CHARLOTTE WATER

WATER AND SEWER

Design and Construction Standards

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INTRODUCTION AND DISCLAIMER

This document was created and assembled for use in planning, designing, and constructing water and sanitary sewer infrastructure that will be owned and operated or permitted by Charlotte Water, a department within the City of Charlotte.

Charlotte Water is the largest public water and wastewater utility in the Carolinas, serving more than a million customers in the City of Charlotte and greater Mecklenburg County -- including the towns of Matthews, Mint Hill, Pineville, Huntersville, Davidson, and Cornelius.

The manual will be available from our website and may be downloaded and printed.

The manual will be reviewed periodically for updating and revisions will be made as significant changes or additions are made. Please be sure and check the website and the revision log for the most current version.

https://www.charlottenc.gov/water/Commercial-Development/Development-Design-Standards/Latest-Design-Manual

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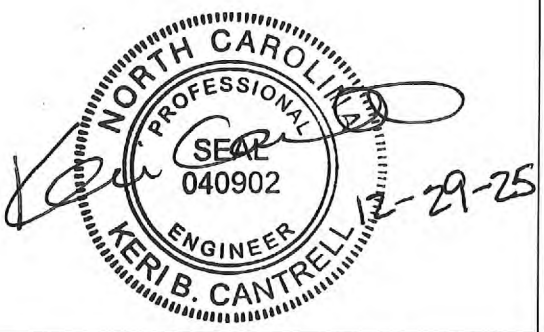
REVISIONS

Enclosed is the Charlotte Water *Water and Sewer Design and Construction Standards*, which supersedes and encompasses all the material in prior versions of the manual. This manual takes precedence over all previous versions of the Charlotte Mecklenburg Utility Department's "Water and Sewer Policies, Procedures, Standards and Specifications".

It will prove necessary to modify portions of the manual to comply with new design practices and changing technologies. Revisions to this manual will be summarized in the table below. The date found in the footer identifies the month and year that each section was last revised.

Commencing on **February 02, 2026**, this issue of the Charlotte Water *Water and Sewer Design and Construction Standards,* will be applicable to all water and sanitary sewer design projects, unless otherwise approved by a Chief Engineer.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Revision Number	Date	
Rev 0	April 2024	Release of new manual
Rev 1	January 2025	Revisions
Rev 2	January 2026	Revisions

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List of Abbreviations

AASHTO	American Association of State Highway and Transportation Officials
ABMA	American Bearing Manufacturers Association
ABS	Acrylonitrile Butadiene Styrene
ABC	Aggregate Base Course
AC	Alternating Current, Asbestos Cement
ACI	American Concrete Institute
ACP	Asbestos Cement Pipe
ACPPA	American Concrete Pressure Pipe Association
ADA	Americans with Disabilities Act
ADD	Average Daily Demand
ADF	Average Daily Flow
ADU	Accessory Dwelling Unit
AIS	American Iron and Steel
AISC	American Institute of Steel Construction
ALT	Alternate
AMI	Advanced Metering Infrastructure
AMP	Ampere
AMPP	Association for Materials Protection and Performance
ANSI	American National Standards Institute
ARV	Air Release Valve
ASME	American Society of Mechanical Engineers
ASSE	American Society of Sanitary Engineering
ASTM	American Society for Testing and Materials
ATS	Automatic Transfer Switch
AVV	Air Vacuum Valve
AWG	Average Wire Gauge
AWM	Appliance Wiring Material
AWS	American Welding Society
AWWA	American Water Works Association
B.C.D.	Bolt Circle Diameter
BEP	Best Efficiency Point
BFP	Backflow Preventer
BFV	Butterfly Valve
BMP	Best Management Practice
B.O.	Blowoff

BOC	Back of Curb
BOM	Bill of Material
BPA	Backflow Prevention Assembly
BWP	Bar Wrapped Steel Cylinder Pipe
C	Celsius
CABC	Compacted Aggregate Base Course
CAP	Capacity Assurance Program
CBD	Central Business District
CC	AWWA Taper Thread
CCTV	Closed Circuit Television
CDF	Controlled Density Fill, i.e. Flowable Fill
CDOT	Charlotte Department of Transportation
cf	Cubic Feet
CFS	Cubic Feet per Second
CI	Cast Iron
CIP	Capital Investment Plan, Cast Iron Pipe
CIPP	Cured-In-Place Pipe
City	City of Charlotte
CL	Center Line
CLDSM	Charlotte Land Development Standards Manual
CLSM	Controlled Low Strength Material, i.e. Flowable Fill
CLTW	Charlotte Water
cm	Centimeter
cm^2	Square Centimeter
CMCSI	Charlotte-Mecklenburg Certified Site Inspector
CP	Cathodic Protection
CPU	Central Processing Unit
CPVC	Chlorinated Polyvinyl Chloride
CTS	Copper Tubing Size
Cu	Copper
CY	Cubic Yard
dB	Decibel
dBA	Unit of Sound Level
DC	Direct Current
DEG	Degree
DEG C	Degrees Celsius

DEG F	Degrees Fahrenheit
DI	Ductile Iron
DIA or D	Diameter
DIP	Ductile Iron Pipe
DIPRA	Ductile Iron Pipe Research Association
DIPS	Ductile Iron Pipe Size
DR	Dimension Ratio
EA	Each
ECP	Embedded Cylinder Pipe
ENR	Engineering News Record
EOR	Engineer of Record
EP	Edge of Pavement
EPDM	Ethylene Propylene Diene Monomer Rubber
EPP	Expanded Polypropylene
ERT	Electronic Radio Transmitter, Encoder/Receiver/Transmitter
ETL	Electrical Testing Laboratories
EX	Example
F	Fahrenheit
FEMA	Federal Emergency Management Agency
FH	Fire Hydrant
FIPT or FIP	Female Iron Pipe Thread
FIT	Flow Indicator Transmitter
FLA	Full Load Amperes
FLG	Flange Joint
FLU	Future Land Use
FM	Force Main, Factory Mutual
FMCT	Combined Fire and Domestic Service Meter
FNPT	Female National Pipe Thread
FPS or ft/s	Feet per Second
FRPMP	Fiberglass Reinforced Polymer Mortar Pipe
FT or ft	Feet, Foot
FTSE	Flow Tracking/Acceptance for Sewer Extension Applications
Fu	Tensile Strength
FVNR	Full Voltage Non-Reversing
Fy	Yield Strength
GA	Gage

gal	Gallon
GALV	Galvanized
GFI/GFCI	Ground Fault Circuit Interrupter
GPD or gpd	Gallons per Day
GPH	Gallons per Hour
GPM	Gallons per Minute
GPS	Global Positioning System
GSM	Grams per Square Meter
HDCL	High Density Cross Laminated Polyethylene
HDPE	High Density Polyethylene
HMWPE	High Molecular Weight Polyethylene
Hg	Mercury
HOA	Homeowner’s Association
Hp/HP	Horsepower
Hr	Hour
Hz	Hertz
IAPMO	International Association of Plumbing and Mechanical Officials
IBC	International Building Code
ICBO	International Conference of Building Officials
ICC	International Code Council
ICCP	Impressed Current Cathodic Protection
ID	Internal Diameter (Pipe)
IEEE	Institute of Electrical and Electronics Engineers
IN or In	Inch
INF	Interference Test Station
INV	Invert
IPS	Iron Pipe Size
ISO	International Organization for Standardization
ITP	Inspection and Test Program
kg	Kilogram
kPa	Kilopascal
ksi	Kips per Square Inch
kW	Kilowatt
L	Length
LBS	Pounds
LCP	Lined Cylinder Pipe

LED	Light Emitting Diode
LF	Linear Feet (Foot)
LPSS	Low Pressure Sanitary Sewer
M	Meter
mA	Milliampere
MAX or Max	Maximum
MCC	Motor Control Center
MDD	Maximum Day Demand
mg	Milligram
MGD	Million Gallons per Day
MH	Manhole
MHz	Megahertz
Mid	Middle
MIJ	Monolithic Insulating Joint
mils	Measurement of Thickness that Equals One-Thousandth of an Inch or 0.001 inch
MIPT or MIP	Male Iron Pipe Thread
MIN or Min	Minimum, Minute
MJ	Mechanical Joint
mm	Millimeter
mph	Miles per Hour
MTW	Machine Tool Wire
mV	Millivolt
N	Newton
N/A	Not Applicable
NAD	North American Datum
NASSCO	National Association of Sewer Service Companies
NAVD	North American Vertical Datum
NBR	Nitrile Rubber
NC or N.C.	North Carolina
NCAC	North Carolina Administrative Code
NCBEES	North Carolina Board of Examiners for Engineers and Surveyors
NCDEQ	North Carolina Department of Environmental Quality
NCDOT	North Carolina Department of Transportation
NCGS	North Carolina Geodetic Survey
NCSBC	North Carolina State Building Code
NEC	National Electric Code

NEMA	National Electrical Manufacturer's Association
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NFPA	National Fire Protection Association
NGS	National Geodetic Survey
NO.	Number
NOM	Nominal
NPSH	Net Positive Suction Head
NPT	National Pipe Thread
NPW	Non-Potable Water
NSF	National Sanitation Foundation
NTS or N.T.S.	Not to Scale
NTU	Nephelometric Turbidity Unit
OC or O.C.	On Center
OD	Outside Diameter (Pipe)
O&M	Operations and Maintenance
OSHA	Occupational Safety and Health Act/Administration
OS&Y	Outside Screw and Yoke
oz	Ounce
PC	Pressure Class
PCCP	Prestressed Concrete Cylinder Pipe
PCF	Pounds per Cubic Foot
PE	Professional Engineer, Plain End, Polyethylene
PET	Polyethylene Terephthalate
PF	Peaking Factor
pH	Acid/Alkaline Scale
PHD	Peak Hour Demand
PL or P/L	Property Line
PLC	Programmable Logic Controller
PLS	Professional Land Surveyor
PPI	Plastic Pipe Institute
ppm	Parts Per Million
PRV	Pressure Reducing Valve
PSF	Pounds per Square Foot
psi	Pounds per Square Inch
PSV	Pressure Sewer Valve
PVC	Polyvinyl Chloride

PVMT	Pavement
QC	Quality Control
QTY	Quantity
RAB	Registration Accreditation Board
RCP	Reinforced Concrete Pipe
RGS	Rigid Galvanized Steel
RHH	Thermoset Flame Retardant and Moisture Resistant
RHW	Flame Ozone and Moisture Resistant Over 2,000 Volts
RJ	Restrained Joint
RJIB	Restrained Joint in Bell
RMJ	Restrained Mechanical Joint
RMS	Root Mean Square
ROW or R/W	Right-of-Way
RP	Reduced Pressure
RPM	Rotations per Minute
RPPA	Reduced Pressure Principle Assembly
RPZ	Reduced Pressure Zone Device
SBC	State Building Code
SBR	Styrene Butadiene Rubber
SCADA	Supervisory Control and Data Acquisition
SCH	Schedule
SCM	Stormwater Control Measure
SCR	Silicon Control Rectifier
SDR	Standard Dimension Ratio
SDWA	Safe Drinking Water Act
SF	Square Feet, Safety Factor
SQ	Square
SS	Sanitary Sewer, Stainless Steel
SSPC	Society of Protective Coatings
STD	Standard
STEP	Septic Tank Effluent Pump
SWIM	Surface Water Improvement and Management
TBM	Temporary Benchmark
TDH	Total Dynamic Head
TEMP or temp	Temporary, Temperature
THHN	Thermoplastic High Heat Nylon

THHW	Thermoplastic High Heat and Water-Resistant
THWN	Thermoplastic Heat and Water-Resistant Nylon
TOD	Transit Oriented Development
TPR	Thermoplastic Rubber
TW	Thermoplastic Water-Resistant
TYP	Typical
UDO	Unified Development Ordinance
UL	Underwriters Laboratory
UPS	Uninterruptible Power Supply
USCFCCHR	University of Southern California Foundation for Cross Connection Control and Hydraulic Research
UV	Ultraviolet
V	Volt
VAC	Volts Alternating Current
VDC	Volts Direct Current
VCP	Vitrified Clay Pipe
VOC	Volatile Organic Compounds
VOLT	Voltage
W	Width
W/	With
W/O	Without
WATCH	Work Area Traffic Control Handbook
WM	Water Main
WT	Weight
WWF	Welded Wire Fabric
XHHW	Cross-Linked Polyethylene High Heat Resistant and Water-Resistant
XLPE	Cross Linked Polyethylene
YR or yr	Year
1PH	Single-Phase
3W	Three Wire
3PH	Three-Phase
4W	Four Wire

DEFINITIONS

Accessory Dwelling Unit	An additional dwelling unit associated with and incidental to a principal single-family dwelling on the same lot. An accessory dwelling unit must include separate cooking and sanitary facilities and is a complete, separate dwelling unit. The accessory dwelling unit may be within or attached to the principal dwelling unit or within a detached accessory structure, such as a garage.
Activation	Placing into service a new water or sewer main or other facility. Activation may precede final acceptance.
Alley	A private or public right-of-way or easement and runs between two or more lots or located on a single lot, affording primary or secondary vehicular access to the properties which abut it, but not including a street, utility easement, or railroad right of way.
Backflow	The flow of any substance from a customer's property back into the water distribution system. Backflow can result from improper connection of pressurized equipment to the plumbing system or from accidental pressure drops in the public water system which can be caused by pipe breaks or other equipment failure. Backflow of contaminated water into the public system can create a hazardous situation to other customers.
Backflow Preventer	An assembly, device, or method that prohibits the backflow of water into the public water supply system.
Backfill	Soil material or controlled low-strength material used to fill an excavation.
Base Course	Aggregate layer placed between the subbase course and hot-mix asphalt paving.
Bedding Course	Aggregate layer placed over the excavated subgrade in a trench before laying pipe.
Borrow or Borrow Soil	Satisfactory soil imported from off-site for use as fill or backfill.

Charlotte Water Engineer, Chief Engineer, Owner's Engineer, or Engineer

Charlotte Water engineer with supervisory duties and review, approval, rejection, and signatory authority for applications, permits, methods, and materials.

Contractor — The North Carolina licensed person, firm, or corporation responsible for the completion of the construction phase of a project.

Customer — A person or entity, including a property owner or resident, who is capable of receiving water from the Public Water System through a water service connection for beneficial use or discharges wastewater through a lateral into the Public Sewer System.

Developer — A person, including a governmental agency or redevelopment authority, who undertakes any development and who is the property owner of land to be developed or who has been authorized by the property owner to undertake development on that property.

Distribution Main — Pipes smaller than 16 inches designed to convey water from larger transmission mains to distribute water to street mains including public and private users and providing fire protection.

Drainage Course — Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

Duplex, Triplex, or Quadraplex Dwelling

A structure containing two, three, or four dwelling units.

Design Engineer, Consultant Engineer, or Engineer of Record

The North Carolina licensed; professional engineer responsible for the design of the project.

Dwelling — A structure, or portion thereof, designed or used for human habitation.

Dwelling Unit — A single unit providing complete, independent living facilities for no more than one family, including permanent provisions for living, sleeping, eating, cooking, and sanitation.

Easement	Authorization by an owner for the use, by others for a specific purpose, of a designated part of their property.
Encroachment	Agreement with another utility or jurisdiction, such as NCDOT, CDOT, railroad companies, Duke Power, or Town, to place water or sewer facilities within their right of way.
Excavation	Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
Fill	Soil materials used to raise existing grades.
Final Acceptance	Documented agreement between Charlotte Water and the contractor or developer of a project that the work is satisfactorily completed and that there are no outstanding claims or deficiencies. Completion of the project may also involve submittal of maps, affidavits, tax statements, or other documents that are required by contractual agreement.
Final Backfill	Backfill placed over initial backfill to fill a trench.
Fire Protection	Provision of adequately sized water mains, water volumes, and fire hydrants at suitable intervals to allow use by fire departments in fighting fires. The level of protection varies with land use and development type.
Floodplain	The land subject to inundation by the community base flood and is encompassed by the community special flood hazard area.
Grading	Excavation or fill of material, including the resulting conditions thereof.
Gravity Sewer System	The normal type of wastewater collection system that relies on the natural, downhill flow of wastewater through pipes constructed along drainage patterns and creeks to a wastewater treatment facility**.**
Initial Backfill	Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
Instantaneous Flow	Volume of flow recorded during a fixed amount of time, expressed as a volume per unit time.

Interceptor	A larger sewer pipe usually constructed along a major creek which collects wastewater flow discharged from trunk mains. Interceptors are sometimes also referred to as “outfalls”.
Irrigation Service	A water service requested and installed for the purpose of irrigating lawns or property. Water provided through such a service does not return to the wastewater collection system.
Licensed Utility Contractor	An individual, firm, or corporation which is licensed by the North Carolina Licensing Board for General Contractors to perform public utility and/or unclassified construction projects which have a contract value not exceeding their license limitation.
Long Side	An extension, service, lateral or appurtenance that requires crossing the roadway and is on the opposite side of the roadway from the main.
Lot	Any quantity of land capable of being described in definitive terms with respect to its location and boundaries, which have been established through some legal instrument such as a recorded deed or map. Lots are also referred to as parcels.
Low Pressure Sewer System	A type of wastewater collection system which utilizes individual pumping by each private property owner into a common force main. This type of system is utilized along waterfront property where natural drainage patterns have been disrupted by the creation of a large lake.
Maximum Daily Flow	Largest volume of flow recorded during a continuous 24-hour period, expressed as a volume per unit time.
Multi-Dwelling Development	A development consisting of two or more single-family, twin home, duplex, triplex, quadraplex, townhouse, and/or multi-family structures, constructed on the same lot or parcel of land under single ownership, and planned and developed with a unified design of buildings and coordinated open space and service areas. Accessory dwellings units, where allowed with a principal dwelling, are not considered a Multi-Dwelling Development.
Multi-Family Dwelling Unit	A structure containing five or more dwelling units, with dwelling units either stacked or attached horizontally.

New Construction / Development The establishment or substantial improvement of streets, buildings, useable property, or infrastructure where such facilities did not exist or were not suitable for the newly intended purposes.

Owner Charlotte Water or the entity that owns and operates the facilities.

Parcel See “Lot”.

Peak Hour Flow Highest/peak volume recorded during a one-hour period, expressed as a volume per unit time.

Permits Documentation of permission by Federal, State, and/or local agencies which have regulatory jurisdiction over the construction and operation of water and/or wastewater utilities to expand or modify the public water and/or sewer system.

Public Water and/or Sewer System The water and/or sewer pipes, storage facilities, pumping stations, lift stations, treatment facilities and appurtenances that are owned by the City of Charlotte and operated and maintained by Charlotte Water.

Right of Way A non-possessory interest in the land of another for the purpose of constructing, reconstructing, operating, and maintaining facilities that is dedicated or otherwise legally established for public use.

Rock Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that cannot be removed without drilling and blasting, wedging, sledging, cutting, or barring for its removal.

Septic System A ground absorption sewage disposal system consisting of a holding or settling tank and a ground absorption field.

Short Side An extension, service, lateral or appurtenance that does not require crossing the roadway and is on the same side of the roadway as the main.

Single Family Dwelling A structure containing only one dwelling unit.

Storm Drainage	The natural and manmade network, of structures, channels, and underground pipes that convey stormwater to local creeks, streams, and rivers.
Storm Drainage Facility	The system of inlets, conduits, channels, ditches, and appurtenances that serve to collect and convey stormwater through and from a given drainage area.
Stormwater Control Measure	Also known as "Best Management Practice" or "BMP", a permanent structural device that is designed, constructed, and maintained to remove pollutants from stormwater runoff by promoting settling or filtration; or to mimic the natural hydrologic cycle by promoting infiltration, evapotranspiration, post-filtration discharge, reuse of stormwater, or a combination thereof.
Stream	A channel on the land surface for conveying water.
Street Main	A water or sewer pipe installed along a street, road, or highway primarily for the purpose of providing water or sewer service to the properties along that street.
Structures	Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
Subbase Course	Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
Subdivision	Divisions of a tract or parcel of land into two or more lots, building sites, or other divisions when any one or more of those divisions is created for the purpose of sale or building development, whether immediate or future, and shall include all divisions of land involving the dedication of a new street or a change in existing streets.
Subgrade	Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.
Temporary Construction Easement	A temporary right in a specific tract of land for which Charlotte Water has entered into an agreement with the

	owner that grants Charlotte Water the right to use the land for a limited period of time in order to provide space needed to construct water and sewer facilities.
Top of Bank	The landward edge of the stream during high water or bank full conditions at the point where the water begins to overflow onto the floodplain.
Townhouse	A structure consisting of three or more dwelling units, the interior of which is configured in a manner such that the dwelling units are attached horizontally, separated by a party wall, and each is located on a separate sublot.
Transmission Main	A water pipe constructed primarily for the movement of water from one area to another, typically but not always, pipes 16 inches and larger. Transmission mains usually supply water to smaller distribution mains.
Treatment Facility	A plant designed and constructed for the purpose of removing pollutants and/or other impurities from wastewater or from raw water.
Tributary	A stream or pipe which flows by gravity or is pumped into another stream or pipe.
Trunk Main	A sewer pipe constructed along a drainage pattern or minor creek to collect flows discharged from sewer street mains.
Utilities	On-site above ground or underground pipes, conduits, ducts, and cables as well as underground services within buildings.

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CHAPTER 1
DESIGN REVIEW AND APPROVAL

CHAPTER 1
DESIGN REVIEW AND APPROVAL

North Carolina Department of Environmental Quality (NCDEQ) delegated authority to Charlotte Water to permit all water distribution and transmission mains and sanitary sewer gravity collection extensions following Chapter 23 of Charlotte City Code.

Projects not under this delegated authority are required to be permitted by NCDEQ. Furthermore, Charlotte Water requires any designs and plans that will be sent to NCDEQ for permitting, to be reviewed and approved by Charlotte Water first prior to submittal to NCDEQ.

NCDEQ will continue issuing permits for public water systems such as subdivisions or business parks receiving their water supply from a source other than Charlotte Water. Such sources of supply include, but are not limited to, well or surface water or another utility provider. In addition, raw water mains, treatment devices or facilities, wells, pumping stations, and storage tanks will require permits though NCDEQ.

All connections to Charlotte Water's wastewater collections system requesting a new water service 1-1/2 inch or larger (or equivalent sewer flow) require a Capacity Assurance Program (CAP) approval. All development projects requiring an infrastructure permit also require a CAP approval. This CAP approval verifies capacity in the public wastewater system for new developments and redevelopments.

For details and updates, see the Charlotte Water website at:

https://www.charlottenc.gov/water/Commercial-Development/Commercial-Customer-Services/Capacity-Assurance-Program

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CHAPTER 2
PLACEHOLDER FOR FUTURE TOPIC

CHAPTER 2
FUTURE TOPIC

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CHAPTER 3
PLACEHOLDER FOR FUTURE TOPIC

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CHAPTER 4
PLACEHOLDER FOR FUTURE TOPIC

CHAPTER 4
FUTURE TOPIC

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CHAPTER 5
REGULATORY REQUIREMENTS AND PERMITS

CHAPTER 5
REGULATORY REQUIREMENTS AND PERMITS

1. GENERAL

A. During the preparation of the contract documents and prior to constructing a project, the Design Engineer is responsible for obtaining all required Federal, State, and Local permits, licenses, encroachments, and easements necessary and incidental to the project including payment of all associated fees.

B. It is the responsibility of the Design Engineer and/or Developer to verify which permits, encroachments, and easements are applicable to the project and furnish proof of acquisition of all necessary permits, encroachments, easements, and notices to Charlotte Water prior to startup on any project.

2. PERMITS AND ENCROACHMENTS

A. North Carolina Department of Environmental Quality (NCDEQ) delegated authority to Charlotte Water to permit all water distribution and transmission mains and sanitary sewer gravity collection extensions following Chapter 23 of Charlotte City Code.

B. Projects not under this delegated authority, including pumping stations, low pressure sewer systems, wells, treatment devices or facilities, and storage tanks are required to be permitted by NCDEQ. Furthermore, Charlotte Water requires any designs and plans that will be sent to NCDEQ for permitting, to be reviewed and approved by Charlotte Water first prior to submittal to NCDEQ.

C. Design and permitting of erosion and sediment control devices shall be in accordance with Charlotte Land Development Standards including the City of Charlotte Soil Erosion and Sedimentation Control Ordinance for Developer-Donated projects. Charlotte Water designed projects shall meet NCDEQ requirements, as outlined in the North Carolina Erosion and Sediment Control Planning and Design Manual. Projects outside of Mecklenburg County shall follow the appropriate county, town, and/or state requirements.

D. Encroachment permits are required from the governing agency (CDOT, NCDOT, Towns, CATS, CSX Corporation, Norfolk Southern Railway, NC Railroad, hydrocarbon transmission pipelines, powerlines, natural gas lines, communication lines) and must be between the City of Charlotte and the controlling agency.

E. Street Cut Permits and/or Right-of-Way Encroachments are required prior to any cutting of pavement for installation or excavation in the road right-of-way within governing jurisdictions (CDOT, Towns).

F. Blasting permits are required whenever blasting is required to remove rock. Permits may be obtained from the Charlotte Fire Department when work is performed within the City of Charlotte or from the Mecklenburg County Fire Marshal's Office for work within Mecklenburg County.

G. If wetlands exist on a project or the project impacts any waters of the State, a wetlands permit must be obtained from the US Army Corp of Engineers (USACOE) in accordance with Section 404 of the Clean Water Act and a 401 water quality certification is required from the NC Division of Water Resources (NCDWR) in accordance with Section 401 of the Clean Water Act.

H. The Design Engineer shall determine if the project meets the applicability requirements of the North Carolina (or state) Environmental Policy Act of 1971(SEPA) for review of the project's potential environmental effects. A SEPA review is required if the project includes state-provided funds, the use of public lands, or has an impact of greater than or equal to 10 acres of land.

3. ENVIRONMENTAL PROTECTION

A. The project must follow all local and state environmental and safety protections including but not limited to:

   a. Tree Ordinance per Chapter 21 of the City Code of Charlotte

   b. Noise Ordinance per Chapter 15 of the City Code of Charlotte

   c. Underground Utility Safety and Damage Prevention Act of NCGS Chapter 87 Article 8A

   d. Overhead High-Voltage Line Safety Act of NCGS Chapter 95 Article 19A

CHAPTER 6
EASEMENTS AND PROPERTY ACQUISITON

CHAPTER 6
EASEMENTS AND PROPERTY ACQUISITION

1. PIPELINE EASEMENTS

A. All public pipes outside of public road rights-of-ways shall be installed in recorded permanent easements as approved by Charlotte Water.

B. Permanent easement shall be located at least 10 feet outside the stream top of bank.

C. Temporary construction easements are project specific and must consider the site conditions and equipment being utilized for construction. Temporary construction easements are typically 10 or 15 feet or as required by Charlotte Water for construction.

D. Easement width shall be based on the deepest trench. For sanitary sewers, the easement width shall be based on the deepest trench between manholes and shall be a single width from manhole to manhole.

E. An easement purchased for a single pipeline is assumed to be centered along the pipe.

F. Minimum widths of permanent easements are provided in Table 6.1 based on pipe diameter and trench depth to pipe invert. When additional fill is approved to be added over existing pipes, additional easement widths shall be required as indicated in the table at the new depth. Note that the required width may vary depending on site specific conditions at Charlotte Water's discretion.

G. Minimum permanent easement width for all pipes shall be 20 feet.

H. Charlotte Water reserves the right to require variance in the width of easements at their discretion, on a case-by-case basis.

I. Utilities placed in a tunnel and/or casing may be required to provide additional easement to facilitate maintenance and/or replacement of the carrier pipe in the future, to be provided at Charlotte Water's discretion.

J. Additional easement width may be needed for consideration of location of structures and pipe depth, at Charlotte Water's discretion.

Table 6.1: Minimum Permanent Easement Width Requirements (Feet)					
		Pipe Diameter			
		2” – 12”	15” – 18”	20” – 36”	42” and larger
Trench Depth to Pipe Invert (feet)	0.00’ – 8.00’	20	20	25	35
	8.01’ – 14.00’	30	40	40	50
	14.01’ – 20.00’	45	45	50	60

H. For easement widths of pipes with greater than 20 feet of trench depth, use the following calculation:

1) Multiply 2 feet of full easement width by each foot of pipe invert depth, plus

2) The maximum trench width adder (see Table 6.2), plus

Table 6.2: Maximum Trench Width Allowance		
Pipe Diameter	Trench Width Adder	Maximum Trench Width
8” – 30”	36”	54” – 66”
$\geq$ 30”	42”	Pipe Diameter + 42”

3) Allowance of 4 feet for equipment and shoring accessibility, and

4) Round up to the nearest 5-foot increment, if needed.

Example: For a 24-inch sewer pipe with 25 feet of invert depth:

1) 2 feet of easement width x 25 feet to invert depth, plus

2) 3 feet of outside pipe diameter adder, plus

3) 4 feet for equipment and shoring equals 57 feet of total calculated easement width,

4) Round up to 60 feet of total easement width.

I. Considerations for multiple pipes within a single easement include:

1) Refer to the Water and Sewer Design chapters for minimum separation requirements for parallel pipes within a single easement.

2) Additional easement meeting minimum separation requirements for future parallel pipe and protection of existing pipe during future construction activities including blasting of rock.

3) Additional easement width for protection of existing pipe during construction of new pipe so as not to impart any additional pipe loads.

4) An existing Charlotte Water easement may be used for new pipe installation unless prohibited by the existing easement language.

2. ACCESS EASEMENTS

A. Access easements shall be provided where Charlotte Water maintenance equipment cannot easily access easements from public roadways.

B. Provide adequate access at least every 2,000 feet (1,000 feet in each direction) along the pipeline easement from public roadways. Access easements are to allow Charlotte Water entry to the pipe easements with equipment without the need to traverse lengthy distances on private property. The angle of intersection of the access easement to the public road shall be no less than 85 degrees with a clear sight distance in each direction of travel a minimum of 300 feet.

C. Access easements should be a minimum of 20 feet wide and have a grade of no steeper than 15% with a maximum cross-slope of 10%. Vertical curves shall be transitioned over a minimum 200-foot horizontal distance. The minimum radius of curvature shall be 50 feet.

D. For sewers $\geq$ 24", access easements shall be provided to allow tractor trailer access (AASHTO Interstate Semitrailer WB-67).

E. Gates shall be provided to limit public access to easements and be a minimum of 12 feet wide. Charlotte Water will provide a master lock for each gate. When access easements are located in manicured lawns, gates may be located near the back of the lots.

F. Charlotte Water may require additional requirements based on particular site conditions.

3. LIFT STATIONS

A. All new lift station sites, existing lift station sites undergoing modifications, and access drives, including all appurtenances and vehicular turnaround areas, shall be located on fee simple owned property, owned by the City of Charlotte.

4. MAINTENANCE OF EASEMENTS

A. All easements shall be graded and smoothed to allow sufficient access and use for maintenance and mowing equipment with a maximum cross-slope of 10%.

B. No property owner shall place any part of a structure, construction fill material (temporary or permanent), permanent equipment, irrigation system, or water or stormwater impoundment on easements. Prohibited structures include such items such as, but not limited to buildings, houses, air conditioning units/heat pumps, decks, storage sheds, swimming pools, gazebos, walls, retaining walls including footings, tie backs and geogrid, and masonry fences.

C. Metal, wooden, or plastic fences are allowed across easements if a 12-foot access gate is provided. Fences shall be placed perpendicular to the easement and up to an angle of 35 degrees across the easement. Fences are not allowed to parallel within the easement. Charlotte Water will install a lock to be installed with other utility locks as appropriate with the property owner. Any restricted items that are found within an easement during maintenance activities will not be replaced at Charlotte Water's expense.

D. No trees shall be planted within a permanent easement. No plants with an invasive root system are allowed within a permanent easement. Allowable groundcover, ornamental grass, and small shrub plantings are provided in Charlotte Water's *Landscaping/Planting Guidelines within Charlotte Water Permanent Easement Areas, latest revision* publication on the Charlotte Water's website, https://cltwaterblog.org/wp-content/uploads/2023/03/landscapingguidelines.pdf

E. Gardens, crops, shrubs, or other ornamental plants with a shallow root system are acceptable within an easement but shall not be replaced at Charlotte Water's expense.

F. Critical easements located off-road, as defined by Charlotte Water, shall be marked with 3-foot-tall plastic markers every 300 feet or at the property line, whichever comes first. Water easements will be marked with white markers and sewer easements with green markers.

G. On all developer-donated projects, the developer is required to obtain all necessary easements to complete the project. Infrastructure may not be installed within an existing easement by operation of law, until an easement agreement is recorded.

H. Supplemental easement requirements may be required over existing infrastructure on a case-by-case basis.

5. ACQUISITION AND RECORDING OF EASEMENTS

A. All easements shall be acquired by the developer for donated projects and dedicated to the City of Charlotte.

B. All private services or lateral easements shall be acquired by the developer/property owner when applicable to confirm land locked customers have established and maintained access to their services or laterals. Private service and lateral easements are allowed in these situations:

   a. Property is landlocked, i.e. no frontage on a public street,

   b. Property has Charlotte Water sewer service directly available, but the property owner prefers to connect in a different location, i.e. to provide gravity service, or

   c. There is no justification to require Charlotte Water sewer or water to be extended to the property, i.e. all surrounding property is served.

   The property owner requesting the variance to allow a private service or lateral easement must provide a recorded easement agreement between the property owners involved prior to Charlotte Water accepting payment and application for the connection.

This easement is NOT to be recorded between the property owner and Charlotte Water (City of Charlotte), Charlotte Water does not have the authority to acquire or condemn for the private service or lateral easements.

C. Plat or subdivision maps are to be sealed by a surveyor and approved by a review officer for Mecklenburg County prior to recording. Approval by a review officer is not required for easement maps attached to deeds.

D. All easements (permanent, temporary construction, access) shall be recorded by plat, where applicable, and by deed of easement prior to construction approval.

6. EASEMENT MAP REQUIREMENTS

A. Maps shall be prepared to meet the North Carolina Board of Examiners for Engineers and Surveyors Policy for Existing and New Easements, Policy Number: BP-1709-1.

B. All maps must be 8 ½-inch x 14-inch size with a standard Charlotte Water title block.

C. Title block to include the following:

a. Title as: Sanitary Sewer Easement To Serve: (*Project Name*); or Water Meter (or Main) Easement To Serve: (*Project Name*).

b. Property of (*Current Property Owner*).

c. Job number, file number, and

d. Scale.

D. Maps must contain the following minimum information:

a. Entire boundary of property where easement is located.

b. Deed Book and Page references.

c. Tax Code number.

d. Vicinity map.

e. North Arrow and Basis.

f. A detail where required for clarification.

g. References of adjoining properties, i.e., Deed Book and Page Numbers, Lot Numbers, Owners, Tax Code numbers.

h. Bearings and distances on centerline of sanitary sewer or water main easement.

i. Distances tied to the overall parcel.

j. Easement must be shaded and labeled as "CLTWater SS Easement" or "CLTWater WM Easement".

k. Surveyor's Address must be on each individual easement map to be recorded.

l. Original recordable easement map with original seal and signature of a North Carolina Professional Land Surveyor must be reviewed and stamped by one of the Mecklenburg County Review Officers prior to recordation. Mecklenburg County Review Officers are located at Charlotte Water and other City and County agencies. Original and copy must have an original seal and signature of a North Carolina professional land surveyor.

CHAPTER 7
SURVEY STANDARDS

CHAPTER 7
SURVEY STANDARDS

1. GENERAL

A. Surveys shall be performed to collect the field data and required information outlined in this chapter to assist in the preparation of clear, concise, and accurate set of construction plans and easement maps for sewer and water pipelines and lift station projects.

B. All field surveying shall adhere to the standards outlined in this chapter and be performed under the direct supervision of a licensed NC Professional Land Surveyor. Post-construction surveys shall be performed by a surveyor provided by Charlotte Water or the Engineer of Record and may not be employed by the contractor.

C. All surveying for Charlotte Water projects shall be oriented to the NC State Plane Coordinate System and all elevations based on NGS and or NCGS datum.

D. All data collected will be as per 21 NCAC 56.1608 (Class AA) *Classification Land Information System/Geographic Information System Surveys*, latest revision. Positional accuracy is deemed acceptable if 100% of the features are located according to the following specifications:

1) Horizontal accuracy should be in North Carolina State Plane 3200 NAD 83(2011/PA11/MA11) epoch 2010.00 for field data collection and be equal to or less than 0.10 feet (0.033 meters) to the center of the appurtenance lid or cover (center of rim for sanitary sewer and water manholes or operating nut for water or sewer valves and fire hydrants).

2) Vertical accuracy should be in NAVD 88 Geoid 18 or latest version for field data collection and be equal to or less than 0.098 feet (3 centimeters).

E. All Global Positioning System (GPS) Survey Requirements include:

1) Elevation Mask greater than 15 degrees

2) PDOP value of 5 or less

3) RMS error must be less than 70 millicycles

4) Minimum Number of 30 epochs observed

F. Topography shall be surveyed, do not use published GIS topography.

G. All surveys shall follow NCGS Chapter 87 Article 8A *Underground Utility Safety and Damage Prevention Act*, latest revision.

H. Post-construction survey requirements and standards are provided in Section 4.

2. DESIGN SURVEY REQUIREMENTS

A. Sanitary Sewer Outfall and Trunk Lines

Important procedures to follow and field information to collect for gravity sewer trunkline, at a minimum, are as follows:

1) Maintain and clear a line of sight between proposed manholes.

2) Proposed manholes shall be located with rebar or iron pipes of at least 1/2-inch diameter. This helps to relocate manholes during construction.

3) Show centerline station on guard stakes at proposed manhole locations.

4) Locate existing downstream manhole from Station 0+00 manhole with flow line elevation.

5) Locate all features within the proposed easement and temporary construction easements. Generally, locate within 25' of either side of centerline.

6) Locate all important physical features relating to the proposed line such as creeks, fences, other utility lines, property corners, buildings, large trees, R/W monuments, and road or railroad crossings.

7) Show the distance to creek banks and the width of the banks.

8) Obtain bottom elevation of creek at 100-foot distances and elevation of top of creek banks.

9) Locate any significant trees within the proposed alignment. These may be larger trees than the average or species such as walnut, dogwood, or similar specimen that may have a bearing on the final alignment or Charlotte Water's ability to obtain easements.

10) Locate any significant ground features that may affect construction such as rock outcrops and swampy ground conditions.

11) Locate any wells within 150 feet of centerline of proposed sanitary sewer.

12) Tie all elevations to NCGS or NGS monuments.

13) Verify elevation of flow line, pipe inverts, and rim of the existing manhole where the proposed sanitary sewer line begins.

14) Set temporary benchmarks (TBM) along the proposed sewer route near each manhole and establish by differential leveling. TBMs shall be located outside of the easement or area to be disturbed during construction activities.

15) Place additional temporary benchmarks adjacent to any road or underground utility crossings, as well as stream crossings that may require piers.

16) Obtain bank of creek and flow line of creek elevations at each proposed manhole.

17) When crossing underground utilities, obtain as much information as is available, such as utility locate markings and nearby visible appurtenances.

18) Obtain the location, size, and elevations on all storm drainage pipes and culverts that cross or parallel the proposed sewer centerline.

19) At road or street crossings, obtain elevations along the road in either direction as necessary.

20) At bores or tunnels under roads, perform settlement monitoring per requirements of governing agency.

21) On areas of extreme side slopes, take cross-section elevations to at least 25 feet on either side of the proposed sewer centerline.

B. Sanitary Sewer Street Extensions

Important procedures to follow and field information to collect for sanitary sewer street extensions, at a minimum, are as follows:

1) Locate all physical features within the street right-of-way or adjacent areas if feature could impact construction such as property irons and monuments, utility poles, existing valves and meters, curbs, driveways (define type), storm drainage pipes and structures, planters, mailboxes, signs, fences, trees and shrubs, gas lines, telephone cable, and electric lines at a minimum.

2) These features shall be located on both sides of the street. It may be necessary to shift to the other side during design.

3) Show width of street surface and type of pavement.

4) If proposed lines are located in existing pavement, magnails shall be used in lieu of stakes.

5) Show centerline station on guard stakes at proposed manholes. If proposed manhole is in pavement, mark with paint on pavement.

6) Locate any wells within 150' of centerline of proposed sanitary sewer.

7) Verify flow line, pipe inverts and rim of existing manhole where extension begins and the downstream manhole. Note all pipe and service lateral alignments and invert elevations.

8) Note whether there is an outside drop in the manhole.

9) If a doghouse manhole is to be used for the beginning manhole, obtain flow line, pipe inverts, rim elevations, and tie distances to both upstream and downstream manholes.

10) TBMs shall be set near the beginning of the line (do not use the existing rim), at the end of the extension, and near each proposed manhole. TBMs shall be located outside of the easement or area to be disturbed during construction activities.

11) Locate and obtain elevations of any structure (finished floor and ground) or vacant lot lower than the street. Note any structures with basements.

12) If there is a depression between the street main and any existing structure, run a profile to the structure.

13) Obtain flow line elevation and location of lateral if a lateral is already installed at the structure to be served by the extension main.

14) If the proposed extension does not extend to the crest of a hill, continue the profile to a minimum of 300 feet upstream from the terminus manhole. Charlotte Water retains the right to require additional information.

15) At bores or tunnels under roads, perform settlement monitoring per requirements of governing agency.

16) Survey parallel storm pipes and storm pipe crossings that may impact sewer pipe design elevations.

C. Water Mains

Important procedures to follow and field information to collect for water mains, at a minimum, are as follows:

1) Locate the main line valve, which will become Station 0+00, and blow-off at the end of the existing line that the proposed line will connect to and obtain the elevation of operating nut.

2) Locate all physical features within the street right-of-way or along the proposed water main alignment if feature could impact construction such as property irons and monuments, utility poles, existing valves and meters, curbs, driveways (define type), storm drainage pipes and structures, planters, mailboxes, signs, fences, trees and shrubs, gas lines, telephone cable, and electric lines at a minimum.

3) Locate any significant ground features that may affect construction such as rock outcrops and swampy ground conditions.

4) Set TBMs along the proposed route near intersections and at all creek crossings.

5) When crossing underground utilities, get as much information as is available, such as utility locate markings and nearby visible appurtenances.

6) Obtain the location, size, and elevations on all storm drainage pipes and culverts that cross or parallel the proposed water main centerline.

7) At road or street crossings, obtain elevations along the road in either direction as necessary.

8) At bores or tunnels under roads, perform settlement monitoring per requirements of governing agency.

9) On areas of extreme side slopes, take cross-section elevations to at least 25’ on either side of the proposed water main centerline.

10) For water mains 16” and larger where profiles are required, obtain centerline ground elevation, edge of pavement and side ditch elevations at 100-foot stations.

3. PRE-CONSTRUCTION SURVEY REQUIREMENTS

A. Construction Stakeout for Sanitary Sewers

1) Cut sheets are required for any sanitary sewer that is being built under a Charlotte Water contract. Cut sheets shall be signed and sealed by a licensed NC Professional Land Surveyor and shall contain the firm’s name, phone number, and email address. A sample cut sheet is provided at the end of this chapter.

2) Changes to construction grade and/or alignment from the approved construction plans to avoid obstructions must be pre-approved by Charlotte Water.

3) Place offsets for manholes outside of permanent easements but within the temporary construction easement if possible.

4) Construction stakes shall be set at every manhole and pier.

5) If benchmarks or construction stakes have been destroyed during clearing, set new TBMs or construction stakes.

6) Differential levels must be run on all construction stakes. Mark the offset from the manhole or pier and the station number on the guard stake adjacent to each offset hub.

7) Reference the centerline of all bores approximately 50 feet before beginning of bore and 50 feet past the end of bore.

8) Set an offset stake at any existing manhole at the beginning of the project. Do not use an existing rim as a reference; rims may the disturbed during excavation around existing manholes.

9) Check stakes at a minimum of every 30 days. Provide Charlotte Water a letter confirming accuracy following inspections.

B. Construction Stakeout for Water Mains, Low Pressure Sewer Mains and Sanitary Sewer Force Mains

1) Cut sheets shall be signed and sealed by a licensed NC Professional Land Surveyor and shall contain the firm's name, phone number, and email address. A sample cut sheet is provided at the end of this chapter.

2) Cut sheets for water mains and sanitary sewer force mains are not required when running parallel to an existing curb.

3) Changes to construction grade and/or alignment from the approved construction plans to avoid obstructions must be pre-approved by Charlotte Water

4) Construction stakes shall be placed along the centerline of the pipe or offset from the alignment.

5) Place offsets and/or elevations for horizontal and/or vertical bends.

6) Construction stakes shall be set at grades for cut sheets on areas of critical elevation.

7) Reference the centerline of all bores approximately 50 feet before beginning of bore and 50 feet past the end of bore.

8) Check stakes at a minimum of every 30 days. Provide Charlotte Water a letter confirming accuracy following inspections.

9) Additional requirements for construction staking are provided in Part 3 of Chapters 10 and 13 for Water and Lift Station Specifications, respectively.

