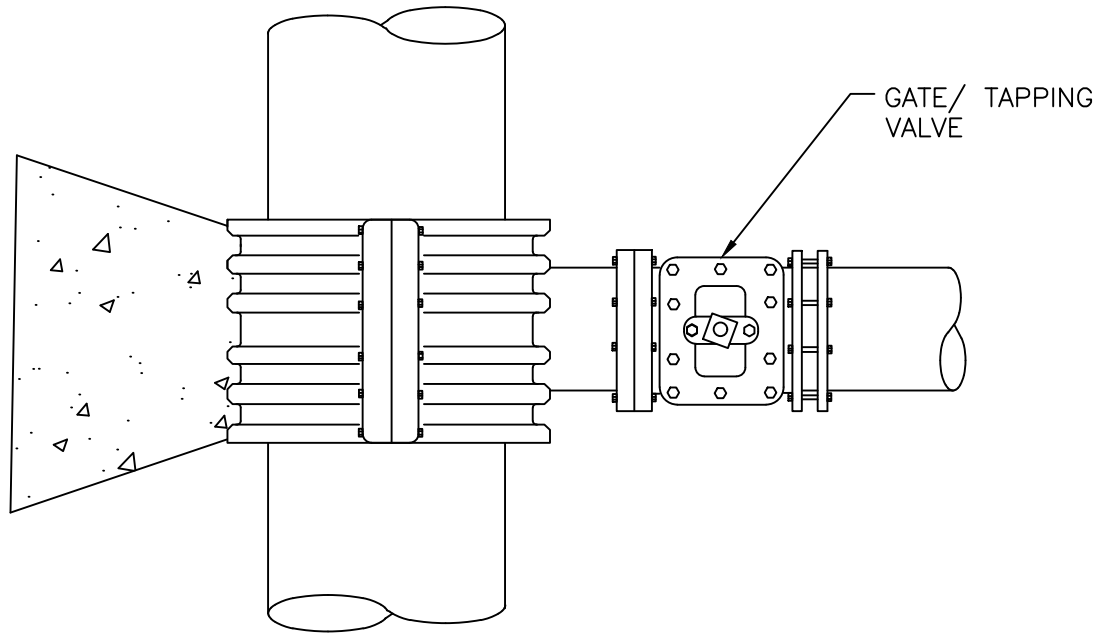
1. REUSE WATER MARKER TO BE PURPLE IN COLOR.
2. REUSE WATER MARKER TO BE LABELED "RALEIGH REUSE WATER".
3. TO BE SPACED ALONG CENTERLINE OF MAIN EVERY 300 FEET.
4. MARKERS TO BE ROUND AND 4" IN DIAMETER.



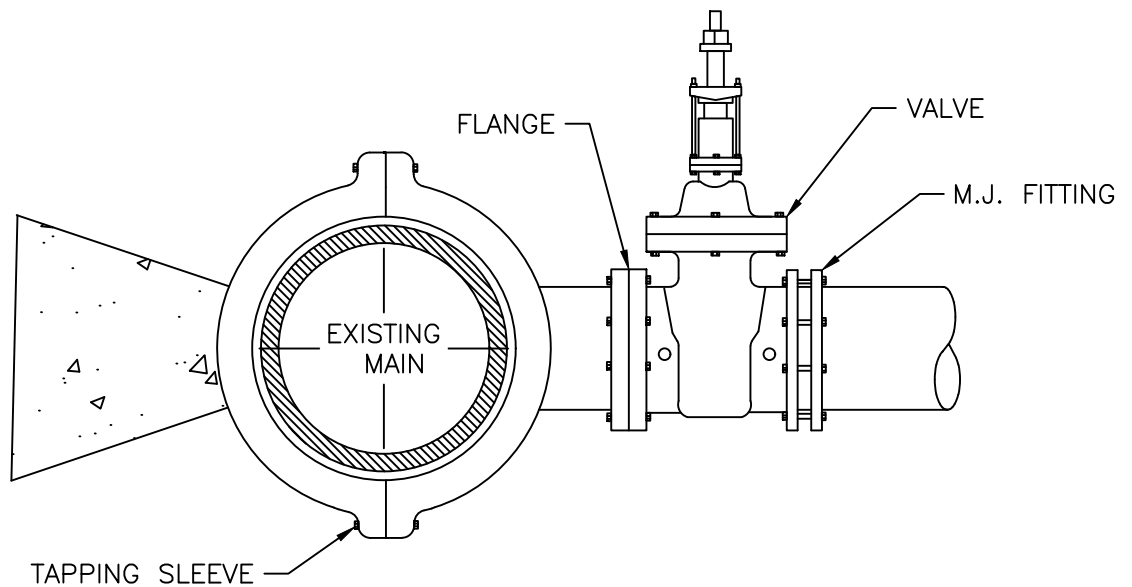
REUSE WATER MAIN

**CITY OF RALEIGH
STANDARD DETAIL**

REVISIONS	DATE: 01/18/2025	NOT TO SCALE
	MAIN AND VALVE MARKERS FOR REUSE WATER IN EASEMENTS	
R-10		



TOP VIEW



SIDE VIEW

NOTES:

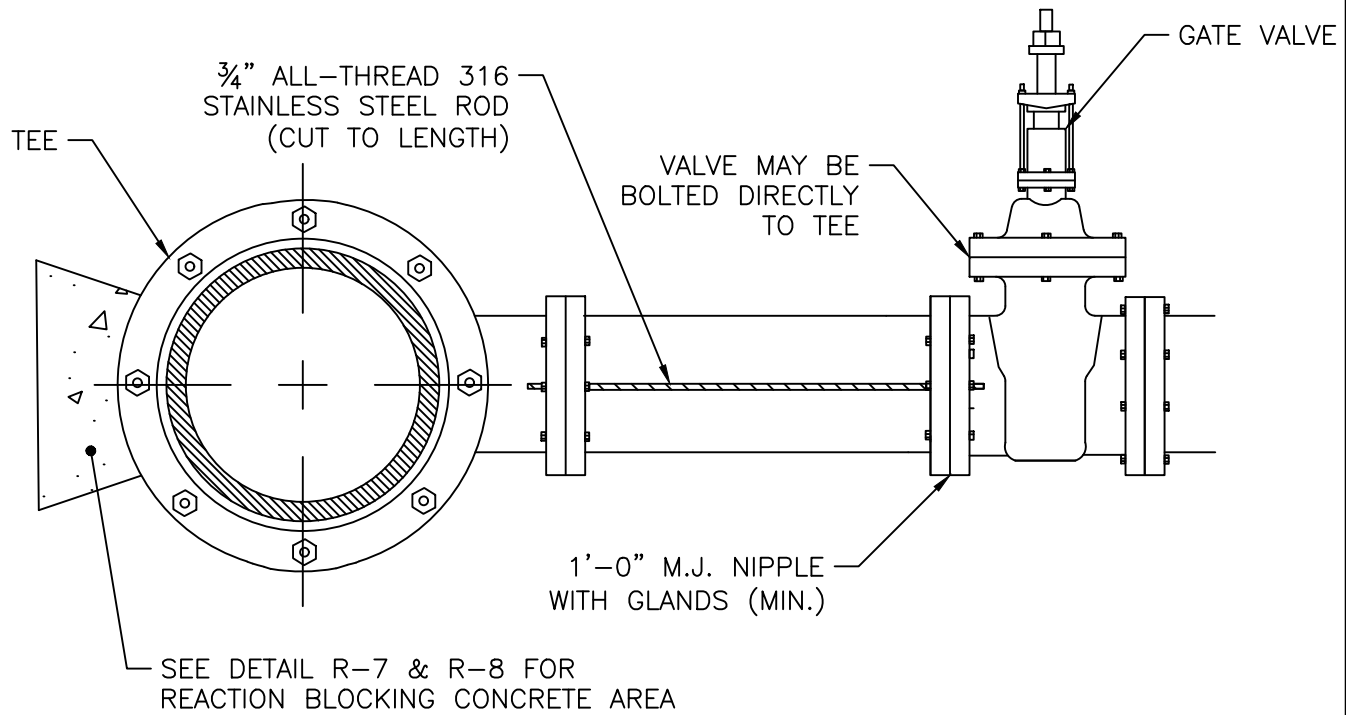
1. CONCRETE SHALL NOT CONTACT BOLTS OR ENDS OF MECHANICAL JOINT FITTINGS.
2. SEE DETAIL R-7 & R-8 (REACTION BLOCK TABLES) FOR AREA OF CONCRETE REQUIRED.
3. 3,000 PSI SOLID CONCRETE SHALL BE USED AS FOOTING FOR DUCTILE IRON PIPE.