FIGURE 7.1: CUT SHEET SAMPLE

SANITARY SEWER CUT SHEET

PROJECT NAME: **COMPANY:**
PROJECT NUMBER: **SURVEYOR:**

EX MH#_____ TO MH#_____

STRUCTURE #	STATION #	INVERT ELEVATIONS		PIPE LENGTH	SLOPE	HUB ELEVATION	OFFSET	(-)CUT/(+)FILL	NOTES
EX MH	0+00.00	INV OUT							
		INV IN(1)							
PROP MH 1		INV OUT(EX)							
		INV IN(2)							
PROP MH 2		INV OUT(MH#)							
		INV IN(MH#)							
PROP MH 3		INV OUT(MH#)							
		INV IN(MH#)							
PROP MH 4		INV OUT(MH#)							
		INV IN(MH#)							
PROP MH 5		INV OUT(MH#)							
		INV IN(MH#)							
PROP MH 6		INV OUT(MH#)							
		INV IN(MH#)							
PROP MH 7		INV OUT(MH#)							
		INV IN(MH#)							
PROP MH 8		INV OUT(MH#)							
		INV IN(MH#)							
PROP MH 9		INV OUT(MH#)							
		INV IN(MH#)							
PROP MH 10		INV OUT(MH#)							
		INV IN(MH#)							

4. POST-CONSTRUCTION SURVEY REQUIREMENTS

All infrastructure and appurtenances (inclusive of the list on the subsequent pages) shall be field collected and inventoried to the survey specifications below after their construction has been completed. The resulting data shall be collected using Charlotte Water's current data dictionary and be delivered prior to final inspection. The data shall be submitted in an ESRI geodatabase (.gdb) and all features shall include Northing, Easting, and Elevation. Charlotte Water will provide the current data dictionary, an example geodatabase, and other necessary documents. The attributes to be collected and submitted are as follows:

A. Water Features and Attributes to be Collected and Surveyed

1) **Water Air Release (wAirRelease)**

a. Accessible – used to indicate whether the feature is accessible to the surveyor

i. Yes – feature is accessible to the surveyor and able to be opened, if applicable

ii. No – feature is not accessible to the surveyor and/or not able to be opened, if applicable, provide additional details in InaccessibleReason field

iii. Unknown – typically used if the feature is not found

b. InaccessibleReason – used to indicate the reason the feature is inaccessible

i. PavedOver – feature is paved over with asphalt or concrete

ii. FullofDirt – feature is full of dirt or debris

iii. FullofWater – feature is full of water

iv. Locked – feature is locked and/or lock is unable to be operated due to damage

v. Sealed – feature has been sealed with tar or other material that is not easily replaced

vi. SubGrade – feature is buried more than 1 foot below existing grade

vii. Obstruction – feature is covered by debris or other objects that prevent access

viii. NotFound – feature is not able to be located, only used when there is reasonable evidence of the feature's potential existence

ix. Other – feature is inaccessible due to a situation that does not fit the other options, provide additional details in Notes field

c. Notes – used to denote any extra or pertinent information about the feature or its collection

d. Accuracy – used to store the accuracy of the data collected

   i. TSSurvey – feature located with conventional survey equipment or total station

   ii. SurveyGPS – feature located with survey grade GPS

   iii. MappingGPS – feature located with mapping grade GPS, sub-meter accuracy, Not adequate for our specification

   iv. Digitized – feature's location determined without survey of any kind, Not adequate for our specification

e. Surveyor – used to store the initials of the survey firm and the surveyor with a space in between (Ex. CW ABC)

f. Collection Date – date field for the date of collection

2) **Water Backflow Device (wBackflowDevice)**

a. Type – used to denote the type of backflow device

   i. DoubleCheck

   ii. ReducePrinciple

b. Location – used to denote the location of the backflow device

   i. AboveGround – usually inside a plastic/fiberglass, insulated housing

   ii. BelowGround – usually in a vault with a metal lid

   iii. Inside – inside a building or structure

c. Size – used to denote the size of the backflow device, noted on device

d. Manufacturer – used to denote the manufacturer of the backflow device, noted on device

e. ModelNumber – used to denote the model number of the backflow device, noted on device

f. SerialNumber – used to denote the serial number of the backflow device, noted on device

g. Accessible – used to indicate whether the feature is accessible to the surveyor

   i. Yes – feature is accessible to the surveyor and able to be opened, if applicable

ii. No – feature is not accessible to the surveyor and/or not able to be opened, if applicable, provide additional details in InaccessibleReason field

iii. Unknown – typically used if the feature is not found

h. InaccessibleReason – used to indicate the reason the feature is inaccessible

i. PavedOver – feature is paved over with asphalt or concrete

ii. FullofDirt – feature is full of dirt or debris

iii. FullofWater – feature is full of water

iv. Locked – feature is locked and/or lock is unable to be operated due to damage

v. Sealed – feature has been sealed with tar or other material that is not easily replaced

vi. SubGrade – feature is buried more than 1 foot below existing grade

vii. Obstruction – feature is covered by debris or other objects that prevent access

viii. NotFound – feature is not able to be located, only used when there is reasonable evidence of the feature's potential existence

ix. Other – feature is inaccessible due to a situation that does not fit the other options, provide additional details in Notes field

i. Notes – used to denote any extra or pertinent information about the feature or its collection

j. Accuracy – used to store the accuracy of the data collected

i. TSSurvey – feature located with conventional survey equipment or total station

ii. SurveyGPS – feature located with survey grade GPS

iii. MappingGPS – feature located with mapping grade GPS, sub-meter accuracy, Not adequate for our specification

iv. Digitized – feature's location determined without survey of any kind, Not adequate for our specification

k. Surveyor – used to store the initials of the survey firm and the surveyor with a space in between (Ex. CW ABC)

l. Collection Date – date field for the date of collection

3) **Water Blow Off Valve (wBlowOff)**

a. Accessible – used to indicate whether the feature is accessible to the surveyor

i. Yes – feature is accessible to the surveyor and able to be opened, if applicable

ii. No – feature is not accessible to the surveyor and/or not able to be opened, if applicable, provide additional details in InaccessibleReason field

iii. Unknown – typically used if the feature is not found

b. InaccessibleReason – used to indicate the reason the feature is inaccessible

i. PavedOver – feature is paved over with asphalt or concrete

ii. FullofDirt – feature is full of dirt or debris

iii. FullofWater – feature is full of water

iv. Locked – feature is locked and/or lock is unable to be operated due to damage

v. Sealed – feature has been sealed with tar or other material that is not easily replaced

vi. SubGrade – feature is buried more than 1 foot below existing grade

vii. Obstruction – feature is covered by debris or other objects that prevent access

viii. NotFound – feature is not able to be located, only used when there is reasonable evidence of the feature's potential existence

ix. Other – feature is inaccessible due to a situation that does not fit the other options, provide additional details in Notes field

c. Notes – used to denote any extra or pertinent information about the feature or its collection

d. Accuracy – used to store the accuracy of the data collected

i. TSSurvey – feature located with conventional survey equipment or total station

ii. SurveyGPS – feature located with survey grade GPS

iii. MappingGPS – feature located with mapping grade GPS, sub-meter accuracy, Not adequate for our specification

iv. Digitized – feature's location determined without survey of any kind, Not adequate for our specification

e. Surveyor – used to store the initials of the survey firm and the surveyor with a space in between (Ex. CW ABC)

f. Collection Date – date field for the date of collection

4) **Water Hydrant (wHydrant)**

a. Manufacturer – used to denote the manufacturer of the hydrant, occasionally noted on device

b. HydrantType – used to denote the style of hydrant

i. Standard – hydrant with one large connection

ii. DoubleSTORZ – hydrant with two large STORZ connections

iii. AirRelease – hydrant which doubles as an air release, usually painted blue

iv. NonConforming – hydrant with no large connections

v. Other – hydrant which does not fit the other options

c. BarrelSize – used to denote the barrel size of the hydrant, occasionally noted on device

d. FabricationYear – used to denote the year the hydrant was made, occasionally noted on device

e. SteamerStreet – used to denote the street the main steamer connection faces

f. SteamerConnection – used to denote the type of steamer connection

i. CMUD 4.875x6 – standard, non-STORZ connection

ii. STORZ – STORZ connection

iii. Other – some other type of connection, rare

g. Color – used to denote the predominant paint color of the hydrant

i. Black - usually only found in Uptown Charlotte

ii. Blue – denotes an air release hydrant

iii. Green - rare

iv. Red – usually denotes a private hydrant

v. Yellow – vast majority of hydrants

vi. NotPainted – rare

h. Notes – used to denote any extra or pertinent information about the feature or its collection

i. Accuracy – used to store the accuracy of the data collected

i. TSSurvey – feature located with conventional survey equipment or total station

ii. SurveyGPS – feature located with survey grade GPS

iii. MappingGPS – feature located with mapping grade GPS, sub-meter accuracy, Not adequate for our specification

iv. Digitized – feature's location determined without survey of any kind, Not adequate for our specification

j. Surveyor – used to store the initials of the survey firm and the surveyor with a space in between (Ex. CW ABC)

k. Collection Date – date field for the date of collection

5) **Water Manhole (wManhole)**

a. LidType – used to denote the type of manhole lid

i. CMUDStandard – 24" lid

ii. CMUDLarge – 30" lid

b. Accessible – used to indicate whether the feature is accessible to the surveyor

i. Yes – feature is accessible to the surveyor and able to be opened, if applicable

ii. No – feature is not accessible to the surveyor and/or not able to be opened, if applicable, provide additional details in InaccessibleReason field

iii. Unknown – typically used if the feature is not found

c. InaccessibleReason – used to indicate the reason the feature is inaccessible

i. PavedOver – feature is paved over with asphalt or concrete

ii. FullofDirt – feature is full of dirt or debris

iii. FullofWater – feature is full of water

iv. Locked – feature is locked and/or lock is unable to be operated due to damage

v. Sealed – feature has been sealed with tar or other material that is not easily replaced

vi. SubGrade – feature is buried more than 1 foot below existing grade

vii. Obstruction – feature is covered by debris or other objects that prevent access

viii. NotFound – feature is not able to be located, only used when there is reasonable evidence of the feature's potential existence

ix. Other – feature is inaccessible due to a situation that does not fit the other options, provide additional details in Notes field

d. Notes – used to denote any extra or pertinent information about the feature or its collection

e. Accuracy – used to store the accuracy of the data collected

i. TSSurvey – feature located with conventional survey equipment or total station

ii. SurveyGPS – feature located with survey grade GPS

iii. MappingGPS – feature located with mapping grade GPS, sub-meter accuracy, Not adequate for our specification

iv. Digitized – feature's location determined without survey of any kind, Not adequate for our specification

f. Surveyor – used to store the initials of the survey firm and the surveyor with a space in between (Ex. CW ABC)

g. Collection Date – date field for the date of collection

6) **Water Meter (wMeter)**

a. MeterSerial – used to denote the serial number of the meter

b. ERTSerial – used to denote the serial number of the encoder receiver transmitter

c. HouseNumber – used to denote the house number corresponding to the meter, should only be populated when obvious

d. StreetName – used to denote the street name corresponding with the house number

e. LidType – used to denote the style of lid

   i. Epoxy – white or green epoxy lid

   ii. HingedMetalDoors – metal door(s) with hinge(s)

   iii. MetalPlates – metal lid with no hinges

   iv. Concrete – concrete surrounding smaller metal plate with hinge

   v. Other – other type of lid which does not fit the other options

f. Accessible – used to indicate whether the feature is accessible to the surveyor

   i. Yes – feature is accessible to the surveyor and able to be opened, if applicable

   ii. No – feature is not accessible to the surveyor and/or not able to be opened, if applicable, provide additional details in InaccessibleReason field

   iii. Unknown – typically used if the feature is not found

g. InaccessibleReason – used to indicate the reason the feature is inaccessible

   i. PavedOver – feature is paved over with asphalt or concrete

   ii. FullofDirt – feature is full of dirt or debris

   iii. FullofWater – feature is full of water

   iv. Locked – feature is locked and/or lock is unable to be operated due to damage

   v. Sealed – feature has been sealed with tar or other material that is not easily replaced

   vi. SubGrade – feature is buried more than 1 foot below existing grade

   vii. Obstruction – feature is covered by debris or other objects that prevent access

   viii. NotFound – feature is not able to be located, only used when there is reasonable evidence of the feature's potential existence

   ix. Other – feature is inaccessible due to a situation that does not fit the other options, provide additional details in Notes field

h. Notes – used to denote any extra or pertinent information about the feature or its collection

i. Accuracy – used to store the accuracy of the data collected

i. TSSurvey – feature located with conventional survey equipment or total station

ii. SurveyGPS – feature located with survey grade GPS

iii. MappingGPS – feature located with mapping grade GPS, sub-meter accuracy, Not adequate for our specification

iv. Digitized – feature's location determined without survey of any kind, Not adequate for our specification

j. Surveyor – used to store the initials of the survey firm and the surveyor with a space in between (Ex. CW ABC)

k. Collection Date – date field for the date of collection

7) **Water Valve (wValve)**

a. Subtype – used to denote the function of the valve

i. Inline – mainline valve

ii. Service – valve on a service connection

iii. HydrantGuard – valve on a hydrant service connection

iv. Unknown – used when unable to determine the function of the valve

b. Cover – used to denote whether the valve has a cover or not

i. Yes

ii. No

iii. Unknown

c. Accessible – used to indicate whether the feature is accessible to the surveyor

i. Yes – feature is accessible to the surveyor and able to be opened, if applicable

ii. No – feature is not accessible to the surveyor and/or not able to be opened, if applicable, provide additional details in InaccessibleReason field

iii. Unknown – typically used if the feature is not found

d. InaccessibleReason – used to indicate the reason the feature is inaccessible

   i. PavedOver – feature is paved over with asphalt or concrete

   ii. FullofDirt – feature is full of dirt or debris

   iii. FullofWater – feature is full of water

   iv. Locked – feature is locked and/or lock is unable to be operated due to damage

   v. Sealed – feature has been sealed with tar or other material that is not easily replaced

   vi. SubGrade – feature is buried more than 1 foot below existing grade

   vii. Obstruction – feature is covered by debris or other objects that prevent access

   viii. NotFound – feature is not able to be located, only used when there is reasonable evidence of the feature's potential existence

   ix. Other – feature is inaccessible due to a situation that does not fit the other options, provide additional details in Notes field

e. Notes – used to denote any extra or pertinent information about the feature or its collection

f. Accuracy – used to store the accuracy of the data collected

   i. TSSurvey – feature located with conventional survey equipment or total station

   ii. SurveyGPS – feature located with survey grade GPS

   iii. MappingGPS – feature located with mapping grade GPS, sub-meter accuracy, Not adequate for our specification

   iv. Digitized – feature's location determined without survey of any kind, Not adequate for our specification

g. Surveyor – used to store the initials of the survey firm and the surveyor with a space in between (Ex. CW ABC)

h. Collection Date – date field for the date of collection

8) **Water Main (wMain)**

Should be used only for cartographic connectivity. Not intended to be used for top of pipe collection.

a. Notes - used to denote any extra or pertinent information about the feature or its collection

B. Wastewater Features and Attributes to be Collected and Surveyed

1) **Backflow Manhole (wwBackflowMH)**

a. Accessible – used to indicate whether the feature is accessible to the surveyor

i. Yes – feature is accessible to the surveyor and able to be opened, if applicable

ii. No – feature is not accessible to the surveyor and/or not able to be opened, if applicable, provide additional details in InaccessibleReason field

iii. Unknown – typically used if the feature is not found

b. InaccessibleReason – used to indicate the reason the feature is inaccessible

i. PavedOver – feature is paved over with asphalt or concrete

ii. FullofDirt – feature is full of dirt or debris

iii. FullofWater – feature is full of water

iv. Locked – feature is locked and/or lock is unable to be operated due to damage

v. Sealed – feature has been sealed with tar or other material that is not easily replaced

vi. SubGrade – feature is buried more than 1 foot below existing grade

vii. Obstruction – feature is covered by debris or other objects that prevent access

viii. NotFound – feature is not able to be located, only used when there is reasonable evidence of the feature's potential existence

ix. Other – feature is inaccessible due to a situation that does not fit the other options, provide additional details in Notes field

c. Notes – used to denote any extra or pertinent information about the feature or its collection

d. Accuracy – used to store the accuracy of the data collected

i. TSSurvey – feature located with conventional survey equipment or total station

ii. SurveyGPS – feature located with survey grade GPS

iii. MappingGPS – feature located with mapping grade GPS, sub-meter accuracy, Not adequate for our specification

iv. Digitized – feature's location determined without survey of any kind, Not adequate for our specification

e. Surveyor – used to store the initials of the survey firm and the surveyor with a space in between (Ex. CW ABC)

f. Collection Date – date field for the date of collection

2) **Wastewater Cleanout (wwCleanout)**

a. LidType – used to denote the material of the cleanout lid

i. PVC

ii. DIP

iii. Brass

iv. Unknown

b. Accessible – used to indicate whether the feature is accessible to the surveyor

i. Yes – feature is accessible to the surveyor and able to be opened, if applicable

ii. No – feature is not accessible to the surveyor and/or not able to be opened, if applicable, provide additional details in InaccessibleReason field

iii. Unknown – typically used if the feature is not found

c. InaccessibleReason – used to indicate the reason the feature is inaccessible

i. PavedOver – feature is paved over with asphalt or concrete

ii. FullofDirt – feature is full of dirt or debris

iii. FullofWater – feature is full of water

iv. Locked – feature is locked and/or lock is unable to be operated due to damage

v. Sealed – feature has been sealed with tar or other material that is not easily replaced

vi. SubGrade – feature is buried more than 1 foot below existing grade

vii. Obstruction – feature is covered by debris or other objects that prevent access

viii. NotFound – feature is not able to be located, only used when there is reasonable evidence of the feature's potential existence

ix. Other – feature is inaccessible due to a situation that does not fit the other options, provide additional details in Notes field

d. Notes – used to denote any extra or pertinent information about the feature or its collection

e. Accuracy – used to store the accuracy of the data collected

i. TSSurvey – feature located with conventional survey equipment or total station

ii. SurveyGPS – feature located with survey grade GPS

iii. MappingGPS – feature located with mapping grade GPS, sub-meter accuracy, Not adequate for our specification

iv. Digitized – feature's location determined without survey of any kind, Not adequate for our specification

f. Surveyor – used to store the initials of the survey firm and the surveyor with a space in between (Ex. CW ABC)

g. Collection Date – date field for the date of collection

3) **Low Pressure Service Box (wwLowPressureServiceBox)**

a. Accessible – used to indicate whether the feature is accessible to the surveyor

i. Yes – feature is accessible to the surveyor and able to be opened, if applicable

ii. No – feature is not accessible to the surveyor and/or not able to be opened, if applicable, provide additional details in InaccessibleReason field

iii. Unknown – typically used if the feature is not found

b. InaccessibleReason – used to indicate the reason the feature is inaccessible

i. PavedOver – feature is paved over with asphalt or concrete

ii. FullofDirt – feature is full of dirt or debris

iii. FullofWater – feature is full of water

iv. Locked – feature is locked and/or lock is unable to be operated due to damage

v. Sealed – feature has been sealed with tar or other material that is not easily replaced

vi. SubGrade – feature is buried more than 1 foot below existing grade

vii. Obstruction – feature is covered by debris or other objects that prevent access

viii. NotFound – feature is not able to be located, only used when there is reasonable evidence of the feature's potential existence

ix. Other – feature is inaccessible due to a situation that does not fit the other options, provide additional details in Notes field

c. Notes – used to denote any extra or pertinent information about the feature or its collection

d. Accuracy – used to store the accuracy of the data collected

i. TSSurvey – feature located with conventional survey equipment or total station

ii. SurveyGPS – feature located with survey grade GPS

iii. MappingGPS – feature located with mapping grade GPS, sub-meter accuracy, Not adequate for our specification

iv. Digitized – feature's location determined without survey of any kind, Not adequate for our specification

e. Surveyor – used to store the initials of the survey firm and the surveyor with a space in between (Ex. CW ABC)

f. Collection Date – date field for the date of collection

4) **Wastewater Manhole (wwManhole)**

h. MH_Geometry – used to denote the geometry or shape of the manhole structure

i. Eccentric – manhole lid is offset slightly from the rest of the structure

ii. Concentric – manhole structure is conical, and not offset

iii. Box – manhole structure is square or rectangular, typically used for lamp holes in older areas of the system

iv. Flattop – manhole is usually precast concrete with a flat surface above ground, typically found on larger diameter mains and/or outfalls

v. Other – shape of manhole that does not fit any of the above options – provide additional details in Notes field

vi. Unknown – typically used when manhole is not accessible

i. MH_Function – used to denote the function or purpose of the manhole

i. Inline – manhole has pipes in and out, most commonly seen manhole

ii. HeadofLine – manhole has only one pipe out

iii. Lamphole – manhole has small, square lid and sides

iv. DoubleHead - manhole has no invert in and two invert out pipes typically at the same elevation

v. SiphonBox –manhole where gravity main connects to upstream and/or downstream side of siphons generally at creek crossings

vi. JunctionBox – manhole used to allow flow to pass between systems

vii. DiversionBox – manhole where flow can be diverted from one gravity line to another parallel gravity line, generally includes a weir

viii. Wetwell – manhole receiving flow for a lift station, generally very deep with a float inside

ix. Other – manhole function that does not fit any of the above options; provide additional details in Notes field

x. Unknown – typically used when manhole is not accessible

j. Material – used to denote the predominant material used to construct the manhole

i. Concrete – usually precast

ii. Brick – red brick laid with mortar

iii. MasonryBlock – concrete brick or block with or without mortar

iv. Polymer – thinwall precast polymer concrete

v. Unknown – typically used when manhole is not accessible

vi. Other – material that does not fit any of the above options, provide additional details in Notes field

k. LidType – used to denote the type of lid covering the manhole opening

i. Vented – lid with holes for ventilation

ii. VentedCamLock – vented lid with locking cam devices

iii. Solid – lid with no holes for ventilation

iv. SolidCamLock – solid lid with locking cam devices

v. SolidBoltedSeal – bolted solid lid which bolts down and has a gasket around the manhole opening

vi. SolidBoltedNoSeal – solid lid which bolts down

vii. WaterTight – solid lid which has been sealed with tar or other waterproofing material

viii. WaterTightLocked – watertight lid with locking cam devices

ix. CertainTeed – specific brand of lid with a thinner lid that rotates in the frame to lock

x. Unknown – typically used when manhole is not accessible

l. LiningType – used to denote the type of material used to line manhole to prevent ground water from leaking into manhole walls

i. Cementitious

ii. Epoxy

iii. CuredInPlace

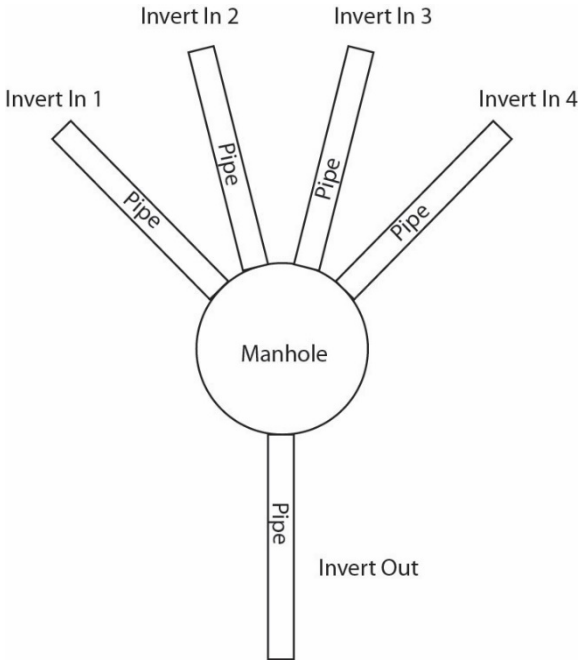
iv. PVC

v. None – no lining is visible

vi. Unknown – typically used when manhole is not accessible

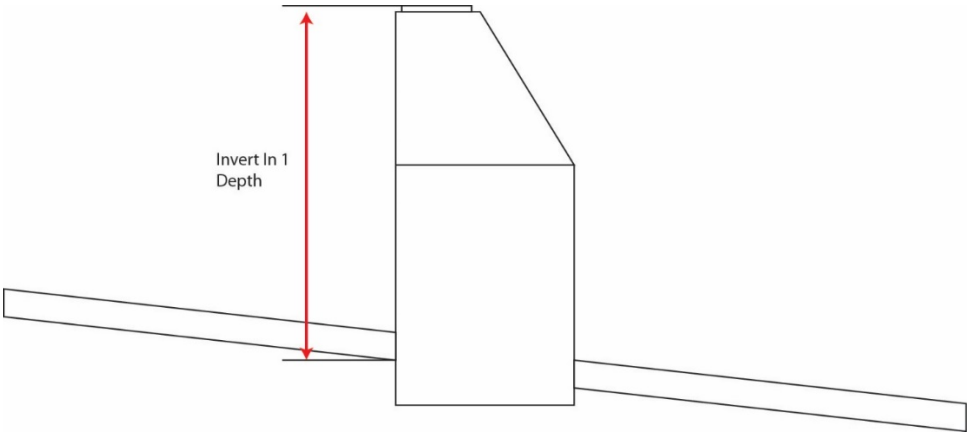
m. Manhole Invert Numbers – Invert In numbers are assigned by going clockwise around the manhole starting from the Invert Out. When going clockwise around the manhole, the first 6-inch or larger line will be named “Invert In 1”, unless that 6-inch line is an obvious lateral serving a nearby building. Lines of 4-inch are laterals and should not be considered an Invert In or included in this numbering.

FIGURE 7.2: MANHOLE INVERT NUMBERS



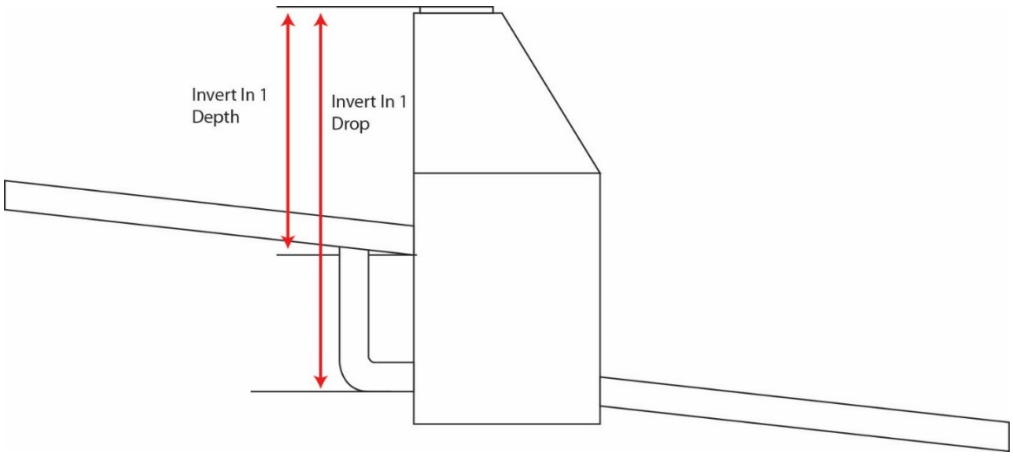
n. InvertIn1 – used to denote the distance in feet between the bottom of the pipe at Invert In 1 and the top of the manhole rim that holds the lid

FIGURE 7.3: INVERT IN 1



o. InvertIn1Drop – used to denote the distance in feet between bottom of the drop pipe at Invert In 1 and the top of the manhole rim that holds the lid

FIGURE 7.4: INVERT IN 1 DROP



Repeat this process as needed for additional invert pipes:

InvertIn2 – if applicable, same as InvertIn1 applied to Invert In 2

InvertIn2Drop - if applicable, same as InvertIn1 applied to Invert In 2

InvertIn3 – if applicable, same as InvertIn1 applied to Invert In 3

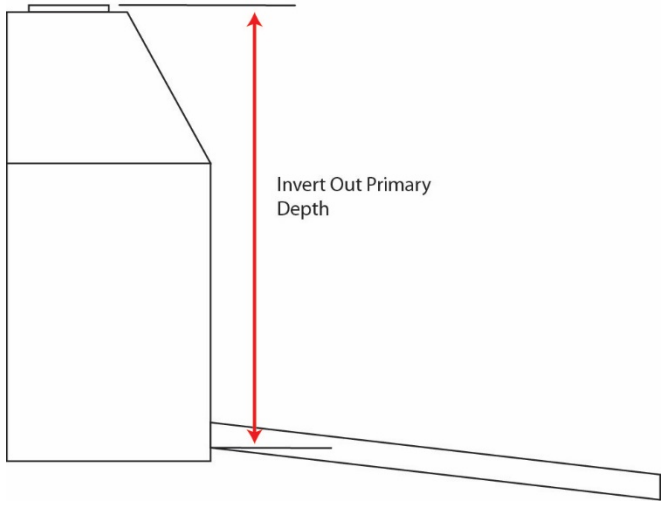
InvertIn3Drop - if applicable, same as InvertIn1 applied to Invert In 3

InvertIn4 – if applicable, same as InvertIn1 applied to Invert In 4

InvertIn4Drop - if applicable, same as InvertIn1 applied to Invert In 4

p. InvertOutPrimary – used to denote the distance in feet between bottom of the outflowing pipe at the lowest elevation or at the outflowing pipe that collects a majority of the flow leaving the manhole and the top of the manhole rim that holds the lid

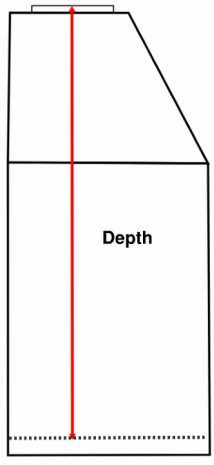
FIGURE 7.5: INVERT OUT PRIMARY



q. InvertOutSecondary – if applicable, used to denote the distance in feet between bottom of the outflowing pipe at the second lowest elevation or at the outflowing pipe that collects a minority of the flow leaving the manhole and the top of the manhole rim that holds the lid. If the Primary Out and Secondary Out are at equal depths and/or there is no majority/minority flow, then there is no preference for which Out gets which values.

r. Depth – used to denote the distance in feet from bottom trough of the manhole to the top of the manhole rim that holds the lid

FIGURE 7.6: DEPTH



s. Vent – used to denote the presence of a vent pipe on the manhole structure

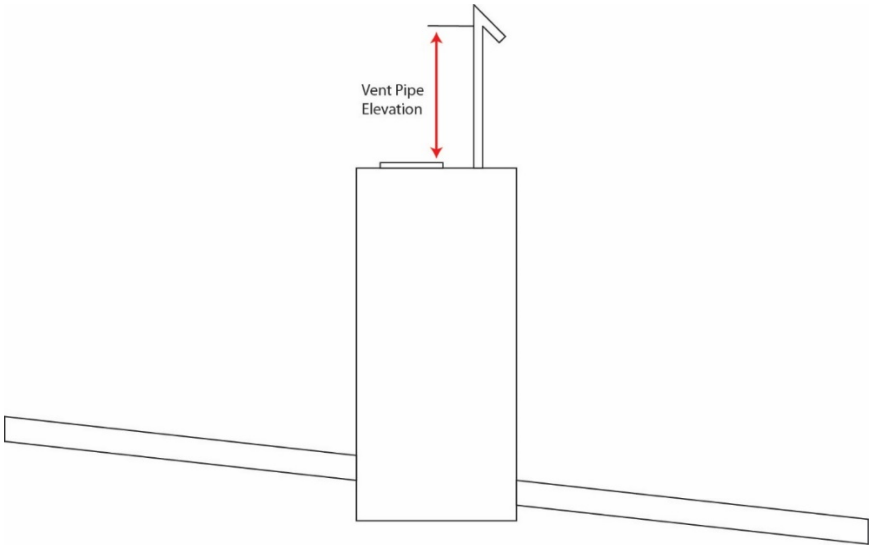
i. Yes

ii. No

iii. Unknown

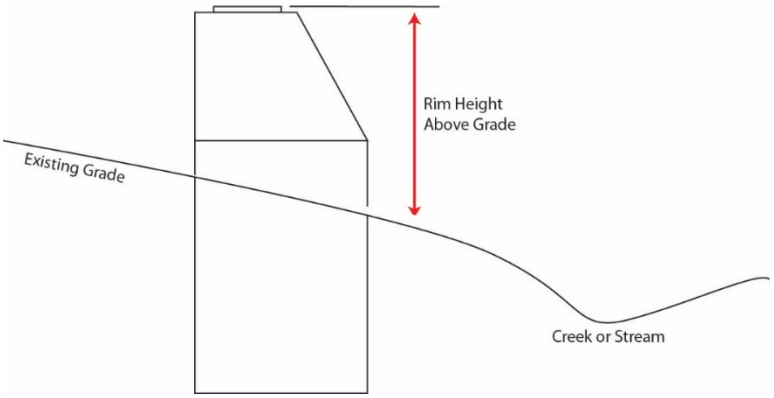
t. VentElevation – used to denote the distance in feet between the manhole rim and the inside bend of the vent pipe

FIGURE 7.7: VENT ELEVATION



u. RimHeightAboveGrade – used to denote the distance in feet between the manhole rim and the lowest point of existing grade. If the manhole is in the street or is flush with grade, enter 0 for the value. Do not leave as null or blank.

FIGURE 7.8: RIM HEIGHT ABOVE GRADE



v. Accessible – used to indicate whether the feature is accessible to the surveyor

i. Yes – feature is accessible to the surveyor and able to be opened, if applicable

ii. No – feature is not accessible to the surveyor and/or not able to be opened, if applicable, provide additional details in InaccessibleReason field

iii. Unknown – typically used if the feature is not found

w. InaccessibleReason – used to indicate the reason the feature is inaccessible

i. PavedOver – feature is paved over with asphalt or concrete

ii. FullofDirt – feature is full of dirt or debris

iii. FullofWater – feature is full of water

iv. Locked – feature is locked and/or lock is unable to be operated due to damage

v. Sealed – feature has been sealed with tar or other material that is not easily replaced

vi. SubGrade – feature is buried more than 1 foot below existing grade

vii. Obstruction – feature is covered by debris or other objects that prevent access

viii. NotFound – feature is not able to be located, only used when there is reasonable evidence of the feature's potential existence

ix. Other – feature is inaccessible due to a situation that does not fit the other options, provide additional details in Notes field

x. Notes – used to denote any extra or pertinent information about the feature or its collection

y. Accuracy – used to store the accuracy of the data collected

i. TSSurvey – feature located with conventional survey equipment or total station

ii. SurveyGPS – feature located with survey grade GPS

iii. MappingGPS – feature located with mapping grade GPS, sub-meter accuracy, Not adequate for our specification

iv. Digitized – feature's location determined without survey of any kind, Not adequate for our specification

z. Surveyor – used to store the initials of the survey firm and the surveyor with a space in between (Ex. CW ABC)

aa. Collection Date – date field for the date of collection

5) **Wastewater Valve (wwValve)**

a. InManhole – used to denote whether the valve is inside a manhole or not

i. Yes

ii. No

iii. Unknown

b. Cover – used to denote whether the valve has a cover or not

i. Yes

ii. No

iii. Unknown

c. Accessible - used to indicate whether the feature is accessible to the surveyor

i. Yes – feature is accessible to the surveyor and able to be opened, if applicable

ii. No – feature is not accessible to the surveyor and/or not able to be opened, if applicable, provide additional details in InaccessibleReason field

iii. Unknown – typically used if the feature is not found

d. InaccessibleReason - used to indicate the reason the feature is inaccessible

i. PavedOver – feature is paved over with asphalt or concrete

ii. FullofDirt – feature is full of dirt or debris

iii. FullofWater – feature is full of water

iv. Locked – feature is locked and/or lock is unable to be operated due to damage

v. Sealed – feature has been sealed with tar or other material that is not easily replaced

vi. SubGrade – feature is buried more than 1 foot below existing grade

vii. Obstruction – feature is covered by debris or other objects that prevent access

viii. NotFound – feature is not able to be located, only used when there is reasonable evidence of the feature's potential existence

ix. Other – feature is inaccessible due to a situation that does not fit the other options, provide additional details in Notes field

e. Notes – used to denote any extra or pertinent information about the feature or its collection

f. Accuracy – used to store the accuracy of the data collected

i. TSSurvey – feature located with conventional survey equipment or total station

ii. SurveyGPS – feature located with survey grade GPS

iii. MappingGPS – feature located with mapping grade GPS, sub-meter accuracy, Not adequate for our specification

iv. Digitized – feature's location determined without survey of any kind, Not adequate for our specification

g. Surveyor – used to store the initials of the survey firm and the surveyor with a space in between (Ex. CW ABC)

h. Collection Date – date field for the date of collection

6) **Wastewater Main (wwMain) – Cartographic Sketch Only**

Should be used only for cartographic connectivity. Not intended to be used for top of pipe collection.

a. Diameter – used to denote the diameter of the wastewater main

b. Material – used to denote the material of the wastewater main

c. Notes - used to denote any extra or pertinent information about the feature or its collection

CHAPTER 8
DRAFTING STANDARDS

CHAPTER 8
DRAFTING STANDARDS

1. GENERAL

A. All drawings shall be done in AutoCAD (DWG) format, latest version. Manual drawings are not acceptable.

B. The standard symbols, pen weights, and sizes used in drafting Charlotte Water sewer and water plans are given on the following pages.

C. A legend of symbols is required with each set of construction plans or record drawings and where additional symbols are required, they shall be clearly defined and included in the legend. Symbols shall be annotated to scale appropriately to the base file.

D. The standard scale for Charlotte Water construction drawings is 1" = 40' in plan view and 1" = 4' in profile view. Expanded detail drawings should be used whenever needed to clearly convey details. Alternate scales may be used upon Charlotte Water's approval however, water plan view scales shall not exceed 1" = 100'. Charlotte Water retains the right to require a smaller scale for denser developments to maintain readability.

E. Standard sheet size shall be 24" x 36" (ARCH D) for construction plans and 8.5" x 14" (Legal) for easement and encroachment maps.

F. All sheets must contain the standard Charlotte Water title block format.

G. Both plan and profile views shall be shown on the same sheet. Profiles shall be located directly above the corresponding plan view. Elevations must be shown at the left side of the profile section. Station numbering should increase from left to right and should be approximately above the corresponding plan view stationing. Sewer line drawings should run from left to right upstream.

H. Structures and appurtenances (vaults, manholes, hydrants, valves, piers, fittings, etc.) should be labeled in plan and profile views with station number and standard detail reference if applicable.

I. Parallel storm pipe and structures shall be shown in plan and profile.

J. Profiles in road right of ways shall include the pipe centerline profile and the edge of pavement profile.

K. Distance from edge of pavement to water main pipes shall be labeled.

L. Erosion control devices shall be shown on plan views and properly labeled. Drainage ditches shall be shown with direction of storm runoff.

M. All underground obstructions shall be shown in both plan and profile, if applicable. The profile view shall label vertical clearances.

N. Pipe sizes shall be shown on the plan view and properly scaled on the profile view with both inside and outside diameters shown.

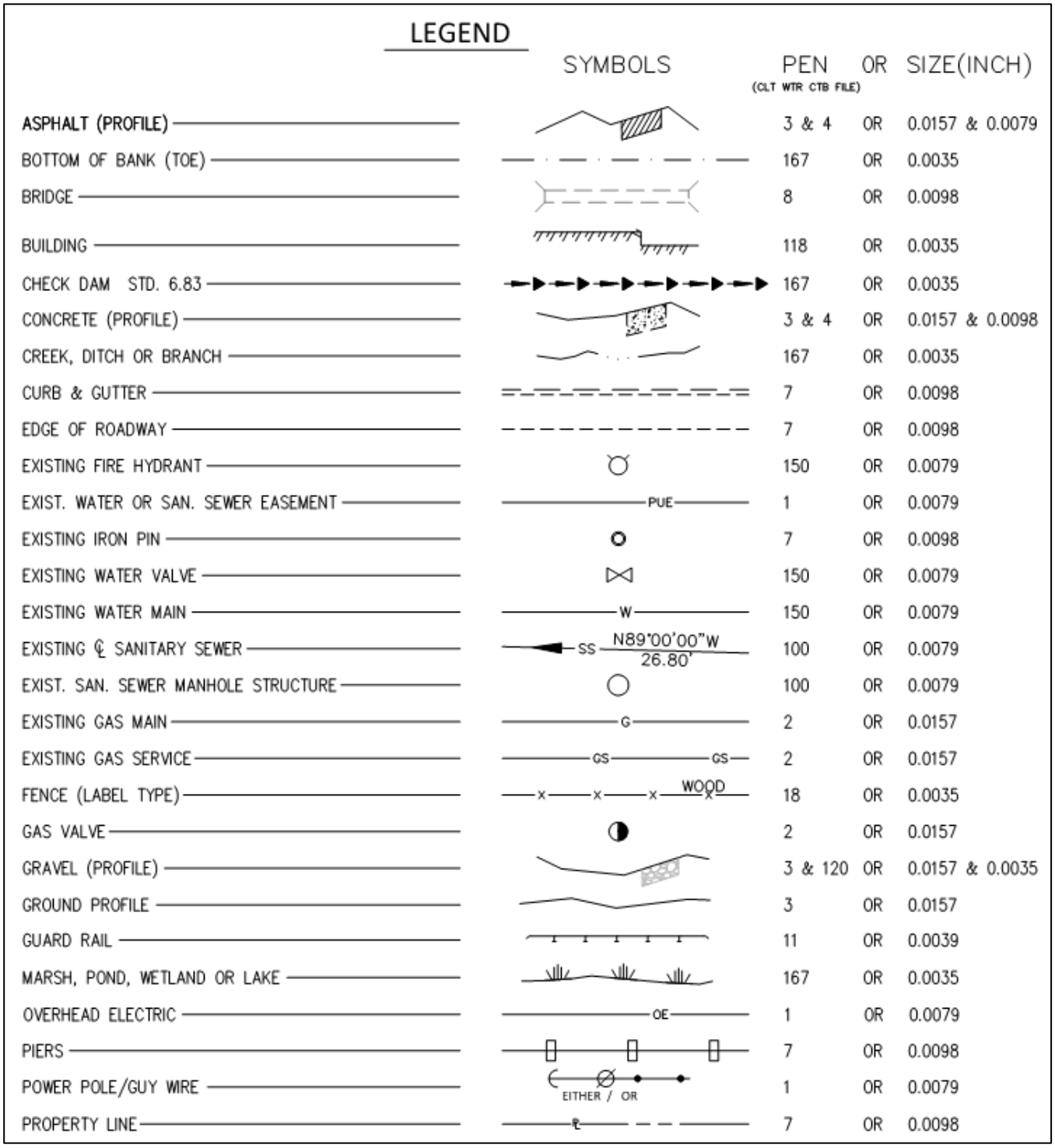
O. Sewer lines shall be labeled with bearings and distances in the upstream direction when in easements.

P. Water lines shall be stationed from valves or tees for each branch. Station 0+00 shall be the closest existing valve when connecting to a pipe stubout. Station 0+00 shall be the new valve when cutting in a tee and valve.

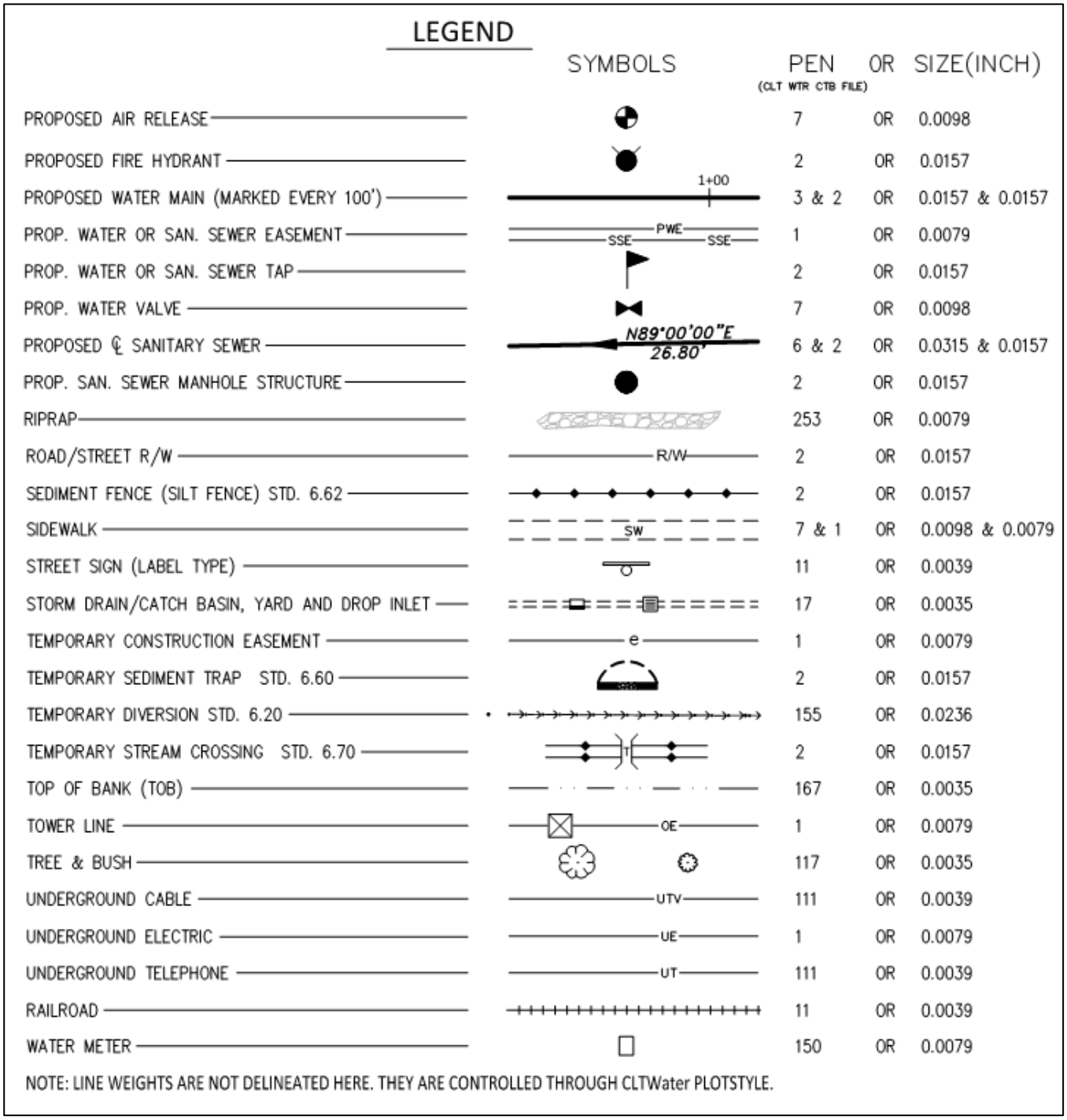
Q. Subdivision sewer plans and water distribution plans shall both include sewer lateral and water service locations on each plan to illustrate how each lot will be served. Field adjustments of sewer laterals or water service locations during construction shall be coordinated with Charlotte Water and reflected on record drawings.

R. The Charlotte Water AutoCAD symbols, pen weights, plot style, and title block are available for download from the website.

FIGURE 8.1: STANDARD SYMBOLS AND LINE WEIGHTS



LEGEND



NOTE: LINE WEIGHTS ARE NOT DELINEATED HERE. THEY ARE CONTROLLED THROUGH CLTWater PLOTSTYLE.

CHAPTER 9
RECORD DRAWINGS

CHAPTER 9
RECORD DRAWINGS

1. GENERAL

A. Record Drawings shall be submitted at the completion of construction of all Charlotte Water sewer and water pipeline and lift station projects.

B. Record drawings shall be accurate, informative, and consistently represent the actual installed infrastructure.

C. One hard/paper copy on 24” by 36” paper, a PDF file, and CAD files shall be submitted for review and approval by Charlotte Water.

2. RECORD DRAWING REQUIREMENTS

A. Record drawings must be sealed by a licensed NC Professional Land Surveyor that is not employed by the contractor.

B. Each record drawing shall contain two seals from a NC Professional Engineer (NCPE), both signed and dated:

   A. The original seal for the design information, and

   B. A new seal specifically for the release of the record drawing information.

C. If the original PE is no longer available or if the drawing was not updated to show record drawing conditions, the following two notes shall be added:

   Note 1: NOTE: ORIGINAL PLANS WERE APPROVED BY CHARLOTTE WATER ON (DATE), WHICH WERE SIGNED, SEALED, AND DATED BY (NCPE), NORTH CAROLINA PROFESSIONAL ENGINEER # (NCPE LICENSE NUMBER) ON (DATE).

   Note 2: NOTE: THESE DRAWINGS ARE NOT CONSIDERED A CERTIFIED DOCUMENT AS TO THE ORIGINAL DESIGN BUT ONLY AS TO THE RECORD DRAWING CHANGES.

D. A note to indicate who supplied the information shall also be added to each drawing:

   NOTE: THIS DRAWING HAS BEEN MODIFIED TO REFLECT CHANGES MADE DURING CONSTRUCTION OF THE PROJECT. THIS IS BASED ON INFORMATION OBTAINED FROM THE CONTRACTOR, THIRD-PARTY SURVEYOR, INSPECTOR, AND/OR CONSTRUCTION OBSERVATION BY THE ENGINEER’S AUTHORIZED REPRESENTATIVES.

E. The revision block in the title block shall be updated with the Record Drawing date. The cover page pipe information block shall be updated with actual pipe lengths, sizes, and materials and all contractor and inspector names listed.

F. All proposed design information shall be marked through and the actual, installed information shown near it.

G. Record locations must be redrawn when there is the following deviation from proposed location:

   A. More than a 2-foot horizontal or 6-inches vertical deviation for sewer lines

   B. More than 1/8-inch deviation of scaled horizontal or vertical water line

   C. Proposed drop manhole was not installed

H. Stationing shall be provided by the surveyor for water mains, services, and sewer laterals.

I. Directional arrows or street names shall be used to denote which main the water services or sewer laterals are tapped into if there is more than one option.

J. When major changes have occurred or specific details are provided by Charlotte Water's inspector, provide insets with greater detail.

K. Record drawing information for sewer and water pipelines, services, and sewer laterals should stand out and be easy to read. Following the drafting guidelines, record information shall be bold line type and text shall not be placed over features.

L. Where pipes are located in easements outside of public roads, easement deed book and page references shall be provided under each parcel label.

M. Pipe material and classifications shall be noted on each drawing and stationed where changes occur.

N. A standard note for sewer lateral and water service material should be added to the record drawing cover with deviations located and noted on the drawings. A summary table shall be added for each sewer lateral and water service that notes the location, lot number, and material signed by Charlotte Water's inspector and the contractor.

3. SEWER

A. Survey data shall be obtained for all surface level sewer pipe infrastructure including cleanouts per Chapter 7.

B. Rim and invert elevations shall be shown to the nearest 0.01 foot.

C. Bearings and distances between manholes shall be shown to the nearest 0.01 foot.

D. Revised stationing shall be provided for manholes, laterals, concrete collars, ends of casing pipe, cathodic protection test stations, tracer wire terminal points, and piers where applicable. Pier heights and pile lengths shall also be recorded.

4. WATER

A. The scale on the water plan cover sheet shall be no larger than 1” = 100’.

B. Survey data shall be obtained for all surface level water pipe infrastructure per Chapter 7.

C. All above-ground features such as valves, hydrants, meters, air releases, blow offs, and cathodic protection test stations, including temporary gate valves and blow-offs, shall be provided with revised stationing, preferably on the water distribution drawing.

D. Revised stationing shall be provided for services, concrete collars, ends of casing pipe, tracer wire terminal points, and piers where applicable. Pier heights and pile lengths shall also be recorded.

E. Crosses and tees shall have more than one station number. Arrows shall be used to denote which direction the numbers are increasing.

F. Where pipes are located in easements outside of public road rights-of-way, obtain survey every 100 feet and on all fittings, bends, and location of change in pipe material. Use tracer wire location equipment to mark the surface alignment and survey to confirm the main alignment is properly located in the easement.

G. Stub out inset details shall include station numbers for wall blocking, plug, blow off valve, and blow off standpipe.

H. Provide inset details for all fire hydrants, air release assemblies, and blow off assemblies including station numbers for all features from the public main to the assembly.

I. Provide inset details for all commercial water services including station numbers for all features from the public main to the property line valve.

5. LIFT STATIONS, LPSS, AND FORCE MAINS

A. Force mains shall be recorded from Charlotte Water inspector's sketch designating stationing for valves, services, wyes, bends, air releases, manual cleanouts, and cathodic protection test stations.

B. Revised stationing shall be provided for services, concrete collars, ends of casing pipe, tracer wire terminal points, and piers where applicable. Pier heights and pile lengths shall also be recorded.

C. Survey data shall be obtained for all surface level sewer pipe infrastructure per Chapter 7.

D. For force mains, obtain survey data every 100 feet and on all fittings, bends, and location of change in pipe material. Use a soft dig excavation to obtain top of pipe elevation and provide edge of pavement elevation to confirm actual pipe depth.

E. Provide pipe manufacturer, type, class of pipe, valve manufacturer, model, and actual number of turns to operate valve.

F. Provide a profile of the centerline of access roads/driveways and geotechnical test results for compaction in the access road/driveway, containment basin, lift station site, and pipe trenches.

G. Provide location and elevation of storm drain pipes, water service lines, and earthen containment basins. Provide certification of capacity of containment basins.

H. For each lift station, provide design average and peak flows, static head, system and pump curves, operational points, wet well level control elevations, storage capacity, pump model and horsepower, and a copy of the final permit on one drawing.

I. Electrical plan shall be updated with locations of installed electrical equipment and conduits.

6. PARTIAL DRAWINGS FOR PHASED DEVELOPMENT

A. Partial plans shall clearly show the work installed with future infrastructure that was not installed fully marked through.

B. Provide the easement deed book and page reference for the entire length of the sewer to the tie-in manhole. If the sewer will be located in a future street, the recorded easement shall be the width of the future street right-of-way. Easements are not acceptable for water lines, force mains, or low-pressure sewer mains as they must be in a recorded street right-of-way.

C. Clearly show all water services are tapped into water mains that are in a recorded street or can be isolated by valves within the recorded area.

CHAPTER 10
WATER MAINS

CHAPTER 10
WATER MAIN DESIGN

1. GENERAL

A. This chapter covers the minimum design criteria to be used for designing water pipelines and appurtenances including those portions of water service connections that lie in public rights-of-way and in easements granted to Charlotte Water. All other systems are the responsibility of the respective property owner unless otherwise documented via agreement with Charlotte Water.

B. All engineering plans for water pipelines must meet the Charlotte Water design standards as presented and the State standards as indicated in the most recent amended *North Carolina Administrative Code, Title 15A, Subchapter 18C, Section .0900 Distribution Systems* administered by the North Carolina Department of Environmental Quality (NCDEQ). In general, the Charlotte Water standards should be the primary source for design guidance with the State standards as a supplement. In some cases, the Charlotte Water standard is more stringent than the State standard.

C. All projects must be sealed by a North Carolina professional engineer.

2. HYDRAULIC DESIGN

A. General

1) Water distribution systems shall be designed to provide adequate flow and pressure for both domestic supply and fire protection.

2) A North Carolina Professional Engineer shall submit calculations upon Charlotte Water's request for all flow requirements including fire flow, average daily flow, maximum daily flow, and peak hourly flow.

3) Available water pressure and capacity can be confirmed with the Charlotte Water Planning Division.

B. Fire Flow and Residual Pressure

1) New water infrastructure shall meet a minimum fire flow of 1,000 gallons per minute in an 8-inch main with a residual pressure of 20 pounds per square inch (psi), as measured at the hydrant being tested.

2) It is the responsibility of the Engineer of Record to incorporate private-side booster pumping if needed to meet applicable flow and pressure criteria on the parcel. If booster pumping is necessary, the Engineer of Record shall confirm to Charlotte Water that the distribution main can meet the required booster pumping and testing flows and pressures for the parcel without affecting the domestic supply and fire protection for adjacent parcels.

3) Local fire district shall govern fire flow requirements for individual parcels.

4) Mixed-use developments, significant users, and large developments (developments with more than 100 parcels) shall provide redundant connections to the distribution system, maintain fire protection sizing throughout, and minimize dead ends. An outage analysis shall demonstrate fewer than 100 customers or residential units will be affected during an outage.

5) The bottom elevation of the elevated storage tanks in the distribution system to be used for consideration of fire flows is summarized in Table 10.1:

Table 10.1: Elevated Storage Tank Bottom Elevations	
Pressure Zone	Tank Bottom Elevation (ft)
882	847.0
960	922.0
978	939.0

C. Demands

1) Water distribution systems shall be sized to serve the population as calculated from Future Land Use (FLU) plans.

2) Average Day Demand (ADD) shall be calculated from plumbing fixture counts, number of services, and Future Land Use (FLU). It is the average flow that a water main is expected to handle within an annual basis.

3) Maximum Day Demand (MDD) is the maximum volume expected to flow through a main in a single 24-hour period in a year.

4) Peak Hour Demand (PHD) is the maximum volume expected to flow through a main in a single hour period in a year.

5) The peaking factors to calculate MDD and PHD is summarized in Table 10.2.

Table 10.2: Peaking Factors	
Demand	**Peaking Factor**
MDD	1.6 x ADD
PHD	1.7 x MDD

6) Instantaneous demand for residential areas shall be based on the number of 5/8-inch service connections, based on Figure 4-1 *AWWA Manual M22 Sizing Water Service Lines and Meters*. Instantaneous demand for business and industrial development shall be based on detailed analysis of water volume and usage patterns for the given type of development.

D. Pressures

Water systems shall be designed to supply the demands of all customers while maintaining the following minimum pressures, as measured at the meter or at the back of curb of each parcel, shown in Table 10.3.

Table 10.3: Minimum Pressures	
Demand	**Pressure (psi)**
MDD	40 psi
PHD	30 psi
MDD + Fire Flow	20 psi

E. Velocities

1) Pipelines shall be designed to meet the following maximum velocities summarized in Table 10.4.

Table 10.4: Maximum Velocity		
Demand	**Pipe Size (in)**	**Maximum Velocity (ft/s)**
PHD	All	5.0
MDD + Fire Flow	< 16	10.0
MDD + Fire Flow	≥ 16	7.0

2) Mains shall be designed to provide:

a. 5 feet per second (fps) for flushing mains 12-inches or less

b. 4 fps for flushing for mains 12-inches or greater

F. Head Loss Criteria

1) A Hazen-William C-factor of 120 shall be used for new pipes 16-inches and smaller, to account for hydraulic degradation over the life expectancy of the pipe.

2) Pipes greater than 16 inches shall be designed to meet the performance criteria in Table 10.5 when velocities are 5.0 fps.

Table 10.5: Allowable Head Loss	
Size	**Allowable Head Loss**
> 16 to 36-inches	5.0 ft / 1,000 linear feet
> 36 to 54-inches	3.0 ft / 1,000 linear feet
> 54-inches	2.0 ft / 1,000 linear feet

3) A C-factor of no greater than 100 shall be used for the existing pipe between the fire hydrant tested and the new system tie-in connection. The C-factor of the existing pipe may be reduced from 100 down to a value of no less than 25 by Charlotte Water depending on the location within the distribution system.

4) All calculations and pipe sizes shall be based on actual internal diameter (ID) of the pipe, not the nominal pipe size.

G. Services

1) Services and meters, including irrigation meters, shall be sized and locations designed in accordance with applicable Domestic Meter Selection Guidelines and/or Charlotte Water Standards.

2) The minimum service size shall be a ¾-inch service line with a 5/8-inch meter.

3) Any water service customer which has a static water pressure greater than 80 psi is required by North Carolina State Building Code to install and maintain a pressure reducing valve (PRV), to be installed on the building service line after the meter. This installation is covered by the Plumbing Code and is not maintained by Charlotte Water.

4) Individual taps on lines 20 inches or greater are not permitted. Variances must be approved by Charlotte Water and consideration may be given for isolated services and customers on a case-by-case basis. Both sides of the tap 8-inches and larger shall include mainline valves for isolation and parallel connection feeds to meet fire flow requirements.

H. Private Systems

1) Private distribution systems including potable and non-potable, shall meet the cross-connection control requirements of 15A NCAC 18C .0406(b) which requires installation of a testable backflow prevention assembly or air gap.

2) Looped private distribution systems are discouraged and will only be considered by Charlotte Water if it is needed to meet fire flow requirements.

I. Minimum Pipe Sizing and Limitations on Use of Small Diameter Mains

1) The minimum water main diameter when providing public fire flow shall be 8-inches.

2) 2-inch lines may be used within residential subdivisions on cul-de-sacs or dead end right of way with no potential for future extension for a maximum length of 1,000 feet where fire flow requirements and minimum fire hydrant spacing is provided by water mains 8-inches and larger.

3) No more than 10 residential customers, or the equivalent of 10 residential customers, with 5/8-inch services may be served from a dead-end 2-inch main.

4) No more than 20 residential customers, or the equivalent of 20 residential customers, with 5/8-inch services, may be served from a looped 2-inch main. A looped 2-inch main is connected to a minimum 6-inch main on each end.

5) The maximum service size on 2-inch mains shall be 1 ½-inch service.

J. Terminal Ends

1) The maximum length of a dead-end non-looped 8-inch water main is 2,000 feet.

2) The terminal end of 8-inch and larger water mains shall have a blow off, a fire hydrant or a permanent auto-flusher at Charlotte Water's discretion.

3. LOCATION AND DEPTH

A. Location

1) Water mains shall be located only within the limits of public road rights-of-way (ROW). Water mains located outside public ROW shall require a dedicated easement and with Charlotte Water approval. Specific horizontal alignment shall be made with consideration to property lines, construction conditions, underground conflicts, and property owner requirements.

2) Water mains shall not be located in either public or private alleys.

3) When an existing water line is replaced with new pipe, the existing water services along this section must be replaced from the main line to the angle valve on the front side of the meter yoke bar. The existing tailpiece assembly is not replaced.

4) Any pipes requiring replacement due to upsizing and/or relocating shall be to property lines unless otherwise approved by Charlotte Water.

B. Depth

1) Depth of water mains shall be set to minimize high and low points and shall be measured from top of pipe.

2) Minimum cover depths per pipe size shall be as shown in Table 10.6.

Table 10.6: Minimum Cover Depth Allowable for Water Main Pipe Size		
Pipe Size (inches)	Minimum Depth* in Road Rights-of-Way (feet)	Minimum Depth in Cross-Country Easements (feet)
less than 12	3	5
12, 16, 20	4	5
24	5	5
≥ 30	6	6
*Minimum depth of pipe shall ensure all applicable clearances are met, with consideration given for future utility locations.		

Table 10.6 ensures pipe will be buried to a depth below the frost line in Mecklenburg County (approximately 12 inches). In no case shall any pipe be installed with less than 30 inches of cover.

3) Minimum cover depth requirements of water main located inside a road right-of-way shall be measured from the top of pipe below the adjacent roadway pavement edge of pavement elevation or below the pipe centerline ground elevation, whichever is greater. Charlotte Water reserves the right to require more depth of cover if needed.

4. PIPE MATERIAL AND THICKNESS DESIGN

The following pipe materials, displayed in Table 10.7, are approved for various applications. All pipe sizes shall be based on internal diameter (ID). Thickness requirements below are based on a minimum depth of cover of 3 feet. If depths are approved less than 3 feet or if depth of cover exceeds 10 feet, then the pipe thickness must be determined by AWWA standards, or the Ductile Iron Pipe Research Association (DIPRA) thickness design calculator based on cover depth and type of bedding to be used.

Table 10.7: Water Main Materials and Thickness			
Pipe Size (inches)	Material	Thickness	Specifications
SERVICE LINES			
¾ - 2	Copper	Type K	ASTM B88
¾ - 1	HDPE	SDR 9 Copper Tube Size	ASTM D2737 AWWA C901
1 ½ - 3	HDPE	DR 9 IPS	ASTM D3035 AWWA C906
≥ 3	DIP, RJ	Pressure Class 350	AWWA C151
DISTRIBUTION LINES			
2	HDPE	SDR 9 IPS	ASTM D3035 AWWA C901
	PVC	SDR 13.5	ASTM D2241
6 - 12	HDPE	DR 9 IPS	AWWA D3035 AWWA C906
	PVC	SDR 14	AWWA C900
	DIP	Pressure Class 350	AWWA C151
TRANSMISSION MAINS			
16 - 30	DIP	Pressure Class 250 Minimum, Thickness design per AWWA C150	AWWA C151
16 - 32	HDPE	DR 9 IPS	AWWA D3035 AWWA C906
36 - 64	DIP	Pressure Class 250 Minimum, Thickness design per AWWA C150	AWWA C151
≥ 30	PCCP	Per Appendix C AWWA C301	AWWA C301
	Steel	Special Cases for Charlotte Water Review	AWWA M11

5. THRUST RESTRAINT

A. Thrust Blocks

1) Thrust blocks may be used on pipe 8 inches and smaller.

2) Thrust blocks shall be used on pipe greater than or equal 12 inches at all bends and tees.

3) Thrust blocks shall bear on undisturbed soil.

B. Restrained Joints

1) Restrained joints shall be integrally cast at the factory. Field-installed restrained joints will not be allowed. Push-on joint gripper gasket restraint may be used on 12 inch and smaller ductile iron pipe. Gripper gasket restraint shall not be used on larger diameter ductile iron pipe or any size plastic pipe.

C. Thrust Restraint Criteria

Thrust restraint criteria is summarized in Table 10.8, per *AWWA Manual M41 Ductile Iron Pipe and Fittings* and *DIPRA Thrust Restraint Design for Ductile Iron Pipe*, latest editions, shall be used to calculate thrust and joint restraint length.

Table 10.8: Thrust Restraint Criteria per AWWA M41

Variable	Criteria
Pressure (whichever is greater)	• Working pressure plus surge pressure • Working pressure x 1.5 • 200 psi
Soil Type for Bearing Strength	• Actual soil type • Silt 1 (if soil type is unknown)
Safety Factor	• Two (2)
Cover Depth	• Table 10.6 or actual depth if shallower is approved
Trench Type or Laying Designation	• Type 2 when Charlotte Water Type 1 bedding is used • Type 3 when Charlotte Water Type 1A bedding is used • Type 4 when Charlotte Water Type II bedding is used • Type 5 when Charlotte Water Type III or greater bedding is used

6. VALVING REQUIREMENTS

A. Main line valves shall be located at all pipeline intersections and at changes in pipe diameters.

B. Isolation valves shall be added to minimize the number of customers affected during an outage.

C. Maximum valve spacing shall be 1,500 feet for distribution lines, 2- to 12-inch lines.

D. Maximum valve spacing shall be 3,000 feet for transmission mains, 16 inches and larger mains.

E. Maximum valve spacing shall be 250 feet within the Central Business District (CBD)/ inside of the I-277 loop, Neighborhood 2-B Zoning District or greater, and Transient-Oriented Development (TOD).

F. Intersecting pipe may utilize a cross-style connection up to a maximum diameter of 12-inches. Round connections shall be used for pipe larger than 12-inches in diameter.

G. A minimum of two (2) valves shall be provided at all tees and a minimum of three (3) valves shall be provided at all crosses, with valves located at road intersection radius points or as close to the fittings as possible.

H. Isolation valves are required on both sides of a water line crossing a railroad, light rail, streetcar rails, major creek/stream, or major road (interstates, US or State numbered highways, roads with 6 or more travel lanes).

I. When valves must be located away from intersections due to conflicts, they shall be located at hydrant installations.

J. If the line is a one-way feed, the valve shall be on the dead-end side of the hydrant branch. On looped mains, the valve should be located downstream from the water flow direction.

K. Tie-in connections shall be made with tees and valves. Tapping sleeves and tapping valves shall not be allowed. Tapping sleeves and valves are only allowed for service connections. If a size-on-size service connection is to be installed, a mechanical joint tapping sleeve is required. Bolt-on sleeves are not allowed.

L. Fire hydrants shall have a hydrant guard valve located at the hydrant tee.

M. For transmission mains 30 inches and larger, fire hydrants shall have two (2) hydrant guard valves: one (1) on the fire hydrant line at the hydrant tee and one (1) on the fire hydrant line at the hydrant.

N. Allowable valve types for various applications are summarized in Table 10.9.

Table 10.9: Allowable Valves for Water Mains

Valve Type	Application and Installation
Butterfly Valves	• Water mains 36 inches and larger • Valve operators to be located within a vault
Resilient Seated Gate Valves	• Water mains 30 inches and smaller • All Pressure Zone Boundary Valves • ≤ 12 inches, valves direct buried with standard valve box • 16- to 30-inch valves with vertical orientation, direct buried, with 20.5-inch clear opening valve box • 16- to 30-inch valves with horizontal orientation, direct buried, shall have operator/nut located inside a manhole

7. FIRE HYDRANTS

A. Standard fire hydrants shall be used on 8-inch water mains. For water mains 12 inches and larger, a high velocity fire hydrant shall be used. High velocity fire hydrants are not allowed on water mains less than 12 inches unless approved by Charlotte Water.

B. For new water main installations, the spacing between public fire hydrants shall be no greater than 1200 feet for residential purposes or 800 feet for commercial and multifamily purposes. These distances are measured along an improved public roadway.

1) For new public fire hydrants requests on existing water main along existing improved public roadway, Charlotte Water will review the request on a case-by-case basis dependent on existing public fire hydrant spacing.

C. Fire hydrants on new water main installations shall be located within 600 feet of a subdivision entrance that includes a public right-of-way.

D. Fire hydrants shall be located at major or significant arterial, thoroughfare, boulevards, and collector street intersections that include public ROW. This requirement is also applicable to Uptown Street classifications as defined in the Charlotte UDO.

E. Where streets are designed with median dividers or four or more traffic lanes that cannot be crossed by firefighters pulling hose lines, including those streets incorporating light rail systems, fire hydrants shall be spaced between 400 and 600 feet based on adjacent land use, measured along public street centerlines on alternating sides of the roadway.

F. The maximum distance between fire hydrants shall not exceed 1,200 feet where new water mains are extended along streets where fire hydrants are not needed for fire protection of structures or similar fire protection problems.

G. Fire hydrants shall NOT be placed inside the radius points of intersections or commercial driveway entrances.

H. Fire hydrants shall NOT be installed in ADA ramps nor impede ADA access requirements.

I. Fire hydrants shall be located within the public ROW.

J. Fire hydrants cannot be within 15 feet of on-street parking.

1) Accommodations may include removal of public parking spaces, installation of a grass island, or others as approved by regulatory authority.

K. Terminal end of a water main 8 inches and larger shall have a blow off, fire hydrant or permanent auto-flusher at Charlotte Water's discretion.

8. AIR-RELEASE VALVES, VACUUM VALVES, AND BLOW-OFFS

A. Manual air-release valves (ARVs) shall be provided at high points on water mains 12 inches and larger.

B. Manual ARVs shall be provided at high points on 6-inch and 8-inch water mains where air cannot be adequately released through a service connection.

C. Manual 2-inch ARVs are required on both sides of transmission main line valves 16 inches and smaller. 6-inch manual ARV/standard hydrant shall be provided for 24-inch and 30-inch water mains and 8-inch manual ARV/high velocity hydrant shall be provided for water mains 36-inch and larger.

D. The Engineer of Record shall evaluate the need for automatic ARV and air vacuum valves (AVV) on pumped lines or any other application where the potential for water

column separation exists and supply the results of the surge analysis upon request by Charlotte Water.

E. The Engineer of Record shall use AWWA M51 to determine recommended locations and sizes of automatic ARVs.

F. Automatic ARV and AVV discharge piping shall include a downward-facing elbow with a stainless-steel insect screen. Screen shall be constructed of 0.009-inch thick 316 grade stainless steel 18 x 18 mesh with 0.047-inch openings.

G. Automatic AVVs shall be located inside vaults.

H. Transmission mains 24 inches and larger shall be designed such that they can be dewatered within 4 hours through blow-offs and hydrants.

I. Dead-end lines 12 inches and smaller shall be terminated with a 2-inch blow-off. Dead-end lines 16 inches through 24 inches shall be terminated with a 4-inch blow-off. Dead-end lines 30 inches and larger shall be terminated with a flushing hydrant. Larger blowoffs may be required by Charlotte Water as needed to provide adequate flushing velocities.

J. 12-inch blow-offs shall be installed at low point of 24-inch and larger water mains for drainage. Welded-on outlets to ductile iron pipe are not allowed. Tees shall be utilized.

K. Water quality appurtenances, e.g., auto flushers or sampling stations, may be required by Charlotte Water based on the planned development and/or extension network and shall be installed by the developer.

9. UTILITY SETBACKS AND SEPARATIONS

The minimum clearance requirements for conflicts with utilities and other features, in accordance with NCAC 18C .0904 and .0906 and governing utility guidelines, is shown in Tables 10.10 and 10.11. Depth of cover shall be defined from the top of the pipe. Charlotte Water reserves the right to require increased separations.

Table 10.10: Minimum Separations for Water Mains per NCAC 18C .0904 & .0906	
Setback Parameter	Separation Requirements*
Storm Sewers and other utilities not listed below	
Vertical	1 foot
Horizontal	5 feet
Sewer Lines, existing or proposed	
Horizontal	10 feet*
*If local conditions or barriers prevent a 10-foot lateral/horizontal separation, then: 1) The water main shall be laid in a separate trench, with the elevation of the bottom of the water main at least 18 inches above the top of the sewer, or 2) The water main shall be laid in the same trench as the sewer, with the water main located at one side on a bench of undisturbed earth and with the elevation of the bottom of the water main at least 18 inches above the top of the sewer. And the reasons for preventing the 10-foot separation shall be documented on the permitted plans.	
Vertical, water over sewer including in shared benched trenches or crossings	18 inches
Crossings	Center one full pipe length over crossing to maximize joint distance from sewer
Reclaimed Water Lines	
Vertical, water main over reclaimed water line	18 inches
Horizontal, water main over reclaimed water line	10 feet
Crossings	Center one full pipe length over crossing to maximize joint distance from sewer

Final earth grade (vertical) Where it is impracticable to provide 30 inches of cover, a deviation may be approved on a case-by-case basis taking into consideration feasibility, cost, and supporting data from the design engineer including pipe material, cover material, land cover, land use, land slope, depth of the frost line, and location of other utilities.	Below frost line of 12 inches or minimum 30 inches whichever is greater
*At a minimum, 12 inches shall be maintained between the outside of the water main and the outside of other utilities to allow for construction and repair. If it is impractical to maintain the separation distances, a deviation may be approved on a case-by-case basis if supported by data and alternative construction criteria submitted by the design engineer. Data and alternative construction criteria to be provided per 15A NCAC 18C .0904 (c) and .0906 (f).	

Table 10.11: Minimum Separations for Water Mains to Other Features	
Parallel pipes in same trench	Minimum 10-foot separation or outside 1:1 slope whichever is greater at the discretion of Charlotte Water
Stormwater BMP	Water main trench to remain outside 1:1 slope to the BMP easement
Retaining Wall	Water main to remain 5 feet from footings and outside of geogrid area/structural impact of retaining wall
Roadways	2 feet from edge of pavement and/or back of curb
Any other stream, lake, impoundment, or ground water lowering and surface drainage ditches	10 feet
Any building foundation	10 feet
Any basement	10 feet
Top slope of embankment or cut of 2 feet or more vertical height	10 feet
Drainage systems and interceptor drains	5 feet
Swimming pools	10 feet

A. Storm structures are not permitted in Charlotte Water easements. Stormwater BMPs are not allowed in Charlotte Water easements.

10. STREAM CROSSINGS

Stream crossings shall be minimized, and the following design standards shall be followed:

A. Streambanks shall be protected from erosion at all times and shall comply with all requirements of the jurisdiction having authority.

B. When approved by Charlotte Water, water mains shall cross stream channels at a near-perpendicular direction.

C. When possible, stream crossings shall be made with the top of pipe a minimum of 5 feet below the stream bed. Pipe shall be protected from flotation by the use of piers, piles, and/or concrete collars.

D. When necessary, as dictated by depth of cover, stream width, flow conditions, and soil conditions, special anchorage shall be required to prevent flotation and/or washout.

E. Pipe for submerged stream crossings shall be factory installed restrained joint ductile iron or Charlotte Water approved material.

F. Aerial stream crossings are not recommended and shall only be reviewed by Charlotte Water in extreme circumstances.

G. Designers shall be responsible for compliance with floodplain regulations and any approval(s) required by appropriate jurisdiction having authority.

11. CORROSION PROTECTION

A. Where ductile iron pipe is installed in corrosive soils, polyethylene encasement of the ductile iron pipe and fittings is required. Soil testing shall be required to be conducted by an experienced technician as certified by The Association for Materials Protection and Performance (AMPP) to determine if additional protective measures are required.

B. Where pipes are installed near impressed current utilities, such as gas pipelines, high voltage power transmission lines, light rail, street cars, and railroads, a stray current field analysis and soil testing shall be required to be conducted by an experienced technician as certified by The Association for Materials Protection and Performance (AMPP) to determine if additional protective measures are required. External protective measures may include zinc coating, polyethylene encasement, or bonded joints and sacrificial anodes as approved by Charlotte Water. PVC or HDPE pipe is preferred. At a minimum ductile iron pipe and fittings shall be double wrapped in polyethylene encasement. Upon approval of controlling agency, restrained joint C900 PVC carrier pipe inside a casing or open cut HDPE casing pipe may be allowed for 12-inch and smaller water mains.

C. Reference Chapter 18 Corrosion Control for specific requirements and details for corrosion control and monitoring systems.

12. DESIGN OF EROSION AND SEDIMENT CONTROL MEASURES

Regardless of size, all water main projects shall include measures and/or devices to prevent erosion and to contain sediment within the limits of the right-of-way and/or proposed easements. Design and permitting of erosion and sediment control devices shall be in accordance with Charlotte Land Development Standards including the City of Charlotte Soil Erosion and Sedimentation Control Ordinance for Developer-Donated projects. Charlotte Water designed projects shall meet NCDEQ requirements, as outlined in the North Carolina Erosion and Sediment Control Planning and Design Manual. Projects outside of City limits but within Mecklenburg County or outside of Mecklenburg County shall follow the appropriate county, town, and/or state requirements.

13. BORES AND TUNNELS

A. Water main crossings of railroads, major city streets, secondary roads, hydrocarbon transmission (e.g. natural gas or oil) pipeline easements, and numbered highways must be encased in a steel pipe installed by either auger boring, boring and jacking, hand tunneling lined with prefabricated steel liner plates, or by another approved method by the controlling agency.

B. Minor city streets and secondary roads may be open cut with specific permission of the controlling agency, CDOT, NCDOT, or respective governing agency and if detailed on the construction drawings.

C. The carrier pipe shall be restrained ductile iron pipe, restrained AWWA C900 DR 14 PVC pipe, HDPE SDR 9 pipe, or other controlling agency approved pipe material. Carrier pipe thickness requirements must be calculated based on site conditions and actual depth of cover.

D. Encasement pipe shall be new and manufactured of Grade “B” steel with minimum yield strength of 35,000 psi. Steel pipe shall have machine cut, bevel ends that are perpendicular to the longitudinal axis of the casing and fully welded watertight or Permalok brand jointed casing pipe. Pipe shall be designed in accordance with *AWWA M11 Steel Pipe – A Guide for Design and Installation*.

E. Casing spacers shall be used on all water pipes installed within a steel or HDPE casing pipe or tunnel. A minimum of 3 casing spacers per joint shall be required. Casing spacers shall be evenly spaced to support the same weight of the carrier pipe and provide the necessary grade of the carrier pipe. Casing spacer manufacturer shall provide the load carrying capacity of each spacer to determine when additional casing spacers are required. Casing spacers shall not allow the carrier pipe to float more than 2 inches within the casing pipe.

F. Within NCDOT encroachments, the annular space between the carrier and casing pipe shall be filled if the casing pipe has a diameter of 24 inches or larger. Lightweight cellular concrete grout shall be used to fill the annular space to allow future carrier pipe removal if necessary. The Engineer of Record may certify the casing pipe durability and design life of 100 years in lieu of filling the annular space when approved by NCDOT.

G. Bores and tunnels shall be designed to meet specific encroachment permit requirements, based on the governing agency (CDOT, NCDOT, CSX Corporation,

Norfolk Southern Railway, NC Railroad, hydrocarbon transmission pipeline, etc.) based on loadings, depths, and minimum separation and clearances. The minimum size and thickness standards for steel casing pipe, carrier pipe, and tunnels for various water pipe sizes shall be in accordance with the governing agencies and meet the minimum requirements in Table 10.12.

H. The minimum thickness provided in Table 10.12 are provided by the controlling agencies. The actual thickness required must be calculated based on site conditions and actual depth of cover.

Table 10.12: Minimum Requirements for Steel Casing Pipe and Tunnels

Carrier Pipe Size (inches)	Casing Pipe Minimum Thickness (inches)			Minimum Tunnel Size (inches)
	Casing Pipe Size (inches)	NCDOT	Railroads	
3 or 4	12	.250	---	36
6	12	.250	.250	36
8	18	.250	.312	48
10	20	.250	.344	48
12	24	.250	.375	48
16	30	.312	.469	48
24	36	.375	.532	54
30	48	.500	.750	60
36	54	.500	.781	72
42	60	.500	.844	84
48	66	.625	.938	90
54	72	.625	1.000	96

I. When HDPE SDR9 casing pipe is used for open cut casing installations, the minimum casing pipe size shall be as shown in Table 10.13. Bedding shall be Charlotte Water Type IV Granular Stone Bedding.

Table 10.13: Minimum Requirements for HDPE Open Cut Casing Pipe			
Carrier Pipe Size (inches)	Casing Pipe Size (OD, inches)	Casing Pipe Minimum Thickness (inches)	Casing Pipe Average ID (inches)
6	18	2.000	13.760
8	22	2.444	16.819
12	28	3.111	21.405
16	34	3.778	25.991

14. TESTING, DISINFECTION, AND DECHLORINATION

A. All water main testing and disinfection shall be in accordance with *AWWA C651 Disinfection Water Mains,* latest edition.

B. All testing shall be performed by a state-approved and certified laboratory. Charlotte Water is state-approved and the preferred laboratory; other laboratories may be approved by the Chief Engineer in extenuating circumstances.

C. All new water mains and appurtenances shall be disinfected according to the continuous feed method of chlorination unless otherwise approved by Charlotte Water. Chlorination shall be with hypochlorite or other chlorine solution at least 25 parts per million (ppm) at the time of injection and shall remain in contact with the interior surfaces for 24 hours. A residual chlorine concentration at blow-offs and air release sample points shall be at least 10 ppm at the end of the 24-hour period.

D. Sample points are required every 1,200 feet, at any dead-end line, blow-off, air release or commercial sized water service.

E. Upon approval from the Inspector, the water mains shall be flushed to less than 2 ppm chlorine residual whereby a Bac-T test can be taken.

F. A jumper connection with a certified reduced pressure backflow device shall be provided to furnish the water for filling the main, flushing the main at a minimum of 3 feet per second to remove air and particles, pressure and leakage testing, chlorination injection, flushing, dichlorination, and sampling. No direct connections to existing waterlines are permitted. The jumper connection must be inspected, approved, and tested by a Charlotte Water approved third party backflow testing firm prior to use.

G. New water mains may be tied to the existing system with a backflow jumper connection at one point only prior to filling, flushing, pressure testing and disinfection.

H. When the connection is such that the new main will be pressure tested against an existing valve, the valve shall be pressure tested, prior to the connection, at the same differential pressure that will be applied during testing of the new main. If the valve does not hold constant pressure for a ten (10) minute test period, using a mechanical

pressure gauge, then the connection will not be permitted by Charlotte Water until the new main is tested and disinfected.

I. Following testing against an active valve, the valve shall be opened, and the line thoroughly flushed through the valve.

J. Access to flush points for Contractors and Charlotte Water staff shall be provided.

K. Where new mains are connected to the existing system by tapping sleeves and valves, (in situations where permitted by Charlotte Water the valves shall be hydrostatically tested after the sleeve and valve have been bolted on but prior to when the tap is made.

L. Temporary taps and air release may be made to accommodate testing and disinfection with the approval of the Charlotte Water. Where possible, blow-offs shall be located in close proximity to sanitary sewer manholes for convenient disposal of de-chlorinated water following disinfection.

M. Contractor shall provide 24-hour notice for request of Bac-T testing from Charlotte Water Inspector. Charlotte Water laboratory only accepts 10 samples per day per job and results typically take 24 hours, excluding weekends and City holidays.

N. Chlorinated water should be running at a low flow rate for a minimum of 2 hours prior to scheduled water sample collection times by Charlotte Water Lab Services. The Charlotte Water Inspector and Lab Services must be present at the time of sample collection.

O. If one (1) sample fails, the entire project sample points must be recollected. If the project fails three (3) times, the water main must be re-chlorinated.

P. Water mains shall be connected to the existing public water system and activated within 14 days after being approved by Charlotte Water Lab Services or shall be continually flushed and chlorine residual monitored. Chlorine residual must be maintained above 1.5 ppm to avoid additional Bac-T testing by Charlotte Water Lab Services. Residual monitoring shall be witnessed by the Charlotte Water Inspector. After 14 days of inactivation, the main must be retested by Charlotte Water Lab Services.

Q. Dechlorination shall comply with *AWWA C655 Field Dechlorination,* latest edition. Contractor shall request approval from Charlotte Water Inspector for dechlorination agent and process to be used, and prior to discharge to the ground or storm drain once the concentration is 0.0 ppm following dechlorination.

R. Chlorine residual shall be tested by the Contractor to confirm no elevated chlorine readings in the discharge at any time.

S. Contractor shall provide additional required erosion control measure to prevent erosion and migration of sediment during discharge process.

15. ABANDONMENT AND DISMANTLEMENT

A. Abandonment of existing pipes, structures, appurtenances, and limits of abandonment shall be clearly indicated on the project plans and shall meet the minimum requirements listed below. Abandonment procedures may be more stringent in accordance with the appropriate governing agency's standards.

1) All water mains to be abandoned that are greater than 15 inches shall be filled with excavatable flowable fill, lightweight cellular concrete, or removed.

2) All open ends of abandoned 15-inch and smaller pipe shall be plugged watertight.

3) Comply with current standards for water main to be abandoned inside NCDOT rights-of-way.

4) All water main pipes with less than 3 feet of cover shall be filled with excavatable flowable fill.

5) Water mains shall be dismantled and removed to the active main connection at both ends and the pipe tee shall be replaced with new pipe; no dead-end stub-outs shall remain.

6) If a new tee or tap connection on an existing main is made and determined to be faulty, the water mains shall be dismantled and/or cut out and replace with new pipe as directed by Charlotte Water.

7) All above-ground features on an abandoned and dismantled water main shall be removed and plugged watertight at the active main.

8) Valves shall be removed from valve boxes and boxes and covers shall be demolished to 3 feet below grade, removed from the site, and remaining structure filled with excavatable flowable fill or washed stone.

9) Fire hydrants, auto flushers, sampling stations, and above-ground appurtenances shall be removed. If connected directly to the water main with a valve, the pipe tee shall be removed to the valve, close the valve, install a restrained mechanical joint plug to the valve, and restrain the plugged end. If there is no valve at the main, the tee shall be removed from the main and replaced with a short piece of ductile iron pipe short and restrained mechanical joint long pattern solid sleeve.

10) Abandoned aerial crossings and piers shall be fully removed and plugged watertight with thrust restraint at the active main.

11) Abandoned residential service lines and meters shall be removed to the corporation stop at the water main. Close the corporation stop and install a brass plug or cap.

12) Large service lines shall be dismantled and removed as close to water main as possible. If there is a restrained valve and tee connection, close the valve, install a restrained mechanical plug to the valve, and restrain the plugged end. If there is no restrained valve, remove all the service line piping and the water main connection

and install a DIP short and restrained mechanical joint long pattern solid sleeve on the active main.

13) When a water service dismantlement is requested, the water service and meter shall be dismantled to the corporation stop/tap at the water main.

14) Abandonment of existing asbestos concrete pipe shall be done in accordance with all federal and local laws and submitted for review and approval by Charlotte Water.

15) All abandonment work which requires temporary shut off of active water mains shall be scheduled with the Charlotte Water inspector and shall be witnessed by the inspector.

16) All disturbed areas shall be properly restored per Chapter 23 Restoration.

END OF SECTION

CHAPTER 10
WATER MAINS

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PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Ductile Iron Pipe and Fittings
2. PVC Pipe and Fittings
3. Prestressed Concrete Pressure Pipe, Steel-Cylinder Pipe (PCCP)
4. Concrete Pressure Pipe, Bar Wrapped Steel Cylinder Pipe (BWP)
5. Steel Water Pipe
6. High Density Polyethylene Pipe (HDPE) (OD-Based Iron Pipe Size – IPS) and Fittings
7. Red Brass Pipe (Iron Pipe Size – IPS) and Fittings
8. Stainless Steel Pipe and Fittings
9. Copper Tubing (CTS – Copper Tubing Size)
10. Polyethylene (PE) Tubing – (Copper Tubing Size – CTS)
11. Copper Tracer/Locator Wire
12. Fire Hydrants
13. Valves
14. Water Main Taps
15. Repair/Tie-In Sleeves/Clamps
16. Ferrous Castings
17. Miscellaneous Steel
18. Concrete
19. Stone and Brick
20. Clay Anti-Seep Collars

1.2 DEFINITIONS AND ABBREVIATIONS

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

1.3 SUBMITTALS

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

1. Product brochures
2. Catalog cut sheets
3. Shop drawings including dimensions and part/material lists
4. Certification of compliance
5. Prior product acceptance test reports

6. Reference contact data
7. Shipping tickets and purchase invoices

B. Provide product data for the following:

1. Ductile Iron Pipe and Fittings
2. PVC Pipe and Fittings
3. Prestressed Concrete Pressure Pipe, Steel-Cylinder Pipe (PCCP)
4. Concrete Pressure Pipe, Bar Wrapped Steel Cylinder Pipe (BWP)
5. Steel Water Pipe
6. High Density Polyethylene Pipe (HDPE) (OD-Based Iron Pipe Size – IPS) and Fittings
7. Red Brass Pipe (Iron Pipe Size – IPS) and Fittings
8. Stainless Steel Pipe and Fittings
9. Copper Tubing (CTS – Copper Tubing Size)
10. Polyethylene (PE) Tubing – (Copper Tubing Size – CTS)
11. Copper Tracer/Locator Wire
12. Fire Hydrants
13. Valves
14. Water Main Taps
15. Repair/Tie-In Sleeves/Clamps
16. ¾ - 1-inch Water Services
17. 1-1/2 -inch and Larger Water Services
18. Ferrous Castings
19. Miscellaneous Steel
20. Concrete
21. Stone and Brick
22. Clay Anti-Seep Collars

C. Shop Drawings:

1. Required shop drawings shall include, but are not limited to, the following: Ductile Iron Pipe, PVC Pipe, PCCP Pipe, BWP Pipe, Steel Water Pipe, HDPE Pipe, Fire Hydrants, Valves, Tapping Sleeves, Tie-in Sleeves, Water Services, etc.
2. Pipeline laying schedule showing stations and elevations and identifying each piece by mark number. Each bend, bevel, or other special fitting shall be marked to clearly identify the centerline at the top of the piece.
3. Details of standard pipe, joints, specials, and fittings.

D. Design:

1. Design calculations for pipe, fittings, precast vaults, structures, reinforcement and/or test data.

2. Details of joint bonding and field welded joint restraint calculations when specified.

E. Pre-excavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth-moving operations. For Donated Projects, these requirements apply to existing road rights-of-way only. Submit before earth moving begins.

F. Product Certificates:

1. Required for all products furnished.

2. Comply with NSF 61 Annex G for materials for water service piping and specialties for domestic water.

G. Qualification Data: For qualified testing agency.

H. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:

1. Classification in accordance with to ASTM D 2487.

2. Laboratory compaction curve in accordance with to ASTM D 698.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic pipe and fittings in direct sunlight. All pipe shall be in brand new factory condition, and no more than one year old from manufacturer date to installation. Pipe manufacturer shall provide letter regarding exposure requirements.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. All PVC and HDPE Pipe shall be shipped, stored, and strung at the project in such a manner as to be protected from total accumulated exposure to sunlight and possible ultraviolet radiation of no more than four (4) weeks.

D. The Contractor shall be responsible for the safe storage of materials furnished by or to them, and accepted by them, until they have been incorporated in the completed project. Handling and storage of all project materials are to be in compliance with the manufacturer's recommendations for handling and storage. The interior of all pipe, fittings and other accessories shall be kept free from dirt and foreign materials at all times. Valves, meters and pressure gauges shall be protected from freezing at all times.

E. Transportation of Materials and Equipment: The Contractor and their Suppliers are directed to contact the North Carolina Department of Transportation to verify axle load limits on State maintained roads (and bridges) which would be used for hauling of equipment and materials for this project. The Contractor and their Suppliers shall satisfy the Department of Transportation requirements and shall be responsible for any damage to said roads which may be attributed to this project. Unless otherwise specified, all materials required to construct this project shall be furnished by the Contractor and shall be delivered and distributed at the site by the Contractor or their material supplier.

F. Loading and Unloading Materials: Ductile iron pipe accessories shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Pipe, fittings,

and other accessories shall be unloaded with hoists and/or as recommended by the respective manufacturers. Under no circumstances shall such materials be dropped. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground.

G. Responsibility for Materials on Site: In distributing the material at the site of the work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench. Each piece shall be redundantly chocked at each end to prevent movement or rolling. Pedestrian or vehicular traffic shall not be unduly inconvenienced in placing of material along the streets or right-of-way, as applicable.

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

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

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

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

I. Care of Coatings and Linings: Pipe, fittings, and other accessories including frames and covers, steps, straps, etc., shall be so handled such that the coating or lining shall not be damaged. If, however, any part of the coating or lining is damaged, the repair or replacement shall be made by the Contractor at their expense in a manner satisfactory to the Engineer and the coatings manufacturer.

1.5 FIELD CONDITIONS

A. Interruption of Existing Water Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted and then only after provisions for temporary service in accordance with Charlotte Water requirements are in place.

PART 2 - PRODUCTS

2.1 PIPE, GENERAL

A. All materials furnished in accordance with these specifications shall be new and unused, unless otherwise specified in the project Special Provisions. Unless superseded or modified by a Special Provision; all materials, apparatus, supplies, methods of manufacture, or construction shall conform to the specifications for same contained in this Section. National material standards (ASTM, ANSI, AWWA, NSF (NSF International), etc.) referred to herein shall be considered to be the latest revisions only. All materials that come in contact with potable drinking water shall conform to the requirements of the Safe Drinking Water Act and NSF/ANSI 61 – Drinking Water System Components – Health Effects.

B. Quality Assurance and Quality Control:

1. Pipe smaller than 24-inch in diameter shall conform to the minimum thickness and pressure class/rating requirements for the individual pipe materials as indicated in the sections below, as shown on the construction drawings, or Standard Details.

2. 24-inch and larger diameter pipe shall conform to the minimum thickness and pressure class/rating requirements for the individual pipe materials as indicated in the sections below, as shown on the construction plans, as specified in the project Special Provisions, and shall also meet the following design and quality control/quality assurance requirements:

a. General: The 24-inch and larger pipe and fittings may be designed around ductile iron pipe; however, pre-stressed concrete pipe and steel water pipe may be considered as alternatives when indicated in the project Special Provisions or shown on the construction plans. In all cases, the pipe manufacturer and contractor shall submit a detailed design for review prior to an alternative pipe being approved.

The contractor/manufacturer shall notify the Engineer at least two weeks prior to the date production runs are scheduled. Full access shall be provided to the Engineer's Inspectors to all parts of the plant that concern production of the pipe and all reasonable facilities shall be provided to the Inspector to allow them to verify that the pipe is being furnished in accordance with to the applicable standards and the approved design. All such inspections shall be conducted so as not to interfere unnecessarily with the operation of the plant. All costs of the Inspector's transportation, meals, and lodging shall be borne by Charlotte Water.

b. Design Criteria: The following criteria shall govern the design of the pipe regardless of the pipe materials.

1) Qualifications:

a) Manufacturers who are reputable, and qualified in the manufacture of the products to be furnished shall furnish all pipe and fittings. The pipe and fittings shall be designed, constructed, and installed in accordance with product specifications, best practices and methods and shall comply with these specifications as applicable.

b) Pipe cylinders, coating, lining, and fabrication of specials shall be the product of one manufacturer that has not less than 5 years successful experience manufacturing pipe of the particular type and size indicated. The pipe manufacturer shall have a certified quality assurance program.

2) Markings:

a) The contractor/manufacturer shall legibly mark all pipes and specials in accordance with the laying schedule and marking diagram. Each pipe shall be numbered in sequence and said number shall appear on the laying schedule and marking diagram in its proper location for installation. All special pipe sections and fittings shall be marked at each end with top field centerline. The word "top" or other suitable markings shall be painted or marked on the outside top spigot end of each pipe section.

3) Depth of Cover:

a) A minimum depth of 12-feet or maximum depth as shown on plans plus 4-feet overburden, plus a HS20 live load shall be used in the calculation of the design of the pipe. When pipe is located within Railroad or NCDOT ROW, Contractor shall follow all loading requirements of the governing authority having jurisdiction of the ROW.

4) The ground water level for the design shall be 3-feet above the top of the pipe (minimum).

5) A soil weight of 120 pounds per cubic foot shall be used for calculation of the dead load.

c. Stone bedding shall be as specified in this document, or in the project Special Provisions or as shown on the construction plans. Where required due to existing soil conditions, additional bedding requirements may be required. The contractor shall be responsible for maintaining stable trench walls with the standard width shown on the bedding details, including any required sheet piles or shoring.

d. Restrained joint design and details shall be submitted for approval. Submittal shall include calculations of the required length of restrained joint sections. Unless otherwise specified and in the absence of project specific requirements and/or site specific geotechnical information, these calculations shall be based on a minimum 200 PSI test pressure or 1.5 times the static pressure at the lowest point (whichever is greater), a factor of safety of 2.0, a soil weight of 120 pounds per cubic feet, a Silt 1 soil designation, a pipe bedding condition as specified in this document and on the actual depth of cover shown on the construction plans, excluding future fill by others, but including future cut by others.

e. Detectable Warning Tape:

1) Detectable warning tapes shall be 6-inch wide with 5-mil thickness, blue and black tape located 24 inches below finish grade.