**CITY OF RALEIGH
STANDARD DETAIL**

REVISIONS DATE: 01/18/2025 NOT TO SCALE

4"-24" TAPPING SLEEVE
AND VALVE ASSEMBLY

R-11



ROD REQUIREMENTS

NO. OF RODS	BRANCH SIZE
4"	2
6"	2
8"	4
12"	4
16"	6
24"	6
30"	8
36"	8

NOTES:

1. STEEL RODS AND BOLTS SHALL BE 3/4" 316 STAINLESS STEEL.
2. SEE DETAIL R-7 & R-8 (REACTION BLOCK TABLES) FOR AREA OF CONCRETE REQUIRED.
3. CONCRETE SHALL NOT CONTACT BOLTS OR ENDS OF MECHANICAL FITTINGS.

CITY OF RALEIGH STANDARD DETAIL

REVISIONS	DATE: 01/18/2025	NOT TO SCALE
	VALVE RESTRAINT AT TEES AND CROSSES FOR LINES (4"-24")	
	R-12	

VALVE SIZE	MH DIA.
16"	5'
24"	6'
≥30"	8'

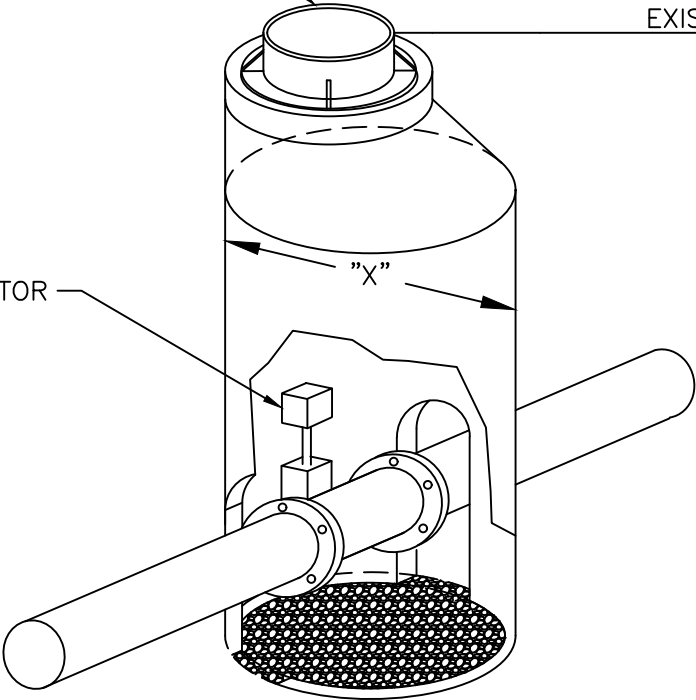
NOTES:

1. USE STANDARD PRECAST ECCENTRIC TOP.
2. BASE SECTION SHALL BE OF "DOG HOUSE" TYPE TO FIT OVER MAIN.
3. PROVIDE A MIN. OF 12" OF #67 STONE FOR POSITIVE DRAINAGE IN BOTTOM OF MANHOLE.
4. GROUT RISER/BASE SECTION AS NECESSARY.
5. MANHOLE LID SHALL SAY "REUSE".
6. FLAT TOP MAY BE USED IN NON-PAVED AREAS WHEN NECESSARY TO MATCH GRADE.

ECCENTRIC TOP WITH COVER
OPENING OVER ACTUATOR

EXISTING GRADE

NUT TYPE ACTUATOR

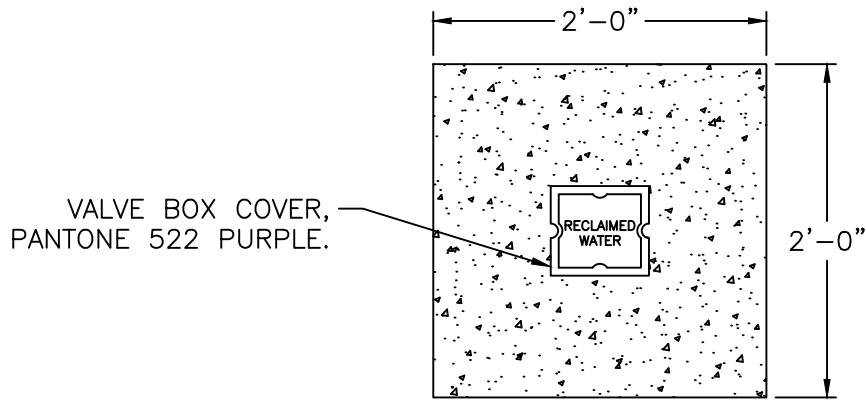


CITY OF RALEIGH
STANDARD DETAIL

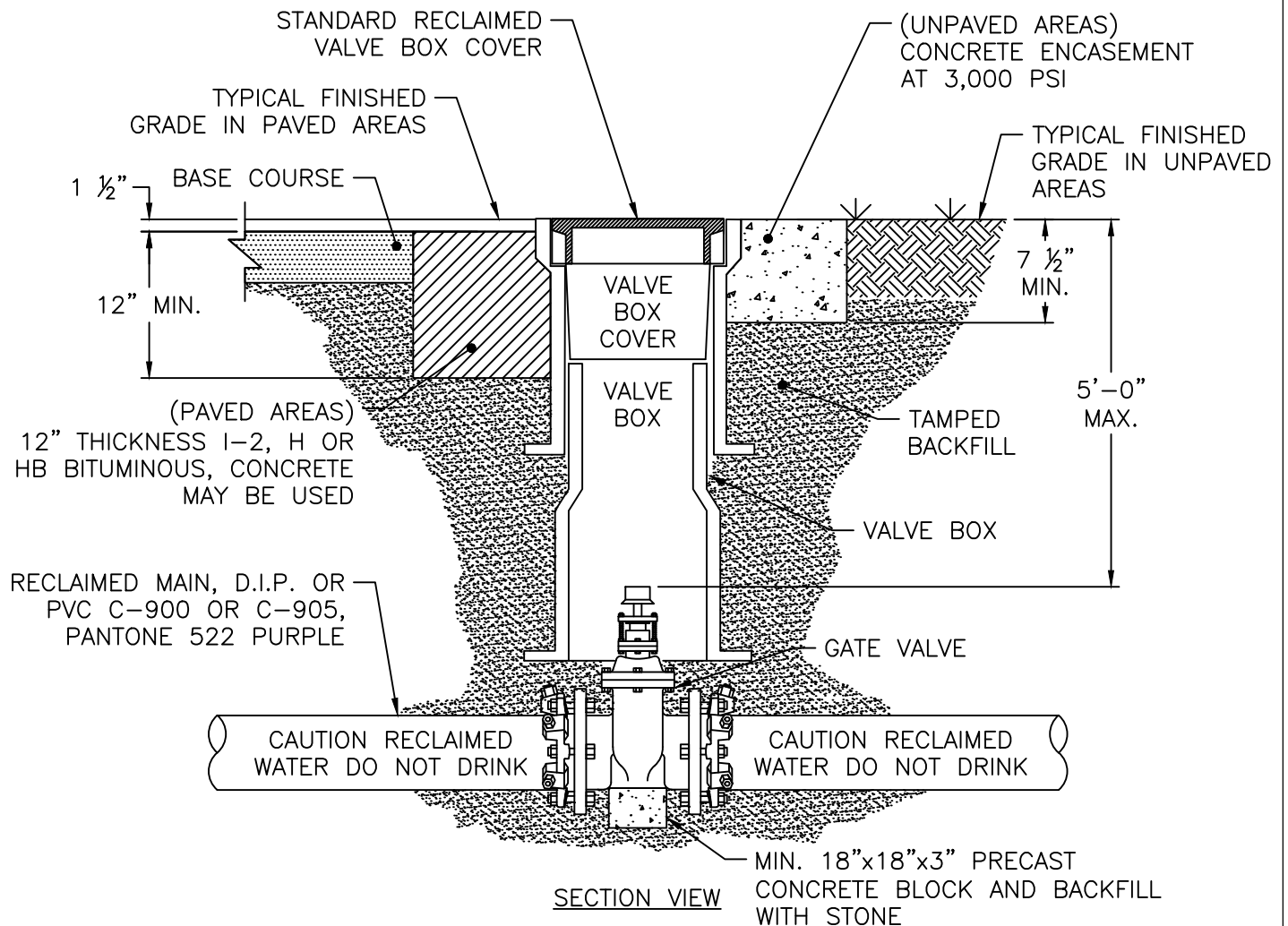
REVISIONS	DATE: 01/18/2025	NOT TO SCALE
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	BUTTERFLY VALVE MANHOLE FOR 16" AND LARGER MAINS
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R-13



PLAN VIEW

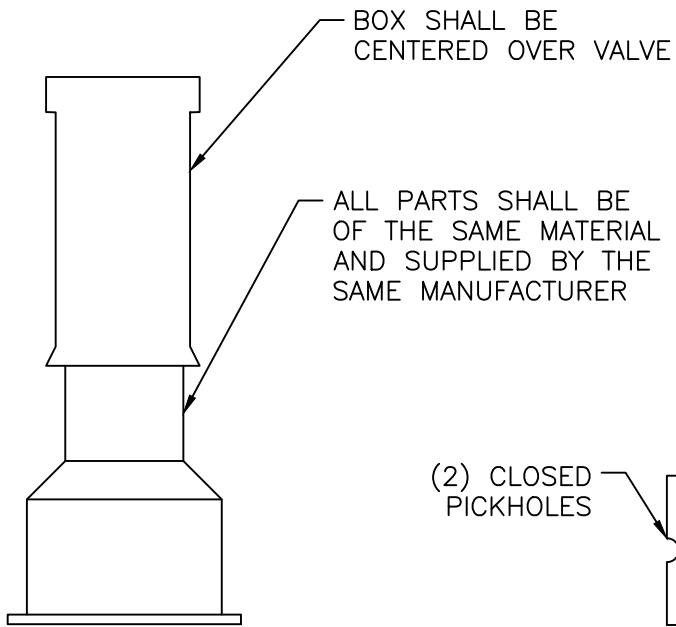


NOTES:

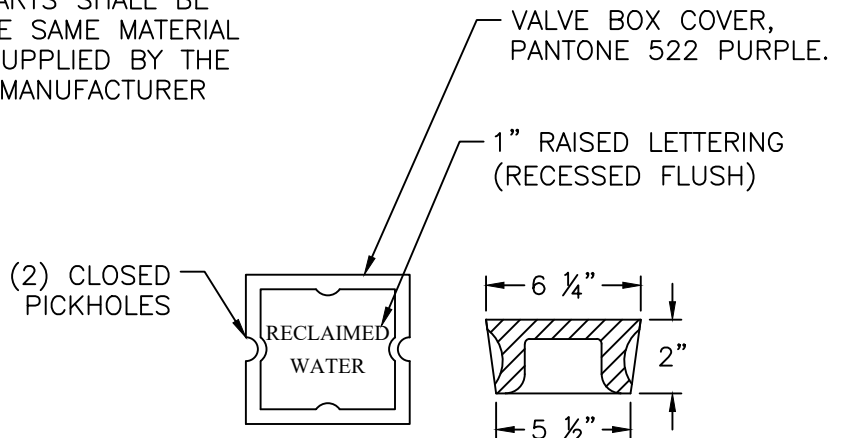
1. ONLY MANUFACTURED VALVE BOX EXTENSIONS SHALL BE ALLOWED.
2. VALVE OPERATING NUT MUST BE EXTENDED SO THAT THE DEPTH IS NO GREATER THAN 5' FROM THE SURFACE USING A MANUFACTURER APPROVED EXTENSION KIT.
3. PRECAST CONCRETE ENCASEMENT IS ALLOWED OUTSIDE OF PAVED AREAS.
4. VALVE BOX SHOULD NOT CONTACT MAIN OR VALVE.

CITY OF RALEIGH
STANDARD DETAIL

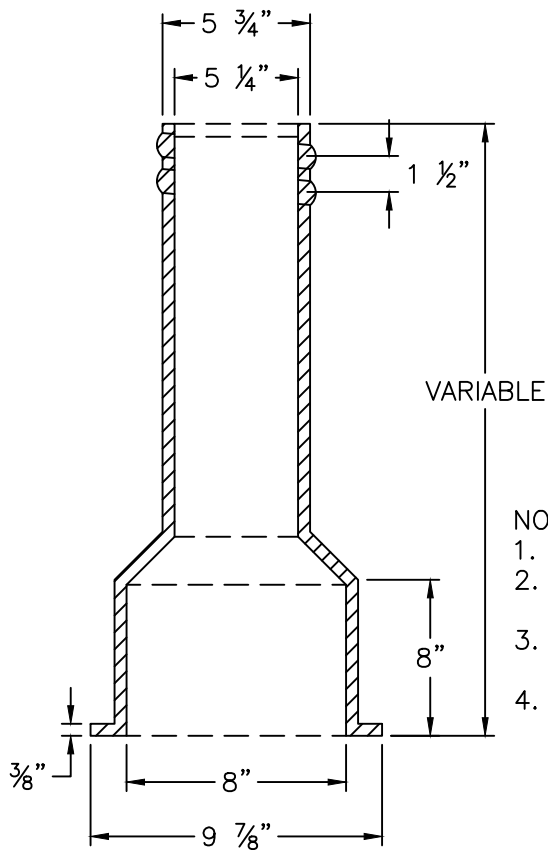
REVISIONS	DATE: 01/18/2025	NOT TO SCALE
	RECLAIMED WATER VALVE AND BOX INSTALLATION	
	R-14	



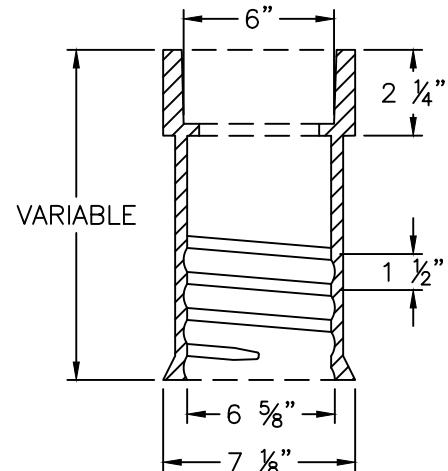
COMPLETE BOX



COVER AND LID



BOTTOM SECTION



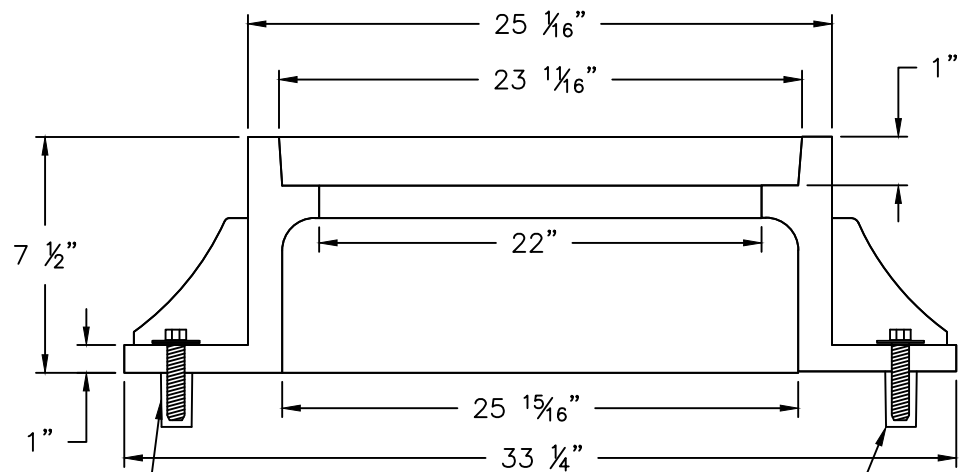
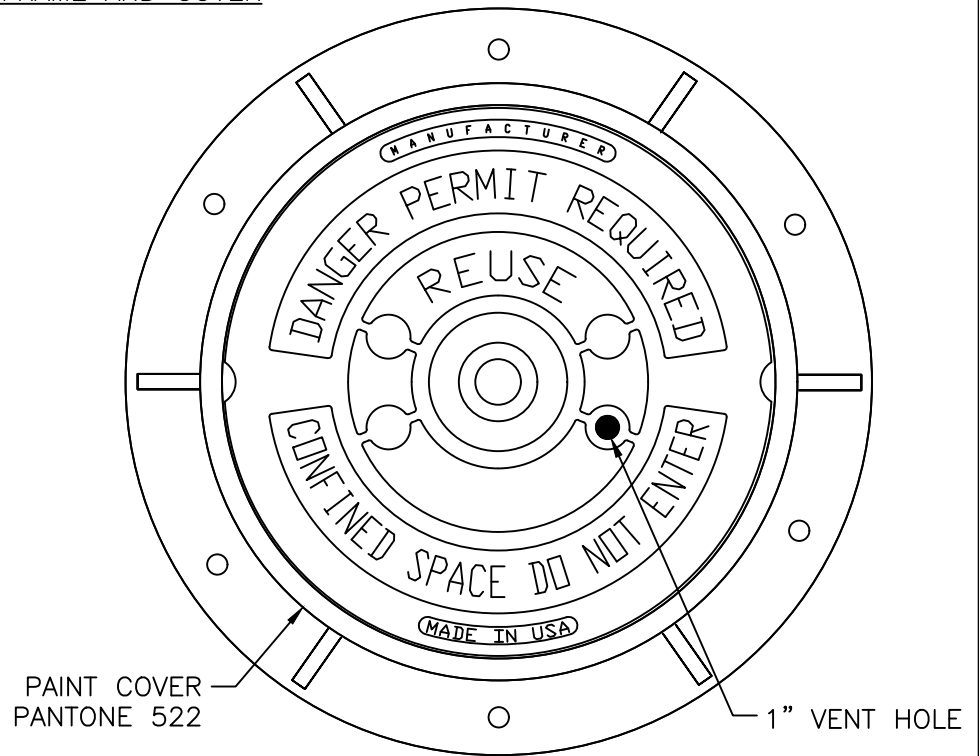
SQUARE UPPER SECTION

NOTES:

1. VALVE BOX COVER SHALL WEIGH A MINIMUM 13 LBS.
2. ENTIRE VALVE BOX ASSEMBLY & COVER SHALL BE CAST FROM CLASS 35 GRAY IRON.
3. ASSEMBLY SHALL BE DOMESTICALLY MADE AND MANUFACTURED IN THE U.S.A.
4. ASSEMBLY OTHER THAN COVER SHALL BE PAINTED BLACK.