2) Warning tape shall be brightly colored non-biodegradable plastic ribbon. The words "Warning Buried Water Line Below" shall be printed continuously along the length of the ribbon in large letters.

3) Approved Products:

a) Brady Underground Utility Marking Tape

b) Terra Tape

c) Seton Detectable Underground Warning Tape

d) Pre-Approved equal by Charlotte Water

C. Unless amended on the Construction Drawings, or approved by Charlotte Water, all piping shall be Ductile Iron, PVC, HDPE, Prestressed Concrete Pressure Pipe (Steel-Cylinder Pipe), Concrete Pressure Pipe (Bar Wrapped Steel Cylinder Pipe), Steel Water Pipe, Red Brass, Stainless Steel, Copper Tubing, or Polyethylene (PE) Tubing, as specified herein.

2.2 DUCTILE IRON PIPE AND FITTINGS

A. Pipe: At a minimum, ductile iron pipe shall conform to the requirements of AWWA Standard C-151, ASTM A-746 with thickness design conforming to the procedures outlined in AWWA C-150. Unless otherwise shown on the construction plans, all ductile iron pipe shall be furnished with push-on joints in accordance with AWWA C-111 and a cement mortar lining of standard or double thickness in accordance with AWWA C-104. The minimum cement mortar lining thickness shall be:

Standard Thickness Cement Mortar Lining	
Pipe and Fitting Diameter Inches	Thickness of Lining (Min.) Inches
3-12	1/16
16-24	3/32
30-64	1/8

1. Pipe (36-inch diameter through and including 64-inch diameter): AWWA C151/A21.51, ASTM A-746, minimum pressure class 200, with cement mortar lining in accordance with AWWA C104. The pipe class selection shall be based on the installation conditions. The pipe shall conform to the Quality Assurance/Quality Control and Design Criteria sections indicated above. See project Special Provisions and Construction Drawings for additional design requirements, standards and details. A higher pipe class may be shown on the construction plans and/or elsewhere in Special Provisions.

2. Pipe (16-inch diameter through and including 30-inch diameter): AWWA C151/A21.51, ASTM A-746, minimum pressure class 250, with cement mortar lining in accordance with AWWA C104. The pipe class selection shall be based on the installation conditions. 30-inch diameter pipe shall conform to the Quality Assurance/Quality Control and Design Criteria sections indicated above. A higher pipe class may be shown on the construction plans and/or elsewhere in Special Provisions.

3. Pipe (12-inch diameter and smaller): AWWA C151/A21.51, ASTM A-746, minimum pressure class 350, with cement mortar lining in accordance with AWWA C104. A higher pipe class may be required based on installation conditions and as shown on the construction plans and/or elsewhere in Special Provisions.

Ductile Iron Pipe Requirements	
Pipe Diameter Inches	Minimum Pressure Class
3 - 12	350
16 - 30	250
36 - 64	200

4. The pipe class selection for all diameters shall be based on the installation conditions and existing or proposed depth of cover. Special thickness class pipe up to and including thickness class 56 shall be required when specified, based on installation conditions and depth of cover/loading conditions.

5. The pipe shall contain all product markings required by ASTM A-746 and AWWA C-151. The minimum pipe markings shall include the weight, class or nominal thickness, casting date. The manufacturer's mark, the country where cast, the production year, and the letters "DI" or "DUCTILE" shall be cast or metal stamped on the pipe, and on pipe sizes 14-inch and larger shall not be less than ½-inch in height. All markings shall be clear and legible, and all cast or metal-stamped marks shall be on or near the bell.

6. DIP pipe shall be manufactured within the North American Continent by an approved manufacturer.

7. Manufacturers:

   a. DIP shall be as furnished by American Cast Iron Pipe, McWane Cast Iron Pipe, US Pipe Company.

B. Mechanical Joint Accessories: Mechanical joint glands shall be ductile iron. Glands, bolts, nuts, and gaskets for mechanical joint pipe and fittings shall be furnished by the pipe/fitting manufacturer and shall conform to ANSI Specifications A21.11 (AWWA C-111).

1. Rubber gaskets shall be made of vulcanized styrene butadiene rubber (SBR), unless otherwise shown on the plans or specified. Nitrile (NBR) rubber (acrylonitrile butadiene) gaskets shall be furnished when specified or shown on the construction plans and when water mains are located near contaminated soils or gasoline storage facilities.

2. Gasket lubricant shall be as recommended by the pipe manufacturer and shall conform to the requirements of the Safe Drinking Water Act and be NSF/ANSI 61 certified.

3. The gaskets shall contain all product markings required by the appropriate AWWA Standard. The minimum gasket markings shall include size, manufacturer's mark, country where molded, year, mold number, and "MJ".

4. Bolts shall be Tee Head or Stud Bolts where required. Bolts shall be provided with standard hexagonal cold pressed nuts unless otherwise specified. Bolts and nuts shall be made of the best quality refined iron or mill steel and shall have sound, well-fitting threads. Bolts and nuts shall be threaded in accordance with to ASME B1.1 and B1.2, coarse-thread series unified coarse (UNC), Class 2A, External, and Class 2B, Internal. Bolts and nuts shall be of high-strength, low alloy steel conforming to the chemical and mechanical requirements of AWWA C-111, minimum 45,000 PSI tensile strength.

5. If the pipe manufacturer furnishes third party accessories, the pipe manufacturer shall provide a written and notarized statement signed by a current officer of the pipe manufacturer accepting unit responsibility for both the fitting, pipe, and accessories for 30-inch and larger products.

C. Push-On Joint Material: Gaskets for push-on pipe shall be furnished by the pipe manufacturer. Joint type shall be Tyton or Fastite only. Gaskets and gasket lubricant shall conform to ANSI Specifications A21.11 (AWWA C-111).

1. Rubber gaskets shall be made of vulcanized styrene butadiene rubber (SBR), unless otherwise shown on the plans or specified. Nitrile (NBR) rubber (acrylonitrile butadiene) gaskets shall be furnished when specified or shown on the construction plans and when water mains are located near contaminated soils or gasoline storage facilities.

2. Gasket lubricant shall be as recommended by the pipe manufacturer and shall conform to the requirements of the Safe Drinking Water Act and be NSF/ANSI 61 certified.

3. If the pipe manufacturer furnishes third party accessories, the pipe manufacturer shall provide a written and notarized statement signed by a current officer of the pipe manufacturer accepting unit responsibility for both the fitting, pipe, and accessories for 30-inch and larger products.

D. Flange Joints and Accessories: Ductile iron flange joints shall be furnished in accordance with the requirements of ANSI Specifications A21.11 (AWWA C-111) and ANSI A21.15/AWWA C-115. The bolt circle and bolt holes of these flanges shall match those of ANSI/ASME B16.1, Class 125 flanges and can be joined with these class 125 flanges or with ANSI/ASME B16.5, class 150 flanges as required.

1. Flanges, stainless steel flange bolts and nuts, and gaskets shall conform to the dimensional requirements of ANSI/ASME B16.1, AWWA C-111 and C-115 for Class 125.

2. Bolts shall have standard hexagonal heads and shall be provided with standard hexagonal cold pressed nuts unless otherwise specified. Bolts and nuts shall be made of the best quality refined iron or mill steel and shall have sound, well-fitting threads. Bolts shall conform to the requirements of ASME B18.2.2. Bolts and nuts shall be threaded in accordance with to ASME B1.1, Unified Inch Screw Threads, UN and UNR Thread Form, Class 2A, External, and Class 2B, Internal. Bolts and nuts shall be stainless steel ASTM A240 Type 316 or Type 316L. Anti-seize compound shall be used on all bolts and nuts.

3. When screw-on flanges are approved, the flange shall contain all product markings required by the appropriate AWWA/ANSI/ASME Standard. The minimum markings

shall include the manufacturer's mark, size, and the letters "DI" cast or stamped on the back face of the flange.

4. Rubber gaskets shall be made of vulcanized styrene butadiene rubber (SBR), unless otherwise shown on the plans or specified. Nitrile (NBR) rubber (acrylonitrile butadiene) gaskets shall be furnished when specified or shown on the construction plans and when water mains are located near contaminated soils or gasoline storage facilities. Gaskets shall be ring or full-faces, and 1/8-inch thick. Gaskets using one or more annular rings molded into the gasket to improve the joint performance shall be acceptable.

5. If the pipe manufacturer furnishes third party accessories, the pipe manufacturer shall provide a written and notarized statement signed by a current officer of the pipe manufacturer accepting unit responsibility for both the fitting, pipe, and accessories for 30-inch and larger products.

E. Factory Restrained Joint Pipe Systems: Flexible restrained joint ductile iron pipe shall be as supplied by the pipe manufacturer. Joint type shall be restrained Mechanical Joint, Tyton, or Fastite only. Minimum rated working pressure shall be as shown on the table below.

1. Only designs using a welded retainer ring on the spigot shall be allowed for 30-inch through 64-inch diameter pipe. Restrained push-on or mechanical joint designs may be used for the pipe and associated fittings. When 30-inch through 64-inch pipe/fittings are added during construction and are not shown on the construction plans, they shall be factory restrained joints, if available from the pipe manufacturer, or may be wedge action thrust restrained mechanical joints as specified, when approved by the Engineer.

2. Designs using a welded retainer ring on the spigot are approved for 16-inch through 24-inch diameter pipe. Factory restrained push-on, or mechanical joint designs may be used for the pipe and associated fittings. When 16-inch through 24-inch pipe/fittings are added during construction and are not shown on the construction plans, they may be factory restrained joint pipe/fittings or wedge action thrust restrained mechanical joint/pipe fittings only.

3. Designs using a welded retainer ring on the spigot shall be allowed for 4-inch through 12-inch diameter pipe. Factory restrained push-on, or mechanical joint designs may be used for the pipe and associated fittings. When 4-inch through 12-inch pipe are added during construction and are not shown on the construction plans, they may be factory restrained joint pipe, wedge action thrust restrained mechanical joint pipe or push-on restrained joint pipe gasket systems, as specified below.

4. If the pipe manufacturer furnishes third party accessories, the pipe manufacturer shall provide a written and notarized statement signed by a current officer of the pipe manufacturer accepting unit responsibility for both the fitting, pipe, and accessories for 30-inch and larger products.

5. The following flexible factory restrained joint pipe system products are approved:

Manufacturer	Factory Restrained Joint Name	Pipe Size Range (inches)	Min. Rated Working Pressure (PSI)
American CIPC	FLEX-RING	4-24	350
	FLEX-RING	30-48	250
	LOK-RING	54-64	250
	SUPER LOCK	6-24	350
	SUPER LOCK	30	250
McWane Industries (Atlantic States CIPC, McWane CIPC, Pacific States CIPC)	THRUST-LOCK	6-24	350
	THRUST-LOCK	30-36	250
	TR FLEX	4-24	350
	TR FLEX	30-36	250
U. S. Pipe Co.	TR FLEX	4-24	350
	TR FLEX	30-36	250
	BOLT-LOK (MJ)	4-24	350
	BOLT-LOK (MJ)	30-48	250
	HP LOK	60, 64	350
	HDSS	4-54	350

F. Push-On Restrained Joint Pipe Gasket System: For 3-inch through 12-inch ductile iron pipe only, push-on joint pipe may be made restrained joint pipe by replacing the standard pipe gasket with restrained joint gaskets that include internal stainless steel locking segments. The internal stainless steel locking segments shall be corrosion resistant hardened stainless-steel and shall be integrally molded and vulcanized into the gasket and shall grip the pipe spigot to prevent joint separation. The restraining system shall be UL Listed for 350 PSI working pressure and Factory Mutual approved for 250 PSI working pressure. Gasket restraining system shall be produced and tested in accordance with AWWA C-111 and shall have a 350 PSI pressure rating.

1. Gasket lubricant shall be as recommended by the pipe manufacturer and shall conform to the requirements of the Safe Drinking Water Act and be NSF/ANSI 61 certified.

2. Restrained joint pipe gasket products shall be furnished by the ductile iron pipe manufacturer. Third party restrained joint pipe gasket systems are NOT approved. If considered, third party restrained joint pipe gasket systems shall be pre-approved by the Engineer. Third party restrained joint pipe gasket systems shall only be considered when the product submittals are accompanied by a certified statement from the ductile iron pipe manufacturer that they approve the restrained joint gasket system product for use with its pipe joint. Third party restrained joint gasket system products shall be accompanied by Underwriters Laboratories and Factory Mutual approval. The pipe manufacturer shall accept unit responsibility for the pipe and gasket restrained joint system.

3. The following push-on restrained joint pipe gasket system products are approved:

Pipe Manufacturer	Push-On Restrained Joint Gasket System	Pipe Size Range (inches)	Min. Rated Working Pressure (PSI)
Gripper Gasket, LLC	Gripper Gasket	3-12	350
American CIPC	Fast Grip Gasket	4-12*	350
McWane Industries (Atlantic States CIPC, McWane CIPC, Pacific States CIPC)	SURE STOP 350 Gasket	4-12	350
U. S. Pipe Co.	FILED LOK 350 Gasket	4-12*	350

* Only 3-inch through 12-inch is approved as a standard product. 16-inch restrained joint pipe shown on the construction plans shall be Factory Restrained Joint Pipe System as specified. When 16-inch restrained joint pipe is added during construction and is not shown on the construction plan, factory restrained joint pipe shall be provided, if available from the pipe manufacturer, or may be restrained joint pipe gasket systems, when specifically approved by the Engineer in writing.

4. As stated in the pipe manufacturer's published literature, the restrained joint pipe gasket systems shall NOT be used in the following conditions or applications:
    a. Spray on lubricants shall not be used.
    b. Pipe coating system shall not exceed 6 mils on the plain end of the pipe.
    c. Gaskets shall not be reused, as they may have been damaged during any previous installation or during removal.
    d. Gaskets shall not be used as an electrical conductor. Use bonded joints where applicable.
    e. Gaskets shall not be used in above ground applications.
    f. Gaskets shall not be used in casing/tunnel applications, unless installed straight, by pulling, NOT pushing the pipe through the casing. Assembly of the joints shall be controlled, such as come-a-longs or cable hoists, to prevent fully homing the spigot to the base of the socket.
    g. Gaskets shall not be used with gray iron pipe/fittings or with plastic pipe.
    h. Gaskets shall not be used with push-on plugs.
    i. Joint shall not be rotated after assembly.

G. Fittings: All fittings shall be cast from the standard grade 70-50-05 ductile iron with conformance values of 70,000 PSI minimum tensile strength, 50,000 PSI minimum yield strength and 5% minimum elongation.

1. 30-inch through 48-inch diameter: minimum Pressure Class 250, cast from ductile iron, in accordance with AWWA C-110 for full body fittings or AWWA C-153 for compact fittings.
2. 3-inch through 24-inch diameter: minimum Pressure Class 350, cast from ductile iron, in accordance with AWWA C-110 for full body fittings or AWWA C-153 for compact fittings.
3. All cast fittings shall have a cement mortar lining of standard or double thickness in accordance with AWWA C-104, or fusion bonded epoxy lining and coating of minimum thickness in accordance with AWWA C-116.

4. The fittings shall contain all product markings required by AWWA C-110 or C-153 as applicable. The minimum markings on each fitting shall include the identity of the AWWA standard, the pressure rating, nominal diameters, manufacturer's identification, the county where cast, the letters "DI" or "DUCTILE", and the angle of all bends. The markings shall be distinctly cast raised or in relief on the outside of the fitting body.

5. Manufacturers:

   a. All fittings, including gaskets, glands, and bolts, shall be furnished by one fittings manufacturer.

   b. 30-inch and larger fittings shall be manufactured within the North American Continent by an approved manufacturer (Note: See 2.2 B 5 for additional information):

      1) American Cast Iron Pipe Co
      2) U.S. Pipe Co
      3) McWane Cast Iron Pipe

   c. 24-inch and smaller fittings shall be manufactured within the North American Continent or imported by an approved manufacturer:

      1) American Cast Iron Pipe Co
      2) U.S. Pipe Co
      3) McWane Cast Iron Pipe
      4) Star Pipe Corporation
      5) Sigma Corporation
      6) SIP Industries
      7) Tyler/Union Foundry

H. Mechanical Joint Fittings: Fittings shall be furnished with mechanical joints as indicated on the construction plans. All mechanical joint fittings shall be Bell and Bell unless otherwise indicated on the plans.

I. Wedge Action Thrust Restraint for Mechanical Joint Fittings:

1. Restrained joints shall be used where shown on the plan, standard details or as directed or approved by the Engineer.

2. Mechanical joint thrust restraints may be through the use of a follower gland with restraining device that imparts a wedging action against the pipe. The restraining device shall have twist off nuts to ensure proper contact with the pipe. Glands and restraining devices shall be manufactured of Ductile Iron conforming to ASTM A536. The restraining devices shall be heat treated to a hardness of 370BHN. Gland dimensions shall be compatible with the MJ fittings hereinbefore specified. The restrained joint shall be rated for a minimum 200 PSI working pressure for pipes with diameters greater than 48-inches, 250 PSI working pressure for pipes with diameters 18-inch through 48-inch, and 350 PSI for pipes with diameters 3-inch through 16-inch with a 2:1 safety factor.

3. Wedge action thrust restraint mechanical joint restraints may be through the use of a specially machined ductile iron ring and follower gland that is used with standard mechanical joint gaskets and T-bolts.

4. There shall be no additional tool required for installation other than the tools required to install standard sizes of hex nuts from 5/8-inch to 1 1/8-inch. The hex heads, bolts, and rods shall be designed to tighten clockwise. The hex heads, bolts, and rods shall be manufactured to allow for disassembly and re-installation of the restraint.

5. Retainer glands shall NOT be permitted.

6. Wedge action thrust restraint shall not be used on plain end fittings.

7. 30-inch and larger wedge action thrust restraints for mechanical joint fittings shall only be used when specifically called out on the construction plans or special provisions. Where permitted, 30-inch and larger wedge action thrust restraints for mechanical joint fittings shall be:

   a. Megalug Series 1100 as manufactured by EBAA Iron, Inc.

   b. OneLoc Series SLDE as manufactured by Sigma Corporation

   c. StarGrip Series 3000 as manufactured by Star Pipe

   d. TufGrip Series 1000 as manufactured by Tyler Union Corp

   e. Ford Uni-Flange Series UFR1400 as manufactured by Ford Meter Box Co.

8. When 30-inch and larger fittings are added during construction and are not shown on the construction plans, they shall be factory restrained joint fittings if available from the pipe manufacturer or may be wedge action thrust restrained mechanical joint fittings as specified above, when approved by the Engineer.

9. 24-inch and smaller wedge action thrust restraints for mechanical joint fittings shall be:

   a. Megalug Series 1100 as manufactured by EBAA Iron, Inc.

   b. OneLoc Series SLDE as manufactured by Sigma Corporation

   c. StarGrip Series 3000 as manufactured by Star Pipe

   d. TufGrip Series 1000 as manufactured by Tyler Union Corp.

   e. Ford Uni-Flange Series UFR1400 as manufactured by Ford Meter Box Co.

   f. EZ Grip Series EZD as manufactured by SIP Industries

10. When 24-inch and smaller fittings are added during construction and are not shown on the construction plans, they may be wedge action thrust restrained mechanical joint fittings as specified above, or factory restrained joint fittings as specified below.

J. Factory Restrained Joint Fittings:

1. For 30-inch and larger water mains, factory restrained joint fittings shall be supplied by the pipe manufacturer with Fast-Tite or Tyton gasket joints for fittings shown on the construction plans. Only designs using a welded retainer ring on the spigot shall be allowed. The following manufacturer's factory restrained joint fittings products are approved:

Manufacturer	Factory Restrained Joint Name	Pipe Size Range (inches)	Min. Rated Working Pressure (PSI)
American CIPC	FLEX-RING	30	150
	FLEX-RING	30-48	250
	LOK-RING	54-64	250
McWane Industries (Atlantic States CIPC, McWane CIPC, Pacific States CIPC)			
	THRUST-LOCK	30-36	250
	TR FLEX	30-36	250
U. S. Pipe Co.	TR FLEX	30-36	250
Ford Meter Box	Uni-flange	30-48	250
SIP Industries	EZD	30-48	250
	EZDPTP	30-36	250
	EZDTP	30-48	300
	EZFADP	36	250

2. When 30-inch and larger fittings are added during construction and are not shown on the construction plans, they shall be factory restrained joint fittings if available from the pipe manufacturer or may be wedge action thrust restrained mechanical joint fittings as specified above, when approved by the Engineer.

3. When 16-inch and smaller fittings are added during construction and are not shown on the construction plans, they may be factory restrained joint fittings or wedge action thrust restrained mechanical joint fittings as specified above.

4. Factory restrained joint fittings shall be manufactured in North America.

K. The Engineer reserves the right to witness any or all acceptance tests. Prior notice of testing schedules shall be provided by the manufacturer to the Engineer to accommodate travel or independent third-party witness arrangements.

L. Quality Control/Quality Assurance: The manufacturer shall perform the standard acceptance tests required by AWWA C-151, Section 5.1.1.2 and shall keep test records on file for inspection by the Engineer. The manufacturer shall furnish an affidavit that the materials used in the making of the pipe meet all provisions of the applicable AWWA and ASTM standards and that the pipe, fittings, accessories, and rubber gaskets meet all applicable provisions of AWWA C-104, C-110, C-111 C-115, C-150, and C-153 respectively.

M. Corrosion Protection: When indicated on the plans, corrosion protection equipment and installation shall be in accordance Charlotte Water standard specifications for Corrosion Control.

2.3 PVC PIPE

A. Unless amended on the Construction Drawings or elsewhere in these specifications, all 2-inch and 6-inch through 12-inch diameter water main pipe may be Polyvinyl Chloride (PVC) Pipe as specified below.

B. Pipe: Pipe shall be made from blue (only) pigmented virgin materials and shall be furnished in lengths of 20 feet or longer. Lesser lengths will be accepted to allow the proper placement of fittings, valves, etc.

1. All PVC Water Pipe shall be shipped, stored, and strung at the project in such a manner as to be protected from total accumulated exposure to sunlight and possible ultraviolet radiation of no more than four (4) weeks. Pipe shall be installed within 12 months of the manufacture date stamped on the pipe wall.

2. PVC pipe shall be manufactured within the North American Continent. An officer of the manufacturing company shall certify that all PVC pipe products were manufactured in North America.

3. Rubber gaskets shall be as furnished by the pipe manufacturer and shall be made of vulcanized ethylene propylene diene monomer rubber (EPDM) or styrene butadiene rubber (SBR), unless otherwise approved or specified. Gaskets shall meet the requirements of ASTM F-477 for high head applications. Gaskets shall conform to the requirements of the Safe Drinking Water Act and be NSF/ANSI 61 certified.

4. Gasket lubricant shall be as recommended by the pipe manufacturer and shall conform to the requirements of the Safe Drinking Water Act and be NSF/ANSI 61 certified.

5. Push-on Joint: Pipe jointing shall be by elastomeric (gasket) joints only. Joints shall conform to AWWA C-900 for 6-inch, 8-inch, and 12-inch diameter pipe.

   Pipe bells, with gasket seats, shall be formed as the pipe is extruded. Sleeve couplings are not permitted.

6. Restrained Joint: When restrained joints are required, all restrained pipe and fittings shall conform to the requirements for restrained joint ductile iron pipe as specified above or to the requirements for restrained joint PVC pipe as specified later in this section.

C. IPS (Iron Pipe Size Equivalent) PVC Pipe: All 2-inch diameter water main shall be PVC 1120 in accordance with ASTM D-2241 with push-on joints. The pipe shall be water pressure rates at 315 PSI with a standard dimension ratio (SDR) of 13.5. The pipe shall be manufactured from white or blue pigmented virgin PVC compounds and shall equal or exceed PVC class 12454.

IPS PVC Pipe				
Nominal Pipe Size - Inches	**Outside Diameter - Inches**	**Min Wall Thickness - Inches**	**Standard Dimension Ratio (SDR)**	**Pressure Rating - PSI**
2	2.375	0.176	13.5	315

PVC pipe shall contain the product markings as required by ASTM D-2241. The pipe markings shall be spaced at intervals of not more than 5 feet. The minimum pipe markings shall include the nominal pipe size, the Standard Dimension Ration (SDR 13.5), the ASTM designation (ASTM D-2241), the manufacturer's name or trademark, a production code which allows the manufacturer to trace production and the seal or mark of the laboratory certifying the pipe for use with potable water.

D. CIOD (Cast Iron-equivalent Outside Diameter) PVC Pipe: All 6-inch through 12-inch diameter water main pipe may be PVC pipe conforming to the requirements of AWWA C-900 with push on joints, unless otherwise shown on the construction plans or specified. The pipe shall be minimum Pressure Class (PC) 305 PSI with a Dimension Ratio (DR) of 14 per AWWA C-900. The pipe shall be manufactured from blue (ONLY) pigmented virgin PVC resin compounds and shall equal or exceed PVC class 12454 as described in ASTM D-1784. The pipe shall also qualify for a minimum hydrostatic design basis (HDB) of 4000 PSI at 73.4-degree Fahrenheit in accordance with the requirements of PPI TR-3.

C-900 PVC PIPE - CIOD				
Nominal Pipe Size (inches)	Outside Diameter (inches)	Min Wall Thickness (inches)	Dimension Ratio (DR)	Pressure Class (PSI)
6	6.900	0.493	14	305
8	9.050	0.646	14	305
12	13.200	0.943	14	305

1. CIOD C-900 PVC pipe shall contain the product markings required by AWWA C-900. The pipe markings shall be spaced at intervals of not more than 5 feet. The minimum pipe markings shall include the nominal pipe size and outside diameter base (for example, “6 CI”), type of plastic (“PVC”), Dimension Ratio (“DR 14”), AWWA pressure class (“PC305”), AWWA designation (“AWWA C900”), manufacturer’s name or trademark, and the seal or mark of the testing agency certifying the pipe for use with potable water.

2. The manufacturer shall submit certification and test results that the pipe has been tested in accordance with AWWA-C-900 and has been found to meet all requirements. Test samples shall be as selected by the manufacturer or testing laboratory unless otherwise stipulated in the Special Provision Section of the contract.

3. The Engineer reserves the right to witness any or all acceptance tests. Prior notice of testing schedules shall be provided by the manufacturer to the Engineer to accommodate travel or independent third-party witness arrangements.

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

   a. Harco Fittings LLC
   b. Westlake Pipe & Fittings, formerly Lasco
   c. Westlake Pipe & Fittings, formerly NAPCO
   d. JM Eagle
   e. Diamond Plastics
   f. National Pipe
   g. Sanderson Pipe
   h. JetStream (by Pipelife)

E. Restrained Joint in Bell (RJIB): Unless amended on the Construction Drawings or elsewhere in these specifications, all 6-inch through 12-inch diameter restrained joint water main pipe may be Polyvinyl Chloride Pipe with restrained joints in bell as specified below.

1. Restrained joint PVC Water Pipe shall be made from blue (only) pigmented virgin materials and shall be furnished in lengths of 20 feet. Lesser lengths will be accepted to allow the proper placement of fittings, valves, etc.

2. All restrained joint PVC Water Pipe shall be shipped, stored, and strung at the project in such a manner as to be protected from total accumulated exposure to sunlight and possible ultraviolet radiation of no more than four (4) weeks. Pipe shall be installed within 12 months of the manufacture date stamped on the pipe wall.

3. Restrained joint PVC pipe shall be manufactured within the North American Continent. An officer of the manufacturing company shall certify that all restrained joint PVC pipe products were manufactured in North America.

4. Rubber gaskets shall be as furnished by the pipe manufacturer and shall be made of vulcanized ethylene propylene diene monomer rubber (EPDM) or styrene butadiene rubber (SBR), unless otherwise approved or specified. Gaskets shall meet the requirements of ASTM F-477 for high head applications. Gaskets shall conform to the requirements of the Safe Drinking Water Act and be NSF/ANSI 61 certified.

5. Gasket lubricant shall be recommended by the pipe manufacturer and shall conform to the requirements of the Safe Drinking Water Act and be NSF/ANSI 61 certified.

6. Manufacturers: Restrained joint PVC pipe restraining system shall be:
   a. BullDog™ Restraint System – Eagle Loc 900™ as manufactured by JM Eagle, Lok-21® as manufactured by Diamond Plastics, or pre-approved equal.
   b. Spline/Groove Restraint System – Certa-Lok® as manufactured by Westlake Pipe and Fittings, or pre-approved equal.

7. All 6-inch through 12-inch diameter restrained joint water main pipe may be PVC pipe conforming to the requirements of AWWA-C900, unless otherwise shown on the construction plans or specified. The pipe shall be minimum Pressure Class (PC) 305 PSI with a Dimension Ratio (DR) of 14 per AWWA C-900. The pipe and coupling shall be manufactured from blue (only) pigmented virgin PVC resin compounds and shall equal or exceed PVC class 12454 as described in ASTM D-1784. The PVC compounds shall also qualify for a minimum hydrostatic design basis (HDB) of 4000 PSI at 73.4-degree Fahrenheit in accordance with the requirements of ASTM D-2837.

8. Pipe shall be made restrained joint by using a PVC coupling and high-strength flexible thermoplastic splines inserted into mating precision machined grooves in the pipe to provide full 360 degree evenly distributed restraint. Couplings shall be designed for use at or above the pressure class of the pipe and shall incorporate twin elastomeric sealing gaskets meeting the requirements of ASTM F-477. Joints shall be designed to meet the zero leakage test requirements or ASTM D-3139.

9. Restrained Joint PVC pipe shall be C900/RJIB Certa-Lok PVC Pressure Pipe, or pre-approved equal.

C-900/RJ RESTRAINED JOINT PVC PIPE - CIOD						
Nominal Pipe Size - Inches	Pipe Outside Diameter - Inches	Pipe Min Wall Thickness - Inches	Dimension Ratio (DR)	Pressure Class - PSI	Restraint Spline Groove Width - Inches	Restraint Spline Groove Min. Depth - Inches
6	6.90	0.493	14	305	0.375	0.125
8	9.05	0.646	14	305	0.500	0.130
12	13.20	0.943	14	305	0.500	0.200

10. Restrained joint C-900 pipe shall contain the product markings required by AWWA C-900. The pipe markings shall be spaced at intervals of not more than 5 feet. The minimum pipe markings shall include the nominal pipe size and outside diameter base (for example, “6CI”), type of plastic (“PVC”), Dimension Ratio (“DR 14”), AWWA pressure class (“PC305”), AWWA designation (“AWWA C900”), manufacturer’s name or trademark, and the seal or mark of the testing agency certifying the pipe for use with potable water.

11. The manufacturer shall submit certification and test results that the pipe has been tested in accordance with AWWA C-900 and has been found to meet all requirements. Test samples shall be as selected by the manufacturer or testing laboratory unless otherwise stipulated in the Special Provision Section of the contract.

12. The Engineer reserves the right to witness any or all acceptance tests. Prior notice of testing schedules shall be provided by the manufacturer to the Engineer to accommodate travel or independent third-party witness arrangements.

F. Ductile Iron Fittings For Use With PVC Pipe

1. For 6-inch, 8-inch, and 12-inch PVC Pipe:

a. Minimum Pressure Class 350, cast from ductile iron, in accordance with AWWA C-110 for full body fittings or AWWA C-153 for compact fittings.

b. All cast fittings shall have a cement mortar lining of standard or double thickness in accordance with AWWA C-104, or fusion bonded epoxy lining and coating of minimum thickness in accordance with AWWA C-116.

c. Manufacturers:

1) All fittings, including gaskets, glands, and bolts, shall be furnished by one fittings manufacturer.

2) Fittings shall be manufactured within the North American Continent or imported by an approved manufacturer:

a) U.S. Pipe Co

b) McWane Cast Iron Pipe

c) Tyler/Union Foundry

d) Star Pipe Corporation

e) Sigma Corporation

f) SIP Industries

G. Valve and Fitting Restraint Systems for PVC Pipe

1. Restraint at connection to mechanical joint valves and fittings shall be by the use of wedge action thrust restraint for mechanical joints as specified for use with restrained joint PVC pipe.

   a. EBAA Iron – 2000PV MEGALUG – Series 2000

   b. Star Pipe Products – PVC Stargrip – Series 4000

   c. Romac Industries – GripRing

   d. Tyler Union Corp – TufGrip – Series 2000

   e. SIP Industries – EZ Grip Ultra Joint Restraint

   f. Ford Meter Box Co – Uni-Flange Series UFR1500

2.4 PRESTRESSED CONCRETE PRESSURE PIPE, STEEL-CYLINDER PIPE (PCCP)

A. All 30-inch through 144-inch diameter water main pipe may be PCCP pipe conforming to the requirements of the applicable AWWA Standards, unless otherwise shown on the construction plans or specified. All wire wrapped prestressed concrete steel-cylinder pipe furnished shall be either prestressed concrete lined-cylinder (LCP) pipe with rubber and steel joint, or prestressed concrete embedded-cylinder (ECP) pipe with rubber and steel joints all in compliance with AWWA C-301 and AWWA C-304. The pipe shall be designed and furnished to fit the profile and head conditions shown on the construction plans and hydrostatic tests herein specified, plus the standard allowance for water hammer.

B. The pipe shall conform to the Quality Assurance/Quality Control and Design Criteria Sections indicated above. See project Special Provisions and Construction Drawings for additional design requirements, standards and details.

C. All connections for main line valves shall be mechanical joint for 30-inch through 48-inch diameter pipe, unless otherwise shown on the construction plans or specified. Connections for main line valves shall be flange joint for 54-inch through 144-inch diameter pipe, unless otherwise shown on the construction plans or specified. Connections for side outlets shall be flanged, mechanical joint, or factory restrained joint as indicated on the construction plans, or as specified.

D. The pipe shall be manufactured within the North American Continent. An officer of the manufacturing company shall certify that all PCCP was manufactured in North America.

E. Rubber gaskets shall be made of vulcanized styrene butadiene rubber (SBR), unless otherwise shown on the plans or specified. Nitrile (NBR) Rubber (Acrylonitrile Butadiene) gaskets shall be furnished when specified or shown on the construction plans and when water mains are located near contaminated soils or gasoline storage facilities.

F. Gasket lubricant shall be as recommended by the pipe manufacturer and shall conform to the requirements of the Safe Drinking Water Act and be NSF/ANSI 61 certified.

G. If the pipe manufacturer furnishes third party accessories, the pipe manufacturer shall provide a written and notarized statement signed by a current officer of the pipe manufacturer accepting unit responsibility for both the fitting, pipe, and accessories.

H. The pipe shall contain all product markings required by AWWA C-301. The product markings shall be marked on the inside of the bell or spigot ends and shall be a waterproof marking material. The minimum pipe markings shall include the manufacturer's name or trademark, the production year, piece number per the laying schedule and the pressure rating or area of circumferential reinforcement per unit length of pipe wall. Beveled pipe shall be marked with the amount of bevel and the point of maximum pipe length shall be marked on the beveled end. All markings shall be clear and legible.

I. The Engineer reserves the right to witness any or all acceptance tests. Prior notice of testing schedules shall be provided by the manufacturer to the Engineer to accommodate travel or independent third-party witness arrangements.

J. Prestressed concrete cylinder pipe and fittings shall be manufactured in accordance with to AWWA C-301, AWWA C-304, and as modified below:

1. The pipe shall be designed for working pressure, surge pressure, as specified, and live and dead loads as directed in the AWWA C-304 and as required in Section 2.1B.

2. Concrete core thickness and the area, tension and spacing of pre-stressing wire shall be designed as outlined by Appendix A of AWWA C-304.

3. Testing: All materials used in the manufacture of the pipe shall be tested as outlined in the applicable ASTM standard for that material. Test reports shall be obtained by the manufacturer and held on file for inspection by the Engineer. Hydrostatic tests of the completed cylinders with joint rings and compression tests of concrete cylinders shall be made by the manufacturer during the production process and test reports shall be held on file for inspection by the Engineer. The manufacturer shall furnish an affidavit that the materials used in making the pipe meet all provisions of the applicable ASTM standard and that the pipe and fittings meet all applicable provisions of AWWA C-301.

4. Restrained joints shall be snap ring or approved equal.

5. Manufacturers: Thompson Pipe Group w/Snap Rings®, Forterra Precast or approved equal.

2.5 CONCRETE PRESSURE PIPE, BAR WRAPPED STEEL CYLINDER PIPE (BWP)

A. All 30-inch through 72-inch diameter water main pipe may be BWP pipe conforming to the requirements of the applicable AWWA Standards, unless otherwise shown on the construction plans or specified. All BWP pipe furnished shall be concrete pressure pipe with a bar wrapped steel-cylinder with rubber and steel joints all in compliance with AWWA C-303. The pipe shall be designed and furnished to fit the profile and head conditions shown on the construction plans and hydrostatic tests herein specified, plus the standard allowance for water hammer.

B. The pipe shall conform to the Quality Assurance/Quality Control and Design Criteria Sections indicated above. See project Special Provisions and Construction Drawings for additional design requirements, standards and details.

C. Connections for main line valves shall be mechanical joint for 30-inch through 48-inch diameter pipe, unless otherwise shown on the construction plans or specified. Connections for main line valves shall be flange joint for 54-inch through 72-inch diameter pipe, unless otherwise shown on the construction plans or specified.

Connections for side outlets shall be flanged, mechanical joint, or factory restrained joint as indicated on the construction plans, or as specified.

D. The pipe shall be manufactured within the North American Continent. An officer of the manufacturing company shall certify that all steel pipe was manufactured in North America.

E. Rubber gaskets shall be made of vulcanized styrene butadiene rubber (SBR) unless otherwise shown on the plans or specified. Nitrile (NBR) Rubber (Acrylonitrile Butadiene) gaskets shall be furnished when specified or shown on the construction plans and when water mains are located near contaminated soils or gasoline storage facilities.

F. Gasket lubricant shall be as recommended by the pipe manufacturer and shall conform to the requirements of the Safe Drinking Water Act and be NSF/ANSI 61 certified.

G. If the pipe manufacturer furnishes third party accessories, the pipe manufacturer shall provide a written and notarized statement signed by a current officer of the pipe manufacturer accepting unit responsibility for both the fitting, pipe, and accessories.

H. The pipe shall contain all product markings required by AWWA C-303. The product markings shall be marked on the inside of the bell or spigot ends and shall be a waterproof marking material. The minimum pipe markings shall include the manufacturer's name or trademark, the production year, piece number per the laying schedule and the pressure rating or area of circumferential reinforcement per unit length of pipe wall. Beveled pipe shall be marked with the amount of bevel and the point of maximum pipe length shall be marked on the beveled end. All markings shall be clear and legible.

I. The Engineer reserves the right to witness any or all acceptance tests. Prior notice of testing schedules shall be provided by the manufacturer to the Engineer to accommodate travel or independent third-party witness arrangements.

J. Bar Wrapped Pipe shall be manufactured in accordance with to AWWA C-303, and as modified below:

1. The pipe shall be designed for working pressure and surge pressure, as specified, and dead and live loads as directed in AWWA M9, Manual of Practice for Concrete Pressure Pipe, Chapter 7, and as required by Section 2.1B.

2. Concrete lining and coating thickness, steel cylinder thickness, and bar diameter and spacing shall conform to AWWA C-303 and M-9.

3. Restrained joints shall be snap ring or approved equal.

4. Manufacturers: Thompson Pipe Group w/Snap Rings®, Forterra Precast w/Snap Rings®, Northwest Pipe Company, or approved equal.

2.6 STEEL WATER PIPE

A. All 30-inch through 144-inch diameter water main pipe may be fabricated steel pipe conforming to the requirements of the applicable AWWA Standards, unless otherwise shown on the construction plans or specified. The pipe shall be designed and furnished to fit the profile and head conditions shown on the construction plans and hydrostatic tests herein specified, plus the standard allowance for water hammer.

B. The pipe shall conform to the Quality Assurance/Quality Control and Design Criteria Sections indicated above. See project Special Provisions and Construction Drawings for additional design requirements, standards and details.

C. Connections for main line valves shall be mechanical joint for 30-inch through 48-inch diameter pipe, unless otherwise shown on the construction plans or specified. Connections for main line valves shall be flange joint for 54-inch through 144-inch diameter pipe, unless otherwise shown on the construction plans or specified. Connections for side outlets shall be flanged, mechanical joint, or factory restrained joint as indicated on the construction plans, or as specified.

D. The pipe shall be manufactured within the North American Continent. An officer of the manufacturing company shall certify that all steel was manufactured in North America.

E. Rubber gaskets shall be made of vulcanized styrene butadiene rubber (SBR) unless otherwise shown on the plans or specified. Nitrile (NBR) Rubber (Acrylonitrile Butadiene) gaskets shall be furnished when specified or shown on the construction plans and when water mains are located near contaminated soils or gasoline storage facilities.

F. Gasket lubricant shall be as recommended by the pipe manufacturer and shall conform to the requirements of the Safe Drinking Water Act and be NSF/ANSI 61 certified.

G. If the pipe manufacturer furnishes third party accessories, the pipe manufacturer shall provide a written and notarized statement signed by a current officer of the pipe manufacturer accepting unit responsibility for both the fitting, pipe, and accessories.

H. The pipe shall contain all product markings required by AWWA C-200. The product markings shall be marked on the inside of the bell or spigot ends and shall be a waterproof marking material. The minimum pipe markings shall include the manufacturer's name or trademark, the production year, piece number per the laying schedule and the pressure rating. Beveled pipe shall be marked with the amount of bevel and the point of maximum pipe length shall be marked on the beveled end. All markings shall be clear and legible.

I. The Engineer reserves the right to witness any or all acceptance tests. Prior notice of testing schedules shall be provided by the manufacturer to the Engineer to accommodate travel or independent third-party witness arrangements.

J. Steel pipe shall conform to AWWA C-200 and as modified below:

1. Steel pipe shall conform to AWWA C200. Steel plate used in the manufacture and fabrication of steel pipe shall meet the requirements of ASTM A1011 or A1018. All longitudinal and girth seams, whether straight or spiral, shall be butt-welded using an approved electric-fusion-weld process.

2. Pipe is to be furnished principally in 50-feet net laying lengths with shorter lengths, field trim pieces and closure pieces as required by plan and profile for location of elbows, tees, reducers and other in-line fittings or as required for construction. The pipe fabricator shall prepare a pipe-laying schedule showing the location of each piece by mark number with station and invert elevation at each bell end.

3. Pipe cylinders, coating, lining, and fabrication of specials shall be the product of one manufacturer that has not less than 5 years successful experience manufacturing pipe of the particular type and size indicated. The Pipe Manufacturer shall have a certified quality assurance program.

4. Unless otherwise shown on the plans, all specials and fittings shall conform to the dimensions of AWWA C208. Pipe material used in fittings shall be of the same material and pressure class as the adjoining pipe. The minimum radius of elbows shall be 2 ½ times the pipe diameter and the maximum miter angle on each section of the elbow shall not exceed 11 ¼ degrees (one cut elbow up to 22 ½ degrees).

If elbow radius is less than 2 ½ times the pipe diameter, stresses shall be checked per AWWA M11 and the pressure class increased if necessary.

5. Fittings shall be equal in pressure class design as the adjoining pipe. Specials and fittings, unless otherwise shown on the plans, shall be made of segmentally welded sections from hydrostatically tested pipe, with ends compatible with the type of joint or coupling specified for the pipe. All welds made after hydrostatic testing of the straight sections of pipe shall be tested per the requirements of AWWA C200 Section 5.2.2.1.

6. The standard joint for 54-inch through 84-inch diameter pipe shall be a Carnegie bell and spigot rubber gasket joint unless otherwise noted on the plans. Rolled groove rubber gasket joints shall conform to AWWA C303 and AWWA M9. The O-ring gasket shall have sufficient volume to approximately fill the area of the groove. Restrained joints shall be lap-welded joints with a full penetration, full thickness weld performed on the pipe interior. All welds shall be tested utilizing ultrasonic, magnetic particle or radiographic (x-ray) testing methods as described in AWWA C206-17. After pushing on joints or welding restrained joints, the pipe exterior shall be wrapped with tape coat or shrink wrap.

7. The standard joint for 90-inch through 144-inch diameter pipe shall be a lap-welded joints with a full penetration, full thickness weld performed on the pipe interior. All welds shall be tested ultrasonically. After pushing on joints or welding restrained joints, the pipe exterior shall be wrapped with tape coat or shrink wrap.

8. Interior surface 30-inch through 84-inch diameter steel pipe, fittings and specials shall be lined in the shop with cement-mortar lining applied centrifugally and conforming with AWWA C205. All interior joint recesses shall be hand mortared.

9. Interior surface 90-inch through 144-inch diameter steel pipe, fittings and specials shall be lined with cement-mortar lining factory applied centrifugally and conforming with AWWA C205.

10. Fittings, including those specially made, shall be cement-mortar lined per AWWA C205.

11. Pipe shall be coated with a bonded tape system per AWWA C214 or cement mortar per AWWA C205.

12. Deflection of the backfilled pipe shall be limited to 3% of the outside diameter.

13. The manufacturer shall submit details for joint restraint, including calculations of the required length for restrained joint sections, for approval prior to shipment of the pipe. These calculations shall be based on the pressures specified, earth cover at the location in question, soil weight of 120 pcf, and a friction factory of 0.25. Bedding shall be in accordance with Charlotte Water standard bedding requirements or as specified.

2.7 HIGH DENSITY POLYETHYLENE (HDPE) PIPE (OD-BASED IRON PIPE SIZE – IPS) AND FITTINGS

A. The HDPE pipe shall be manufactured in accordance with AWWA C-901 or C-906 and ASTM D-3035, using PE 4710 resin (ASTM D-3350, Cell Classification PE 445574). Polyethylene pipe shall be 250 PSI pressure class, OD based Iron Pipe Size – IPS pipe and shall meet the dimension ratio (DR) below. Each pipe nipple shall contain no more than two (2) butt fusion joints. Due to the pipe wall thickness of HDPE pipe and due to

IPS OD-based pipe, the HDPE pipe size shall be based on ID dimensions of the HDPE pipe (e.g. when 24-inch nominal pipe is called out on the plans, 32-inch HDPE is needed to provide the required 24-inch ID pipe).

Pipe Use	Outside Diameter (inch)	ASTM Test Method	AWWA Standard	Pressure Class (PSI)	Max Dimension Ratio
Water Mains	4 - 30	D2239, D2239, D2737, D3035, D3350, F714	C906	250	DR 9
Water Mains and Service Lines	1.5 - 3	D2239, D2737, D3035, D3350	C901	200	DR 9

IPS HDPE Pipe Sizes based on DR9 (250 psi)				
Pipe Size (inch)	**Outside Diameter (inch)**	**Min Wall Thick-ness (inch)**	**Inside Diameter (inch)**	**Weight (pounds/foot)**
3	3.5	0.389	2.68	1.66
4	4.5	0.5	3.44	2.75
6	6.625	0.736	5.06	5.96
8	8.625	0.958	6.59	10.11
10	10.75	1.194	8.22	15.70
12	12.75	1.417	9.75	22.08
14	14.00	1.556	10.70	26.63
16	16.00	1.778	12.23	34.78
18	18.00	2.00	13.76	44.02
20	20.00	2.222	15.29	54.34
22	22.00	2.444	16.819	65.75
24	24.00	2.667	18.35	78.25
26	26.00	2.889	19.88	91.84
28	28.00	3.111	21.40	106.51
30	30.00	3.333	22.93	122.27

B. 1.5-inch and 2-inch pipe for use on services, blow-offs and air releases (only), may be furnished in high density polyethylene (HDPE) with stainless steel threaded end pieces.

C. The transition pieces at each end of the HDPE pipe shall be Series 710 Male NPT couplings as manufactured by Poly-Cam, Inc or approved equal, and shall be press fit onto the HDPE pipe. The HDPE shall extend through the full length of the transition piece with no metal exposed in the waterway. The transition piece shall be manufactured from 304 or 316 stainless steel.