CITY OF RALEIGH
STANDARD DETAIL

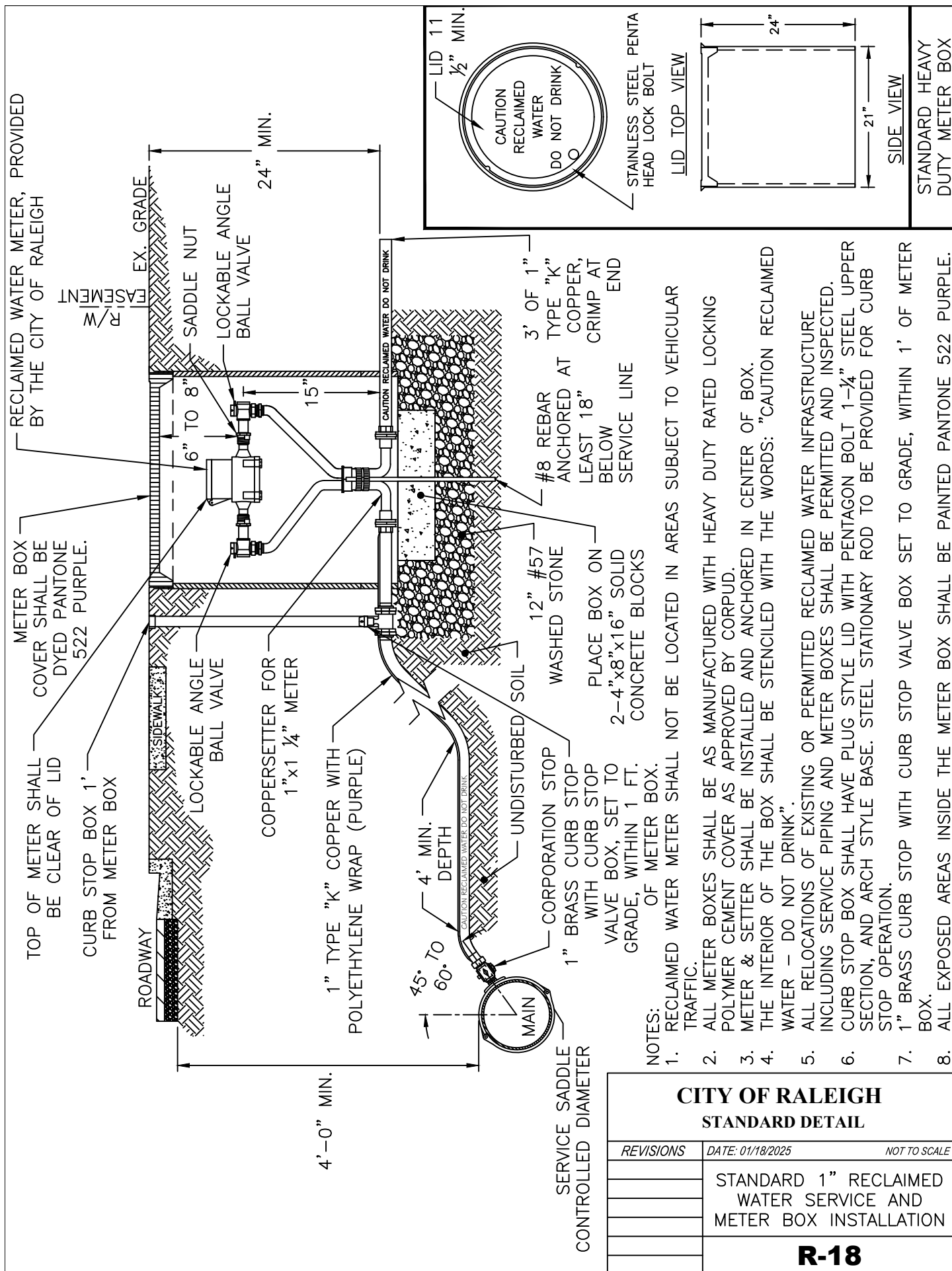
REVISIONS	DATE: 01/18/2025	NOT TO SCALE
	STANDARD VALVE BOX	
	R-15	



5/8"x3" LAGSHIELD IN HOLE DRILLED INTO
CONE OR RING WITH ANCHOR SUNK TO
DESIGN DEPTH, AND 3/8"x3" HOT DIPPED
GALVANIZED LAG BOLT AND WASHER

CITY OF RALEIGH
STANDARD DETAIL

<i>REVISIONS</i>	<i>DATE: 01/18/2025</i>	<i>NOT TO SCALE</i>
	STANDARD MANHOLE COVER	
	R-17	





Appendix C

Checklists for Raleigh Water Plans



Raleigh
Water

General Submission requirements for ASR, SUB, and SPR plans in Raleigh and corresponding plans for Merger towns

1. A vicinity sketch or key map at a scale of not more than one thousand (1000) feet to the inch (1"=200' is preferred on cover sheet and is REQUIRED on as-built drawings per Raleigh Water specifications), showing the position of the project with its relation to surrounding streets and properties, and oriented in the same direction as the site plan.
2. True north arrow, with north being at the top of the map.
3. Scale of the map using engineer's scale (1"=10', 1"=50', etc.) both graphic and numeric and date of preparation, including all revision dates (1"=50' horizontal and 1"=5' vertical preferred on site plan reviews, REQUIRED on as-built drawings per Raleigh Water specifications).
4. Date of preparation, including all revision dates
5. Each plan sheet shall be signed AND sealed by a NC registered Professional Engineer, Surveyor, or design professional.
6. Plans shall demonstrate overall conformance with all Local, State, and Federal requirements.
7. A legend and notes sheet shall be included with all line types and symbols clearly shown for interpretation.

Title Block/Site Data

1. The name of the development, name of the owner and agent, name, address, telephone number and email of the designer who prepared the plan
2. Project address, PIN number, and project name.
3. Planned number of bedrooms, along with their anticipated water and sewer flow requirements in gallons per day (gpd).
4. Infrastructure Inspections Quantities Table
5. Appendix D notes
 - a. Contractor Note – required on all plans that show water and/or sewer main extensions (Public or Private)
 - b. Signature Blocks – required on cover page, utility pages, plan and profile sheets
 - c. Standard Utility Notes – required on the utility page(s)
6. Calculations for anticipated flow shown on the utility plan sheet or cover page.

General plan information

1. An accurate and complete legend is required on each plan sheet (detail sheets do not require a legend).
2. Names of property owners of adjacent properties or subdivisions of record.
3. Proposed streets, existing and platted streets on adjoining properties and in the proposed development with right-of-way widths (and NCDOT SR numbers if applicable).
4. Existing or proposed sidewalks, both on public rights-of-way and on-site.
5. Dry underground utilities location for gas, fiber, phone, electric.
6. All proposed and existing easements, widths, purposes noted, public or private and book and page numbers.

7. Water and sewer lines shall be color coded and labeled for better distinction.
8. Location, material, and size of any existing utilities (water, sanitary sewer, septic, storm water, etc.) along with their owners' names, and inverts on all sanitary sewer and storm water facilities.
9. Stations are shown on all plan views and correspond to plan and profile sheets.
10. Location of all existing and proposed buildings (with their water and sewer services), as well as buildings to be removed, along with any water and sewer taps to be abandoned.
11. Floodplain information, including base flood elevation, 100-year flood boundary, floodway and floodway fringe areas, indicating source of information.
12. Any overlay districts and watershed districts.
13. Wetlands on the site.

General Gravity sewer information

1. All existing gravity sanitary sewer lines are shown and accurately described (slope and material shown), as well as existing manholes, clean-outs or pump stations.
2. All existing and proposed potable water wells are clearly shown.
3. All sanitary sewer lines and manholes shown on plans match existing and proposed line types shown in the legend.
4. All gravity sanitary sewer lines meet the requirements of the Public Utilities Handbook.
5. All proposed sanitary sewer manholes are properly shown on the plans along with rim and invert elevations called out.
6. All proposed utility crossings have the required vertical separation and are shown both on the plan sheet and plan/profile sheet.
7. If pipe sizes change, profile matches to top of pipe.
8. Sewer must be extended and sized to extend to adjacent properties for sanitary sewer service potential.
9. All pertinent Public Utilities sewer detail sheets are printed on the plans.

General Force Main and Pump Station information

1. All existing sanitary sewer force-mains are shown and accurately described, as well as existing manholes, air release valves, and pump stations.
2. All existing and proposed potable water wells are clearly shown.
3. All force-mains, valves, and fittings shown match the proposed and existing line types in the legend.
4. All sanitary sewer force-mains must be proposed only using materials approved for Raleigh Water
5. All sanitary sewer force-mains shown to have a minimum three (3) feet of cover.
6. All proposed sanitary sewer manholes are properly shown on the plans along with rim and invert elevations called out.
7. All proposed utility crossings have the required vertical separation and are shown accurately both on the plan sheet and plan/profile sheet.
8. All sanitary sewer plan sheets (including plan & profiles) have the General Utility Notes.
9. All valves, fittings, and changes in line size are clearly shown and noted on the plans.

10. All pump stations must meet the guidelines set forth in the Raleigh Water handbook and the most recent version of Minimum Design Criteria for the Fast-Track Permitting of Pump Stations and Force Mains as published by NCDENR; whichever is most stringent.
11. The calculation package submitted with the pump station construction plans should include a minimum of:
 - a. Peak and average daily flow calculations.
 - b. Total dynamic head calculations.
 - c. System curve and pump curve analysis with operation point.
 - d. Pump station cycle and run times.
 - e. Pump station flotation/buoyancy.
 - f. Minimum force main velocity.
 - g. Pump station and force main detention times.
 - h. NPSH calculations.
12. Plan and elevation drawings of all access roads shall be shown on the plans.
13. Pump Station driveways must be a minimum 12 feet wide with gravel 12 inches thick for the first 20 feet off the roadway and 6 inches thereafter, with curb cut and apron if on curbed street, and not greater than 10 % slope. A vehicle turnaround area at the pump station shall be provided. The City reserves the right to require concrete or asphalt paving of driveways. Sites with odor control chemical tanks must be accessible by 18 wheel tanker trucks.
14. All pertinent Public Utilities sewer detail sheets are printed on the plans.

General water information

1. Show existing water mains, wells, water meters, valves and other appurtenances.
2. All mains are to be within dedicated street rights-of-way except major transmission mains not affording direct service connection. Mains within the street right-of-way shall be a minimum of 5 feet from the outside of the pipe to the edge of the right-of-way.
3. Proposed water lines are properly shown on plan and profile sheets, along with their size, material, and class.
4. No permanent structures or impoundments shall be constructed on water mains, water transmission mains or within water easements.
5. All water lines, hydrants and valves shown match line types in legend for existing and proposed features.
6. All water valves and fittings are properly shown on the plans and called out.
7. All proposed utility crossings have the required vertical separation and are shown both on the plan sheet and plan/profile sheet.
8. All existing and proposed fire hydrants are shown and labeled.
9. Water mains are extended to all extents of a project.
10. Proposed water meter(s) and/or irrigation is shown on plan.
11. All water meters and backflow prevention assemblies are correctly placed and adequately sized for the service.
12. The device and installation shall meet the guidelines of Appendix A – Guidelines and Requirements for the Cross Connection Program in Raleigh's Service Area.

13. Grease Interceptor / Oil Water Separator sizing calculations & installation specifications shall be approved by the Raleigh Water FOG(Fats, Oil and Grease) Program Coordinator prior to issuance of a Utility Connection and/or Building Permit.
14. All pertinent Public Utilities water detail sheets are printed on the plans.



Appendix D

Plan Notes and Permit Blocks



Raleigh
Water

Permitting in the City of Raleigh

CONTRACTOR STATEMENT

- Cover sheet
- Utility plan sheet(s)

ATTENTION CONTRACTORS

The Contractor responsible for the extension of water, sewer, and/or reuse, as approved in these plans, is responsible for contacting the Infrastructure Inspections Division and schedule a Pre-construction meeting on the Development Portal prior to beginning any construction.

Raleigh Water must be contacted at (919) 996-4540 at least twenty-four hours prior to beginning any work activity around critical water and sewer infrastructure.

Failure to notify City Departments in advance of beginning construction, will result in the issuance of monetary fines, and require reinstallation of any water or sewer facilities not inspected as a result of this notification failure.

Failure to call for Inspection, install a downstream plug, have permitted plans on the jobsite, or any other violation of City of Raleigh Standards will result in a fine and possible exclusion from future work in the City of Raleigh.

PERMIT BLOCKS

- Cover sheet
- Utility plan sheet(s)
- Water and Sewer profile page(s)

Public

Water Distribution / Extension System

The City of Raleigh consents to the connection and extension of the City's public water system as shown on this plan. The material and Construction methods used for this project shall conform to the standards and specifications of the City's Public Utilities Handbook.

City of Raleigh

Public Utilities Department Permit # _____

Public

Sewer Collection / Extension System

The City of Raleigh consents to the connection and extension of the City's public sewer system as shown on this plan. The material and Construction methods used for this project shall conform to the standards and specifications of the City's Public Utilities Handbook.

City of Raleigh

Public Utilities Department Permit # _____

Private

Sewer Collection / Extension System

The City of Raleigh consents to the connection to its public sewer system and extension of the private sewer collection system as shown on this plan. The material and constructions methods used for this project shall conform to the standards and specifications of the City's Public Utilities Handbook.

City of Raleigh

Public Utilities Department Permit # _____

INSPECTIONS QUANTITIES TABLE (former Public Improvement table)

- Cover sheet

INFRASTRUCTURE INSPECTIONS QUANTITIES TABLE			
Phase Number(s)	PHASE 1	PHASE 2	PHASE 3
Number of Lot (s)			
Lot Number (s) by Phase			
Number of Units			
Livable Buildings			
Open Space?			
Number of Open Space Lots			
Public Water (LF)			
Private Water* (LF)			
Public Sewer (LF)			
Public Force Main (LF)			
Private Sewer** (LF)			
Public Street (LF) - FULL			
Public Street (LF) - PARTIAL			
Public Sidewalk (LF) - FULL			
Public Sidewalk (LF) – PARTIAL			
Multi-Use Path*** (LF)			
Public Stormdrain (LF)			
Street Signs (LF)			
Water Service Stubs			
Sewer Service Stubs			
Average Daily Flow per phase****			
<p>* Water mains 4" and larger</p> <p>**Sewer mains and manholes as part of a collection system</p> <p>*** 10 or 12 ft wide path in lieu of sidewalk or a Multi-Use path as part of a development amenity</p> <p>**** Entire Project Flow. Based on 75gpd per bedroom for residential (Apartments, single Family dwelling, townhouse, condos), or based on 15A NCAC 02T .0114 Wastewater Design Flow Rates for Commercial and Industrial.</p>			

Permitting in Merger Communities

CONTRACTOR STATEMENT

- Cover sheet
- Utility plan sheet(s)

ATTENTION CONTRACTORS

The Contractor responsible for the extension of water, sewer, and/or reuse, as approved in these plans, is responsible for contacting the Public Utilities Inspector at 919-996-3245 or <https://cityworks.raleighnc.gov/pucontractors> and schedule a Pre-construction meeting prior to beginning any construction.

Raleigh Water must be contacted at (919) 996-4540 at least twenty-four hours prior to beginning any work activity around critical water and sewer infrastructure.

Failure to notify the Divisions in advance of beginning construction, will result in the issuance of monetary fines, and require reinstallation of any water or sewer facilities not inspected as a result of this notification failure.

Failure to call for Inspection, install a downstream plug, have permitted plans on the jobsite, or any other violation of City of Raleigh Standards will result in a fine and possible exclusion from future work in the City of Raleigh.

PERMIT BLOCKS

- Cover sheet
- Utility plan sheet(s)
- Water and Sewer profile page(s)
- Raleigh Standard Detail sheet(s)

Public

Water Distribution / Extension System

The City of Raleigh consents to the connection and extension of the City's public water system as shown on this plan. The material and Construction methods used for this project shall conform to the standards and specifications of the City's Public Utilities Handbook.

City of Raleigh

Public Utilities Department Permit # _____

Private

Sewer Collection / Extension System

The City of Raleigh consents to the connection to its public sewer system and extension of the private sewer collection system as shown on this plan. The material and constructions methods used for this project shall conform to the standards and specifications of the City's Public Utilities Handbook.

City of Raleigh

Public Utilities Department Permit # _____

Public

Sewer Collection / Extension System

The City of Raleigh consents to the connection and extension of the City's public sewer system as shown on this plan. The material and Construction methods used for this project shall conform to the standards and specifications of the City's Public Utilities Handbook.