D. The pipe shall be manufactured within the North American Continent. An officer of the manufacturing company shall certify that all HDPE was manufactured in North America.

E. Pipe shall be manufactured at a facility that has a Registered ISO 9001:2000 Quality Management System. Copy of current ISO 9001:2000 registration shall be submitted with product submittals.

F. Pipe markings shall be as required by AWWA C-901 and C-906 and/or ASTM D-3035. Product markings shall be at intervals of not more than 5 feet. The minimum pipe markings shall be as follows:

1. Manufacturer's Name or Trademark and product record.
2. Nominal pipe size.
3. IPS.
4. Dimension Ratio ("DR 9").
5. AWWA C-901 or C-906.
6. Seal of testing agency that verified the suitability of the pipe.
7. Resin type (PE4710).
8. Color identification requirements:
    a. 1.5-inch and 2-inch HDPE Pipe shall be blue exterior.
    b. Larger than 2-inch HDPE Pipe shall be identified by a blue stripe on exterior. Striping material shall be the same as piping material.
9. Manufacturers: Performance Pipe, GF Piping Systems, JM Eagle, Driscoplex, WL Plastics or approved equal.

G. Fittings:

1. Butt Fusion Fittings:
    a. Butt fusion fittings shall be made of HDPE material with a minimum material designation code of PE 4710 and with a minimum Cell Classification as required for HDPE Pipe.
    b. Butt fusion fittings shall meet the requirements of ASTM D3261. Molded and fabricated fittings shall have a pressure rating equal to or greater than the pipe unless otherwise specified on the plans.
        1) Fabricated Fittings shall be Equivalent Dimension Ratio to DR9.
        2) Pipe stock used to manufacture fabricated fittings shall meet requirements of AWWA C901 or C906 and meet the material designation code of PE4710.
        3) Fabricated Fittings typically require a lower DR rating than the pipe to meet or exceed the pipe pressure rating. Calculate the difference for a fabricated fitting based on a published rerating percentage.

4) Fabricated bend and tee fittings shall have a minimum of 3 segments.

5) Fabricated bend fittings over 45 degrees through 90 degrees shall have a minimum of four segments.

6) Field fabricated fittings are not allowed.

c. All fittings shall meet the requirements of AWWA C901 or C906.

d. Markings for molded fittings shall comply with the requirements of ASTM D3261.

1) Standard Designation (ASTM D 3261).

2) Manufacturer's name or trademark.

3) Material designation (PE4710).

4) Date of manufacture or manufacturing code.

5) Size.

6) Dimension Ratio (example: DR 9).

e. Fabricated fittings shall be marked in accordance with ASTM F 2206.

1) Standard Designation (ASTM F 2206).

2) Manufacturer's name or trademark.

3) Material designation (PE4710).

4) Date of manufacture or manufacturing code.

5) Size.

6) Equivalent Dimension Ratio.

7) Manufacturers: ISCO, IPEX, GF Piping Systems, or approved equal.

2. HDPE Electrofusion Fittings:

a. Electrofusion Fittings shall be made of HDPE material with a minimum material designation code of PE 4710 and with a minimum Cell Classification as noted for HDPE pipe.

b. Electrofusion Fittings shall have a manufacturing standard of ASTM F1055. Fittings shall have a pressure rating equal to the pipe unless otherwise specified on the plans.

c. All electrofusion fittings shall be suitable for use as pressure conduits and have nominal burst values of four times the Working Pressure Rating (WPR) of the fitting.

d. Markings shall be in accordance with to ASTM F 1055.

1) Standard Designation (ASTM F 2206).

2) Manufacturer's name or trademark.

3) Material designation (PE4710).

4) Date of manufacture or manufacturing code.

5) Size.

6) Equivalent Dimension Ratio.

7) Manufacturers: Agru America, GF Piping Systems, Integrity Fusion Products, IPEX, MT Deason Company, NUPI Americas Inc, or approved equal.

3. Flanges and Mechanical Joint Adapters (MJ Adapters):

a. Flanges and Mechanical Joint Adapters shall have a material designation code of PE4710 or higher and a minimum Cell Classification as noted for HDPE pipe.

b. Flanged and Mechanical Joint Adapters can be made to ASTM D 3261 or if machined, shall meet the requirements of ASTM F 2206.

c. The outside diameter of Flanges shall be based on Iron Pipe Size (IPS).

d. The MJ Adapters shall be based on Iron Pipe Size by Ductile Iron Pipe Size (IPS x DIPS).

e. Flanges and MJ Adapters shall have a pressure rating equal to the pipe unless otherwise specified on the plans.

f. Markings for molded or machined flange adapters or MJ Adapters shall be per ASTM D 3261.

1) Manufacturer's name or trademark

2) Material designation (PE4710)

3) Date of manufacture or manufacturing code

4) Size

5) Where recessed marking is used, take care not to reduce the wall thickness below the minimum specified.

g. Fabricated (including machined) flange adapters shall be per ASTM F 2206.

h. Metal gland for MJ Adapter may be either AWWA C110 (full body) or AWWA C153 (compact).

i. Low alloy steel bolts shall comply with AWWA C 111.4. Bolts, rods, and hex nuts shall be manufactured from 304 stainless steel as per ANSI/ AWWA C111/A21.11.

j. Van-Stone style, metallic (including stainless steel), convoluted, or flat-plate back-up rings and bolt materials shall follow the guidelines of Plastic Pipe Institute Technical Note # 38, and shall have the bolt-holes and bolt-circles conforming to one of these standards: ASME B-16.5 Class 150, ASME B-16.47 Series A Class 150, ASME B-16.1 Class 125, or AWWA C 207 Class 150 Series B, D, or E.

k. The back-up ring shall provide a long-term pressure rating equal to or greater than the pressure-class of the pipe with which the flange adapter assembly shall be used, and such pressure rating shall be marked on the back-up ring. The back-up ring, bolts, and nuts shall be protected from corrosion by a system such as coal-tar epoxy, galvanization, polyether, or polyester fusion bonded epoxy coatings, anodes, or cathodic protection, as specified by the Engineer.

l. Stiffening insert required shall comply to Part 2.7.G.4.

m. Manufacturers: Georg Fisher, DriscoPlex, IPP, or approved equal.

4. Stiffening Insert (Stiffener):

a. Provide stiffeners at each MJ adapter and coupling per Standard Details.

b. Stiffening inserts shall be specially designed for use on the inside of HDPE pipe in conjunction with AWWA C111 mechanical joints.

c. Provide stainless steel per ASTM 240, type 304 or 316.

d. Stiffener shall be manufactured within the pipe or MJ adapter by the factory.

e. Field installed stiffeners may be allowed upon approval of Charlotte Water inspector. Wedge style stiffeners are allowed.

f. Stiffener length shall be sufficient to fully encompass the area of the pipe being restrained.

g. Inserts shall be designed for underground pressurized fluid service and are pressure rated to match the pipe DR pressure rating, derated as appropriate for service temperature. Maximum test pressure limited to pipe rated pressure.

h. Stiffener design shall prevent movement causing fitting to slide or rotate on the pipe.

i. Manufacturers: Georg Fisher, ROMAC, or approved equal.

5. Flex Coupling Restraint Device:

a. HDPE flex coupling restraint devices shall be rated for minimum of 8,000 pounds of force.

b. Resin used to manufacture device shall meet requirements of ASTM 3350 with minimum cell classification of 445474C.

c. Device shall include bar code and product label tag.

d. Device shall install by electrofusion.

6. Stainless Steel Threaded Fitting: Stainless steel fittings, including bends, street tees, and couplings, used with HDPE pipe shall be type 304 or type 316 stainless steel with NPT threads. The minimum wall thickness shall be 0.130-inches. Fittings shall be Standard Weight 150# Stainless Fittings as manufactured/supplied by Smith-Cooper International, or pre-approved equal. The fittings may be import or domestic production and shall be manufactured in as IS0 9001:2000 manufacturing facility.

2.8 RED BRASS PIPE (OD BASED IRON PIPE SIZE) AND FITTINGS

A. 2-inch diameter and smaller red brass pipe, for use in water mains and water service laterals shall be seamless red brass pipe, when shown on the construction plans or when specified. Pipe shall conform to the requirements of ASTM B-43, annealed temper (O61), and AWWA C-800 Section A.3: Red Brass Pipe. Pipe shall be Regular Strength or Schedule 40. Red brass pipe shall contain 84-86% copper, max 0.05% lead, max 0.05% iron and remainder zinc in conformance with ASTM B-43.

B. The pipe shall come in standard twelve-foot lengths and shall be threaded on each end. Shorter lengths may be used for placement of valves and fittings. Lengths less than 10 feet may not be used to make up straight sections of pipe in order to limit the number of couplings. All red brass pipe may be of domestic manufacture or import.

RED BRASS PIPE - IPS				
Nominal Pipe Size (inches)	Outside Diameter (inches)	Min Wall Thickness (inches)	Weight (pounds/foot)	Strength
¾	1.050	0.114	1.27	Regular
1	1.315	0.126	1.78	Regular
1 ½	1.900	0.150	3.13	Regular
2	2.375	0.156	4.12	Regular

C. Pipe markings shall be as required by ASTM B-43. The minimum product markings shall include the ASTM designation ("ASTM B-43"), the alloy number or designation, manufacturer's name or trademark, and the country where cast. All markings shall be clear and legible.

D. Red brass fittings and couplings shall conform to the requirements of ASTM B-584 and AWWA C-800. Components shall be made from Copper Alloy UNS No. C89520 or No. C89833. All red brass components may be of domestic manufacture or import.

RED BRASS CASTINGS - IPS							
Classification	Copper Alloy UNS No.	Commercial Designation	Normal Composition - %				
			Copper	Tin	Lead	Zinc	Bismuth
Bismuth Selenium Brass	C89520	Sebiloy II	86	5.5	-	5	1.9
Bismuth Red Brass	C895833	Bismuth Brass	89	5	-	3	2.2

E. Although the Normal Composition of Leaded Red Brass is 5% lead, the maximum lead content shall be 0.05% as specified above, for pipe in contact with potable water. The manufacturer shall provide test reports and certification that the pipe conforms to the stated standards.

F. Cast component markings shall be as required by ASTM B-584 and ASTM B-824. The minimum product markings shall include the ASTM designation ("ASTM B-854"), manufacturer's name or trademark, and the country where cast. All markings shall be clear and legible.

G. The piping shall be manufactured within the North American Continent. An officer of the manufacturing company shall certify that all piping was manufactured in North America, if not included in product markings.

H. Red Brass Fittings: Fittings for copper tubing, red brass pipe and polyethylene tubing shall be no lead or low lead red brass alloys containing not greater than 0.25% lead

(weighted average) and shall comply with NSF Standard 61, NSF Standard 372 and the Reduction of Lead in Drinking Water Act passed in 2011 (or most recent applicable amendments to the Safe Drinking Water Act). Fittings for tubing shall be compression, in accordance with AWWA C-800. Stab type fittings are not approved. Red brass fittings shall have threaded ends conforming to National Pipe Thread standards.

I. The minimum product markings shall include the manufacturer's name or trademark and lettering indicating no-lead or low-lead compliance on the fittings.

2.9 STAINLESS STEEL PIPE AND FITTINGS (OD BASED STAINLESS STEEL SIZE)

A. 1.5- and 2-inch diameter stainless steel pipe, for use in water mains and water service laterals shall be seamless stainless steel, when shown on the construction plans or when specified. Pipe shall conform to the requirements of ASTM A312. Piping less than 3 inches in nominal diameter shall have a minimum wall thickness not less than the Schedule 40S.

B. The piping shall be manufactured within the North American Continent. An officer of the manufacturing company shall certify that all piping was manufactured in North America, if not included in product markings.

C. The pipe shall come in standard twenty-foot lengths and shall have threaded ends with NPT threads made up with Teflon tape. Shorter lengths may be used for placement of valves and fittings. Lengths less than 10 feet may not be used to make up straight sections of pipe in order to limit the number of couplings. All stainless-steel pipe may be of domestic manufacture.

STAINLESS STEEL - SEAMLESS				
Nominal Pipe Size (inches)	Outside Diameter (inches)	Min Wall Thickness (inches)	Weight (pounds/foot)	Type
¾	1.050	0.113	1.131	Sch 40S
1	1.315	0.133	1.679	Sch 40S
1-1/2	1.900	0.145	2.718	Sch 40S
2	2.375	0.154	3.653	Sch 40S

D. Fittings: Threaded fittings with forged stainless steel shall conform to ASME B16.11. Unless otherwise indicated, fittings shall be in accordance with the pressure classes called for in the Piping Schedule. Where not indicated, fittings shall have the same pressure rating as the pipe.

E. Cleaning: All pickling treatment of stainless-steel pipe and fittings shall be done at the point of manufacture, scrubbed, and washed until all discoloration is removed in accordance with ASTM A380 or ASTM A967.

F. Manufacturers: As approved by Charlotte Water.

2.10 COPPER TUBING – (OD BASED COPPER TUBING SIZE)

A. Copper tubing shall conform to the requirements of ASTM B-88 and AWWA C-800, Section A.2: Copper Water Tube. Copper tubing shall be Type K seamless copper water tubing. Chemical composition of material shall be a minimum 99.9% copper, by weight,

and shall be copper UNS No. C10200, C12000 or C12200. End connections may be compression type connections unless otherwise approved.

COPPER TUBING - SEAMLESS				
Nominal Pipe Size (inches)	Outside Diameter (inches)	Min Wall Thickness (inches)	Weight (pounds/foot)	Type
3/4	0.875	0.065	0.641	K
1	1.125	0.065	0.839	K
1-1/2	1.625	0.072	1.360	K
2	2.125	0.083	2.060	K

B. The tubing shall be manufactured within the North American Continent. An officer of the manufacturing company shall certify that all copper tubing was manufactured in North America, if not included in product markings.

C. The tubing shall contain all product markings required by ASTM B-88. The minimum pipe markings shall include the following: the manufacturer's name or trademark, and the type ("TYPE K") shall be permanently marked (incised) on the tubing at intervals not greater than 1.5-feet. On tubing produced from C102000 and C12000 copper, the UNS copper designation shall be identified at intervals not greater than 3 feet. Country of origin is optional at no greater than 3-feet intervals. All markings shall be clear and legible.

D. Copper tubing shall be installed in a single segment between the corporation stop on the water main pipe and the water meter. No fittings shall be used on the tubing. Couplings may not be installed between the corporation stop and the meter box.

E. Required submittals for product approval include, but are not limited to, product brochure, catalog cuts, certification of compliance, prior product acceptance test reports, and reference contact data.

2.11 POLYETHYLENE (PE) TUBING – (OD BASED COPPER TUBING SIZE)

A. ¾-inch and 1-inch diameter water service tubing may be polyethylene tubing unless otherwise shown on the construction plans or specified. Polyethylene tubing shall conform to the requirements of AWWA C-901, and be manufactured in accordance with ASTM D2239, D2737, D3035, D3350, and F2769, using PE 4710 resin (ASTM D-3350, Cell Classification PE 445574). Polyethylene water service tubing shall be SDR-9, 200 PSI pressure class, and shall comply with AWWA C-901, NSF 61, and NSF 14.

POLYETHYLINE TUBING - CTS				
Nominal Pipe Size (inches)	Outside Diameter (inches)	Min Wall Thick-ness (inches)	Pressure Class (psi)	SDR – Standard Dimension Ratio - Outside Diameter Based
3/4	0.875	0.097	200	9
1	1.125	0.125	200	9

B. The tubing shall be manufactured within the North American Continent. An officer of the manufacturing company shall certify that all polyethylene tubing was manufactured in North America.

C. The pipe shall contain all product markings required by AWWA C-901. The product markings shall be at intervals of not more than 5 feet. The minimum pipe markings shall include the nominal pipe size, production record code, standard PE code designation ("PE 3408"), Dimension Ratio ("SDR 9"), AWWA pressure class ("PC 200" or "200 PSI"), AWWA designation ("AWWA C901") and/or ASTM designation ("ASTM D-2737"), the word "Tubing" or "CTS", manufacturer's name or trademark, and the seal or mark of the testing agency certifying the pipe for use with potable water. All markings shall be clear and legible.

D. PE tubing shall be installed in a single segment between the corporation stop on the water main pipe and the water meter. No fittings shall be used on the tubing.

E. Pipe Shall be Blue or Black with Blue Stripe in color.

2.12 COPPER TRACER/LOCATOR WIRE

A. All main line water main pipe and service line pipe or tubing shall be installed with copper tracer/locator wire, regardless of the pipe material.

B. Tracer/Locator Wire System: The tracer wire shall be a single conductor AWG No. 12 (gauge) solid copper wire with HDPE insulation. The insulation shall be blue and shall be 30 mils thick for open cut installation or 45 mils thick for Horizontal Directional Drill (HDD) installation. HDD installations shall require 2 conductors. The copper conductor wire shall conform to the requirements of ASTM B-3. Tracer wire shall be furnished in coiled rolls of 500-feet or greater length on distribution project with multiple water services. Tracer wire shall be furnished on coiled rolls of 2500-feet or greater lengths on transmission main projects (typically without services), to limit splices. Tracer wire shall be secured to the pipe every 10' using an HDPE zip tie or Duct Tape. A 24" pigtail shall be provided in any structure exposed to daylight.

1. The wire may be of domestic manufacture or import.

2. The product markings shall be at intervals of not more than 5 feet. The minimum product markings shall include the production record code, conductor average wire gauge ("AWG No. 12"), manufacturer's name or trademark, and the insulation rating. All markings shall be clear and legible.

C. Wire Splice System: Tracer wire shall be as continuous as possible to the greatest extent. When wire splices are required, they shall conform to the Standard Details and shall be made with a butt splice, and three layers of vinyl and rubber tapes. The butt splice shall be made with copper alloy split connector or copper crimp connector.

1. The splice system may be of domestic manufacture or import and shall be pre-approved by Charlotte Water.

2. The product packaging shall indicate approved conductor type and size, the manufacturer's name, product name or number, and that the product is designed for direct bury and submersible installations. All markings shall be clear and legible.

2.13 FIRE HYDRANTS

A. Standard Fire Hydrants (3-Way):

1. Fire hydrants shall conform to the extent applicable to AWWA C-502, Underwriters Laboratories 246 Listed, Factory Mutual 1510 Approved, and shall be constructed for 3'-6" minimum depth of bury. See Standard Details for additional minimum bury

depth requirements, based on water main diameters. Fire hydrant bury depths shall be based on the actual depth and/or the plan profile depth, to avoid using hydrant extension kits.

2. Fire hydrants shall have a minimum working pressure of 250 PSI and a minimum test pressure of 500 PSI.

3. All fire hydrants shall be constructed with a bronze main valve seat which screws into a threaded bronze connection at the base of the hydrant. All fire hydrants shall be equipped with two 2 ½ -inch brass hose nozzles with National Standard Threads, and one 5-inch STORZ connection pumper nozzle. 2 ½-inch nozzle caps shall be retained to the hydrant with zinc plated chains.

4. Hydrants shall be traffic breakaway type. Hydrant drain valves shall force flush with each operation and shall include a minimum of 2 drain outlets. Hydrant main valve shall be constructed of EPDM rubber. Hydrant shoe interior and exterior shall be fusion bonded epoxy coated conforming to AWWA C550.

5. The pumper nozzle shall meet the NFPA – fire hose connection standard for 5-inch STORZ connection and shall be compatible with 5-inch coupled large diameter fire hose. The nozzle connection shall be brass, shall be of a one-piece design, and shall be integral to the fire hydrant assembly. Add on adaptors shall not be permitted. The nozzle connection shall be resistant to tamper or removal by persons not familiar with fire hydrant construction. An aluminum STORZ compatible cap shall be provided and shall be attached to the hydrant by a vinyl coated 0.1875” (3/16”) diameter galvanized aircraft cable or a No. 6 Gauge (0.192) Single Jack Link zinc plated chain. Aluminum shall be 6061 – T6 aluminum and shall be anodized dark gray in color conforming to Mil-A8625f Type 3. Natural or bright aluminum finish shall not be permitted. The Storz assembly (connection and cap) shall NOT be painted.

6. All hydrants shall open by turning to the right or clockwise, shall have a minimum valve opening size of 5 ¼ - inch and shall be furnished with a 6-inch or 8-inch mechanical joint inlet. A 6-inch or 8-inch vertical flange inlet may be used, when approved by the Engineer. Alpha end connections for American-Darling fire hydrants are also approved. Vertical flange hydrants shall have a 2’-6” bury depth. The operating nut shall be 1 ¼ -inch pentagon. Any extensions required for height adjustment shall be as recommended and supplied by the hydrant manufacturer. No more than one hydrant extension may be used with new installations.

    a. Vertical flange shoes shall be manufactured by; McWane Inc., Mueller Company or approved equal.

7. All fire hydrants and any portions of the hydrant assembly (excluding the STORZ connection and cap) exposed to view (above adjacent ground elevation) shall be painted with coating system consisting of two (2) or more evenly applied coats. The coating system shall include a primer coat and a color topcoat and may include a clear coat. The coating system may be a powder coat or wet coat system, industrial grade, exterior grade, full gloss coating system. Application and film thickness shall be in accordance with to the paint manufacturer’s published recommendations. The coating system may be Low VOC HAPs free two component exterior grade full gloss polyurethane enamel, polyurethane, fusion bonded epoxy or cross-linked polyester powder coating system. Paint systems shall be Valspar TGIC (Triglycidyl Isocyamurate) cross linked polyester powder

coat, Axalta (formerly DuPont) Imron 3.5HG Polyurethane, Sherwin Williams POLANE SP polyurethane enamel, or approved equal.

8. The standard fire hydrant shall be OSHA Safety Yellow. Fire Hydrants installed and intended exclusively for use as blow-off assemblies at major low points and creeks shall be OSHA Safety Blue. Fire Hydrants installed and intended exclusively for use as air releases assemblies at major high points in the main shall be OSHA Safety Blue.

9. Hydrants shall be retouched/repainted as necessary after installation and prior to acceptance in accordance with to the fire hydrant manufacturer's recommendations. Touch up paint shall be a high-quality industrial grade enamel intended for exterior use. Surface preparation and film thickness shall be as recommended by the paint manufacturer. Touch up color shall match the original paint color, or the fire hydrant shall be completely re-painted.

10. All standard fire hydrants shall be one of the following models:

Manufacturer	Model	Inlet Connection
American Flow Control (American Cast Iron Pipe Company)	5 ¼" B-84-B-5	6" or 8" MJ shoe or Vertical Flange
Clow Valve Company (McWane Inc.)	5 ¼" Medallion F-2545	6" or 8" MJ shoe or Vertical Flange
Kennedy Valve Company (McWane Inc.)	5 ¼" Guardian K81A	6" or 8" MJ shoe Vertical Flange
Mueller Company (Mueller Water Products)	5 ¼" Super Centurion 250	6" or 8" MJ shoe Vertical Flange
EJ Co.	WaterMaster 5CD250	6" or 8" MJ shoe Vertical Flange

11. Fire hydrant tees shall be Swivel Hydrant tee, Tyler 5-125 swivel hydrant tee or approved equal with integral joint restraint. Swivel 90-degree bends shall be Tyler 5-197 or approved equal with integral joint restraint. Hydrant guard valves shall be connected directly to the hydrant tee and shall be all MJ bell, with wedge action thrust restraint. When swivel tees are not available on large diameter pipe, the guard valve shall be directly connected to the MJ bell tee with a foster adaptor. Dependent on the distance between the main and the fire hydrant, and additional gate valve may be required to connect directly to the fire hydrant with a foster adaptor.

12. Hydrants used for fire hydrant applications shall be on 8-inch pipe ductile iron extensions only (unless otherwise approved by Charlotte Water). Hydrants used for air release applications shall be on 6-inch or 8-inch ductile iron pipe extensions, depending on water main diameter. All pipe between the hydrant tee and the hydrant shall be fully restrained. PVC pipe shall NOT be permitted. Pipe restraint shall be as specified above or an approved factory restraint method. Vertical hydrant extension kits shall be from the hydrant manufacturer. Third party

extension kits provided by manufacturers other than the original fire hydrant manufacturer are not allowed.

13. The hydrants shall contain all product markings required by AWWA C-502, UL 246, and FM 1510 as applicable. The minimum markings on each hydrant shall include AWWA C502 mark, UL Listed mark, FM Approved mark, manufacturer's name or trademark, main valve size, and year of manufacture. The markings shall be distinctly cast raised or in relief on the outside hydrant and legible after hydrant installation.

14. Hydrants shall be manufactured within the North American Continent. An officer of the manufacturing company shall certify that all hydrants were manufactured in North America.

B. High Velocity Fire Hydrants (4-Way):

1. When high velocity fire hydrants are specified or shown on the plans, the following specification shall apply. High velocity fire hydrants shall conform to AWWA C-502, Underwriters Laboratories 246 Listed, Factory Mutual 1510 Approved and shall be constructed for 3'-6" minimum depth of bury. See Standard Details for additional minimum bury depth requirements, based on water main diameters. Fire hydrant bury depths shall be based on the actual depth and/or the plan profile depth, to avoid using hydrant extension kits.

2. Fire hydrants shall have a minimum working pressure of 250 PSI and a minimum test pressure of 500 PSI.

3. All fire hydrants shall be constructed with a bronze main valve seat which screws into a threaded bronze connection at the base of the hydrant. All fire hydrants shall be equipped with two 2 ½ -inch brass hose nozzles with National Standard Threads, and two 5-inch STORZ connection pumper nozzles. 2 ½-inch nozzle caps shall be retained to the hydrant with zinc plated chains.

4. Hydrants shall be traffic breakaway type. Hydrant drain valves shall force flush with each operation and shall include a minimum of 2 drain outlets. Hydrant main valve shall be constructed of EPDM rubber. Hydrant shoe interior and exterior shall be fusion bonded epoxy coated conforming to AWWA C550.

5. The pumper nozzles shall meet the NFPA – fire hose connection standard for 5-inch STORZ connection and shall be compatible with 5-inch coupled large diameter fire hose. The nozzle connection shall be brass, shall be of a one-piece design, and shall be integral to the fire hydrant assembly. Add on adaptors shall not be permitted. The nozzle connection shall be resistant to tamper or removal by persons not familiar with fire hydrant construction. An aluminum STORZ compatible cap shall be provided and shall be attached to the hydrant by a vinyl coated 0.1875" (3/16") diameter galvanized aircraft cable or a No. 6 Gauge (0.192) Single Jack Link zinc plated chain. Aluminum shall be 6061 – T6 aluminum and shall be anodized dark gray in color conforming to Mil-A8625f Type 3. Natural or bright aluminum finish shall not be permitted. The Storz assembly (connection and cap) shall NOT be painted.

6. All hydrants shall open by turning to the right or clockwise, shall have a minimum valve opening size of 5 ¼ - inch or 6-inch depending on the manufacturer. Alpha end connections for American-Darling fire hydrants are also approved. The fire hydrant shall be furnished with an 8-inch mechanical joint inlet, or approved

alternative. An 8-inch vertical flange inlet may be used, when approved by the Engineer. Vertical flange hydrants shall have a 2'-6" bury depth. The operating nut shall be 1 ¼ -inch pentagon. Any extensions required for height adjustment shall be as recommended and supplied by the hydrant manufacturer. No more than one hydrant extension may be used with new installations.

a. Vertical flange shoes shall be manufactured by; McWane Inc., Mueller Company or approved equal.

7. All fire hydrants and any portions of the hydrant assembly (excluding the STORZ connection and cap) exposed to view (above adjacent ground elevation) shall be painted with coating system consisting of two (2) or more evenly applied coats. The coating system shall include a primer coat and a color topcoat and may include a clear coat. The coating system may be a powder coat or wet coat system, industrial grade, exterior grade, full gloss coating system. Application and film thickness shall be in accordance with to the paint manufacturer's published recommendations. The coating system may be Low VOC HAPs free two component exterior grade full gloss polyurethane enamel, polyurethane, fusion bonded epoxy or cross-linked polyester powder coating system. Paint systems shall be Valspar TGIC (Triglycidyl Isocyamurate) cross linked polyester powder coat, Axalta (formerly DuPont) Imron 3.5HG Polyurethane, Sherwin Williams POLANE SP polyurethane enamel, or approved equal.

8. The fire hydrant shall be OSHA Safety Yellow. Fire Hydrants installed and intended exclusively for use as blow-off assemblies at major low points and creeks shall be OSHA Safety Blue. Fire Hydrants installed and intended exclusively for use as air releases assemblies at major high points in the main shall be OSHA Safety Blue.

9. Hydrants shall be retouched/repainted as necessary after installation and prior to acceptance in accordance with to the fire hydrant manufacturer's recommendations. Touch up paint shall be a high-quality industrial grade enamel intended for exterior use. Surface preparation and film thickness shall be as recommended by the paint manufacturer. Touch up color shall match the original paint color, or the fire hydrant shall be completely re-painted.

10. All high velocity fire hydrants shall be one of the following models:

MANUFACTURER	MODEL	INLET CONNEC-TION	5" PUMPER NOZZLES	2.5" HOSE NOZZLES
American Flow Control (American Cast Iron Pipe Company)	6" American-Darling B-84-B-5	8" MJ shoe or 8" Vertical Flange	Two	Two
Mueller Company (Mueller Water Products)	5 ¼" Super Centu-rion A-459 Urban Fire Hydrant	8" MJ shoe or 8" Vertical Flange	Two	Two
Clow Valve Company (McWane Inc.)	5 ¼" Medallion F-2545 4-way	8" MJ shoe or 8" Vertical Flange	Two	Two

11. Fire hydrant tees shall be an 8" swivel outlet, or 8" MJ bell outlet with 8" foster adaptor or approved equal with integral joint restraint. 90-degree bends shall be all MJ bell, with wedge action thrust restraint or approved equal with integral joint

restraint. Hydrant guard valves shall be connected directly to the hydrant tee and shall be all MJ bell, with wedge action thrust restraint. Dependent on distance between the main and the fire hydrant, an additional gate valve may be required to connect directly to the fire hydrant with a foster adapter.

12. Pipe extensions from the main to the hydrant, shall be made with 8-inch ductile iron only. All pipe between the hydrant tee and the hydrant shall be fully restrained. PVC pipe shall NOT be permitted. Pipe restraint shall be as specified above or an approved factory restraint method. Vertical hydrant extension kits shall be from the hydrant manufacturer. Third party extension kits provided by manufacturers other than the original fire hydrant manufacturer are not allowed.

13. The hydrants shall contain all product markings required by AWWA C-502, UL 246, and FM 1510 as applicable. The minimum markings on each hydrant shall include AWWA C502 mark, UL Listed mark, FM Approved mark, manufacturer's name or trademark, main valve size, and year of manufacture. The markings shall be distinctly cast raised or in relief on the outside hydrant and legible after hydrant installation.

14. Hydrants shall be manufactured within the North American Continent. An officer of the manufacturing company shall certify that all hydrants were manufactured in North America.

2.14 VALVES

A. Gate Valves

1. General

a. All valves 30-inch diameter and smaller shall be resilient seat type gate valves in accordance with AWWA C-509 or C-515. Alpha end connections are approved for gate valves sizes from 4-inch to 12-inch diameter. Gate valves shall be furnished with non-rising stems only, and stem seals shall be of the O-ring type only. Gate valves shall be furnished with two-inch square operating nuts, painted red, and shall open by turning to the right or clockwise. Valve ends shall normally be mechanical joint with necessary glands, gaskets and bolts furnished with the valve or approved equal. Flange ends shall be furnished for special installations as shown on the construction plans or standard details. Tapping flange by mechanical joint ends shall be furnished for tapping sleeve & valve installations.

b. Gate valves shall be of the resilient wedge seat type in accordance with AWWA C-509 or AWWA C-515 with a minimum working pressure of 250 PSI. The resilient wedge seat shall be ethylene propylene diene monomer (EPDM) rubber. Resilient seated gate valves shall be furnished with durable opaque end shields to prevent ultraviolet damage to the rubber discs.

c. The body and gate shall have guide surfaces to minimize wear of the gate seats during operation of the valve, to accurately position the gate throughout the travel distance to its seat, and to ensure the alignment of the gate and steam in all orientations without gate binding or galling. As a minimum, wedge guides and body guides shall be hard-faced and machined with appropriate tolerances and clearances to allow for proper valve operation in any orientation, including the effects of wear or galling.

d. Gate valves shall contain all product markings required by AWWA C-509, AWWA C-515, UL 262, and FM 1120/1130 as applicable. The minimum cast in markings on each C509 valve shall include the manufacturer's name or trademark, valve size, working pressure, and year of manufacture. The markings shall also include the UL Listed mark, FM Approved mark, when applicable. The markings shall be distinctly cast raised or in relief on the outside of the casting. C515 valves shall also include the letters "C515". C515 valve markings may be cast in as indicated above or may be stamped on a permanently affixed corrosion-resistant tag.

e. All hardware shall be 304 stainless steel. Operating stem shall be 304 stainless steel.

f. Valves 30-inch and larger shall have spur gear or bevel gear. All spur and bevel gears shall comply with AWWA C509 and AWWA C515.

g. Valve body shall consist of only two components: lower body and top bonnet. A three-component valve shall not be allowed. Valve body and bonnet shall be fully fusion bonded epoxy coated conforming to AWWA C550. Other exterior surfaces shall be epoxy coated or fusion bonded epoxy coated.

h. Bypass piping and valves shall not be required.

i. Valve waterways shall be full nominal diameter. Reduced waterway diameters shall not be allowed.

j. Number of turns to open a water valve shall be three times the valve diameter.

k. Valves shall be manufactured within the North American Continent. An officer of the manufacturing company shall certify that all valves were manufactured in North America.

l. Only valves which have been specifically approved by Charlotte Water may be furnished.

2. 2-inch Gate Valves: Gate valves smaller than three inches shall be iron bodied gate valves constructed with iron pipe thread (FNPT), screw ends, resilient wedge gates and non-rising stems, stem seals shall be of the O-ring type only and shall open by turning to the right or clockwise, shall be furnished with a 2" square operating nut, painted red, and shall have a minimum working pressure of 250 PSI. Materials for such gate valves shall be in accordance with the most recent edition of AWWA C-509 or AWWA C-515 with a minimum working pressure of 250 PSI.

3. 2-inch Through 12-inch Gate Valves: Gate valves 12-inch and smaller in diameter shall be direct bury gate valves and shall be furnished with Charlotte Water Standard valve boxes set in concrete pads as specified and shown on the Standard Details

4. 16-inch Through 30-inch Gate Valves, Vertical Mount: Gate valves 16-inch through 30-inch in diameter, with a vertically mounted orientation, shall be direct bury gate valves and shall be furnished with Charlotte Water standard frame and cover with a 20.5" clear opening as specified and shown on the Standard Details.

5. 16-inch Through 30-inch Gate Valves, Horizontal Mount: Gate valves 16-inch through 30-inch in diameter, with a horizontally mounted orientation, shall be installed in a horizontal line with the main valve shaft horizontal and the operating nut assembly inside a frame and cover assembly as specified and shown on the

Standard Details. A bevel gear operator with grease case shall be used so that the operator shaft and operating nut shall be aligned vertically to accept a valve key operated from the surface.

2" GATE VALVES		
Manufacturer	**C-515 Compact DI Body Valves (Thin Wall) Resilient Seat Valve**	**C-509 Full Body CI Valves (Thick Wall) Resilient Seat Valve**
Mueller (Mueller Water Products)	N/A	A-2362 RWGV
American Flow Control (ACIPCO)	2500 RW NRS Series	N/A
McWane Industries (Clow Valve Co.)	N/A	Clow 2639/2640
McWane Industries (Kennedy Valve)	Kennedy KS-RW 515	Kennedy KS FW 509
EJ (East Jordan Iron Works)	Flowmaster Series #2RW11 THD VLV OR	N/A

3", 4", 6", 8", 10", 12" GATE VALVES		
Manufacturer	**C-515 Compact DI Body Valves (Thin Wall) Resilient Seat Valve**	**C-509 Full Body CI Valves (Thick Wall) Resilient Seat Valve**
Mueller (Mueller Water Products)	A-2361 RWGV	A-2362 RWGV
American Flow Control (ACIPCO)	2500 RW NRS Series	N/A
McWane Industries (Clow Valve Co.)	2638	2639/2640
McWane Industries (Kennedy Valve)	KS-RW-515	KS-FW-509
EJ (East Jordan Iron Works)	Flowmaster Series #RW12	N/A

16", 18", 20", 24", 30" GATE VALVES		
Manufacturer	**C-515 Compact DI Body Valves (Thin Wall) Resilient Seat Valve**	**C-509 Full Body CI Valves (Thick Wall) Resilient Seat Valve**
Mueller (Mueller Water Products)	A-2361 RWGV	N/A
American Flow Control (ACIPCO)	2500 RW NRS Series	N/A
McWane Industries (Clow Valve Company)	2638	N/A
McWane Industries (Kennedy)	KS-RW	N/A
EJ (East Jordan Iron Works)	Flowmaster Series #RW12 (16" – 24")	N/A

B. Butterfly Valves: When required due to depth of cover restrictions, 16-inch through 30-inch direct bury butterfly valves with mechanical joint ends may be used, when approved by Charlotte Water. All valves on water mains 36-inch through 48-inch in diameter shall be butterfly valves with flanged ends conforming to all requirements of AWWA C-504. All valves on water mains 54-inch through 72-inch in diameter shall be butterfly valves with flange ends conforming to all the requirements of AWWA C-504. All valves on water mains 78-inch and larger in diameter shall be butterfly valves with flange ends conforming to all the requirements of AWWA C-516. Unless otherwise shown on the construction plans, all butterfly valves shall be Class 250B and installed in concrete vaults (for 36-inch and larger valves) per Charlotte Water Standard Details.

1. All hardware shall be series 300 Stainless Steel.
2. All valve bodies shall be gray iron or ductile iron. Valve discs shall be ductile iron.
3. Valve shafts shall be stainless steel.
4. Rubber seats shall be clamped or mechanically secured to the valve body or valve seat and shall be designed to allow removal and replacement without removing the valve.
5. Mating surfaces for the rubber seat shall be stainless steel bar stock. Spray on surface methods are not allowed.
6. Shaft seals shall be O-ring type.
7. Interior and exterior surfaces shall be epoxy coated with a minimum dry film thickness of 8 mils. The epoxy coating system shall be NSF 61 approved.

8. Valves shall be manufactured in North America.

9. All valves and actuators shall be designed for submerged applications.

10. All actuators shall have an indicator showing the valve position as “open” and “close”. All extension stems shall have a ground position indicators at the operating nut.

11. Manual actuators shall be a traveling nut design. Worm gear actuator designs may be considered on a case-by-case basis.

12. Valve markings shall be cast raised letters or provided on a stainless-steel plate. Cast letters shall be ½ inch. Etched or engraved letters shall be ¼ inch. Valve markings shall include manufacturer, valve size, pressure class, year of manufacturer and seating direction for seat removal and replacement.

13. Each butterfly valve shall be furnished with a manual operator equipped with a two-inch square operating nut with open direction arrow and “open” painted red. The operator shall open the valve when the operating nut is turned to the right or clockwise. The valve and operator shall be assembled for installation in a horizontal line with the main valve shaft horizontal and the operator shaft and operating nut assembly inside a vault as specified and shown on the Standard Details.

14. Butterfly valves shall be shop painted for buried service in accordance with AWWA C-504 or C-516.

15. Each valve shall be factory leak tested. Tests shall include the required valve body test and closed disc tests in both directions. Each test shall be a minimum of 10 minutes.

16. Prior to shipping butterfly valves, the manufacturer shall submit shop drawings showing the principal dimensions, general construction, and materials used for all parts of the valves and operators. The manufacturer shall include in the submittal the dates the valves are to be tested. The testing shall be scheduled to allow a representative of the Engineer to be present at the discretion of the Engineer. The valves shall be furnished in accordance with these drawings after they have been approved by the Engineer. The manufacturer shall submit written certification that the valves furnished comply with all applicable provisions of AWWA C-504 or C-516. Each valve shall be identifiable through a separate serial number attached to the valve.

17. Valves shall be stored indoors when possible. Outdoor storage is subject to approval. If approved to be stored outside, valves shall be protected from freezing conditions, accumulation of dirt, rocks and debris, and from sunlight UV exposure.

18. Butterfly valves shall be manufactured by:

    a. Clow – Style 1450

    b. Kennedy – Style 1450

    c. M&H Valve Company – Style 1450

    d. ValMatic – 2000 series

    e. or Pre-approved equal

C. Fire Line – Detector Check Valve: Four-inch through ten-inch detector check valves shall be rated for 175 PSI minimum working pressure and 350 PSI hydrostatic test pressure with flanged ends per ANSI B16.1, Class 125 or 150. The valve body may be carbon steel, stainless steel, cast iron, or ductile iron. Carbon steel body valves shall be internally, and externally fusion bonded epoxy coated, 8 mils minimum thickness per AWWA C550. Stainless steel bodies shall be 300 Series stainless. Cast/ductile iron body valves shall be internally, and externally fusion bonded epoxy coated, 8 mils minimum thickness per AWWA C550. Operating mechanism shall be by internal weight or linkage and spring and shall be all bronze or stainless steel. Valve shall have rubber faced clapper and bronze seat. Valves shall have two tapped bosses on each side to permit installation of a metered bypass. Valve shall be UL listed/FM approved. Name plate shall indicate: (1) manufacturer's name, model, (2) Size, (3) flow direction, (4) working pressure (PSI), (5) year of manufacture, and approval mark (UL, FM).

1. The following 4-inch through 10-inch fire line detector check valves are approved:

Manufacturer	Model
Ames Fire and Waterworks	1000 DCV
FEBCO	LF800
Watts Regulator	Series SS 07F
Zurn Wilkins	310

2. Bypass meter piping shall be 1-inch diameter, and the detector meter shall be a standard Charlotte Water 1-inch meter and yoke bar assembly. The one-inch detector meter shall include an angle single check valve in the meter box on the discharge side of the meter. The 1-inch angle single check valve (yoke star nut x FIP) shall be a Ford Model HA91-444-AWT-G-NL, Mueller H142 series, AY McDonald 702 series, or approved equal. A FIP X CTS adapter may be required.

3. Fire Line - Detector Check Valve: Two-inch fire line detector check valves may be used on automatic fire sprinkler systems where fire hydrants are not required. Two-inch detector check valves shall be rated for 175 PSI working pressure and 350 PSI hydrostatic test pressure. The valve ends shall be 2 bolt meter flanges. The valve body shall be cast bronze with a bronze cover. Operating mechanism shall consist of an internally spring-loaded check valve. Valve shall include a bronze replaceable bushing in the cover, a bronze replaceable seat ring, stainless steel spring and Delrin disc holder to insure positive check seating. Valve shall have two tapped bosses on each side of the check to permit installation of a metered bypass.

   a. Name plate shall indicate: (1) manufacturer's name, model, (2) Size, (3) flow direction, (4) working pressure (PSI), (5) year of manufacture.

   b. The following 2-inch fire line detector check valves are approved:

Manufacturer	Model
FEBCO	Series #406

c. Bypass meter piping shall be ¾-inch diameter, and the detector meter shall be a standard Charlotte Water 5/8-inch meter and yoke bar assembly. The 5/8-inch detector meter shall include an angle single check valve in the meter box on the discharge side of the meter. The 5/8 x 3/4-inch angle single check valve shall be a Ford Model HA91323, Mueller H142 series, AY McDonald 702 series, or approved equal.

2.15 WATER MAIN TAPS

A. Tapping Sleeves for Cast Iron Pipe, Ductile Iron Pipe, or PVC Pipe:

1. Tapping sleeves may be ductile iron, mechanical joint, or stainless-steel full gasket with wedge gasket around tap opening. All tapping sleeves shall be rated for a minimum of 200 PSI working pressure. Shop drawings shall be furnished that clearly indicate the minimum design working pressure and burst pressure. The maximum direct tap size shall be in accordance with AWWA C223.

2. Mechanical joint tapping sleeves shall be full body ductile iron furnished complete with joint accessories including split glands, split end gaskets, bolts, etc., and shall be compatible with the type and class of pipe being tapped. The outlet flange shall be Class 125 per ANSI B16.1 compatible with approved tapping valves. The sleeve shall include a brass or stainless-steel test plug for pressure testing the installed sleeve prior to making the tap. DI full body MJ tapping sleeves shall be used for all same size on size taps and may be used on all size taps.

3. Stainless steel tapping sleeves shall be manufactured from 18-8, type 304 stainless steel. The outlet flange may be ductile iron or stainless steel. The gasket shall be a grid pattern design and shall provide full circumferential sealing around the pipe to be tapped. The sleeve shall include a stainless steel or brass test plug for pressure testing the installed sleeve prior to making the tap. All welds shall be passivated. The outlet flange shall be Class D per AWWA C-207-ANSI 150 lb. drilling compatible with approved tapping valves. Rubber or EPDM flange gaskets are required. Paper flange gaskets are not allowed.

4. Bolts, nuts, washers, etc. shall be manufactured from 18-8, type 316 stainless steel. Threads shall be coated with an anti-seize compound.

5. The following table lists approved tapping sleeves:

DI Mechanical Joint	Stainless Steel
Mueller - H615	Ford Meter Box – FTSS & FTSAS
American Flow Control – Series 2800-C	Romac - SST III & STS420
Kennedy – 957 / 960	Smith Blair/Rockwell - 665
	JCM Industries - 432 & 452
	PowerSeal – 3490 AS - 3460 AS-HP
	Mueller #H-304SS

6. Flange Isolation Kit

a. Flange Isolation Kit: Full flange diameter, Type E, made of laminated phenolic with neoprene on each side of gasket with minimum total thickness of 1/8 inch.

1) Dielectric strength: Not less than 500 volts per mil.

2) Compressive strength: Not less than 24,000 psi.

3) Water absorption: Maximum 2.5%.

4) Approved manufacturers/suppliers:

a) Advance Products & Systems, Inc.

b) Central Plastics Company.

c) Pipeline Seal and Insulator, Inc. (PSI).

d) Or equal.

b. Isolation Flange Bolt Sleeves: High density polyethylene or spiral wrapped Mylar with dielectric strength not less than 1,200 volts per mil.

c. Isolation Flange Bolt Washers: High strength phenolic with minimum thickness of 1/8 inch, dielectric strength not less than 500 volts per mil, and compressive strength not less than 25,000 psi.

d. Steel Flange Bolt Washers for placement over insulating washers: Minimum thickness of 1/8 inch and cadmium plated.

e. One Piece Combination Sleeve and Washer, only when noted on Drawings.

1) One piece sleeve and washer of molded acetyl or nylon resin having minimum thickness of 1/8 inch.

a) Dielectric strength not less than 500 volts per mil.

b) Compressive strength not less than 15,000 psi.

B. Tapping Sleeves for HDPE Pipe:

1. Tapping sleeves to be of HDPE material with a minimum material designation code of PE4710 and installed with electrofusion conforming to ASTM F1055 and ASTM F1290. All tapping sleeves shall be rated for a minimum of 200 PSI working pressure. Shop drawings shall be furnished that clearly indicate the minimum design working pressure and burst pressure.

2. Tapping sleeves for HDPE pipe shall be as manufactured by Kinson, GF Piping Systems, or approved equal.

C. Mechanical Tapping Sleeves for HDPE Pipe:

1. Carbon Steel Tapping Sleeve:

a. Body and outlet nozzle shall be made of carbon steel, A36 or equal.

b. Bolts and nuts shall be 5/8” corrosion resistant, high strength alloy, oval neck track head bolt per ASTM A-242 / ANSI / AWWA C111 / A21.11 and heavy

hex nut per A563 Electro Coated, Powercron 590-534. Stainless steel 18-8 type 316 is also acceptable.

c. Flange shall be AWWA C207 Class D, ANSI 150 lb. drilling, recessed for tapping valve MSS-SP60

d. Gaskets shall be NBR, Bunna-N, or SBR per ASTM D2000 MBA 710.

e. Coating shall be fusion bonded epoxy coating, minimum 12 mils thickness per ANSI / AWWA C213, and NSF 61 certified.