City of Raleigh

Public Utilities Department Permit # _____

RALEIGH WATER INSPECTIONS QUANTITIES TABLE

- Cover sheet (Subdivision and Site Plans)

RALEIGH WATER INSPECTIONS QUANTITIES (SUBDIVISIONS AND SITE PLANS)			
Phase Number(s)	PHASE 1	PHASE 2	PHASE 3
Number of Lot (s)			
Number of Units			
Public Water (LF)			
Public Sewer (LF)			
Public Force Main (LF)			
Private Sewer* (LF)			
Water Service Stubs (Quantity)			
Sewer Service Stubs (Quantity)			
Average Daily Flow per phase**			
COMMERCIAL PROJECTS WITH SINGLE WATER AND SEWER SERVICE			
Fire Service (Size)			
Domestic Meter Size			
Irrigation Meter Size			
Average Daily Flow per phase**			
<p>*Sewer mains and manholes as part of a collection system</p> <p>**Entire Project Flow. Based on 75gpd per bedroom for residential (Apartments, single Family dwelling, townhouse, condos), or based on 15A NCAC 02T .0114 Wastewater Design Flow Rates for Commercial and Industrial.</p> <p>The meter size must match domestic service size (Exemption - 3/4" service tap with 5/8" meter)</p>			

STANDARD UTILITY NOTES

• Utility Plan(s) for City of Raleigh and Merger Towns

STANDARD UTILITY NOTES:

1. All materials & construction methods shall be in accordance with City of Raleigh design standards, details & specifications (reference: CORPUD Handbook, current edition)
2. Utility separation requirements:
 - a) A distance of 100' shall be maintained between sanitary sewer & any private or public water supply source such as an impounded reservoir used as a source of drinking water. If adequate lateral separation cannot be achieved, ferrous sanitary sewer pipe shall be specified & installed to waterline specifications. However, the minimum separation shall not be less than 25' from a private well or 50' from a public well.
 - b) When installing water &/or sewer mains, the horizontal separation between utilities shall be 10'. If this separation cannot be maintained due to existing conditions, the variation allowed is the water main in a separate trench with the elevation of the water main at least 18" above the top of the sewer & must be approved by the Public Utilities Director. All distances are measured from outside diameter to outside diameter.
 - c) Where it is impossible to obtain proper separation, or anytime a sanitary sewer passes over a watermain, DIP materials or steel encasement extended 10' on each side of crossing must be specified & installed to waterline specifications.
 - d) 5.0' minimum horizontal separation is required between all sanitary sewer & storm sewer facilities, unless DIP material is specified for sanitary sewer
 - e) Maintain 18" min. vertical separation at all watermain & RCP storm drain crossings; maintain 18" min. vertical separation at all sanitary sewer & RCP stormdrain crossings. Where adequate separations cannot be achieved, specify DIP materials & a concrete cradle having 6" min. clearance (per CORPUD details W- 41 & S-49).
 - f) All other underground utilities shall cross water & sewer facilities with 18" min. vertical separation required.
3. Any necessary field revisions are subject to review & approval of an amended plan &/or profile by the City of Raleigh Public Utilities Department prior to construction.
4. Developer shall provide 30 days advance written notice to owner for any work required within an existing City of Raleigh Utility Easement traversing private property.
5. Contractor shall maintain continuous water & sewer service to existing residences & businesses throughout construction of project. Any necessary service interruptions shall be preceded by a 24-hour advance notice to the City of Raleigh Public Utilities Department.
6. SEWER BYPASS PUMPING – A bypass plan sealed by an NC Professional Engineer shall be provided to Raleigh Water prior to pumping operations for approval. The operations and equipment shall comply with the Public Utilities Handbook.
7. 3.0' minimum cover is required on all water mains & sewer force mains. 4.0' minimum cover is required on all reuse mains.
8. It is the developer's responsibility to abandon or remove existing water & sewer services not being used in redevelopment of a site unless otherwise directed by the City of Raleigh Public Utilities Department. This includes abandoning tap at main & removal of service from ROW or easement per CORPUD Handbook procedure.
9. Install water services with meters located at ROW or within a 2'x2' Waterline Easement immediately adjacent. NOTE: it is the applicant's responsibility to properly size the water service for each connection to provide adequate flow & pressure.
10. Inspections of 4" and larger water mains of the private distribution system will be inspected as part of the infrastructure permit.
11. Private sewer mains as part of a collection system are permitted and inspected under the private Infrastructure permit for sewer.
12. Any water or sewer services on private property that will be installed under Construction Drawings may require a Plumbing Utility Permit in the City of Raleigh. Consult with the Engineering Inspection Coordinator during the pre-construction meeting on the necessary permits.
13. Install sewer services with cleanouts located at ROW or easement line & spaced per the current NC Plumbing code.
14. Pressure reducing valves are required on all water services exceeding 80 psi; backwater valves are required on all sanitary sewer services having building drains lower than 1.0' above the next upstream manhole.
15. All environmental permits applicable to the project must be obtained from NCDWQ, USACE &/or FEMA for any riparian buffer, wetland &/or floodplain impacts (respectively) prior to construction.

16. NCDOT / Railroad Encroachment Agreements are required for any utility work (including main extensions & service taps) within state or railroad ROW prior to construction.
17. Grease Interceptor / Oil Water Separator sizing calculations & installation specifications shall be approved by the RW FOG Program Coordinator prior to issuance of a UC and/or Building Permit. Contact (919) 996-4516 or fog@raleighnc.gov for more information.
18. Cross-connection control protection devices are required based on the degree of health hazard involved as listed in Appendix B of the Rules Governing Public Water Systems in North Carolina.
19. The devices shall meet the American Society of Sanitary Engineering (ASSE) standards and be on the University of Southern California approval list.
20. The device and installation shall meet the guidelines of Appendix A – Guidelines and Requirements for the Cross Connection Program in Raleigh's Service Area.
21. The devices shall be installed and tested (both, initial and periodic testing thereafter) in accordance with the manufacturer's recommendations or the local cross connection control program, whichever is more stringent. Contact Cross.connection@raleighnc.gov for more information.
22. NOTICE for projects that involve an oversized main or urban main replacement. Any City reimbursement greater than \$250,000.00 must undergo the public bidding process.
23. Private sub-metering - No resale of water shall occur without approval of the North Carolina Utility Commission. Sub-metering shall be in accordance with Section 1400 of the "SAFE DRINKING WATER ACT".



Appendix E

RESERVED FOR FUTURE USE



Raleigh
Water



Appendix F

Permitting Scenarios



Raleigh
Water

Definitions - 15A NCAC 2H .0203

Building - Any structure or part of a structure built for the separate shelter or enclosure of persons, animals, chattels, or property of any kind and which has enclosing walls for at least 50 percent of its perimeter. Each unit separated from other units by a four-hour fire wall shall be considered as a separate building.

Building Drain - That part of the lowest piping of a drainage system which receives waste from inside the building and conveys it to the building sewer which begins 10 feet outside the building wall.

Building Sewer - That part of the horizontal piping of a drainage system which receives the discharge from a single building drain and conveys it directly to a public sewer, private sewer, or on-site sewage disposal system. Pipelines or conduits, pumping stations and appliances appurtenant thereto will not be considered to be building sewers if they traverse adjoining property under separate ownership or travel along any highway right of way.

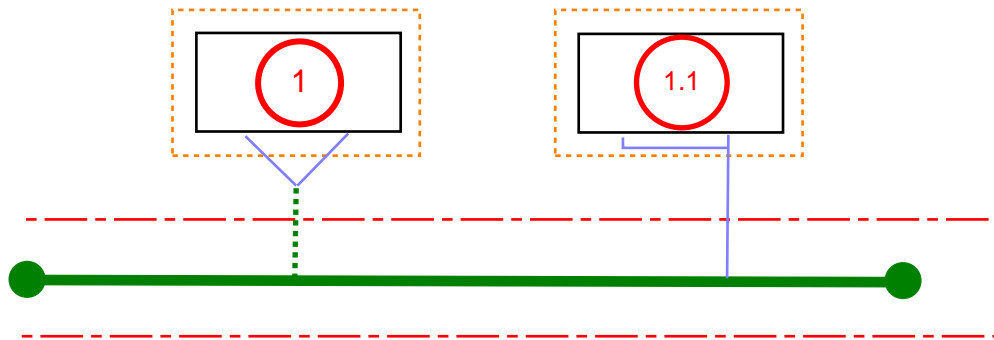
Division - The Division of Water Resources or the Division of Energy, Mineral and Land Resources, Department of Environmental Quality, whichever is the permitting authority. Raleigh Water is the Division for permitting in the context of this document.

Permitting by Regulation - 15A NCAC 2H .0217(a)(3)

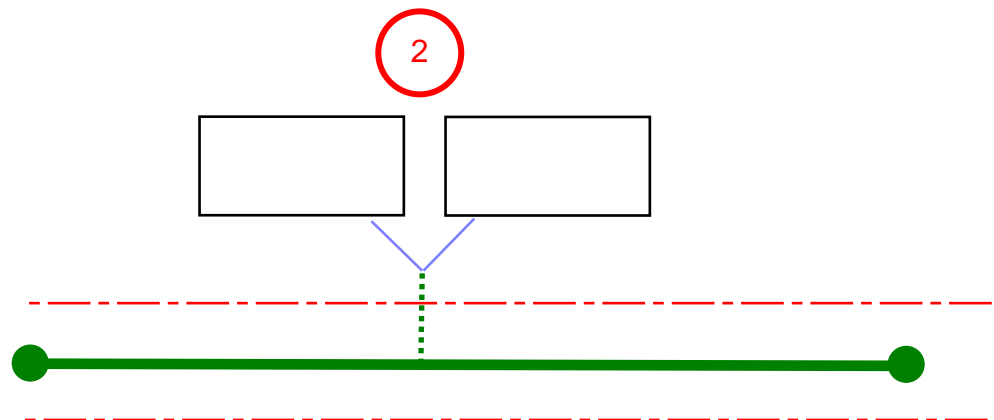
Any building sewer that is documented by the local building inspector and in compliance with the NC State Plumbing Code, is deemed to be permitted pursuant to GS 143-215.1(d) and it shall not be necessary for the Division (Raleigh Water) to issue individual sewer permits for the construction or operation of collection systems.