2. Stainless Steel Tapping Sleeve:

a. Shell and lugs shall be type 304 stainless steel per ASTM A240.

b. Bolts shall be UNC rolled thread, type 304 stainless steel.

c. Nuts shall be heavy hex, type 304 stainless steel per ASTM A194.

d. Washers shall be plastic lubricated flat washers. Spring washers shall be special "spring" grade stainless steel.

e. Flange shall be ductile iron per ASTM 536, Grade 65-45-12; or type 304 stainless steel per ASTM A240. Flange shall accommodate tapping flanges per MSS SP-60.

f. Gaskets shall be SBR per ASTM D2000 MAA 610, compounded for water service.

3. The following table lists approved mechanical tapping sleeves for HDPE pipe:

Carbon Steel Mechanical	Stainless Steel
Romac – FTS423-H	Romac – SST-H
JCM - 422	

D. Tapping Sleeves for Pre-Stressed Concrete Cylinder Pipe:

1. Tapping sleeves to be ASTM A36 steel conforming to the requirements of AWWA C-301, AWWA C-304, AWWA C-223 and as modified below:

a. The tapping sleeve shall be designed for 200 PSI working pressure, 40% surge pressure, live and dead loads as required in the AWWA C-304.

b. Factory Testing - all materials used in the manufacture of the tapping sleeve shall be tested as outlined in the applicable ASTM standard for that material. Test reports shall be obtained by the manufacturer and held on file for inspection by the Engineer. The manufacturer shall furnish an affidavit that the materials used in making the tapping sleeves meet all provisions of the applicable ASTM standard and that the fittings meet all applicable provisions of AWWA C-301.

2. Shop drawings (materials and dimensions) shall be furnished that clearly indicate the minimum design working pressure and burst pressure.

3. The outlet flange shall be Class 125 per ANSI B16.1 compatible with approved tapping valves.

4. The sleeve shall include a brass or stainless-steel test plug for pressure testing the installed sleeve prior to making the tap.

5. Flanged Tapping Sleeves for PCCP:

a. Material:

1) Sleeve shall be designed for an operating pressure of 200 psi.

2) Saddle Plate to be ASTM A36 steel conforming to the requirements of AWWA C-301, AWWA C-304, and AWWA C-223. Entire sleeve shall be fusion bonded epoxy coated.

3) Straps shall be manufactured from ASTM A36 steel or equal.

4) Gasket shall have a broad, flat sealing surface and shall be manufactured of a material suitable for the intended conveyed fluid.

5) Flange to be connected to valve shall be manufactured in accordance with AWWA C207 Class D. Flanges larger than 12" diameter shall have an alignment recess suitable for accepting the alignment lip of the tapping valve.

6) Bolts, studs and nuts shall be type 304 stainless steel with anti-seize compound coating.

7) Approved Manufacturers or approved equal:

Manufacturer	Model Number
Ford Meter Box	FRCTSC, FRCTS2C
Romac Industries	FTS435
Smith-Blair	625
JCM Industries	JCM 415

b. The complete construction of the tapping sleeve and valve (including field assembly, installation, testing, tapping, etc.) shall be performed under the direct supervision and approval of a qualified field services technician working directly for and employed by a United States-based pre-stressed concrete cylinder pipe manufacturer. The technician shall witness and approve each step of the process. The technician shall have been trained in the construction and installation of like-sized or larger tapping sleeves and valves on pre-stressed concrete cylinder pipe. The manufacturer shall provide written proof of qualifications and a history of installations performed under the direction of the proposed technician. The field services technician proposed shall be reviewed by the Engineer as part of the shop drawing approval process.

E. Weld-on Tapping Sleeves for Steel Pipe

1. Tapping Sleeve Material

a. Tapping sleeve shall be high strength type made of a minimum material strength ASTM A36 or A516 GR 70 Steel or equal.

b. Sleeve shall be designed for a minimum operating pressure of 200 psi.

c. Outlet flange shall be AWWA C207 Class D, ANSI 150 lb. Drilling, recessed for approved tapping valve. Tapping Sleeves shall be ANSI/NSF Standard 61, Annex G and ANSI/AWWA 372 Certified.

d. Waterway shall be lined with fusion-bonded epoxy to a minimum thickness of l5 mils in accordance with AWWA C2l3. All other steel shall be coated with a shop coat primer coating. Coatings shall be free of laminations and blister; not peel; and remain pliant and resistant to impact.

e. Tapping Sleeves: Provide with 3/4-inch NPT test opening for testing prior to tapping. Provide 3/4-inch bronze or stainless-steel plug for opening.

f. Steel sleeves shall be shipped in wooden crates that provide protection from damage to epoxy coating during transport and storage.

g. Approved Manufacturers or Approved Equal:

Manufacturer	Model Number
Smith Blair	#626 type 2 or type 3
Power Seal	#3428
Ford Meter Box	FWS
JCM Industries	#416 & #417
ROMAC	FTS 445 Series

2. Flange Isolation Kit

a. Flange Isolation Gasket: Full flange diameter, Type E, made of laminated phenolic with neoprene on each side of gasket with minimum total thickness of 1/8 inch.

1) Dielectric strength: Not less than 500 volts per mil.

2) Compressive strength: Not less than 24,000 psi.

3) Water absorption: Maximum 2.5%.

4) Approved manufacturers/suppliers:

a) Advance Products & Systems, Inc.

b) Central Plastics Company.

c) Pipeline Seal and Insulator, Inc. (PSI).

d) Or equal.

b. Isolation Flange Bolt Sleeves: High density polyethylene or spiral wrapped Mylar with dielectric strength not less than 1,200 volts per mil.

c. Isolation Flange Bolt Washers: High strength phenolic with minimum thickness of 1/8 inch, dielectric strength not less than 500 volts per mil, and compressive strength not less than 25,000 psi.

d. Steel Flange Bolt Washers for placement over insulating washers: Minimum thickness of 1/8 inch and cadmium plated.

e. One Piece Combination Sleeve and Washer, only when noted on Drawings.

1) One piece sleeve and washer of molded acetyl or nylon resin having minimum thickness of 1/8 inch.

a) Dielectric strength not less than 500 volts per mil.

b) Compressive strength not less than 15,000 psi.

F. Service Saddles for PVC Pipe: All corporation stops for services or air releases shall be installed with service saddles having threads to accept standard AWWA Corporation valve inlet AWWA CC – Taper Thread. Service saddles shall comply with the following:

1. The service saddle shall be rated at a minimum of 200 PSI working pressure.
2. Service Saddles for 2-inch PVC shall be all brass.
3. Service saddles for 3-inch and larger pipe may be brass, ductile iron or stainless steel.
4. Unless otherwise approved, all service saddles shall be double bolt/double strap/band style.
5. Ductile iron bodies shall be fusion bonded epoxy coated.
6. Bolts, nuts, straps/bands shall be type 304 stainless steel.
7. Straps/bands shall be pre-formed at the factory to the specified outside diameters of and designed specifically for use on PVC pipe.
8. The following manufacturers and models are approved:

a. All Brass Service Saddles:

Manufacturer	On 2" Pipe	On 6" Pipe	On 8" Pipe	On 12" Pipe
Ford	S70	S90 / S902	S90 / S902	S90 / S902
Mueller	S-13420	H-13441	H-13442	H-13444
A.Y. McDonald	3895	N/A	N/A	N/A
Power Seal	3401	3403	3403	3403
Cambridge Brass	800-0238	800-0690	800-0905	800-1320

b. Brass Service Saddles with Stainless Steel Double Straps:

Manufacturer	On 2" Pipe	On 6" Pipe	On 8" Pipe	On 12" Pipe
Ford	N/A	202BSD	202BSD	202BSD
Mueller	N/A	BR2S	BR2S	BR2S
A.Y. McDonald	N/A	3855	3855	3855
Power Seal	N/A	3409	3409	3409
Cambridge Brass	N/A	812-0750	812-0962	812-1438

G. Service Saddles for Ductile Iron Pipe: All corporation stops for services or air releases shall be installed with service saddles having threads to accept standard AWWA Corporation valve inlet AWWA CC – Taper Thread. Service saddles shall comply with the following:

1. Ductile Iron Service Saddles (Epoxy Coated with SS Straps):

Manufacturer	Stainless Steel Double Strap
Ford	FC202 & FCD202
Mueller	DR2S
Smith Blair/Rockwell	317 & 397
JCM Industries	406
Romac	202NS
PowerSeal	3417 DI or 3417 DI SW
A Y McDonald	4845A

2. Stainless Steel Service Saddles:

Manufacturer	Saddle No.
Ford	FS323
Power Seal	3417 AS, 3417 AS SW

H. Service Saddles for use on existing HDPE Pipe: Service saddles for use on new and existing HDPE pipe shall be electrofusion saddles. See HDPE specifications and standard details for additional requirements of HDPE saddles. If approved on a case-by-case by Charlotte Water, mechanical saddles may be used on existing HDPE pipe as specified below in lieu of HDPE fused saddles. All corporation stops for services or air releases shall be installed with service saddles having threads to accept standard AWWA Corporation valve inlet CC – Taper Thread. Service saddles for HDPE Pipe shall be ductile iron or stainless steel, manufactured with fusion applied epoxy coating to provide protection against corrosion. Service saddles shall have two stainless steel straps preformed at the factory to the specified outside diameters of and designed specifically for use on HDPE Pipe.

1. Service saddles for 2-inch PVC shall be brass.
2. Service saddles for 3-inch and larger pipe may be brass, ductile iron or stainless steel.
3. Unless otherwise approved, all service saddles shall be double bolt/double strap/band style.

4. Ductile iron bodies shall be fusion bonded epoxy coated.

5. Bolts, nuts, straps/bands shall be series 300 stainless steel.

6. Straps/bands shall be pre-formed at the factory to the specified outside diameters of and designed specifically for use on IPS HDPE pipe.

7. The following manufacturers and models are approved:

   a. Epoxy Coated Ductile Iron Service Saddles with Stainless Steel Straps:

Manufacturer	Stainless Steel Double Strap
Ford	FC202
JCM Industries	406
Romac	202 N - H
PowerSeal	3422 AS

I. Adapters for Tapping to the Water Mains:

1. HDPE Adapters

   a. 2-inch valves connecting to HDPE water mains shall connect with a stainless steel or brass MIPT x CTS compression adaptor.

J. Slip-joint DI bell adaptors for PVC: A FBE lined and coated ductile iron MNPT x slip joint bell adaptor shall be installed at threaded 2-inch valves and fittings and bends. Approved manufacturers shall be Harco or approved equal.

K. Corporation Stops: Corporation stops shall be ball valve corporations and shall comply with AWWA C-800 and shall be high pressure rated at 300 PSI working pressure in accordance with Section 3.3 of the standard. Inlet threads shall be standard AWWA Corporation valve inlet thread (CC or Taper Thread). Outlet threads shall be in accordance with to the indicated connection. The valve port diameter shall be the full-service size. Reduced port sizes are prohibited. All corporations installed on C-900 PVC pipe, HDPE pipe, and DIP shall require a tapping saddle/service clamp as hereinafter specified. Taps on HDPE pipe requires electrofused HDPE tapping saddle connections unless mechanical tapping saddles are specifically approved on a case-by-case basis by Charlotte Water. See the service saddle specification above for additional information. Direct taps without a tapping saddle are prohibited.

1. The following manufacturers and models are currently approved:

   a. Services:

Manufacturer	3/4 " Services	1 " Services	1 ½ " Services	2 " Services
	Ball Type			
	CC x Compression	CC x Compression	CC x Compression	CC x Compression
Ford – Grip Joint Compression	FB1000-03-TA-G-NL	FB1000-04-TA-G-NL	FB1000-06-TA-G-NL	FB1000-07-TA-G-NL
AY McDonald – CTS Compression	74101BCAPT-NL	74101BCAPT-NL	74101BCAPT-NL	74101BCAPT-NL
Mueller – Grip Compression Connection	B25008N	B25008N	B25008N	B25008N
Cambridge Brass – Grip Joint Compression	311NL	311NL	311NL	311NL

b. Air Release:

Manufacturer	2" Air Release
	CC x Female Iron Pipe
Ford	FB1600-07-NL
AY McDonald	73148B-NL
Mueller	B20045N
Cambridge	301NL-A7F7

2.16 REPAIR/TIE-IN SLEEVES/CLAMPS

A. Long Pattern Solid Sleeves (2-inch through 64-inch): Solid cast ductile iron mechanical joint sleeves (long pattern) shall be used where required for tie-ins between new mains and existing mains and when replacing defective sections of pipe with new pipe. Special gasket sizing (oversize or undersize) may be required to conform to existing pipe outside diameters.

Approved Manufacturers: Tyler/Union, Star Pipe Products, Sigma Corp, SIP Industries, U.S. Pipe

B. Steel Couplings: Long Pattern steel sleeves may be used when necessary to conform to non-standard existing pipe outside diameters. Special gasket sizing (oversize or undersize) may be required to conform to existing pipe outside diameters. Steel sleeves may only be used when long pattern solid sleeves will not accept the odd pipe diameter and have been specifically approved by the Engineer. Steel sleeves shall be designed for a minimum of 200 PSI working pressure and shall be stainless steel or coated with a minimum of 12 mils of fusion bonded epoxy. Follower rings shall be ductile iron. Bolts, nuts, washers, etc. shall be manufactured from 18-8, type 316 stainless steel. Threads shall be coated with an anti-seize compound.

1. The following steel couplings are approved:

Manufacturer	24-inch and Smaller Epoxy Coated Steel Couplings
Smith Blair	411
JCM	202
Romac Industries	400

2. Shop drawings shall be required from the manufacturer for 16-inch and larger steel couplings. Couplings shall meet the minimum requirements as indicated above, and shall be manufactured by Smith Blair, JMC, Romac, or approved equal.

C. Ductile Iron Restrained Joint Couplings: Long pattern ductile iron restrained joint couplings may be used when necessary to conform to non-standard existing pipe outside diameters. Gasket sizing shall be as required to conform to the existing pipe outside diameters. Ductile iron couplings may only be used when long pattern solid sleeves will not accept the OD size pipe diameter. Ductile iron couplings shall be designed for a minimum of 350 PSI working pressure and shall be fusion bonded epoxy coated inside and out with a minimum thickness of 12 mils. Bolts, nuts, washers, etc. shall be type 304 or 316 stainless steel. Threads shall be coated with an anti-seize compound.

1. The following Ductile Iron restrained joint couplings are approved in sizes 1.5-inch through 16-inch diameters:

   a. Romac Industries – Standard Alpha Coupling, Alpha XL, and Alpha Transition Coupling for 4-inch though 16-inch sizes.

2. Shop drawings shall be required from the manufacturer for 16-inch and larger ductile iron couplings.

Repair clamps or split sleeves shall not be allowed on new construction. These may be used to repair existing mains (not installed as part of new construction projects) if specifically approved by the Engineer or Owner's representative.

2.17 FERROUS CASTINGS

A. Valve Boxes:

1. All valve boxes shall conform to the dimensions shown on the Standard Details. Valve boxes shall be of cast iron conforming to ASTM A-48, Class 35B and shall be manufactured in domestic foundries or may be import product manufactured at approved foundries such as Star Pipe, SIP Industries, Sigma Corporation or approved equal.

2. Adjustment riser sections placed between the top section of the valve box and the cover are PROHIBITED on proposed construction. They may be used on resurfacing projects if designed specifically for use in the Charlotte Water standard valve box as detailed in the Charlotte Water Standard Detail and are approved by Charlotte Department of Transportation and/or NCDOT and Charlotte Water. Adjustment riser sections shall be submitted for approval by the Charlotte Water Engineer.

3. Valve boxes shall use a plastic valve centering disk to keep the valve box aligned during back filling.

a. Disks shall be Plastic Posi-Cap Valve Box Aligner Disk manufactured by Pollardwater or approved equal.

B. Manhole Frames and Covers:

1. All manhole frames and covers shall conform to the dimensions shown on the Standard Details. Manhole frames and covers shall be of cast iron conforming to ASTM-A-48, Class 35B and shall be manufactured in domestic foundries only. Frames and covers shall meet the minimum requirements established by and be approved for use in NCDOT rights-of-way. All covers shall have two non-penetrating lift holes, and two non-penetrating lifting bars, sized and shaped to facilitate the cover removal from the frame by use of a standard manhole hook and/or railroad pick. The manufacturer's name and model number shall be cast into the surface of the cover and into the frame. Frame and covers with a 21-, 24-, or 30-inch clear opening, conforming to the standard details, and shall have the following cast into the surface of the cover: "WARNING: DO NOT ENTER".

2. The following manufacturers and models are currently approved:

a. US Foundry

b. EJ Corp

c. Or, approved equal

3. Adjustment riser sections placed between the frame and the cover are PROHIBITED on proposed construction. They may be used on resurfacing projects if designed specifically for use in the Charlotte Water frame and cover and are approved by Charlotte Department of Transportation and/or NC Department of Transportation and Charlotte Water. Adjustment riser sections shall be submitted for approval by the Engineer.

2.18 MISCELLANEOUS STEEL

A. Steel Reinforcing for Concrete:

1. Bars: All reinforcement bars shall conform to the Standard Specifications for billet-steel bars for concrete reinforcement , ASTM A-615, or low alloy steel deformed and plain bars for concrete reinforcement, ASTM A-706. All bars shall be deformed and of structural Grade 60.

2. Wire: All reinforcement wire fabric shall conform to the Standard Specifications for welded steel wire fabric for concrete reinforcement, ASTM A-185 and steel wire, plain, for concrete reinforcement, ASTM A-82. Minimum yield strength shall be 65,000 psi and minimum tensile strength shall be 75,000 psi.

B. Stainless Steel Tie Rods: Tie rods used for thrust restraint of mechanical joints shall be fabricated from stainless steel type 304 or 316 conforming to the specifications of ASTM A193. Tie rods shall be threaded through the bolt holes in the flange and secured by nuts attached to the rod using spacers. The number and diameter of tie rods to be installed is dependent on the pipe diameter, flange size and maximum pipe pressure as shown below.

Pipe Diameter (inches)	Maximum Pressure (psi)		Tie-Rod Diameter Size (inches)
	200	275	
	Required Tie-Rod Quantity		
3	2	2	5/8
4	2	2	5/8
6	2	2	5/8
8	3	3	5/8
10	3	3	3/4
12	3	3	7/8
16	3	4	1
24	6	9	1
30	6	9	1 1/4
36	9	12	1 1/4
42	12	16	1 1/4
48	11	15	1 1/2
54	14	18	1 1/2
60	17	23	1 1/2
66	15	20	1 3/4
72	18	24	1 3/4

2.19 CONCRETE

A. Portland Cement: All concrete shall conform to the Standard Specifications for READY MIXED CONCRETE, ASTM C-94. An air-entraining admixture, conforming to ASTM C-260, shall be added to either Type II, or Type III Portland Cement. Fly Ash conforming to ASTM C-618 for Class F Fly Ash may be added to the concrete mix but shall not be considered as replacement for more than 25% of the cement therein (strengths shall not be less than hereinafter required). Type IL Portland-limestone cement meeting ASTM C-595, shall be allowed in lieu of Type II Portland-cement.

1. Types III and IIIA Portland Cement shall only be used for manhole inverts, concrete encasement, concrete blocking, and/or as directed by the Engineer and shall conform to ASTM C-150.

2. Types II and IIA Portland Cement shall be used in precast vaults, cast in place manhole structures, reinforced concrete pipe and reinforced concrete piers as directed by the Engineer, and shall conform to ASTM C-150 except that Tricalcium Aluminate content shall not exceed 8%. Portland-limestone cement Type IL(MS), conforming to ASTM C-595, shall be allowed in lieu of Types II and IIA.

B. Aggregates: All aggregates used for concreting shall conform to ASTM C-33 and shall be checked daily for any variances in moisture content. Said variances shall be corrected and/or taken into consideration for each batch.

1. Coarse Aggregates: Shall be uniformly and evenly graded for each application in accordance with A.C.I. Standard 318. Unless otherwise approved, aggregate shall be sound, crushed, angular granitic stone. Flat or elongated aggregate or smooth round stones shall not be acceptable.

2. Fine Aggregates: Shall consist of natural sand, manufactured sand or a combination thereof. Fine aggregates shall conform to the sieve analysis as specified in paragraph 4.1 of the ASTM C33 except that the percent passing a No. 50 sieve shall not exceed 5% and the percent passing a No. 100 sieve shall be 0% as provided for in paragraph 4.2 of the ASTM C33.

C. Mix Design: Concrete shall be watertight, resistant to freeze-thaw cycles and moderate sulfate attack, abrasion resistant, workable, and/or finishable. These qualities may be met through the use of admixtures (if and only if approved in the mix design as hereinafter specified) conforming to the appropriate ASTM with the exception of the use of calcium chloride, which shall be limited to no more than 1% by cement weight - thoroughly mixed to insure uniform distribution within the mix. If the concrete is used with reinforcing steel, no calcium chloride shall be allowed. The Contractor shall assume responsibility for concrete mixture. When required by the Engineer, and prior to beginning construction, the Contractor, at their expense, shall obtain from an approved commercial certified testing laboratory a design for a suitable concrete mix and submit same with their list of materials and material suppliers for approval. The concrete shall be proportioned to meet the following requirements: (Note: This mix does not apply "in total" to precast manhole or reinforced concrete pipe).

1. Compressive Strength: Minimum 3,600 psi
2. Water-Cement Ratio By Weight: Maximum 0.50
3. Slump: Minimum 3”, Maximum 5”
4. Superplasticizer Slump: 6” – 8”
5. Air Content (Entrained and Entrapped): Minimum 4%, Maximum 6%
6. Coarse Aggregate: ¾” - 1 ½” (as required by the application)

D. Curing Compound: All concrete curing compounds shall conform to the standard specifications for LIQUID MEMBRANE - FORMING COMPOUNDS FOR CURING CONCRETE, ASTM C-309, Type 2. Curing compounds shall be applied if forms are stripped when concrete is to remain exposed to the atmosphere.

E. Grouts: All grouts shall be of a non-shrink nature (as may be achieved through additives or proportioning) and depending upon application range from plastic to flowable cement water paste. Testing as specified above for concrete may be required for acceptance of grouts to include frequent checks for consistency by a time- of-flow measurement. Expansion grouts shall be either MasterFlow 648 epoxy grout by BASF, or 1428HP Grout by W.R. Meadows, or approved equal. Grouts shall be mixed (if applicable) and placed in accordance with the manufacturer's current recommendations, for each specific application. Expansion grouts shall be used only as directed by the Engineer. Acceptable range of testing requirements:

1. Compressive Strength: 10,500 psi to 12,500 psi.
2. Bond Strength: 1,350 psi to 1,700 psi.
3. Percent Expansion: + 0.025% to + 0.75%

F. Mortar: Mortar used in water meter vaults and water valve vaults shall be Type M mortar in accordance with ASTM C-270.

G. Flowable/Excavatable Fill (CLSM): Contractor shall furnish and place flowable fill i.e. controlled low strength material (CLSM) backfill where shown in the drawings.

1. Cement: All cement used shall be Type II Portland cement which shall conform to the requirements of ASTM C150.

2. Fly Ash: ASTM C618, Class F.

3. Aggregates: Fine aggregate shall conform to the grading and quality requirements of ASTM C33. Coarse aggregate shall conform to the grading and quality requirements of ASTM C33 for size No. 476, No. 57, or No. 67.

4. Water: The batch mixing water and mixer washout water shall conform to the requirements of ASTM C94.

5. Flowable Fill Properties

a. CLSM shall have a maximum fifty-six (56) day compressive strength of one hundred (100) psi when molded and cured as in conformance with ASTM D4832.

b. CLSM shall have a minimum cement content of fifty (50) pounds per cubic yard. The water-cementitious materials ratio of the mix shall not exceed 3.5:1.

c. CLSM shall be air entrained to a total air content of approximately 5%.

d. The minimum slump shall be 6-inches and the maximum slump shall be 8-inches when tested in accordance with ASTM D6103.

e. Fine aggregate shall be between 50% and 60% by volume of the total aggregates in the CLSM mix.

f. The consistency of the CLSM slurry shall be such that the material flows easily into all openings between the pipe and the lower portion of the trench. When trenches are on a steep slope, a stiffer mix of slurry may be required to prevent CLSM from flowing down the trench. When a stiffer mix is used, vibration shall be performed to ensure that the CLSM slurry completely fills all spaces between the pipe and the lower portion of the trench.

H. Lightweight Cellular Concrete Fill – For Use In Annular Spaces Inside Casing Pipe and Tunnel Pipes. See Chapter 21 “Tunneling and Encasement” of the Charlotte Water Standards.

I. Meter Vaults

1. Concrete meter vaults shall conform to the minimum requirements as indicated in the Standard Details. Vaults shall meet the minimum requirements established by and be approved for use in NCDOT road rights-of way as a minimum and as modified herein.

2. Structures shall be designed for a minimum of H/20/HS20 load rating and or a minimum of 3 feet of cover or the actual cover, whichever requires the stronger design.

3. Concrete shall be a minimum of 4000 psi compressive strength at 28 days. Cylinder test results shall be provided to Charlotte Water.

4. Design shall conform to ASTM C858 – Specifications for Underground Precast Concrete Utility Structures.
5. Steel reinforcement design shall conform to ASTM C857.
6. Rebars shall be grade 60 per ASTM A185.
7. Diagonal reinforcing shall be added at all openings.
8. Pipe penetrations shall be sealed with flexible connectors – Rubber manhole boots, or with 8-inches of brick and mortar, including ½ inch thick construction expansion material around the outside diameter of the pipe.
9. All joints shall be made watertight with two (2) rings of butyl rubber joint mastic.
10. All joints shall include a 6-inch-wide external joint wrap made of butyl rubber mastic joint wrap.
11. Manufacturing shall be scheduled with Charlotte Water who reserves the right to inspect all reinforcement placement prior to pouring concrete.
12. All steps shall pass a 1000-pound pullout test. Test results shall be provided to Charlotte Water.
13. All test equipment shall be calibrated at intervals not greater than one year. Calibration reports shall be provided to Charlotte Water.
14. Shop Drawings and Structural Design Calculations sealed by a North Carolina PE shall be submitted for review by Charlotte Water for each size and/or depth of structures.
15. The following precast concrete manufacturers are approved to supply vault products for inclusion into the Charlotte Water system.

MANUFACTURER	VAULTS APPROVED
Tindall Corp.	**Approved for all meter vault sizes**
CP&P Concord (Formerly Precast Supply)	**Approved for all meter vault sizes**
CP&P Denver (Formerly Dellinger)	**Approved for all meter vault sizes**
Howard Precast	**Approved for all meter vault sizes**
Wellington Hamrick Precast	**Approved for 2'x3' vault only for 1.5" and 2" meters**

2.20 BEDDING MATERIALS - STONE AND BRICK/BLOCK

A. Granular Bedding Material: All bedding material shall be angular, clean washed crushed stone graded in accordance with Size #57, Size #67, or Size #78M in ASTM D-448 for "Standard Sizes of Coarse Aggregate" (NCDOT Standard size #57, #67 and #78). Bedding material shall be used only as instructed in the Specifications and/or as specifically directed by the Engineer.

B. Stone Stabilization Material: All stone stabilization material shall be angular, clean washed crushed stone graded in accordance with standard sizes #467 in ASTM D- 448, (NCDOT Standard size #467M). Stabilization material shall be used only as instructed in the specifications and/or as specifically directed by the Engineer. In conditions unsuitable for use of #467 stone, larger material conforming to NCDOT Class A, B, 1,

and 2 stone and ASTM D-448 standard size #357 stone may be used as directed by the Engineer and shall meet the following class and size distribution.

Required Stone Sizes, Inches			
Class	Minimum	Midrange	Maximum
A	2	4	6
B	5	8	12
1	5	10	17
2	9	14	23

No more than 5% of the material furnished can be less than the minimum size specified nor no more than 10% of the material can exceed the maximum size specified.

Weight Percent Passing Each Sieve				
Size No.	Nominal Size Square Openings	2 ½ Inches	2 Inches	1 Inch
#357	2 inches to No. 4	100	95 to 100	35 to 70

C. Foundation Material: Foundation materials shall consist of field stone or rough unhewn quarry stone. The stone shall be sound, tough, dense, resistant to the action of air and water, and suitable in all other respects for the purpose intended. All stone shall meet the approval of the Engineer. While no specific gradation is required, there shall be equal distribution of the various sixes of the stone within the require size range. The size of an individual stone shall be determined by measuring its long dimension. No more than 5% of the material can be less than the minimum size specified and no more than 10% can exceed the maximum size specified. Foundation material shall be used only as instructed in the specifications and/or as specifically directed by the Engineer.

D. Concrete Brick/Block: All concrete brick/block used to make vertical manhole and vault height adjustments shall be solid, of standard building size and meet the requirements of ASTM C55 for Grade S-II. Concrete brick shall conform to NCDOT requirements and shall be red tinted per NCDOT requirements. Concrete brick/block may be used in vertical manhole and vault height adjustments, as shown on the standard details, or when approved by the Engineer.

2.21 CLAY ANTI-SEEP COLLARS

A. Compacted clay for anti-seep collars shall have a specific discharge of 1 X 10–5 cm/sec or less. The clay source material shall be laboratory tested/verified prior to approval by the Engineer. Testing shall be performed by a materials testing laboratory and certified by a geotechnical Professional Engineer or Professional Geologist. Placement of clay anti-seep collars shall as be shown on the construction plans and/or where directed by the Engineer. The clay anti-seep collars shall conform to the Standard Detail. Clay shall be compacted to a minimum of 98% of maximum dry density. Compaction test results shall be required on each anti-seep collar.

PART 3 - EXECUTION

3.1 CONSTRUCTION LAYOUT

A. Construction Staking: Contractor is responsible for staking water main alignments, water main appurtenance structures, easements, rights-of-way, limits of disturbance, tree protection fence line, wetland boundaries, buffers, Project Control Points and other horizontal control reference points and benchmarks for the work shown on the Drawings. Charlotte Water (or the design engineer) shall provide a drawing and/or staking plan files in electronic format to Contractor. Contractor shall confirm all drawing dimensions and elevations and establish elevations, lines, and levels from reference points, utilizing recognized engineering survey practices. During construction, Contractor shall provide competent helpers for checking elevations, lines, and levels deemed necessary by Charlotte Water. Contractor to establish horizontal and vertical control benchmarks and reference points on the site located in prominent and protected places as agreed upon by Contractor and Charlotte Water. All construction staking and survey work shall be performed by a North Carolina Professional Licensed Surveyor (NCPLS). The NCPLS shall be employed by the design engineer or a third-party survey company.

1. Prior to construction, the Contractor shall provide the following construction layout for each pipeline project:
    a. Centerline of proposed water main, water main appurtenance structures shall be established and offset referenced.
    b. Begin and end point of proposed mainline dry bore with steel encasement or tunnel shall be established and offset referenced centerline.
2. Permanent or temporary benchmarks shall be established at or near:
    a. Connection to existing water mains,
    b. Proposed end of water mains,
    c. Approximate 1000-foot station,
    d. Proposed water appurtenance structures
    e. Proposed piers
    f. Mainline bore with encasement or tunnel
3. The Contractor is responsible for protecting these control points until construction is complete. All other construction layout and surveying, which may be required for construction, shall be provided by the Contractor. The Contractor is responsible

for determining the amount of additional construction layout and surveying that may be required to complete construction.

4. On developer donated projects, refer to the donated project general conditions for requirements.

3.2 CONNECTION TO EXISTING MAINS

A. Connections to the existing system shall be pre-scheduled with and made in the presence of Charlotte Water Inspection personnel. Valves, hydrants, blow offs, etc. shall be operated by Charlotte Water personnel and/or the Contractor if specifically directed by Charlotte Water to do so in the presence of Charlotte Water Inspection personnel. The Contractor shall provide all labor, materials, and equipment required for connection to the existing system. Only one (1) connection between the existing system and the new extension shall be allowed until testing, chlorination, and successful sampling of the new extension is complete. The one connection shall include a jumper assembly and backflow assembly. The backflow assembly shall be tested and certified by a Charlotte Water approved third party backflow tester. No water shall pass through the jumper assembly until the backflow assembly has been certified. Provide a copy of the backflow certification to Charlotte Water prior to filling the new water main.

B. If connection to existing mains will necessitate an interruption of service, the Contractor shall schedule the connection for a time that is most convenient to the affected customers as determined by the Engineer. A minimum of seven (7) days' notice shall be provided to those customers who will be put out of service by the connection. For commercial customers, a minimum of thirty (30) days' notice shall be provided if an agreed upon shut down date cannot be agreed to by all impacted customers. When such interruption of service is approved, the Contractor shall have all required labor, material and equipment at the site before beginning any work and the service interruption shall be kept to an absolute minimum.

C. The Contractor shall verify blocking at existing valves prior to scheduling connections and shall be required to block, rod, or restrain existing and new pipe, fittings and valves as necessary.

D. Connections

1. Direct connections to the existing water system, of any size or type, shall not be allowed until:

   a. chlorination is complete.

   b. the new water main has passed all lab tests; and,

   c. the new water main has been approved for connections and activation by the Engineer.

2. Only one temporary jumper connection to the existing water system, of any size or type, shall be allowed until after chlorination is complete and the new water main has passed all lab tests and has been approved for connections and activation by the Engineer. The temporary jumper connection, for the purpose of filling, flushing, testing, disinfection and sampling shall be installed at an approved location and shall be sized to provide a minimum flushing velocity of 3.0 feet per second in all new main diameters.

3. The temporary jumper connection shall include a Reduced Pressure (RP) Principle Backflow Preventer as indicated on the Standard Details and as specified below. Chlorination of the new water main shall be performed through a tap on the new main side of the RP Backflow Preventer after the backflow device has been tested and certified by a certified tester. Temporary jumper connections shall also be required where the only connection to existing water system is with a tapping sleeve (or saddle) and valve (or corporation). At these locations, the tap shall be completed, and (1) on short side extensions, the jumper shall be installed approximately 18-feet from the tapping sleeve and valve; and (2) on long side extensions, the jumper shall be installed after crossing the road. At the time of pipe installation, the contractor shall pressure test the new pipe segment. Then the Contractor shall wash the inside of the new pipe, from the tapping sleeve and valve to the jumper, with 50 PPM free chlorine with 3 hours exposure, or 200 PPM with 30 minutes of exposure. The main shall be immediately flushed and samples pulled by Charlotte Water Lab Services. Only after the new main has passed all lab tests and has been approved for activation, the jumper can be removed, and a long pattern solid sleeve connection shall be completed.

E. Reduced Pressure (RP) Principle Backflow Preventer

1. The RP backflow preventer and jumper piping shall conform with the following size requirements and shall be sized to provide minimum flushing velocity of 3.0 feet per second in all new main pipe diameters:

   a. Proposed water mains shall require a minimum 2-inch PR backflow preventer.

2. The RP backflow preventer shall be as indicated in the following table, or as approved by the Engineer, and shall be included on the “APPROVED” list of RP backflow preventers as maintained by the Backflow Prevention Division of Charlotte Water:

Manufacturer	2-inch Diameter	4-inch Diameter	6-inch Diameter	8-inch Diameter	10-inch Diameter
Conbraco	RPLF40, 40A, 4A	PLF4A, RPLF4AN	PLF4A, RPLF4AN	PLF4A, RPLF4AN	-
Febco	LF825Y, YA, LF860, 860U	760, LF860, LF880V	760, LF860, LF880V	760, LF860, LF880V	760, LF860
Watts	LF909 M1QT, LF009 M2QT, LF919QT, LF919AQT, LFU919QT, LFU919AQT	957, 957N, 957Z, 994, LF909	957, 957N, 957Z, 994, LF909	957, 957N, 957Z, LF909M1	957, LF909M1
Wilkins	375XL, 375XLB, 975XL2, 975XL2MS, 975XL2BMS,975XL2SE, 375AR, 375AST, 375MS	375, 375A, 375AR, 375AST, 375MS, 475, 475MS, 475V, 475VMS, 475ST, 375ASTR	375, 375A, 375AR, 375AST, 375MS, 475, 475MS, 475V, 475VMS, 475ST, 375ASTR	375, 375A, 375AR, 375AST, 375MS, 475, 475MS, 475V, 475VMS, 475ST	375, 375A, 375AR, 375AST, 375MS, 475, 475MS, 475V, 475VMS, 475ST

3. A List of Companies with Approved Certified Testers is maintained by and available from the Backflow Prevention Division on Charlotte Water's web site. A Certified Tester shall test the RP backflow preventer after each installation and prior to each use, in accordance with the requirements of the Backflow Prevention Division. If an RP jumper assembly is set-up at a location, and removed and re-installed at the same location, the RP backflow preventer shall be re-tested upon re-installation. Unless otherwise approved by the Engineer, the project Inspector shall witness the test(s). Whether witnessed or not, the Contractor shall provide the Engineer with a copy of the Certified Tester's Test Reports. The Test Reports shall be in a format that is approved by the Backflow Prevention Division of Charlotte Water.

4. All RP jumper assembly piping and fittings shall be flanged, threaded, restrained or quick connect joints. The Contractor shall install adequate thrust restraint on the proposed main at the jumper location to resist all thrust caused by the filling and flushing procedures. The Contractor shall verify and improve the thrust restraint on the existing main at the jumper location as needed to resist thrust caused by existing pressures and surges, and by the filling and flushing procedures.

5. Adequate traffic control devices shall be in place prior to installation of the RP backflow preventer. Traffic control devices shall be properly maintained throughout the use of the RP backflow preventer. Placement of the RP backflow preventer may be restricted by the requirements of restricted work hour requirements of the NCDOT encroachment and/or CDOT thoroughfare requirements.

6. The RP backflow preventer shall not remain in the road right-of-way during non-work hours unless specifically addressed by the NCDOT or CDOT encroachment agreement, and/or approved by the controlling agency and Charlotte Water.

7. On non NCDOT maintained road rights-of-way, the location and work hour restrictions associated with the RP jumper shall be subject to approval of the controlling agency and Charlotte Water.

3.3 PIPING INSTALLATION GENERAL

A. General Locations and Arrangements: Drawing plans and details to indicate general location and arrangement of underground water piping. Location and arrangement of piping layout consider design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

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

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

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

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

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

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

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

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

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

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

8. Stone Stabilization: When the bottom of the trench is not sufficiently stable to prevent vertical or lateral displacement of the pipe after installation with Type II or Type III bedding, stone stabilization shall be required to develop a non- yielding foundation for the bedding and pipe. When such conditions are encountered, the trench shall be excavated to a depth as great as 2.5 feet below the pipe bell, or as determined by the Engineer, and #467 or #357 crushed stone, ballast stone or rip rap shall be placed to an elevation six (6) inches below the bottom of the pipe. The pipe shall then be laid with Type II, Type III, Type IV or Type V bedding as directed by the Engineer. Stabilization techniques utilizing a geotextile fabric may also be permitted or required by the Engineer.

9. Stone Foundation: When the bottom of the trench is not sufficiently stable to prevent vertical or lateral displacement of the pipe after installation of feet of stabilization stone material, stone foundation materials shall be required to develop a non-yielding foundation for the stone stabilization, bedding and pipe. When such conditions are encountered, the trench shall be excavated to a depth, as

determined by the Engineer. Class A, B, 1, or 2 stone foundation materials shall be placed to an elevation determined by the Engineer. Layering of several classes of stone foundation materials may be required by the Engineer. Stabilization stone shall be used between the stone foundation materials and the bedding stone as determined by the Engineer. The pipe shall then be laid with Type II through Type VI (6) bedding as directed by the Engineer. Should the Engineer determine that the stone foundation material is not capable of providing a non-yielding foundation, then concrete cradles or piers shall be required as specified below. Excavation and disposal of undercut materials necessary for installation of stone foundation material is included as part of stone foundation.

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

E. Depth of Pipe Installation: Unless otherwise indicated on Plans, or required by existing utility location, all pipe shall be installed with the top of the pipe at least 3.0' below the edge of adjacent roadway pavement or 3.0' below the ground at the pipe, whichever is greatest. The Contractor is instructed to check the construction plans and blow-up views for additional requirements.

1. The maximum depth of cover for the previously specified pressure classifications shall be as follows:

DIP maximum depth:

MAXIMUM DEPTH OF COVER - DIP				
Pipe Size	Pressure Class	BEDDING		
		Type I	Type II	Type III
8"	350	20’	34'	50'
10"	350	15’	28'	45'
12"	350	15’	28'	44'
14"	250	15’	23'	36'
16"	250	15’	24'	34'
18"	250	14’	22'	31'
20"	250	14’	22'	30'
24"	250	15’	20'	29'
30"	250	15’	19'	27'
36"	250	14’	18'	25'
42"	250	14’	17'	25'
48"	250	13’	17'	24'
54”	250		16’	24’
60”	250		16’	24’
64”	250		16’	24’

PVC maximum depth: PVC pipe shall be installed with a minimum of 3.0 feet of cover. The maximum depth of cover shall be as follows:

Type I Bedding: 10 feet

Type II Bedding: 15 feet

Type III Bedding: 20 feet

PCCP maximum depth: No maximum depth. Product shall be designed and selected on a per project basis between the Engineer and the Manufacturer.

BWP maximum depth: No maximum depth. Product shall be designed and selected on a per project basis between the Engineer and the Manufacturer.

Steel maximum depth: No specific maximum depth. Product shall be designed and selected on a per project basis between the Engineer and the Manufacturer.

HDPE maximum depth: Not applicable.

2. The Contractor may be required to vary the depth of pipe to achieve minimum clearance from existing utilities while maintaining the minimum cover specified whether or not the existing pipelines, conduits, cables, mains, etc. are shown on the Plans.

F. Alignment and Grade:

1. New Subdivision Streets: The water main shall be laid and maintained to the required lines and grades with fittings, valves and hydrants at the required locations; spigots centered in bells; and all valves and hydrant stems plumb. The curb shall be in place and backfilled, and the area between the curb and the street right-of-way line graded smooth and to finished grade before water mains are installed. The water main shall be installed behind the curb or in the pavement as shown on approved plans or directed by the Engineer.

   a. In special circumstances, the Engineer may approve installation of water mains before the curb is installed. In such cases, the street shall be graded to finish grade in accordance with to approved grading plans for the entire width of the street right-of-way, the water main staked per approved construction plans. In the absence of approved plans, the water main shall be staked five feet behind the proposed curb line with 90 degree offset stakes every 50 feet, and "cut sheets" provided showing the vertical distance between each offset stake and the trench bottom at that point. Such staking shall be done only by a surveyor registered in the State of North Carolina.

   b. After the curb and gutter has been installed, the location and depth of the main, valves, fire hydrants, etc., shall be checked for conformance with Charlotte Water standards and the construction drawings. Soft dig excavations shall be performed by the Contractor to verify compliance at

100-ft intervals. The compliance shall be witnessed by the Charlotte Water Inspector, or the pipe elevation, centerline, ground elevation and edge of pavement elevations shall be recorded by a third-party NC-PLS. The survey data shall be provided to the design engineer and Charlotte Water. The survey data shall be used in the production of the record drawing profiles. Any deficiencies shall be corrected to the satisfaction of the Engineer prior to testing, disinfection and activation of the mains.

2. Existing Streets: The water mains shall be installed as shown on the plans unless an obstruction prevents such alignment or grade. The Contractor shall be required to adjust the location of the water main where possible to avoid such conflicts as specified and as directed by the Engineer.

   a. All construction layout and surveying which may be required for construction shall be provided by the Contractor and any costs associated shall be included in the various pay items of the proposal. The Contractor is responsible for determining the amount of construction layout and surveying that may be required to complete construction.

3.4 INSTALLATION AND ASSEMBLY, GENERAL

A. Proper implements, tools, and facilities satisfactory to the Engineer shall be provided and used by the Contractor for the safe and convenient prosecution of the work. All pipe, fittings, valves and hydrants shall be carefully lowered into the trench piece by piece by means of a backhoe or other suitable means, in such a manner as to prevent damage to protective coatings and linings. Under no circumstances shall water main materials be dropped or dumped into the trench. A tracer wire system shall be installed for all piping based on the standard details and specifications.

1. Inspection of Material: The pipe and fittings shall be inspected for defects.

2. Cleaning Pipe and Fittings: All lumps, blisters and excess coatings shall be removed from the bell and spigot ends of each pipe, and the outside of the spigot and the inside of the bell shall be wire-brushed or wiped clean dry and free from oil and grease before the pipe is laid. A visual inspection shall be completed to determine if there is any foreign object is blocking the inside of pipe and shall be flushed with potable water to clear the opening, if there is any.

3.5 INSTALLATION AND ASSEMBLY OF DUCTILE IRON PIPE

A. DIP water main shall be installed in accordance with the Recommended Practice for the Installation by DIPRA and AWWA C-600 – Installation of DIP and Appurtenances.

B. Laying Pipe: Pipe shall be laid with bell ends facing in the direction of laying, unless otherwise approved by the Engineer. Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed.

1. If the pipe laying crew cannot put the pipe into the trench and in place without getting earth into it, the Engineer may require that before lowering the pipe into the trench, a heavy, tightly woven canvas bag of suitable size shall be placed over each end and left there until the connection is to be made to the adjacent pipe. During laying operations, no debris, tools, clothing or other materials shall be placed in the pipe.

2. After placing a length of pipe in the trench, the spigot end shall be centered in the bell and the pipe forced home and brought to correct line and grade. The pipe shall be secured in place with approved backfill material tamped under it. Precautions shall be taken to prevent dirt from entering the joint space.

3. At times when pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug or other means approved by the Engineer. This provision shall apply during the lunch hours as well as overnight. If water is in the trench, the seal shall remain in place until the trench is pumped completely dry.

C. Permissible Deflection of Joints: Wherever it is necessary to deflect pressure pipe from a straight line, either in the vertical or horizontal plane, to avoid obstruction or plumb valve stems, or where long radius curves are permitted, the amount of deflection allowed shall not exceed 50% of that which is required for satisfactory sealing of the joint as recommended by the manufacturer and shall be approved by the Engineer.

Pipe Diameter (inches)	AWWA C600 Deflection Angle for push-on joint (degrees)	AWWA C600 Deflection Angle for mechanical joint (degrees - minutes)
3	5	8-18
4	5	8-18
6	5	7-07
8	5	5-21
10	5	5-21
12	5	5-21
14	3	3-35
16	3	3-35
18	3	3-00
20	3	3-00
24	3	2-23
30	3	-
36	3	-
42	3	-
48	3	-
54	3	-
60	3	-
64	3	-

D. Installation of Push-On Joint Pipe: The gasket groove and bell socket shall be cleaned and lubricated, and the gasket inserted as specified by the pipe manufacturer. Sterile lubricant, as furnished or specified by the manufacturer shall be applied to the gasket and beveled spigot end of the pipe. The beveled spigot end of pipe shall be pushed straight into bell using either a bar, jack, lever puller, or backhoe. A timber header shall be placed between the jack or backhoe bucket and the pipe to prevent damage to the pipe. At no time shall the joint be made by swinging the pipe. The pipe shall be deflected, if required, after the joint is made.

E. Installing Factory Restrained Joint Pipe: For restrained joint pipe with a factory installed weldment, make conventional push-on joint assembly, fully homing the pipe until the first assembly stripe is in the bell. Insert right-hand and left-hand locking segments and slide segment in appropriate direction. Hold segments apart and wedge the rubber retainer into the slot between the two locking segments. Extend the joint to remove the slack in the locking segment cavity.