Permitting Scenarios







1. If a single building has two or more building drains that connect at a point beyond 10 feet of the building wall, a permit for a private collection system is required.
 - 1.1 This scenario does not require a permit if the services join within 10 feet of the building.



2. When two or more separate buildings, each having a single building drain that connects at any point, a permit for a private collection system is required.

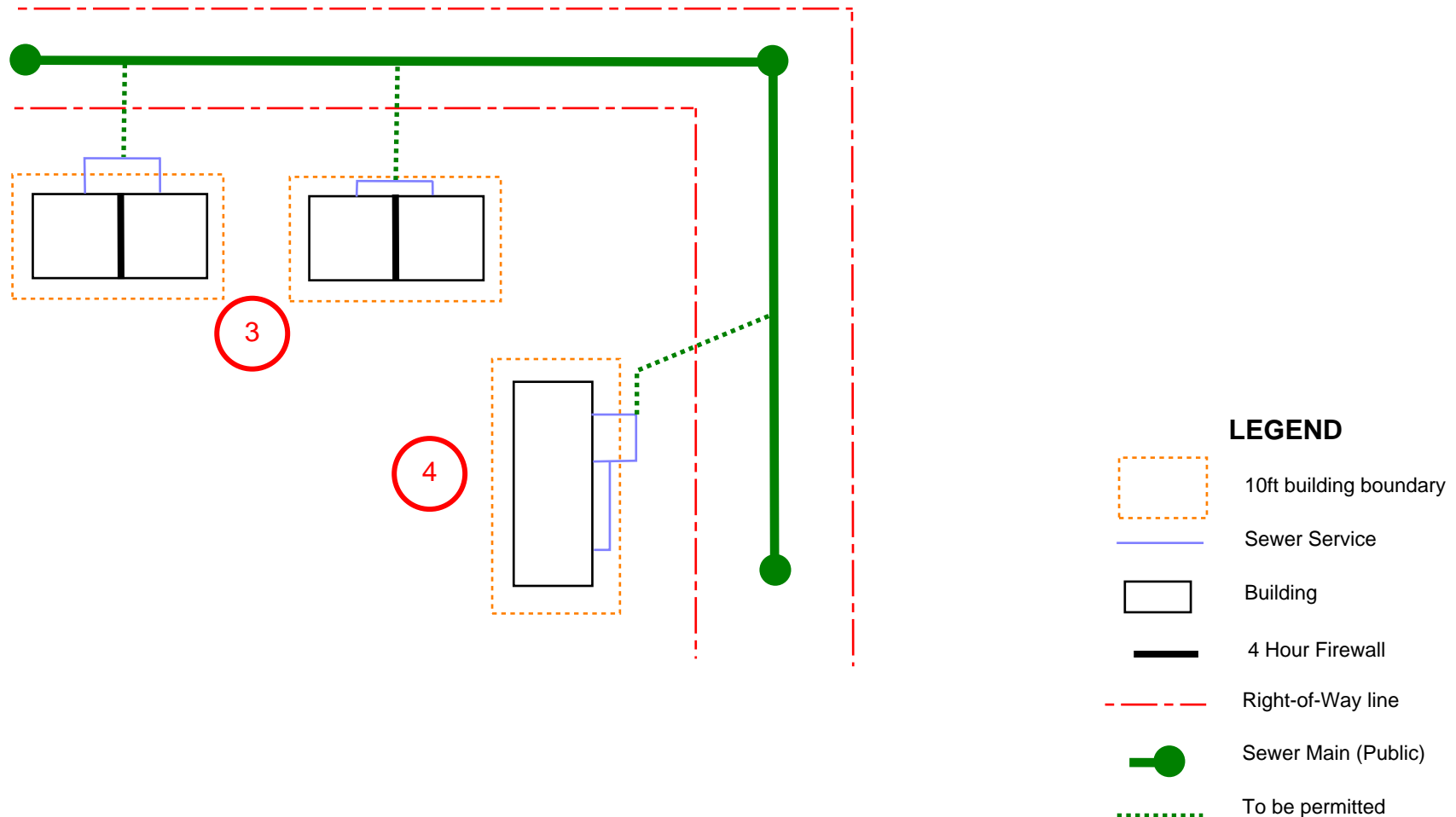


LEGEND

	10ft building boundary
	Sewer Service
	Building
	Right-of-Way line
	Sewer Main (Public)
	To be permitted

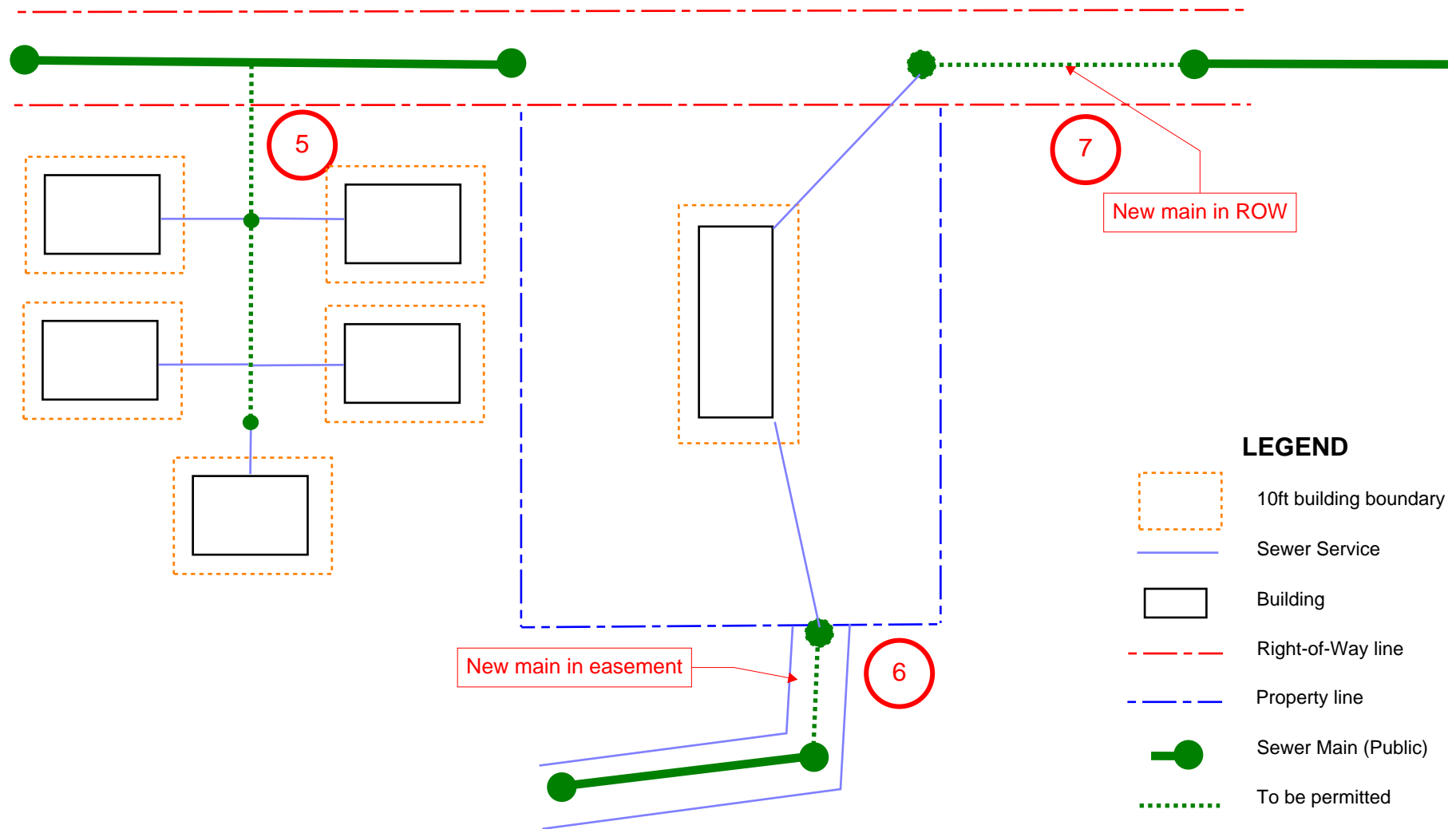
Permitting Scenarios

3. Any single structure separated by a four-hour firewall is considered two separate buildings according to State regulations. A permit for a private collection system is required when the drains connect at any point regardless of the 10 ft setback.
4. If any drain connects at a point beyond the 10ft boundary, a permit for a private collection system is required. If all drains connect at a point within the 10ft boundary, a permit for a private collection system is not required.