F. Installing Mechanical Joint Pipe and Fittings: All spigots shall be centrally located in the bell and adequate anchorage shall be provided where abrupt change in direction and dead ends occur. All pipe surfaces with which the rubber gasket seals come into contact shall be brushed with a wire brush just prior to assembly in order to remove all loose rust or foreign material and to provide a clean surface for the installation of the gasket. The pipe surface with which the gasket comes into contact and the gasket shall be brushed with soapy water just prior to the installation of the gasket and the making up of the joint. Torque loads shall be applied to the standard cast iron bolts used in making the joint as follows:

BOLT SIZE, INCHES	RANGE OF TORQUE, FT. POUNDS
5/8	40-60
¾	60-90
1	70-100
1-1/4	90-120

1. The above torque loads may be applied with torque measuring or indicating wrenches. Torque wrenches may be used to check the application of approximate torque loads applied by people trained to give an average pull on a definite length of regular socket wrench. The following lengths of wrenches should satisfactorily produce the above ranges of torques when used by the average person:

BOLT SIZE, INCHES	LENGTH OF WRENCH, INCHES
5/8	8
¾	10
1	12
1-1/4	14

2. When tightening bolts, the gland shall be brought up toward the pipe flange evenly, maintaining approximately the same distance between the gland and the face of the flange at all points around the socket.

G. Installing Wedge Action Mechanical Joint: Clean and remove all loose materials and rust from the mating surfaces. Lubricate the gasket and plain end by brushing either soapy water or pipe lubricant. Slide the mechanical joint restraint on the plain end with the lip extension towards the plain end, followed by the mechanical joint gasket. Wedge action restraint shall be installed per the manufacturer's recommendations. Mechanical joint restraint shall require conventional tools and installation procedures per AWWA C600, while retaining full mechanical joint deflection during assembly as well as allowing joint deflection after assembly. Proper actuation of the gripping wedges shall be ensured with torque limiting twist off nuts. Torque loads are as follows:

Pipe Size (Inches)	Bolt Size (Inches)	Range of Torque (Ft - Lbs.)
3	5/8	45 – 60
4 – 24	3/4	75 – 90
30 – 36	1	100 – 120
42 – 48	1 1/4	120 - 150

H. DI Pipe Gripper Gasket Joint Restraint: Gripper gasket joint restraint may be used on ductile iron pipe 12-inch and smaller only. Gripper gasket joint restraint shall be installed where shown on the plans, standard details or when approved by the Engineer. Restrained lengths on each side of the fittings shall be as shown on standard details or the plans, or as approved by the Engineer. Installation shall be as per the gripper gasket and pipe manufacturer's recommendations. Gripper gasket joint restraint is prohibited for use in above ground applications, such as bridge crossings. Gripper gasket joint restraint is prohibited for use in directional drilling applications. When used in conventional straight casings, gripper gasket joint restraint shall be installed per the manufacturer's recommendations by pulling, not pushing, the pipe through the casing. Gripper gasket joint restraint is prohibited for use at end of line plugs.

I. Bend and Fitting Location: The Contractor is advised that the bends and fittings indicated on the plans are for a guide only. The Contractor shall be required to furnish additional bends and fittings as needed to complete all installations.

J. Cutting Pipe: The cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or cement lining and so as to leave a smooth end at right angles to the axis of the pipe. Cut ends of a pipe shall be beveled before installation in a push-on joint bell.

1. When making connections to existing mains which require water mains to be removed from service, automatic traveling pipe cutting machines shall be required on pipe 16-inch and larger. At other times, hand-held pipe saws may be used provided the pipe is marked, prior to cutting, such as to provide a cut at right angles to the axis of the pipe. Handheld pipe saws may be used in all applications for cutting pipe smaller than 16-inch.

    a. Flame cutting of pipe with an acetylene torch shall not be allowed.

K. Ductile Iron Pipe shall be installed when the minimum cover is less than 3.0 feet and in all crossings of other pipelines (storm drainage, gas, etc.) when the vertical distance between the water main and the other pipeline is less than 12-inches.

L. Tracer wire and warning tape shall be installed in accordance with the Standard Details and as specified in these specifications.

3.6 INSTALLATION AND ASSEMBLY OF PVC PIPE

A. PVC water main shall be installed in accordance with AWWA C-605 – Underground installation of … PVC … pressure pipe and fittings and with AWWA M23. Backfill shall be as specified elsewhere in these specifications.

B. Laying Pipe: Pipe shall be laid with bell ends facing in the direction of laying, unless otherwise approved by the Engineer. Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed.

1. If the pipe laying crew cannot put the pipe into the trench and in place without getting earth into it, the Engineer may require that before lowering the pipe into the trench, a heavy, tightly woven canvas bag of suitable size shall be placed over each end and left there until the connection is to be made to the adjacent pipe. During laying operations, no debris, tools, clothing or other materials shall be placed in the pipe.

2. After placing a length of pipe in the trench, the spigot end shall be centered and inserted into the pipe bell until the face of the bell is located between the bell homing lines on the pipe spigot and placed at the correct line and grade. Under no circumstance shall the pipe be over homed. The pipe shall be secured in place with approved backfill material tamped under it. Precautions shall be taken to prevent dirt from entering the joint space.

3. At times when pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug or other means approved by the Engineer. This provision shall apply during the lunch hours as well as overnight. If water is in the trench, the seal shall remain in place until the trench is pumped completely dry.

C. Permissible Bending Radius: Wherever it is necessary to deflect pressure pipe from a straight line, either in the vertical or horizontal plane, to avoid obstruction or plumb valve stems, or where long radius curves are permitted, the longitudinal bending radius of unrestrained gasket-joined pipe shall not exceed the values listed below or as recommended by the pipe manufacturer and approved by the Engineer.

Pipe Diameter (inches)	AWWA C605 Minimum Bending Radius (feet)	Charlotte Water Minimum Bending Radius (feet)
2 (PVC)	--	75
6	144	150
8	--	200
10	--	250
12	--	300

D. Permissible Deflection of Joints: Wherever it is necessary to deflect pressure pipe from a straight line, either in the vertical or horizontal plane, to avoid obstruction or plumb valve stems, or where long radius curves are permitted, the maximum amount of angular joint deflection of unrestrained gasket-joined pipe shall not exceed 1% or as recommended by the manufacturer and shall be approved by the Engineer.

E. Installation of Push-On Joint Pipe: Sterile lubricant, as furnished or specified by the manufacturer shall be applied to the gasket and beveled spigot end of the pipe. When inserting a PVC spigot into a ductile iron bell, the beveled end of the PVC spigot shall be removed, and the resulting outer edge shall be ground off. The beveled spigot end of pipe shall be pushed straight into bell using either a bar, jack, lever puller, or backhoe. When inserting a PVC spigot into a ductile iron bell, the insertion line shall be ignored, and the PVC pipe shall be bottomed in the ductile iron bell. A timber header shall be placed between the jack or backhoe bucket and the pipe to prevent damage to the pipe.

At no time shall the joint be made by swinging the pipe. The pipe shall be deflected, if required, after the joint is made.

F. Installing Spline/Groove Restrained Joint Pipe and Fittings: The exposed gasket surface and pipe spigot shall be cleaned and lubricated, and the spigot end inserted into the bell (restraint joint in bell (RJIB)) as specified by the pipe manufacturer. When the pipe end seats against the stop in the coupling, spline grooves are automatically aligned for spline insertion. The spline shall then be inserted through the insertion hole in the coupling and into the aligned grooves until it is fully seated around the circumference of the pipe. A timber header shall be placed between the jack or backhoe bucket and the pipe to prevent damage to the pipe.

G. Installing Bull Dog Restrained Joint Pipe and Fittings: EBAA Iron Series 5000 Mega-Stop shall be installed at the pipe homing line after the pipe spigot is cleaned and lubricated ad before the spigot is inserted into the bell. Once the spigot is installed, the bell stop may be removed and reused in open cut installations. When bulldog restraint systems are used in casing pipe, tunnels or horizontal directional bores, the EBAA iron series 5000 Mega-Stop to be installed at the pipe homing line before the spigot is inserted into the bell. A permanent bell stop is required on all spigots in such installations.

H. Bend and Fitting Location: All bends and fittings on PVC pipe shall be DI mechanical joint. The Contractor is advised that the bends and fittings indicated on the plans are for a guide only. The Contractor shall be required to furnish additional bends and fittings as needed to complete all installations.

I. Installing Restrained Joint Ductile Iron Fittings/Valves on PVC: All ductile iron fittings and valves shall be installed onto AWWA C900 pipe with mechanical joints and wedge action restraint glands. All spigots shall be centrally located in the bell and adequate anchorage shall be provided where abrupt change in direction and dead ends occur. The socket and the plain end shall be cleaned. Lubrication and additional cleaning shall be provided by brushing both the gasket and plain end with soapy water or an approved pipe lubricate meeting the requirements of ANSI/AWWA C111/A21.11 just prior to slipping the gasket onto the plain end for joint assembly. Place the gland on the plain end with the lip extension toward the plain end; follow by the gasket with the narrow edge of the gasket toward the plain end. Insert the pipe into the socket and press the gasket firmly and evenly into the gasket recess. Ensure the joint is kept straight during assembly. Push the gland toward the socket and center it around the pipe with the gland lip against the gasket. Insert bolts and hand-tighten nuts. Make deflection after joint assembly but before tightening bolts. Torque loads shall be applied to the standard cast iron bolts used in making the joint as follows:

Pipe Size (Inches)	Bolt Size (Inches)	Range of Torque (Ft - Lbs.)
3	5/8	45 – 60
4 – 24	3/4	75 – 90
30 – 36	1	100 – 120
42 – 48	1 1/4	120 - 150

1. When tightening the bolts to the normal range of bolt torque, the gland shall be brought up toward the pipe flange evenly, maintaining approximately the same distance between the gland and the face of the flange at all points around the socket.

J. Cutting Pipe: The cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe so as to leave a smooth end at right angles to the axis of the pipe.

1. Hand-held pipe saws may be used provided the pipe is marked, prior to cutting, such as to provide a cut at right angles to the axis of the pipe. Handheld pipe saws may be used in all applications for cutting pipe smaller than 16-inch.

K. Unless otherwise indicated on the Plans, or required by existing utility locations, all PVC water pipe shall be installed with a minimum cover of 3.0 feet.

L. Tracer wire and warning tape shall be installed in accordance with the Standard Details and as specified in these specifications.

3.7 INSTALLATION AND ASSEMBLY OF HDPE PIPE

A. HDPE water main shall be installed in accordance with AWWA M55 and ASTM D2774 and with the pipe manufacturer's recommendations. Backfill shall be as specified elsewhere in these specifications.

B. Service Installation: On new or existing HDPE water mains, mechanical service saddles and corporation stops shall not be allowed. HDPE service line shall be fused to the HDPE water main with a HDPE service saddle. The first mechanical connection shall be in the service box, at the angle valve on 1-inch and smaller services and shall be at the valve in front of the vault on 1.5-inch and larger services.

C. Joining Methods:

1. Socket Fusion: 4-inch and smaller diameter pipes may be joined by the socket fusion procedure as outlined in ASTM F2620, PPI TR-33 and ASTM F3190. All tools used in socket fusion shall be in accordance with ASTM F1056.

2. Butt Fusion: The pipe may be joined by the butt fusion procedure outlined in ASTM F2620 or PPI TR-33. All fusion joints shall be made in compliance with the pipe or fitting manufacturer's recommendations. Fusion joints shall be made by qualified fusion technicians per ASTM F3190. Butt fusion shall not be allowed on 1-inch and smaller HDPE pipe.

3. Saddle Fusion: Saddle fusion shall be done in accordance with ASTM F2620 or TR-41 or the fitting manufacturer's recommendations and PPI TR-41.

4. Electrofusion: Electrofusion joining shall be done in accordance with the manufacturers recommended procedure. Other sources of electrofusion joining information are ASTM F 1290 and PPI TN 34. The process of electrofusion requires an electric source, a transformer, commonly called an electrofusion box that has wire leads, a method to read electronically (by laser) or otherwise input the barcode of the fitting, and a fitting that is compatible with the type of electrofusion box used. The electrofusion box shall be capable of reading and storing the input parameters and the fusion results for later download to a record file.

5. Mechanical: Mechanical connection of HDPE pipe to auxiliary equipment such as valves shall use male HDPE mechanical joint adapters on 3-inch and larger HDPE water mains and other devices in conformance with the PPI Handbook of Polyethylene Pipe, Chapter 9 and AWWA Manual of Practice M55, Chapter 6. On 2-inch water mains valves shall connect to the HDPE main with an HDPE adapter with a stainless steel or brass MNPT threaded end.

D. Minimum Bending Radius: Wherever it is necessary to deflect pressure pipe from a straight line, either in the vertical or horizontal plane, to avoid obstruction or plumb valve stems, or where long radius curves are permitted, the bending radius shall not be less than 31 times the pipe diameter (in feet) or as recommended by the manufacturer and shall be approved by Charlotte Water.

Pipe Dia. (in)	SF	Minimum Bending Radius (ft)	Pipe Dia. (in)	SF	Minimum Bending Radius (ft)	Pipe Dia. (in)	SF	Minimum Bending Radius (ft)
2	31	6	12	31	32	24	31	62
3	31	8	14	31	38	26	31	68
4	31	12	16	31	42	28	31	74
6	31	16	18	31	48	30	31	78
8	31	22	20	31	52	32	31	84
10	31	26	22	31	58			

E. Ductile Iron Pipe shall be installed when the minimum cover is less than 3.0 feet and in all crossings of other pipelines (storm drainage, gas, etc.) when the vertical distance between the water main and the other pipeline is less than 12-inches.

F. Tracer wire and warning tape shall be installed in accordance with the Standard Details and as specified in these specifications.

3.8 INSTALLATION OF PCCP PIPES

A. PCCP water main shall be installed in accordance with AWWA C301 and with the pipe manufacturer's recommendations. Backfill shall be as specified elsewhere in these specifications.

B. Laying Pipe: Laying lengths shall be in accordance with AWWA C301. All pipe and fittings shall be carefully handled and protected against damage. No pipe shall be installed where interior or exterior surfaces show cracks. Before placement of pipe in the trench, each pipe or fitting shall be thoroughly cleaned of any foreign substance which may have collected thereon and shall be kept clean at all times thereafter. For this purpose, the openings of all pipes and fittings in the trench shall be closed during any interruption to the work. Pipe shall be laid directly on the bedding material. No blocking shall be permitted, and the bedding shall be such that it forms a continuous, solid bearing for the full length of the pipe. Excavations shall be made as needed to facilitate removal of handling devices after the pipe is laid. Excavation shall be made as needed outside the normal trench section at field joints to permit adequate access to the joints for field connection operations.

C. Installation Tolerances: Each section of pipe shall be laid in the order and position shown on the laying diagram and in accordance with the following:

1. Each section of pipe having a nominal diameter less than 48-inches shall be laid to line and grade, with a horizontal tolerance of plus or minus 2 inches and a vertical tolerance of plus or minus 1-inch.

2. Each section of pipe having nominal diameter 48-inches and larger shall be laid to line and grade, within a horizontal tolerance of plus or minus 5% of pipe diameter and a vertical tolerance of plus or minus 2.5% of pipe diameter.

3. In addition to the horizontal and vertical tolerances above, lay the pipe so that no high or low points other than those on the laying diagram are introduced.

D. Where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, the Engineer may change the alignment and/or the grades. Such change shall be made by the deflection of joints, by the use of bevel adapters, or by the use of additional fittings. However, in no case shall the deflection in the joint exceed 75% of the maximum deflection recommended by the pipe manufacturer. No joint shall be misfit any amount that shall be detrimental to the strength and water tightness of the finished joint. In all cases the joint opening shall be the controlling factor.

E. Except for short runs that may be permitted by the Engineer, pipes shall be laid uphill on grades exceeding 10%. Pipe that is laid on a downhill grade shall be blocked and held in place until sufficient support is furnished by the following pipe to prevent movement. Bends shall be properly installed as indicated.

F. Pipe struts shall be left in place until backfilling operations have been completed for pipe 42-inches in diameter and larger. Struts shall remain the property of the Contractor. Struts in pipe smaller than 42-inches may be removed immediately after laying.

G. Cold Weather Protection: No pipe shall be installed upon a foundation into which frost has penetrated or at any time that there is a danger of the formation of ice or penetration of frost at the bottom of the excavation. No pipe shall be laid unless it can be established that the trench shall be backfilled before the formation of ice and frost occurs.

H. Rubber Gasketed Joints: Immediately before jointing pipe, the spigot end of the pipe shall be thoroughly cleaned, and a clean rubber gasket lubricated with a non-toxic vegetable-based lubricant shall be placed in the spigot groove. The lubricant shall be a compound listed as in compliance with NSF Standard 61. The volume of the gasket shall be "equalized" by moving a metal rod between the gasket and the spigot ring around the full circumference of the spigot ring. The bell of the pipe already in place shall be carefully cleaned and lubricated with the vegetable-based lubricant. The spigot of the pipe section shall then be inserted into the bell of the previously laid joint and telescoped into its proper position. Tilting of the pipe to insert the spigot into the bell shall not be permitted. After the pipe units have been joined, a feeler gage shall be inserted into the recess and moved around the periphery of the joint to detect any irregularity in the position of the rubber gasket. If the gasket cannot be felt all around, the joint shall be disassembled. The joint shall be reassembled with a new gasket.

I. Joint Coating and Lining: The interior and exterior joint recesses shall be thoroughly wiped clean, and all water, loose scale, dirt and other foreign material shall be removed from the inside surface of the pipe. The grout for joint coating and lining shall be in accordance with AWWA C301

1. Joint Coating: After the pipe has been laid and after sufficient backfill has been placed between the joints to hold the pipe securely in place, the outside annular space between pipe sections shall be completely filled with grout formed by the use of polyethylene foam-lined fabric bands. The grout space shall be flushed with water prior to filling so that the surface of the joint to be in contact with the grout shall be thoroughly moistened when the grout is poured. The joint shall be filled with grout by pouring from one side only and shall be rodded with a wire or other flexible rod or vibrated so that the grout completely fills the joint recess by moving down one side of the pipe, around the bottom of the pipe and up the opposite side. Care shall be taken to leave no unfilled space. Grouting of the outside joint spaces shall be kept as close behind the laying of the pipe as possible except that in no case shall grouting be closer than 3 joints of the pipe being laid.

2. Grout Bands (Diapers): The grout bands or heavy-duty diapers shall be polyethylene foam-lined fabric with steel strapping of sufficient strength to hold the fresh grout, resist rodding of the grout and allow excess water to escape. The foam plastic shall be 100% closed cell, chemically inert, insoluble in water, and resistant to acids, alkalis, and solvents, and shall be Dow Chemical Company, Ethafoam 222, or equal.

3. The fabric backing shall be cut and sewn into 9-inch-wide strips with slots for the steel strapping on the outer edges. The polyethylene foam shall be cut into strips 6-inches wide and slit to a thickness of 1/4-inch that shall expose a hollow or open cell surface on one side. The foam liner shall be attached to the fabric backing with the open or hollow cells facing towards the pipe. The foam strip shall cover the full interior circumference of the grout band with sufficient length to permit an 8-inch overlap of the foam at or near the top of the pipe joint. Splices to provide continuity of the material shall be permitted. The polyethylene foam material shall be protected from direct sunlight.

4. The polyethylene foam-lined grout band shall be centered over the joint space with approximately equal widths extending over each pipe end and securely attached to the pipe with the steel straps. After filling the exterior joint space with grout, the flaps shall be closed and overlapped in a manner that fully encloses the grout with polyethylene foam. The grout band shall remain in position on the pipe joint.

5. Joint Lining: After the backfill has been completed to final grade, the interior joint recess shall be filled with grout. Grout shall be tightly packed in the joint recess and troweled flush with the interior surface. All excess shall be removed. At no point shall there be an indentation or projection of the grout exceeding 1/16-inch. With pipe smaller than 24-inches in diameter, before the spigot is inserted into the bell, the bell shall be daubed with grout; the joint shall be completed, and excess grout on the inside of the joint shall be swabbed out.

J. Installation of Valves: Valves shall be handled in a manner to prevent any injury or damage to any part of the valve. Joints shall be thoroughly cleaned and prepared prior to installation. The Contractor shall adjust stem packing and operate each valve prior to installation to insure proper operation.

1. Valves shall be installed so that the valve stems are plumb, and in the location indicated.

K. Installation of Flanged Joints: Before the joint is assembled, the flange faces shall be thoroughly cleaned of all foreign material with a power wire brush. The gasket shall be

centered, and the connecting flanges drawn up watertight without unnecessarily stressing the flanges. Bolts shall be tightened in a progressive diametrically opposite sequence and torqued with a suitable, approved and calibrated torque wrench. Clamping torque shall be applied to the nuts only. Full face reinforced rubber gaskets shall be applied to the inside face of blind flanges with adhesive.

L. Insulated Joints: Insulated joints and appurtenant features shall be provided as indicated. The Contractor shall exercise special care when installing these joints to prevent electrical conductivity across the joint. After the insulated joint is completed, an electrical resistance test shall be performed by the Contractor. Should the resistance test indicate a short circuit, the Contractor shall remove the insulating units to inspect for damages, replace all damaged portions, and reassemble the insulating joint. The insulated joint shall then be re-tested to assure proper insulation.

M. Flexible Coupled Joints: When installing flexible couplings, care shall be taken that the connecting pipe ends, couplings and gaskets are clean and free of all dirt and foreign matter with special attention being given to the contact surfaces of the pipe, gaskets and couplings. The couplings shall be assembled and installed in conformity with the recommendations and instruction of the coupling Manufacturer.

3.9 INSTALLATION OF BWP PIPES

A. Bar wired cylinder concrete pipes shall be installed in accordance with AWWA C303, M9 and with the pipe manufacturer's recommendations. Backfill shall be as specified elsewhere in these specifications.

B. Laying Pipe: Laying lengths of the BWP shall be in accordance with AWWA M9. Prior to installation, all piping shall be inspected to make sure it is free of defects. All piping shall be flush cleaned of any dust and foreign objects.

C. Joining Methods: All joining methods shall be based on AWWA M9 and with the pipe manufacturer's installation recommendations.

3.10 INSTALLATION OF STEEL PIPES

A. Steel pipes shall be installed in accordance with AWWA C604, M11 and with the pipe manufacturer's recommendations. Backfill shall be as specified elsewhere in these specifications.

B. Laying Pipe: Laying lengths of the steel pipe shall be in accordance with the AWWA M11. Prior to installation, all piping shall be inspected to make sure it is free of defects. All piping shall be flush cleaned of any dust and foreign objects.

C. Joining Methods: All joining methods shall be based on AWWA M11 and with the pipe manufacturer's installation recommendations.

3.11 INSTALLING VALVES, HYDRANTS, AND FITTINGS

A. Valves, hydrants and fittings shall be installed in the manner specified for installation and assembly of pipe. Valves and hydrants shall be installed in accordance with to the Standard Details at locations shown on the plans and/or as directed by the Engineer.

1. Valve Boxes: A valve box assembly conforming to the Standard Details shall be installed for every 12-inch and smaller gate valve and all service 1.5-inch and 2-

inch ball valves. The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the operating nut, with the box cover flush with the surface of the pavement or other existing surface.

a. Where the box is not set in pavement, the top section shall be anchored by a 24” x 24” x 6" thick concrete pad, or an approved pre-cast concrete pad, set flush with the existing terrain. The top section shall be grouted into the pre-cast concrete pad, the full depth of the concrete pad. The location of valves shall be identified by the letter "V" cut/imprinted into the curb adjacent to mainline air release or hydrant valve. The “V” shall point directly toward the valve/box.

b. All 16-inch and larger valves shall be installed with operating nuts plumb and centered beneath a manhole frame and cover, valve box top section and riser pipe as shown in the Standard Details. Extension stems as shown on the standard detail shall be required on valves where the operating nut is more than 3.0 feet below the top of the frame and cover. Operating nut of extension stem is to be 2-inch square. Extension stem shall be Type 316 stainless steel or carbon with ductile iron or stainless-steel top nuts and bottom couplings. The extension stem operating nut and valve nut are pinned to the extension rod/bottom coupling which is drilled to receive stainless steel coil pins or set screws for attachment.

c. 12-inch and smaller valves shall require valve extension stems per the standard details when the valve operating nut is more than 3 feet below the top of the valve box assembly. The valve extension stem shall comply with the requirements above.

d. 12-inch and smaller valves shall require valve centering to keep valve box aligned during backfilling. Refer to the Standard Details for assembly.

2. Valve Blocking: All end of line valves 12-inch and smaller installed on PVC, DIP, or HDPE water mains shall be installed with end of line wall blocking per the standard detail. All 12-inch valves, and smaller, installed along PVC or HDPE water mains shall be securely wedge blocked with concrete bearing against undisturbed soil, and cut into the excavated sides of the trench. All valves installed along HDPE water mains larger than 12-inch shall be restrained with thrust wall blocking in accordance with to the standard detail. Care shall be taken in forming and pouring the "wedge" blocking so the fitting joints shall be accessible for repair and/or valve extraction. All valves shall be double wrapped with two (2) layers of HDPE plastic film, high-density cross-laminated (HDCL) polyethylene per AWWA C-105. Each layer of film shall be a minimum of 4 mils thick. The film shall extend a minimum of 3 feet each side of the valve/fitting.

3. Fire Hydrants: Hydrants shall be manufactured with no less than three and one half (3.5’) foot bury on water mains 12" and smaller and with four and one half (4.5) foot or more for water mains 16" and larger. Because of varying topography, hydrants with greater bury shall be required based on the actual depth. Extensions kits shall be manufactured by the hydrant manufacturer. No more than ONE extension kit shall be installed on a fire hydrant. Third party extension kits provided by manufacturers other than the original fire hydrant manufacturer are not allowed.

a. All hydrants and hydrant guard valves shall be installed plumb and in accordance with the Standard Details. The appropriate plan view shall be

noted on the Plans or in the Special Provisions. Each hydrant installation shall include a drainage bed of clean washed stone approximately one (1) cubic yard in size at the "weep hole" with filter fabric installed around the stone. Piping from the main to the hydrant shall be 6-inch or 8-inch restrained joint DIP only or may be HDPE on new HDPE water mains.

b. All hydrants shall have concrete collars installed on the barrel below the bury line as shown in the standard detail. Placement of hydrants and the hydrant guard valve(s) shall meet the requirements as indicated in the Standard Details. Hydrants shall not be installed within the radius points of streets or driveways and shall not be installed within 15 feet of on street parking spaces.

4. Blocking Fittings: All plugs, caps, tees, and bends deflecting 11-1/4 degree or more on pressure mains 2-inch in diameter or larger shall be provided with thrust blocking, placed as shown on the Plans and/or as directed by the Engineer. Thrust blocking shall consist of ready-mix concrete having a compressive strength of not less than 3,600 lbs. per square inch at 28 days.

a. Bagged mix concrete may be used for blocking, anchorage, concrete valve pads, etc. on water mains and valves 12-inches and smaller, when less than 1/2 cubic yard is required. Bag mix concrete shall be properly mixed as recommended by the manufacturer, prior to placement in the trench.

b. Blocking shall be placed between solid/undisturbed ground and the fittings to be anchored. The area of bearing on the pipe and on the ground in each instance shall be that shown on the standard detail or directed by the Engineer. The blocking shall be so placed that the pipe and fittings shall be accessible for repair. All fittings shall be double wrapped with 2 layers of HDPE plastic film, high-density cross-laminated (HDCL) polyethylene per AWWA C-105. Each layer of film shall be a minimum of 4 mils thick. The film shall extend a minimum of 3 feet each side of the valve/fitting.

5. Restrained Joints: Restrained joints shall be installed where shown on the plans, standard details or when approved by the Engineer, and may be installed in lieu of blocking. Installation shall be per manufacturer's recommendations, as shown on the plans, standard details, special provisions, and/or as directed by the Engineer.

6. Wedge Action Restrained Joints: Wedge action restrained joints shall be installed on mechanical joint valves and fittings where shown on the plans, standard details or when approved by the Engineer, and may be installed in lieu of blocking. Restrained lengths on each side of the fittings shall be as shown on the standard details, plans, or as approved by the Engineer. Installation shall be per manufacturer's recommendations, as shown on the plans, special provisions, and/or as directed by the Engineer.

3.12 WATER MAIN TAPS

A. Installation of Tapping Sleeves and Valves: Tapping sleeves and valves shall be scheduled with and installed only under inspection by the Engineering Division of Charlotte Water and as recommended by the Manufacturer. No work shall be done (including excavation of the existing main) except when Charlotte Water personnel are present.

1. Tapping valves shall be supported at all times to prevent the tapping sleeve from slipping on the main. Tapping sleeves and valves shall be field pressure tested after installation on the pipe but before the tap is made.

2. First, the tapping valve shall be opened, and the sleeve and valve filled with water and placed under the rated pressure of the sleeve (200 PSI). The pressure gauge shall be observed for ten minutes with no loss of pressure. Then the pressure shall be released, the valve closed, and procedure repeated with test pressure against the outside of the valve gate or wedge and with no water inside the tapping sleeve between the existing pipe and the tapping valve.

3. When tapping sleeves are furnished with test plugs, the test may be made in a single step with the valve closed and pressure applied through the test plug.

4. Thrust Blocking: All tapping sleeves shall be provided with thrust blocking, placed as shown on the standard details, the Plans and/or as directed by the Engineer. Thrust blocking shall consist of ready-mix concrete having a compressive strength of not less than 3,600 lbs. per square inch at 28 days.

    a. Bagged mix concrete may be used for blocking, anchorage, concrete valve pads, etc. on water mains and tapping sleeves 12-inches and smaller, when less than 1/2 cubic yard is required. Bag mix concrete shall be properly mixed as recommended by the manufacturer, prior to placement in the trench.

    b. Blocking shall be placed between solid/undisturbed ground and tapping sleeve to be anchored. The area of bearing on the pipe and on the ground in each instance shall be that shown on the standard details or directed by the Engineer. The blocking shall be so placed that the pipe and tapping sleeve shall be accessible for repair. The tapping sleeve shall be double wrapped with 2 layers of HDPE plastic film, high-density cross-laminated (HDCL) polyethylene per AWWA C-105. Each layer of film shall be a minimum of 4 mils thick. The film shall extend a minimum of 3 feet each side of the tapping sleeve.

    c. The tapping valve shall be supported with poured in place concrete to prevent settlement of the valve or rotation of the tapping sleeve. The tapping sleeve shall be double wrapped with 2 layers of HDPE plastic film, high-density cross-laminated (HDCL) polyethylene per AWWA C-105. Each layer of film shall be a minimum of 4 mils thick. The film shall extend a minimum of 3 feet each side of the tapping sleeve.

B. Weld-on Tapping Sleeves for Steel Pipe

1. Welder Qualifications

    a. Welding shall be performed by skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used.

    b. Welders shall be qualified under the provisions of ANSI/AWS D1.1 or the ASME Boiler and Pressure Vessel Code, Section 9 by an independent local, approved testing agency not more than 6 months prior to commencing work on the project.

2. Repair of Welds

a. Defective welds shall be repaired by the Contractor to meet the indicated requirements.

b. Defects in welds or defective welds shall be removed, and that section of the joint shall then be re-welded.

c. Only sufficient removal of defective material that is necessary to correct the defect shall be required.

d. After the repair is made, the joint shall be checked by repeating the original test procedure.

e. Welds deficient in size shall be repaired by adding weld metal.

3. Coating Repairs

a. Mortar-Coated Pipe: Perform coating repairs on mortar-coated pipe in accordance with the requirements of AWWA C205.

b. Tape-Coated Pipe

1) Perform coating repairs on tape-coated pipe tape and primer in accordance with the requirements of AWWA C209.

2) If the holiday re-test indicates a holiday still exists after re-testing, the inner wrap shall be exposed and the exposed area shall be wiped clean with xylol solvent or equal, and the area shall be coated with tape primer.

3) A patch of 35-mil thick cold-applied tape of sufficient size to cover the damaged area plus a minimum lap of 2-inches shall then be applied.

4) The patched area shall again be tested for holidays.

5) If none are detected, a second layer of 35-mil thick tape shall then be applied over the first patch, overlapping the first layer a minimum of 2 inches.

c. Epoxy-Coated Pipe:

1) For liquid-epoxy coated pipes, perform coating repairs on epoxy-coated pipe in accordance with the requirements of ANSI/AWWA C210-15

2) For fusion-bonded epoxy coated pipes, perform coating repairs in accordance with the requirements of AWWA C213.

4. Isolation Joints

a. Isolation joints and appurtenant features shall be provided as indicated in the cathodic protection specifications and standard details.

b. The Contractor shall exercise special care when installing these joints in order to prevent electrical conductivity across the joint.

c. After the isolation joint is completed, an electrical resistance test shall be performed by the Contractor.

d. If the resistance test indicates a short circuit, the Contractor shall remove the isolation units to inspect for damage, replace all damaged portions, and reassemble the isolation joint.

e. The isolation joint shall then be retested to assure proper isolation.

f. All isolation joints shall be tested during the Final Inspection process by an approved third-party NACE certified testing firm and tester. Tests results for each isolation joint shall be provided in a report submitted to the Engineer.

C. Flanged Tapping Sleeves for PCCP

1. The cement pipe coating shall be removed from the steel pipe cylinder as recommended by the tapping sleeve manufacturer, without cutting or damaging the prestressing wires or steel pipe cylinder.

2. If a pipe cylinder weld is in the tapping area the weld shall be flattened as recommended by the pipe manufacturer or the tapping sleeve manufacturer. Grinding the weld flat shall not be allowed.

3. The sleeve shall have a separate gland, which allows the sleeve to be installed, and the annular space between the pipe and the sleeve to be grouted, prior to cutting the prestressed wires.

4. Foam or rubber grout gaskets and hard rubber spacers shall be used to provide an annular space between the pipe and the sleeve. Grout horns shall be furnished to facilitate grouting of the annular space.

5. The annular space shall be grouted with an approved Portland Cement grout. A minimum of 6 grout test cubes shall be made at the time the grouting is complete using the same grout. The grout shall be allowed to set prior to cutting any prestressing wires. The grout test cubes shall confirm that the grout has completely set prior to tightening the bolts on the tapping sleeve straps. Tightening and torquing the strap bolts shall not be scheduled until a minimum of 30 minutes after the test cube grout test has been confirmed. Any accelerant used in the grout shall not be corrosive or deleterious to prestressing wire or the steel pipe cylinder.

6. The pressure plate shall be adequately braced to eliminate vibration & flexing of the plate while the tapping machine is operating.

7. The machined gasket groove on the pressure plate shall be consistently positioned about throat of tapping gland waterway. However, ID of the gasket groove shall be set back a minimum of 1" from the waterway to allow dispersal of forces generated by gasket compression. Gasket grooves machined in a circle and then rolled to an elliptical shape shall not be allowed.

8. All waterway welds shall be dye-penetrant inspected or hydrostatically shop tested for water tightness.

9. The gland shall be equipped with load bearing set screws to transfer thrust loads from the branch piping to the sleeve.

10. A three-flange configuration shall be used on all outlets above twelve-inch to allow for valve bypass.

11. Welding the gland to the steel cylinder of the pipe to provide a watertight seal shall not be permitted.

12. The tapping sleeve shall be encased in a minimum of one inch of Portland cement mortar or concrete for corrosion protection after the tap.

3.13 WATER SERVICES

A. Services shall be installed prior to testing the proposed main. These services shall be installed in a location determined by Charlotte Water after consultation with the Contractor (with Inspector present) and applicants.

B. 3/4" and 1" Water Service Connections: Applications shall be made to the Customer Service Section of Charlotte Water and shall pay current fees for 3/4-inch and 1-inch meters prior to construction and installation of water service connections. Only those connections which have been applied for and approved shall be made.

1. Service lines shall be made perpendicular to the water main or road and shall, unless otherwise approved, terminate in the middle of the lot served. All taps shall be made substantially as shown on the Standard Details. Services lines shall be installed with a minimum depth of cover of 30 inches, 36 inches from the main to the meter box, and 30 inches at the tailpiece. Service connections shall be installed prior to pressure testing and sterilization. Allowance for the joints in service connections shall be included when computing the allowable leakage. The Contractor shall flush each connection prior to pressure testing and immediately after sterilization is complete.

2. Meter box locations shall be as shown on the standard details, construction plans or as approved by the Engineer. Meter boxes shall be plastic, unless otherwise approved or directed by the Engineer. In areas with sidewalks or proposed sidewalks, the meter boxes are to be set either totally in or totally out of the sidewalk. Meter boxes set in sidewalks shall be concrete with plastic lids. Meter boxes shall not be set in driveway locations or within the radius point of roads or driveways.

3. Meters shall be obtained through Charlotte Water and shall be installed by Charlotte Water personnel after activation is approved by the Engineer, subject to receipt of turn-on order. The location of services shall be identified by the letter "W" imprinted/cut into the curb directly in front of the service. Where a service is moved or removed, the "W" shall be removed from the curb or grouted over.

4. On projects without curb, the Contractor shall paint a "W" on the edge of pavement adjacent to the service. Markings shall be made with blue paint conforming to the uniform color code established by the Utility Location And Coordination Council of the American Public Works Association.

5. Service connections:

   a. PVC and DIP shall be made by using tapping saddles threaded to accept corporation stops.

   b. Service connections to 30 inch and larger DIP mains may be made without tapping saddles as direct taps to the pipe.

   c. Service connections to HDPE pipe shall be made using fused HDPE Service saddles with integrated cutter heads.

   d. Mechanical tapping saddles and corporation stops shall NOT be used on HDPE water mains.

6. In new streets, piping beneath pavement on "long side" taps shall be installed prior to paving. Backfill shall be compacted as specified with extreme care taken to prevent damage to the copper or HDPE service piping. All services shall be one

continuous piece from the tap to the angle valve in the meter box. Couplings shall not be allowed on service lines.

C. 1-1/2 Inch and 2-inch Services: 1-1/2-inch and 2-inch services may be installed by the Contractor. Such installation shall conform to the Standard Details, as applicable for the meter installations and to the applicable sections for service line piping. All portions of the installation, including property line valves, shall be contained within the street right-of-way. Where this is not feasible because of vault size or limited right-of-way width, or restrictions by the Controlling Agency, the service vault may be installed on private property served by the meter and shall be located directly outside the road right of way. The Contractor shall consult with the project inspector to determine location of meter vaults before installation begins.

1. Service lines shall be made perpendicular to the water main and shall, unless otherwise approved, terminate in the middle of the lot served. All taps shall be made substantially as shown on the Standard Details. Services lines shall be installed with a minimum depth of cover of 36 inches. Service connections shall be installed prior to pressure testing and sterilization. Allowance for the joints in service connections shall be included when computing the allowable leakage. The Contractor shall flush each connection prior to pressure testing and immediately after sterilization is complete.

2. Service vault locations shall be as shown on the standard details. In areas with sidewalks or proposed sidewalks, the meter vaults are to be set either totally in or totally out of the sidewalk. Meter vaults set in sidewalks shall be ADA compliant with the lid frame flush with the sidewalk, not on the vault or vault brickwork. Meter vaults shall not be set in driveway locations or within the radius point of roads or driveways.

3. Meters shall be furnished and installed by the contractor. The location of services shall be identified by the letter "W" imprinted/cut into the curb directly in front of the service vault. Where a service is moved or removed, the "W" shall be removed from the curb or grouted over.

4. The letter “V” shall be imprinted into the curb, pointing directly to service valves that are not in direct alignment with the “W” specified above.

5. On projects without curb, the Contractor shall paint a "W" on the edge of pavement adjacent to the service. Markings shall be made with blue paint conforming to the uniform color code established by the Utility Location And Coordination Council of the American Public Works Association.

6. Service connections to PVC and DIP shall be made by using tapping saddles threaded to accept corporation stops. Service connections to 30 inch and larger DIP mains may be made without tapping saddles as direct taps to the pipe. Service connections to HDPE pipe shall be made using fused HDPE Service saddles with integrated cutter heads. Mechanical tapping saddles and corporation stops shall NOT be used on HDPE water mains.

7. In new streets, piping beneath pavement on "long side" taps shall be installed prior to paving. Backfill shall be compacted as specified with extreme care taken to prevent damage to the service piping. All services shall be one continuous piece from the tap to the ball valve directly in front of the service vault. Couplings shall not be allowed on service lines.

D. 3-inch through 12-inch water services: 3-inch through 12-inch water services may be installed by the Contractor. Such installation shall conform to the Standard Details, as applicable for the meter installations and to the applicable sections for service line piping. All portions of the installation, including property line valves, shall be contained within the street right-of-way. Where this is not feasible because of vault size or limited right-of-way width, or restrictions by the Controlling Agency, the service vault may be installed on private property served by the meter and shall be located directly outside the road right of way. The Contractor shall consult with the project inspector to determine location of meter vaults before installation begins.

1. Service lines shall be made perpendicular to the water main and shall, unless otherwise approved, terminate in the middle of the lot served. All taps shall be made substantially as shown on the Standard Details. Services lines shall be installed with a minimum depth of cover of 36 inches. Service connections shall be installed prior to pressure testing and sterilization. Allowance for the joints in service connections shall be included when computing the allowable leakage. The Contractor shall flush each connection prior to pressure testing and immediately after sterilization is complete.

2. Service vault locations shall be as shown on the standard details. In areas with sidewalks or proposed sidewalks, the meter vaults are to be set either totally in or totally out of the sidewalk. Meter vaults set in sidewalks shall be ADA compliant with the lid frame flush with the sidewalk, not on the vault or vault brickwork. Meter vaults shall not be set in driveway locations or within the radius point of roads or driveways.

3. Meters shall be furnished and installed by the contractor. The location of services shall be identified by the letter "W" imprinted/cut into the curb directly in front of the service vault. Where a service is moved or removed, the "W" shall be removed from the curb or grouted over.

4. The letter “V” shall be imprinted into the curb, pointing directly to service valves that are not in direct alignment with the “W” specified above.

5. On projects without curb, the Contractor shall paint a "W" on the edge of pavement adjacent to the service. Markings shall be made with blue paint conforming to the uniform color code established by the Utility Location And Coordination Council of the American Public Works Association.

6. Service connections to PVC and DIP shall be made by using tapping saddles threaded to accept corporation stops. Service connections to 30 inch and larger DIP mains may be made without tapping saddles as direct taps to the pipe. Service connections to HDPE pipe shall be made using fused HDPE Service saddles with integrated cutter heads. Mechanical tapping saddles and corporation stops shall NOT be used on HDPE water mains.

7. In new streets, piping beneath pavement on "long side" taps shall be installed prior to paving. Backfill shall be compacted as specified with extreme care taken to prevent damage to the service piping. All services shall be one continuous piece from the tap to the ball valve directly in front of the service vault. Couplings shall not be allowed on service lines.

E. 4-inch through 12-inch fire services: 4-inch through 12-inch fire services may be installed by the Contractor. Such installation shall conform to the Standard Details, as applicable for the meter installations and to the applicable sections for service line piping. All

portions of the installation, including property line valves, shall be contained within the street right-of-way. Where this is not feasible because of vault size or limited right-of-way width, or restrictions by the Controlling Agency, the service vault may be installed on private property served by the meter and shall be located directly outside the road right of way. The Contractor shall consult with the project inspector to determine location of meter vaults before installation begins.

1. Fire service lines shall be made perpendicular to the water main and shall, unless otherwise approved, terminate in the middle of the lot served. All taps shall be made substantially as shown on the Standard Details. Services lines shall be installed with a minimum depth of cover of 36 inches. Service connections shall be installed prior to pressure testing and sterilization. Allowance for the joints in service connections shall be included when computing the allowable leakage. The Contractor shall flush each connection prior to pressure testing and immediately after sterilization is complete.

2. Meters shall be furnished and installed by the contractor. Meters shall be located in appropriately sized meter boxes that allow access.

3. Service connections to PVC and DIP shall be made by using tapping saddles. Service connections to 30 inch and larger DIP mains may be made without tapping saddles as direct taps to the pipe. Service connections to HDPE pipe shall be made using fused HDPE Service saddles with integrated cutter heads. Mechanical tapping saddles and corporation stops shall NOT be used on HDPE water mains.

3.14 CONCRETE PLACEMENT

A. Ready mix concrete shall not be accepted without the inspector receiving the plant dispatch ticket.

B. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by the Engineer.

D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

E. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete shall be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.

2. Consolidate placed concrete with mechanical vibrating equipment in accordance with to ACI 301.

3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of

reinforcement and other embedded items without causing mixture constituents to segregate.

F. Forms: Forms may be made of wood, plywood, metal, or any other material approved by the Engineer. Forms shall be mortar tight, of material strong enough to resist noticeable deflection or bulging between supports, and the interior dimensions of the forms shall be such that the finished concrete shall be of the form and dimensions shown on the Plans. The design of the forms shall consider the effect of vibration of concrete as it is placed and also the rate of speed at which the forms shall be filled. Forms shall be coated with a lubricant as approved by the Engineer. Mechanical vibrators, of an approved type, and continuous spading and/or rodding of concrete shall be used to produce proper contact of concrete with forms and reinforcing steel in piers and with forms and pipe in monolithic inverts insuring a compact, dense and impervious artificial stone of uniform texture.

G. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days Maximum temperature in concrete after placement shall not exceed 160ºF (70ºC). Maximum temperature difference between center and surface of placement shall not exceed 35ºF (19ºC).

2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

4. Do not place concrete until the foundation, the adequacy of the forms, the placing of reinforcement and other embedded items have been inspected and approved.

5. Place concrete in daylight unless an approved lighting system is provided.

6. Remove all debris from the interior of forms in preparation for placing concrete. Moisten earth or base course surfaces on which concrete is to be placed immediately before placing concrete. Do not place concrete on excessively wet or frozen surfaces.

7. Place concrete in its final position in the forms within the time stipulated in Sub article 1000-3(E) of NCDOT'S 2024 Standard Specifications for Roads and Structures, Table 1000-2. Elapsed time shall be measured as the time between adding the mixing water to the mix and placing the concrete. Maximum time in between placing the batches at the work site shall not exceed 20 minutes.

ELAPSED TIME FOR PLACING CONCRETE		
Air or Concrete Temperature, whichever is higher.	Maximum Elapsed Time	
	No Retarding Admixture Used	Retarding Admixture Used
90°F or above	30 minutes	1 hr. 15 minutes
80°F through 89°F	45 minutes	1 hr. 30 minutes
79°F or below[A]	60 minutes	1 hr. 45 minutes
70°F through 79°F[B]	60 minutes	1 hr. 45 minutes
69°F or below[B]	1 hr. 30 min	2 hr. 15 minutes

A. Applicable to Class AA, Class A and Drilled Pier concrete

B. Applicable to Class B concrete.

8. Place concrete to avoid segregation of the materials and the displacement of the reinforcement. Thoroughly work the concrete during placement. Bring mortar against the forms to produce a smooth finish, substantially free from water and air pockets or honeycombs.

9. Do not place concrete when the air temperature, measured at the location of the concrete operation in the shade away from artificial heat, is below 35°F unless permission is otherwise granted by the Engineer. When such permission is granted, uniformly heat the aggregates and water to a temperature no higher than 150°F. Place the heated concrete at a temperature of at least 55°F and no more than 80°F.

10. All concrete shall be prevented from freezing by the Contractor during the initial 7 days of curing. The Contractor shall submit an anti-freezing plan for review. Frozen concrete shall be removed and replaced at the Contractor's expense.

H. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

I. Finishing: Provide the type of finish required by the contract directly applicable to the work being constructed

1. Ordinary Surface Finish: Remove all form ties or metal spacers to a depth of at least 1 inch below the surface of the concrete and clean and fill the resulting holes or depressions with grout. Metal devices with exposed cross-sectional area not exceeding approximately 0.05 sq. inches on surfaces permanently in contact with earth fill may be broken off flush with the surface of the concrete.

Remove all fins caused by form joints and other projections. Remove stains and discoloration. Clean all pockets and fill with grout as directed. Thoroughly soak the surface of all concrete with water before the application of a grout repair.