Permitting Scenarios

5. When multiple buildings connect to a private main on private property, a permit for a private collection system is required. The line may have clean-outs or manholes. Each building service requires a separate plumbing permit.
6. A main extension on adjoining properties for a single building require a permit for a public main extension. The line is installed within a public easement.
7. A main extension in the right-of-way for a single building on a property requires a permit for a public main extension.



Capital Facility Fee Scenarios

The Capital Facility Fee (CFF) is charged for connecting to the water and sewer system of the city, either within or outside the corporate limits of the City or Merger Communities. These fees are calculated based upon the water meter size or sewer-only fee for the property being served by the connection. The Development Fee Schedule outlines Capital Facility Fees. Exceptions based on scenarios outside the described situation will be evaluated on a case-by-case basis.

Scenario	Water CFF	Sewer CFF
New water tap	Yes	
New sewer tap		Yes
Existing water stub, never utilized	Yes	
Existing sewer stub, never utilized		Yes
Existing water, new sewer		Yes
W-34 split – domestic and irrigation smaller than fire line size	Yes - for domestic and irrigation	Yes
Single family dwelling/commercial – irrigation split	No	No
New irrigation tap on water main	CFF charge for irrigation	Yes
New Combined domestic/fire line with irrigation split	Charge for Dom/Fire, no charge for irrigation split	Yes
CCF Fee Credit		
Upsize in existing meter f.e 1" to 2"	Credit given for upsizing	No
Reduction in meter size f.e. 2" to 1"	No	No

Permitting Scenarios for Public and Private Water Distribution Systems

The permitting scenarios and definitions for Public and Private Water Sources are derived from DEQ Manual Section .0200 – LOCATION OF PUBLIC WATER SUPPLIES 15A NCAC 18C .0201 – Surface supplies for public water systems and the SAFE DRINKING WATER ACT-(TITLE XIV OF PUBLIC HEALTH SERVICE ACT) Section 1400 (amended and enacted December 20,2019)

- **New water mains in public right-of-way** – Public Distribution system with individual services for building(s).
- **Townhomes on private property if less than 15 service connections** – Private Distribution system with master meter and backflow assembly.
- **Townhomes on private property if greater or equal to 15 service connections** – Public Distribution system with easement(s) and individual CoR water meters.
- **Apartments and Condominiums** – Private Distribution system with master meter and backflow assembly. The units may be sub-metered in accordance with the NC Utility Commission standards and requirements.
- **Commercial buildings** – Private distribution system with master meter and backflow assembly, or individual services from a public main.
- **Townhomes or Condominiums on private property with a public main request** - Public Distribution system with easement(s) and individual CoR water meters. The water main must serve a public purpose and reach an adjacent right-of-way or road stub.



Appendix G

Approved Products List



Raleigh
Water

PRODUCT LIST - POTABLE WATER DISTRIBUTION SYSTEM

Product Category	Approved Manufacturer	Model/Series
Ductile Iron Pipe: Push-on and Mechanical Joint	American Cast Iron Pipe Company	
	United States Pipe and Foundry Company	
	Griffin Pipe Products Company	
	McWane Cast Iron Pipe Company	
Ductile Iron Pipe: Restrained Joint	U.S. Pipe	TR Flex or HP LOK
	American Pipe	Lok-Ring or Flex-Ring
	Clow	Super-Lock
	Griffin	Bolt-Lok or Snap-Lock
Gate Valves and Tapping Valves 6 to 24 inches	American	
	Mueller	
	Kennedy	
	AVK	
	Clow	
	M&H	
	Waterous Valves	
Valve Boxes	Mueller	AJBV 5
Butterfly Valves (16" or greater)	Mueller	
	Kennedy	
	Pratt	
	DeZURIK	
	Val-Matic	
Fire Hydrants	Kennedy	
	Mueller	
	Clow	
	American Darrling	
2-inch Air Release Valves	Crispin Presure Air Valves	P 20
	Val-Matic	VM-45
Tapping Sleeves	Mueller	M.J. or Outlet Seal
	American	Uniseal
	Kennedy	Square Seal
	Clow	F5205 or F5207
	Smith-Blair	If 100% stainless steel sleeves (all metallic parts including bolts)
	Romac	
	Ford	
JCM		

Product Category	Approved Manufacturer	Model/Series
Tapping Saddles 16" to 24"	Mueller	
	American	
	Kennedy	
	Clow	
Tapping Saddles 30" and larger	American Pipe Company	
	US Pipe Company	
Curb Stops (used on gang meter assemblies)	Mueller	Bronze ball
	Oniseal	Bronze ball
	Hayes NuSeal	Bronze ball
	Ford	Bronze ball
	A.y. McDonald	Bronze ball
Corporation and Curb Stops	Mueller	Bronze ball
	Ford	Bronze ball
	A.Y. McDonald	Bronze ball
Curb Stop Boxes	Ford	
	A.Y. McDonald	
	Trumbull	
Service Saddles	Muller	H-16100
	Jones	J 979
Meter Vault Access Doors	Halliday	
	U.S.F. Fabrication	
Meter	Sensus	
	Neptune	
Copper Setters	Ford	
	Mueller	
	A.Y. McDonald	

PRODUCT LIST - SEWER FORCE MAIN & PUMPING SYSTEM

Product Category	Approved Manufacturer	Model/Series
Air Release Valves	A.R.I. Flow Control	D-020 Combination
Air Release Valves	A.R.I. Flow Control	SAAR Short D-025
Polyurea/ Polyurethane Coatings	SewerKote	Duramer 1030
	Sherwin-Williams	Sherflex Elastomeric Polyurethane
CCFRPM	HOBAS Pipe USA	
Push on and Mechanical Joint Ductile Iron Pipe	American Cast Iron Pipe Company	
	United States Pipe and Foundry Company	
	Griffin Pipe Products Company	
	McWane Cast Iron Pipe Company	
Restrained Joints For DIP	U.S. Pipe	TR Flex or HP LOK
	American Pipe	Lok-Ring or Flex-Ring
	Clow	Super-Lock
	Griffin	Bolt-Lok or Snap-Lok
Carrier Piping	U.S. Pipe	TR Flex
	American Pipe	Lok-Ring or Flex-Ring
	Clow	Super-Lock
	Griffin	Bolt-Lok or Snap-Lock
CIPP Lining	Insituform Technologies, INC.	Insituform
	Inliner USA, Inc.	Inliner
	Spiniello Limited, Inc.	KM-Inliner
	Pipelining Products, Inc.	Cure-Line
PVC to DIP Adapter	Fernco Coupling	
Mechanical Restraining Collar	Mega-Lug	

PRODUCT LIST - REUSE WATER DISTRIBUTION SYSTEM

Product Category	Approved Manufacturer	Model/Series
Polyethylene Pipe Encasement Joint Tape	Chase	Chasekote 750
	Kendall	Polyken900
	3M	Scotcharp 50
Push-on and Mechanical Joint Ductile Iron Pipe	American Cast Iron Pipe Company	
	United States Pipe and Foundry Company	
	Griffin Pipe Products Company	
	McWane Cast Iron Pipe Company	
Restrained Joints For DIP	U.S. Pipe	TR Flex or HP LOK
	American Pipe	Lok-Ring or Flex-Ring
	Clow	Super-Lock
	Griffin	Bolt-Lok or Snap-Lock
Gate Valves	American	
	Mueller	
	Kennedy	
	AVK	
	Clow	
	M&H	
	Waterous valves	
Butterfly Valves 16" or greater	Mueller	
	Kennedy	
	Pratt	
	DeZURIK	
	Val-Matic	
2" Air Release Valves	Crispin Pressure Air Valves	P 20 w/ Vacum check unit
	Val-Matic	VM-45 w/ Vacum check unit
Tapping Sleeves	Mueller	M.J or Outlet Seal
	American	Uniseal
	Kennedy	Square Seal
	Clow	F5205 or F5207
	Smith-Blair	If 100% stainless steel sleeves (all metallic parts including bolts)
	Romac	
	Ford	
	JCM	
Tapping Saddles to 24"	Mueller	
	American	
	Kennedy	
	Clow	
	Mueller	
	Oniseal	

Product Category	Approved Manufacturer	Model/Series
Curb Stops	Hayes NuSeal	
	Ford	
	A.y. McDonald	
Corporation stops	Mueller	
	Ford	
	A.Y. McDonald	
Service Saddles Clamps	Mueller	H-16100 series
	Jones	J 979
Coppersettters or Copper Meter Yokes	A.Y. McDonald	
	Ford Meter Box Company	
Meter Boxes	Bingham & Taylor	
Meter Box Lids	Bingham & Taylor	BTPLASA 12.25RECV2 Purple BTA-32 frame
Ground Hydrants	Watts	HY-500
	Woodford	Y95
	Zurn	Z-1360
Mechanical Restraining	Mega-Lug	