Use grout consisting of one part cement and two parts sand. Use cement from the same source as originally incorporated in work. Cure the grout for at least 3 days.

After the grout has thoroughly hardened, rub the patch with a carborundum stone as required to match the texture and color of the adjacent concrete.

On surfaces that are to be backfilled or surfaces that are enclosed, the removal of form marks, fins and pockets; the rubbing of grouted areas to uniform color; and the removal of stains and discoloration shall not be required.

2. Sidewalk Finish: Strike off fresh concrete and compact until a layer of mortar is brought to the surface. Finish the surface to grade and cross section with a float, trowel smooth and finish with a broom.

3. Rubbed Finish: After the ordinary surface finish has been completed, thoroughly wet and rub the entire surface. Use a coarse carborundum stone or other equally good abrasive to bring the surface to a smooth texture and remove all form marks. Carefully stroke the surface with a clean brush to finish the paste formed by rubbing. Alternatively, spread the paste uniformly over the surface and allow it to take a reset. Finish by floating with a canvas, carpet-faced or cork float or rub down with dry burlap.

4. Float Finish: Finish the surface with a rough carpet float or other suitable device leaving the surface even but distinctly sandy or pebbled in texture.

J. Curing: Cure concrete in accordance with to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

   a. Water.

   b. Continuous water-fog spray.

   c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

   a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.

   b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.

   c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies shall not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller in accordance with to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

K. Flowable Fill/Cellular Concrete:

1. Use straps, soil anchors or other approved means of restraint to ensure correct alignment when flowable fill is used as backfill for pipe or where flotation or misalignment may occur.

2. Protect flowable fill from freezing for a period of 36 hours after placement or until the fill is backfilled.

3. Place flowable fill to the designated fill line without vibration or other means of compaction.

4. Flowable fill may be placed during freezing conditions, provided measures are taken to prevent damage to the concrete until sufficient strength has been attained. Care shall be taken to avoid freezing before initial set. Concrete shall not be placed during heavy or prolonged precipitation.

5. Take all necessary precautions to prevent any damages caused by the hydraulic pressure of the fill during placement prior to hardening. Provide the means to confine the material within the designated space.

L. Testing: The following tests shall be performed by a Testing Laboratory approved by Charlotte Water to ensure the concrete quality. The costs for performing the tests shall be paid by for by Charlotte Water when the test results are in conformity with the specifications below. However, those which show no conformity, or a failure shall be paid for by the Contractor. It shall be the responsibility of the Contractor to properly inform the Testing Laboratory as to when the concrete shall be placed into the forms. For developer projects, the testing laboratory shall be approved by the Engineer and shall be a sub consultant to the developer's consulting engineer. All cost of testing shall be paid by the developer.

1. Compressive strength in accordance with ASTM C-31 and ASTM C-39. Test cylinders which are formed in the field shall be left in the field until compression testing (7-day, 14-day, 28-day, and 56-day for flowable fill and cellular concrete) is completed thereby more closely approximately the curing conditions of the field placed concrete.

2. Slump Test in accordance with ASTM C-143.

3. Air Content Test in accordance with either ASTM C-173 or ASTM C-231.

4. A strength test shall be the average of the strengths of at least two 6 x 12 in. cylinders or at least three 4 x 8 in. cylinders made from the same sample of concrete and tested at 28 days, and 56 days for flowable fill and cellular concrete, or at test age designated for f'c.

5. Cellular concrete unit weight testing shall be in accordance with ASTM C495, ASTM C796 and ASTM C869.

6. The testing agency performing acceptance testing shall comply with ASTM C1077.

7. Samples for preparing strength test specimens of each concrete mixture placed each day shall be taken in accordance with (a) through (c):

   a. At least once a day.

   b. At least once for each 150 CY of concrete.

   c. At least once for each 5,000 SF of surface area for slabs or walls.

8. Engineer shall be consulted if exemption from testing is requested.

3.15 TRACER WIRE, PIPE MARKING, AND IDENTIFICATION

A. Tracer Wire System: A single conductor AWG No. 12 (12-gauge) solid copper wire with 30 mils blue HDPE insultation shall be laid on top of the pipe to aid in locating the pipe for maintenance purposes. For Horizontal Directional Drilling (HDD) installations, two conductor AWG No. 12 (12-gauge) solid copper wires with 45 mils blue HDPE insulation shall be laid on top of the pipe to aid in the locating the pipe for maintenance purposes. The copper conductor wire shall conform to ASTM B-3.

1. The wire shall be secured to the pipe with zip ties or duct tape (2-inches in width) near every bell and at the midpoint of each pipe joint, or at a maximum, every 10 feet. The wires shall **NOT** be fastened to valves, fire hydrants, service saddles, or to copper service tubing. The wire shall be a single continuous conductor from valve box to valve box. When the distance between valve boxes exceeds 500 feet, splices shall be permitted at 500 feet (or greater) intervals, if needed. The splice shall be made watertight as indicated in the standard detail as approved by the Engineer. Splices shall be isolated from direct tension on the wires in accordance with the Standard Details.

2. When wire splices are required, the splices shall be securely bonded together with an approved industrial connector to provide electrical continuity. Connector shall be copper, and insulation shall be repaired as detailed to seal out moisture and corrosion and shall be installed so as to prevent any uninsulated wire exposure. See Standard Details.

3. Valve boxes, for the purposes of this section, shall be defined as mainline valves, fire hydrant guard valves, air release valves, blow off valves, tracer wire termination valve boxes and /or service valves (1.5 inch and greater) which require a standard valve box. At valve boxes, the wire shall be installed along the outside of the valve box assembly from the pipe to the top section of the valve box. The wire shall enter the valve box assembly, directly below the top section of the valve box. The wire shall extend through the top section and shall terminate 24 inches above the top section. This excess wire shall be coiled and stored in the top section, directly below the valve box cover.

4. Contractor shall perform post installation testing of the tracer wire system to confirm conductivity from valve box to valve box on a daily basis during construction. Immediately prior to, or during the final inspection, the Contractor shall perform post installation testing of the tracer wire system to confirm conductivity from valve box to valve box. The test shall consist of applying an alternating High/Low tone voltage to the conductor at one valve box and testing the conductor at the next valve box or service box with Fluke Networks PRO3000 Tone Generator and Probe Kit or approved equal. Every service line pipe segment

shall be tested in addition to all main line pipe segments. Alternate testing methods shall be subject to approval by the Engineer. The testing shall be witnessed by the Engineer. The repair or replacement of any defective or improperly installed systems shall be the responsibility of the Contractor. Any and all repairs or replacement of defective or improperly installed tracer wire systems shall be performed by the Contractor and at no cost to the Engineer. Method of repairs or replacement shall be subject to approval of the Engineer. Upon acceptance by the Engineer, the wires in each valve box shall be connected together with a wire-nut wire connector, coiled and stored in the top section, directly below the valve box cover. The official Tracer Wire Conductivity test shall be performed by the contractor at the time of the Final inspection, or when approved by the Engineer, in presence of the Engineer.

B. Detectable Warning Tape: 6-inch wide blue and black water warning tape shall be installed above the top of the pipe and 24 inches below finish grade.

3.16 FILLING, FLUSHING, TESTING AND INSPECTION

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

1. Filling and Flushing: Upon completion of the installation of the jumper/backflow assembly, the new main may be slowly filled at up to 10 feet per minute to prevent pressure surges due to trapped air removal. Once trapped air has been removed from the pipe, then the new main can be properly flushed at higher velocities between 3 and 6 feet per second. All water usage shall be measured by the water meter required in the jumper assembly. Meter readings shall be documented and recorded daily. The document shall indicate the reason for the water usage each day. The readings shall be provided to the Engineer prior to removal of the jumper/meter assembly. All water usage shall pass through the approved reduced pressure backflow assemblies. The main shall be flushed at a minimum of 3 feet per second and the pipe water volume shall be turned over a minimum of 3 times. Flushing shall continue until all pipe joint/gasket soap/lubricant is removed from the pipe, and until all entrapped air in the pipe is removed. Flushing shall also continue until all visible evidence of dirty water, muddy water or debris is removed from the pipe. Charlotte Water shall provide water free of charge to the Contractor for the initial pipe filling volume and the 3 flushing volume turnovers, or a total of 4 pipe volumes (additional free of charge water volumes are detailed in section 3.16(A)3(b) “Disinfection of mains” herein). All additional water required until the hydrostatic test is approved, shall be billed to the Contractor at the commercial water billing rate.

2. Hydrostatic and Makeup Water Tests: On completion of the line or sections of the lines, connections and appurtenances, the line shall be filled and hydrostatically tested. All water services, air release assemblies, blow off assemblies and fire hydrants shall be complete prior to beginning testing procedures. Fire hydrants shall be rotated to the approved directions and shall be set to final approved finish grade. Hydrant extension kits are limited to one per fire hydrant. Any hydrostatic and makeup water tests shall not begin until all concrete thrust blocking has reached the required

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

a. The Contractor shall use great care to be sure that all air is expelled from each section under test. If fire hydrants or other openings are not available for the purpose of expelling air, the Contractor shall provide air releases of sufficient size (as determined by the Engineer) in accordance with Charlotte Water Standard Drawings, at their expense. Specific procedures for testing mains are as follows:

1) The maximum length of pipe tested in one test shall be 5,000 feet or as close to 5,000 feet as approved by the Engineer, depending on valve spacing.

2) Test pressure shall be 200 PSI or a minimum of 1.25 times the static pressure, whichever is higher, at the high point of the section under test. When testing against valves, the differential pressure at the valve shall not exceed 250 PSI for valves rated at 250 PSI. The maximum water main test pressure shall be 350 PSI based on pipe and fitting ratings. The test pressure shall be rounded up to the next 25 psi pressure interval in the chart below.

Allowable Makeup Water per Service Line (gal/hr)	Water Service Diameter (in)
0.0021	¾
0.0029	1
0.0043	1.5
0.0057	2 and manifold services
0.0086	3
0.0115	4
0.0172	6
0.0229	8
0.0287	10
0.0344	12

3) Allowable makeup water is the volume of water that shall be supplied to the water main to maintain a pressure with 5 PSI of the test pressure and shall be determined by Table 6, AWWA C-600 (see below) or by the formula $L = SD(\sqrt{P})/148{,}000$ where S is the length of pipe under test in feet, D is the pipe diameter in inches, and P is the test pressure

at the low point in the section of pipe being tested during the test (pounds per square inch). The following table lists the additional allowable makeup water for each service on the line being tested, based on the equation in this section and 30-foot average service line lengths at 200 psi testing pressure.

Allowable Makeup Water per 1000 ft. of Pipeline* - gph

Low Point Test Pressure	Nominal Pipe Diameter - *in.*																		
Pressure (psi)	2	3	4	6	8	10	12	14	16	18	20	24	30	36	42	48	54	60	64
350	0.25	0.38	0.51	0.76	1.01	1.26	1.52	1.77	2.02	2.28	2.53	3.03	3.79	4.55	5.31	6.07	6.83	7.58	8.10
300	0.23	0.35	0.47	0.70	0.94	1.17	1.40	1.64	1.87	2.11	2.34	2.81	3.51	4.21	4.92	5.62	6.32	7.02	7.49
275	0.22	0.34	0.45	0.67	0.90	1.12	1.34	1.57	1.79	2.02	2.24	2.69	3.36	4.03	4.71	5.38	6.05	6.72	7.17
250	0.21	0.32	0.43	0.64	0.85	1.07	1.28	1.50	1.71	1.92	2.14	2.56	3.21	3.85	4.49	5.13	5.77	6.41	6.83
225	0.20	0.30	0.41	0.61	0.81	1.01	1.22	1.42	1.62	1.82	2.03	2.43	3.04	3.65	4.26	4.86	5.47	6.08	6.48
200	0.19	0.29	0.38	0.57	0.76	0.96	1.15	1.34	1.53	1.72	1.91	2.29	2.87	3.44	4.01	4.59	5.16	5.73	6.11

* If the pipeline under test contains sections of various diameters, the allowable makeup water shall be the sum of the computed leakage for each size.

4) Makeup water tests shall be run for a duration of two hours plus the time required to complete all valve and service 10-minute testing requirements. For water mains 16 inch and larger, a continuous 8-hour pressure test at the required test pressure shall be conducted, after the makeup water test, to provide proof of restrained joint assemblies and concrete thrust blocking installations.

5) The Contractor shall pressurize the line and complete a pre-test to verify that it is within allowable makeup water before the official test is started. All makeup water shall be measured by a 5/8-inch ultrasonic water meter, furnished by Charlotte Water. Pressure gauges shall be furnished by the Contractor. The official test gauge shall be 4.5-inch dial with accuracy of ±0.5% of span per ASME B40.100, Grade 2A with liquid fill, throttle screw and pulsation damper, or 3-inch digital gauge with accuracy of ±0.25% of span. The gauge shall be 300 PSI or as approved by the Engineer. The gauge shall be calibrated within 90 days of the pressure test. Proof of calibration by a third-party testing/lab company shall be provided prior to the testing. Other observation gauges may be 2.5-inch dials with accuracy of ±3-2-3% of span (ASME B40.100, Grade B).

6) When testing mains with Contractor installed water services, the Engineer shall require jumpers to be installed on a random basis on a minimum of 10 services, or a minimum of 10%, whichever is greater,

of ¾ and 1 inch service meter yokes with full test pressure applied to the property line valve. The jumper locations shall be selected by the inspector. Such jumpers shall be furnished and installed by the Contractor. During the 2-hour pressure test, the random jumper services shall be tested to the property line angle ball valve on the back side of the meter yoke. Front side angle ball valves shall be tested at the end of the water main test, with the jumpers removed. These front side angle ball valve test may be conducted as a single 10-minute test. Services without jumpers shall be tested to the front side angle valve during the 2-hour pressure test.

7) All water service lines shall be flushed to the service box/vault prior to beginning the pressure test. The Inspector shall begin the test and remain at the job for the duration of the official test, making sure that the test pressure is maintained within 5 PSI. The Contractor is to maintain the pressure within 5 PSI for the duration of the test period. During the 2-hour test, the Contractor and the inspector shall inspect all exposed pipe, fittings, valves, hydrants, services, blow offs, and joints. Any defective, damaged or leaking components/joints shall be repaired or replaced, and the test shall be repeated. Any visible leakage shall be repaired regardless of the allowable makeup water results.

8) If makeup water exceeds allowable during the first hour, the makeup water increases during the second hour, or the pressure drops more than 5 psi, the test has failed and shall be terminated. All leaks shall be repaired and the test re-scheduled. If the total makeup water for the two-hour period does not exceed the allowable makeup water, the test has passed and shall be terminated.

9) During the last stages of the test and without any reduction in pressure, first the hydrant guard valves shall be closed. Then progressing in an orderly manner from the end opposite the test pump, each main line valve, fire hydrant valve, air release valve, blow off valve, and service line valve 1.5 inch and larger, shall be closed and pressure released to determine if it is holding pressure (minimum 10 minutes per valve closing).

No visible change in pressure or visible leak is allowed during each valve test. All visible leaks shall be repaired in a manner approved by the Engineer.

10) All services larger than 1-inch shall be tested to the property line valve during the water main test. Each service control valve, including check valves, shall then be tested during the valve testing process after the water main test is complete.

3. <u>Disinfection of Mains</u>:

a. All of the water mains installed shall be thoroughly flushed and disinfected before being placed in service. This work shall be done under the direct supervision of the Engineer's Inspector and shall follow ANSI/AWWA C651 and NC Administrative Code. The AWWA continuous feed method shall be used, unless otherwise approved by the engineer. The specifications below

are based on the continuous feed method and as modified to Charlotte Water Standards. The Contractor shall supply all labor, equipment and materials necessary for carrying out this work.

b. Filling and Flushing for Disinfection and Sampling: All water usage shall be measured by the water meter required in the jumper assembly. Meter readings shall be documented and recorded daily. The document shall indicate the reason for the water usage each day. The readings shall be provided to the Engineer prior to removal of the jumper/meter assembly. All water usage shall pass through the approved reduced pressure backflow assemblies. Charlotte Water shall provide water free of charge to the Contractor for the chlorination, flushing and sampling processes one time or a total of 3 pipe water volumes (additional free of charge water volumes are detailed in section 3.16(A)1 “Filling and Flushing” herein). All additional water required for additional disinfection, flushing, and sampling shall be billed to the Contractor at the commercial water billing rate.

c. Flushing and cleaning are done prior to the pressure test. Sufficient hypochlorite or other chlorine compounds shall be introduced in the lines to produce a chlorine concentration of at least 50 parts per million and not greater than 150 parts per million. Where a direct connection to active water main is required, jumper assembly shall be used for the connection. The jumper shall be inspected by a representative of the Owner and tested by a third-party certified backflow tester prior to use. The jumper shall be located no greater than 10 feet from the chlorination injection point.

d. The chlorine solution shall be retained in the lines for at least twenty-four (24) hours and no greater than 36 hours and tracked at each blow off sampling location. Sampling locations are required every 1200 feet of water main line and at any dead-end line. Blow off standpipes used for sample points shall be a minimum of 24-inches tall and include an extension at a 45- or 90-degree angle of at least 18 inches in length. The blow off shall be constructed of rigid metal pipe and shall end without threads. Fire hydrants are not to be used as sampling points but shall be chlorinated and flushed after 24 hours. At the end of the 24-hour chlorination period, the chlorine residual shall be at least 10 parts per million, prior to flushing. The inspector shall witness the chlorine residual tests at each blow off and sampling location and record the results before the Contractor is approved to begin the flushing and dichlorination processes.

e. The water mains shall then be flushed sufficiently to clear them of chlorine exceeding 0.80 ppm and return the turbidity to less than 1 TBU. Chlorine and turbidity testing shall be witnessed/verified by the Charlotte Water inspector. The flushing velocity shall be no less than 3.0 ft/s. All water services, regardless of size or type, shall be flushed to remove high chlorine concentrations once the water main has been flushed and tested to below 0.80 PPM. This flushing shall be completed within 48-hours of the disinfection processes.

f. Samples of water from the mains shall then be taken and analyzed for bacteriological purity. Water shall be running at a low flow rate for a minimum of 2 hours prior to the sample collection. A representative of the Owner shall be present at the time of sample collection. Sample collection shall be scheduled with the Charlotte Water Laboratory Services a minimum of 24 hours in advance of sample collection. Samples are not collected by the

Laboratory on Friday or City of Charlotte holidays. Results typically take 24 hours and only the Owner may call the laboratory if there are questions regarding the testing. If one sample from the mains fail to meet the bacteriological standard for purity, additional samples shall be collected and retested.

g. If the samples fail three times, disinfecting and flushing shall be repeated until such standards have been met. The Contractor is responsible for the cost of the water required for the additional flushing, disinfection and sampling. The contractor shall also be responsible for the costs of all additional Laboratory testing services. All analysis for chlorine and bacteriological purity shall be by Charlotte Water Laboratory Services. All final connections to the Charlotte Water System shall be completed and the new water mains shall be activated within 14 days after being approved by the laboratory or continually flushed and monitored for chlorine residual. After 14 days of inactivation, the water main shall be retested by the laboratory. The Contractor shall be billed for the water required for the additional flushing and monitoring.

h. If a third-party laboratory is approved for use by Charlotte Water, the Contractor is responsible for all costs, and the Laboratory tests results and reports shall be submitted directly to Charlotte Water from the third-party laboratory.

i. <u>Water Main De-Chlorination and Residual Chlorine Disposal</u>:

1) Water main de-chlorination shall comply with the requirements of AWWA C-655 Field Dechlorination, and as specified below.

2) The total residual chlorine standard set by the NC Department of Environmental Quality (NCDEQ) application to all surface waters of the State, including creeks, streams, ponds, lakes, etc., is 17 parts per billion. Any discharge to waters of the State that results in exceedance of this standard is considered a violation and is subject to enforcement action, including penalties/fines. The Contractor is responsible for reducing the total residual chlorine levels so that this standard is not exceeded in the nearest receiving waters during all water flushing processes.

3) The Contractor shall be required to flush and remove the chlorine from the main 24 hours after initial chlorination. The primary disposal method shall be to de-chlorinate the water on site and discharge to the adjacent ground, nearby creek or the stormwater system. Testing water shall NOT be discharged into the sanitary sewer system. The Contractor shall provide necessary additional erosion control measures to prevent the migration of sediment and prevent erosion. The discharge shall be tested by the Contractor at 15- minute intervals to confirm the total residual chlorine level in the nearest receiving stream is less than 17 parts per billion. Discharge shall be immediately stopped if any elevated chlorine readings are observed by the Contractor or the Engineer. The de-chlorination agent and process shall be approved by the Engineer.

4) Be aware that the over application or miss use of dechlorination agents can deplete dissolved oxygen levels, alter the pH of the receiving stream or otherwise degrade water quality conditions in violation of

State water quality standards. The Contractor is responsible for monitoring downstream conditions to ensure these violations do not occur. The table below indicates the minimum application rates – pounds per 1000 gallons of residual water, required to neutralize the chlorine, based on the residual chlorine concentration and the de-chlorination agent used:

De-Chlorination Agent					
Residual Chlorine Concentration ppm	Ascorbic Acid (Vitamin C) ($C_6O_8H_6$) lbs.	Sodium Thiosulfate ($Na_2S_2O_3$ $5H_2O$) lbs.	Sodium Sulfite (Na_2SO_3) lbs.	Sodium Bisulfite ($NaHSO_3$) lbs.	Sulfur Dioxide (SO_2) lbs.
10	20.9	12.0	14.6	12.5	8.3
50	104.0	60.0	73.0	62.6	41.7
100	208.0	120.0	146.0	125.2	83.4
200	416.0	240.0	292.0	250.4	166.8

4. Drainage of Mains: Drainage of mains and disposal of chlorinated water shall be in accordance with all Federal, State and local laws, ordinances and regulations. Drainage directly to surface waters (creeks, rivers, streams, lakes, ponds, etc.) shall not be allowed. Drainage branches, blowoffs, air release valves/hydrants and appurtenances shall be provided with valves and shall be located and installed as shown on the Plans and Standard Details. Drainage of mains shall be accomplished in such a manner as to minimize erosion and siltation to adjoining properties. Water velocity from drainage and/or blow-off shall be dissipated as necessary to prevent erosion. Temporary energy diffusers shall be used on all discharge ports larger than 2-inch in diameter. Under no circumstances shall discharge water be allowed to enter the sanitary sewer system.

   a. Drainage branches or blowoffs shall not be connected to any sewer, submerged in any streams, or installed in any other manner that shall permit back siphonage into the distribution system.

   b. Metering Water Usage:

      1) All water used during the construction of proposed water mains shall be metered as approved by the Engineer. On projects where a jumper is used between the existing and proposed water mains, the Contractor shall furnish and install a 2 inch or larger water meter as part of the jumper assembly. The meter shall record usage in cubic feet or gallons. All water used, including filling, disinfection, and flushing, shall pass through the meter. The meter shall be read jointly by the contractor and the Charlotte Water inspector prior to installation and immediately prior to removal. See the testing and disinfection sections above for additional information on meter reading and recording requirements.

      2) The Contractor shall provide a water use report to the Engineer at the final inspection. All Cost shall be included in the cost of the pipe.

3) The Owner shall provide water free of charge to the Contractor for Initial main filling, initial flushing to remove air and joint lubricant foaming, flushing to clean the main prior to the pressure testing, the contractor's initial pressure pre-test, the official pressure test, flushing to inject chlorine, flushing to remove chlorine and de-chlorinate, and initial flushing to collect laboratory samples, or a total of 7 times the new main pipe volume. The total 7 free of charge flushing volumes are the combined totals detailed in sections 3.16(A)1 and 3.16(A)3(b) herein. Any additional flushing and discharge of water for any reason shall be the responsibility of the contractor. If additional tests are needed, the Contractor is responsible for the cost of the additional water required to complete the project. The Contractor shall be billed at the commercial water billing rate for all water used in excess of 7 times the new water pipe volume.

3.17 REPAIRS

A. The Contractor shall make any needed repairs to newly installed unactivated mains and shall notify the Owner and Engineer of the repairs. A representative of the Owner shall be on site during repairs. Repairs to existing and/or activated mains shall be made by Charlotte Water unless the Contractor is otherwise directed by the Charlotte Water Engineer.

1. Repairs to New mains: Repairs shall be made by cutting out and removing the damaged/defective section and replacing those with new pipe using long pattern solid sleeves to connect plain ends. Bell clamps and repair clamps shall not be allowed to repair newly installed water mains. The contractor is responsible for all repair costs to new water mains during the warranty period, regardless of who makes the repair.

2. Repairs to Existing Mains: The Contractor shall not be required to repair existing mains unless specifically directed by the Engineer or specified elsewhere in these specifications. Repair methods shall be considered on a case-by-case basis.

3.18 Contractor RECORD DRAWINGS

A. The Engineer shall provide the Contractor a digital set of construction plans to use as the Contractor Record Drawing. The Record Drawings shall be annotated in Bluebeam, by the Contractor, to show all changes encountered or made during the construction of proposed facilities. Record Drawings shall be submitted to the Owner upon completion of construction of facilities required by each sheet. Record Drawings shall be reviewed by the Engineer and Charlotte Water Inspector and subject to approval. Review and approval shall consist of a review for accuracy and completeness, based on the Inspector's knowledge of the project, and based on the minimum requirements indicated below. Record Drawings which are not approved by the Engineer shall be returned to the Contractor for explanation, revision, or correction as deemed necessary by the Engineer.

B. Record Drawings shall meet the following minimum requirements and standards:

1. General to all projects:

   a. Annotations shall be in red digital markups only.

   b. Annotations shall be neatly printed and legible.

c. Add existing facilities encountered but not shown on plans.

d. Revise existing facilities encountered differently from plans.

e. Mark through changed stations, bearings, distances, slopes, etc., and print actual station, bearing, distance, slopes, etc.

f. Mark through “proposed” for items that were actually installed.

g. Mark completely through items that were proposed but were not installed.

h. Correct notes, sizes, diameters, dimensions, classes, types, etc. to actual as installed.

i. Revise profile of proposed facilities to within 0.1 feet of actual vertical and within 1.0 feet of actual horizontal.

j. Revise plan view of proposed facilities to within 1.0 feet of actual.

k. The following sheets are excluded, and do not require updating by the Contractor:

l. Cover Sheet, Permit Sheet. Vicinity/Location Map Sheets

m. Traffic Control Sheets, Erosion Control Sheets, and other Temporary Facilities

n. Standard Detail Sheets unless changes are made on a project specific basis.

2. <u>General to all new water main projects</u>:

a. Indicate pipe manufacturer, type and class of pipe.

b. Indicate station for transition in pipe materials.

c. Indicate restraint type, manufacturer, and beginning and ending stations in profile, or on plan views without profiles.

d. Indicate bedding type and location in profile, or on plan views without profiles.

e. Indicate solid ledge rock in profile to within 0.1 feet of actual vertical and within 1.0 feet of actual horizontal, or on plan views without profiles.

f. All fittings, valves, fire hydrants, air releases, blow-offs, casings, tunnels, etc. shall be stationed.

g. At fire hydrants, a detail shall always be required with station numbers from the tee to the fire hydrant, including all fittings and valves.

h. At fire hydrant, indicate hydrant manufacturer, model, and actual number of turns to operate and direction of open operation (‘open right’ or ‘open left’).

i. At fire hydrant, indicate hydrant actual bury depth, and actual height of hydrant extensions installed, measured to 0.5 feet. Only ONE vertical extension per hydrant is allowed.

j. At air releases and blow-offs, a detail shall always be required with station numbers from the tee to the standpipe/fire hydrant, including all fittings and valves.

k. At ALL valves, indicate valve manufacturer, model, and actual number of turns to operate and direction of open operation (‘open right’ or ‘open left’).

l. At ALL valves, indicate if valve extension stem was installed, and actual height of extension stem, measured to closest 0.1 feet.

m. At services, indicate size, and location of tap, control valve(s), fittings, service box or vault, etc., as measured to closest 1.0 feet along the main and from the closest mainline valve. A detail shall be required with station numbers from the tap to the property line valve for all services other than ¾ and 1-inch residential services, including all fittings and valves.

3.19 FINAL INSPECTION

A. A final inspection shall be held for each project once construction and complete restoration has been completed. The Contractor SHALL ATTEND the final inspection. During the final inspection, all fire hydrants, valves, air releases, blow-offs, and services shall be inspected and operated through one cycle of operation on water projects. All other features of the project, either constructed or reconstructed, shall also be inspected. The official tracer wire test shall be conducted during the Final Inspection process, unless otherwise approved by the Engineer. The Contractor shall be responsible for providing equipment and labor, as may be necessary, to conduct the final inspection and to provide a safe worksite. Deficiencies, if any, shall be noted for correction by the Contractor. The Contractor shall schedule the work with the Inspector. Any and all corrective actions necessary to correct a deficiency noted at the final inspection shall be completed prior to final acceptance of the work and project.

3.20 WARRANTY PERIOD

A. A one-year warranty period is required. The project warranty period shall be established from the date all deficiencies (if any) have been corrected, following the final inspection, and shall extend for one year, unless extended as indicated below.

B. Should deficiencies develop during the warranty period, the Engineer shall determine the severity of the deficiency and advise the Contractor of its priority rating. The priority ratings shall be defined as Emergency, Major, Minor, or Routine. The Engineer reserves the sole right to determine the priority rating of a deficiency and to raise or lower the rating as needed. The Contractor shall respond to these deficiencies in accordance with to the following schedule:

1. Emergency: Once notified, the Contractor shall report to the project site within a maximum of 2 hours and shall mobilize and take all actions necessary to make the site safe. The Contractor and the Engineer shall agree on a course of required actions and timeline for completing those actions. All work necessary to correct the Emergency deficiency shall be completed as quickly as possible.

2. Major: Once notified, the Contractor shall mobilize to the project site within a maximum of 2 business days. The Contractor shall schedule the work with the Inspector. All work necessary to correct the Major deficiency shall be completed within a maximum of 5 business days of mobilization, or in accordance with to timeline approved by the Engineer.

3. Minor: Once notified, the Contractor shall mobilize to the project site within a maximum of 10 business days. The Contractor shall schedule the work with the Inspector. All work necessary to correct the Minor deficiency shall be completed within a maximum of 5 business days of mobilization, or in accordance with to timeline approved by the Engineer.

4. Routine: Once notified, the Contractor shall mobilize to the project site within a maximum of 25 business days. The Contractor shall schedule the work with the Inspector. All work necessary to correct the Routine deficiency shall be completed within a maximum of 5 business days of mobilization, or in accordance with to timeline approved by the Engineer.

C. A warranty inspection shall be scheduled for the project during the final month of the project warranty period. The Contractor SHALL ATTEND the warranty inspection. During the warranty inspection, all fire hydrants, valves, air releases, blow-offs, and services shall be inspected and operated through one cycle of operation on water projects. All other features of the project, either constructed or reconstructed, shall also be inspected. The Contractor shall be responsible for providing equipment and labor, as may be necessary, to conduct the warranty inspection and to provide a safe worksite. Any deficiencies, if any, shall be noted for correction by the Contractor. The Contractor shall schedule the work with the Inspector. The Engineer reserves the sole right to determine the priority rating of each deficiency noted at the warranty inspection. Any and all corrective actions necessary to correct a deficiency noted at the warranty inspection shall be completed within a maximum of 30 days following the warranty inspection.

D. Deficiencies noted and corrected during the warranty period shall extend the project warranty period. The contractor shall warrant and guarantee the corrected work for one year from the date the deficiency is corrected. A warranty inspection shall be conducted within the final month of the extended warranty period. The extended warranty inspection shall be conducted as described above for a warranty inspection for the specific items that required warranty repairs during the warranty period.

3.21 PROPERTY OWNER RELEASES

A. The Contractor shall contain their work activities within the public road rights-of-way, Charlotte Water public utility easements or restricted areas on Charlotte Water Property (where necessary) as shown on the plans. Any contractor activities outside these easements and rights-of-way shall be considered work on private property. Work on private property may require the contractor to obtain from the impacted property owner, a release that holds the city harmless against claim for damages resulting from the contractor's activities on private property. Any specific work or service performed by the contractor on behalf of the property owner shall be noted in the release document. The release shall be signed and dated by the legal owner of the property and shall be witnessed and dated by the Contractor's representative. The contractor is responsible for retaining the original release. The Contractor shall provide a copy of the release to the Engineer prior to request for a final inspection.

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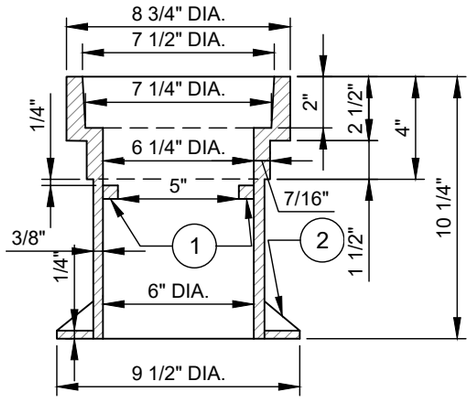
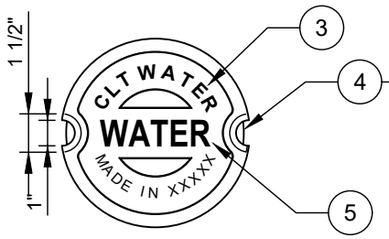
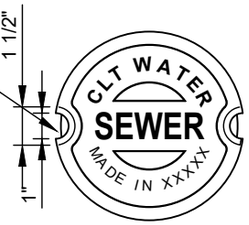


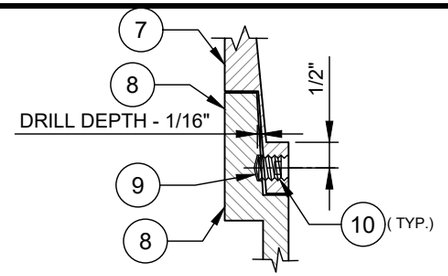
VALVE BOX - TOP SECTION
SECTION VIEW



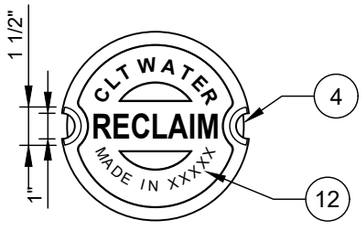
WATER COVER - TOP VIEW



SEWER COVER - TOP VIEW

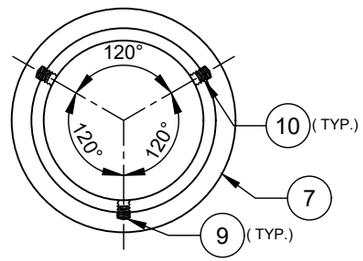


TYPE I CROSS SECTION - ASSEMBLY



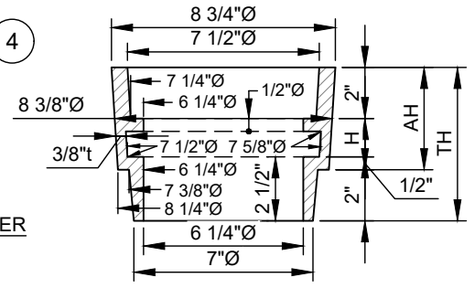
RECLAIMED WATER - TOP VIEW

CATHODIC PROTECTION COVER
TOP - VIEW

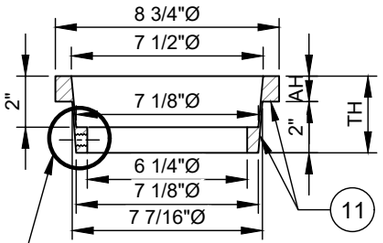


TYPE I - ADJUSTMENT RISER TOP VIEW

TRACER WIRE TERMINAL POINT COVER
TOP - VIEW

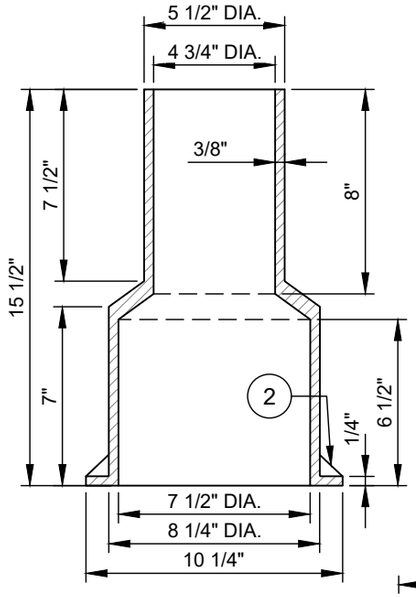


TYPE II - ADJUSTMENT RISER
SECTION VIEW

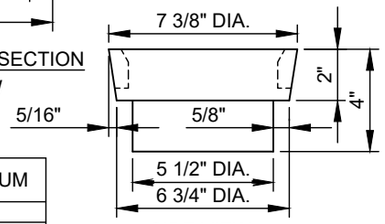


SEE CROSS SECTION

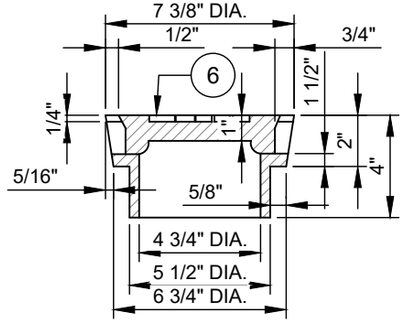
TYPE I - ADJUSTMENT RISER
SECTION VIEW



VALVE BOX - BOTTOM SECTION
SECTION VIEW



SIDE VIEW



COVER - SECTION VIEW

WEIGHT (POUNDS)	MINIMUM
TOP SECTION	31
BOTTOM SECTION	36
COVER	19
TOTAL	86

TYPE II - ADJUSTMENT RISER			
TH - TOTAL HEIGHT	AH - ADJUSTMENT HEIGHT	H	MINIMUM WEIGHT - LBS
< 4 1/2"	< 2 1/2"	NOT APPROVED	NOT APPROVED
4 1/2"	2 1/2"	0	16
5"	3"	1/2"	20
6"	4"	1 1/2"	22.5
7"	5"	2 1/2"	25
8"	6"	3 1/2"	27
10"	8"	5 1/2"	32

TYPE I - ADJUSTMENT RISER		
TH - TOTAL HEIGHT	AH - ADJUSTMENT HEIGHT	MIN. WEIGHT LBS
3"	1"	7
3 1/2"	1 1/2"	9
4"	2"	15
> 4"	NOT APPROVED	N/A

NO.	DESCRIPTION:
1.	2 LUGS 3/8" X 1/4".
2.	(4) 1/4" RIBS.
3.	3/4" LETTERING (TYP.).
4.	(2) PICK HOLES.
5.	1 1/4" RAISED FLUSH LETTERS (TYP.).
6.	RECESSED LETTERING.
7.	TYPE I ADJUSTMENT RISER.
8.	VALVE BOX - TOP SECTION.
9.	1/2" DIAMETER X 1/16" - FIELD DRILL HOLE.
10.	18 - 8 S.S. 3/8"-16 X 3/8" HEX SET SCREW WITH PERMANENT THREAD LOCK (RED) - LOCTITE #271, PERMABOND HM128, OR APPROVED EQUAL.
11.	MACHINED SURFACE.
12.	0.44"-1/2" LETTERING (TYP.).

NOTES:

A. LOAD RATING - HEAVY DUTY.
B. FERROUS CASTINGS MATERIAL - ASTM A48 - CLASS 35 GRAY IRON.
C. COATING - UNDIPPED OR ASPHALT VARNISH.
D. WEIGHT - 0% MINUS TOLERANCE.
E. CASTINGS SHALL CONFORM TO DIMENSION AND WEIGHT REQUIREMENTS.
F. TYPE II ADJUSTMENT RISERS MAY BE STACKED.
G. TYPE I ADJUSTMENT RISERS MAY NOT BE STACKED.
H. ADJUSTMENT RINGS ARE NOT APPROVED FOR USE IN NEW CONSTRUCTION.
I. ADJUSTMENT RINGS MAY ONLY BE USED ON RESURFACING PROJECTS AND IS LIMITED TO ONE RISER PER VALVE BOX.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

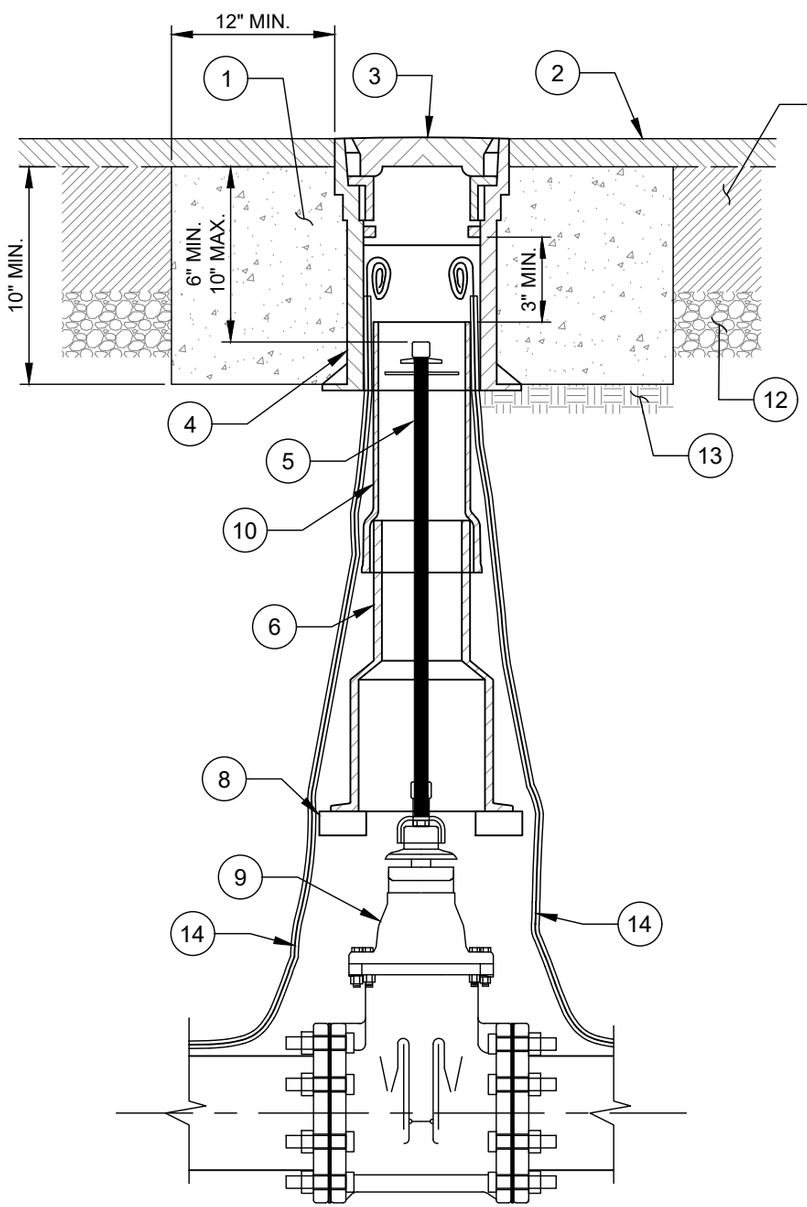
CAST IRON VALVE BOX (12" AND SMALLER VALVES - ONLY)

NO SCALE

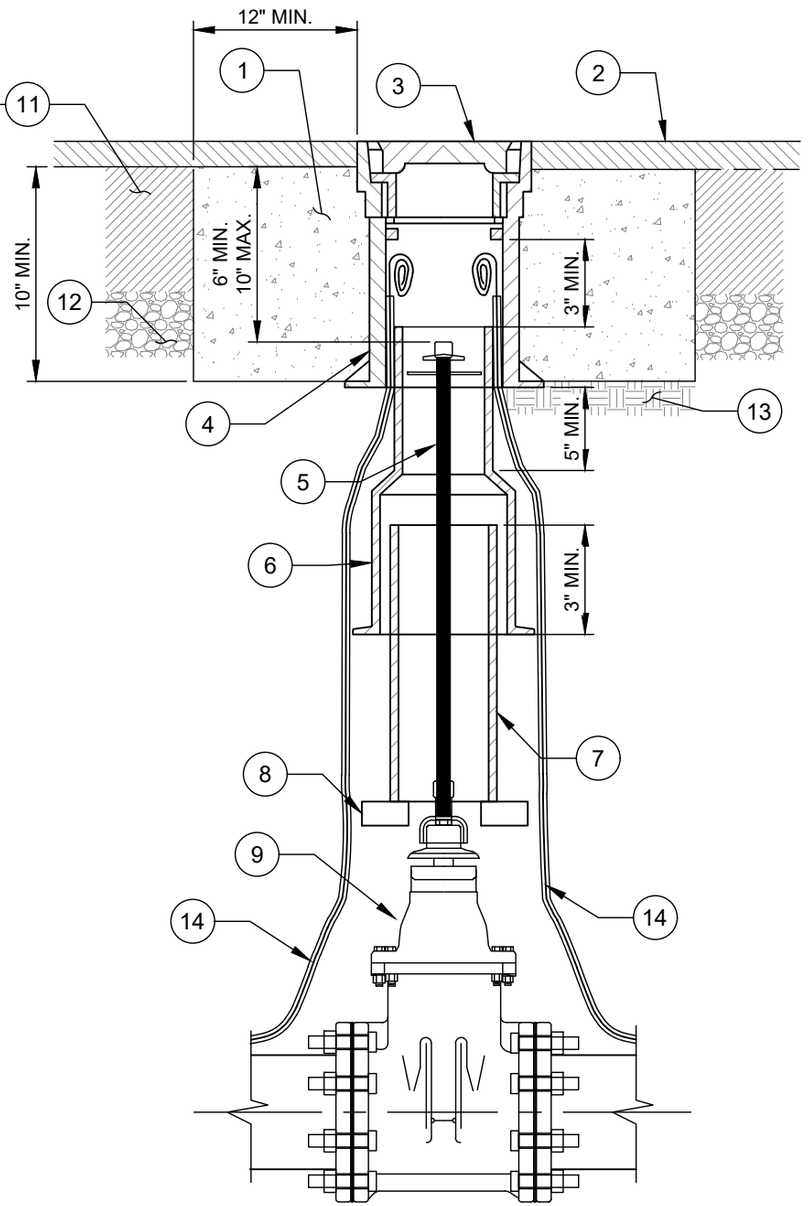
VERSION 1.0

DATE 04/2024

DETAIL 10.1.1



TYPE A
USING CAST IRON SOIL PIPE



TYPE B
USING PVC PIPE

NO. DESCRIPTION:

1. CONCRETE PAD - CAST IN PLACE.
2. FINAL ASPHALT SURFACE COURSE.
3. VALVE BOX COVER.
4. TOP SECTION VALVE BOX.
5. EXTENSION STEM AS REQUIRED.
6. BOTTOM SECTION VALVE BOX.
7. 6" PVC PIPE (C900 OR SDR26).
8. STANDARD CONCRETE BRICK - 2 EACH.
9. GATE VALVE (OR BALL VALVE, AS APPLICABLE).
10. 5" DIAMETER CAST IRON SOIL PIPE - BELL OF PIPE WILL RECEIVE BOTTOM SECTION OF VALVE BOX.
11. EXISTING OR NEW PAVEMENT.
12. COMPACTED AGGREGATE BASE COURSE (CABC).
13. COMPACTED SUBGRADE.
14. AWG #12 GAUGE SOLID COPPER HDPE TRACER WIRE WITH 30 MILS HDPE BLUE INSULATION, TERMINATE WITH 24" EXCESS WIRE (COILED) AT METER BOX AND VALVE BOX (TYP.).

NOTES:

A. WATER VALVE ADJUSTMENTS WILL BE COMPLETED AT LEAST 36 HOURS BEFORE RESURFACING.
B. 12" MINIMUM WIDTH OF EXCAVATION AROUND VALVE BOX.
C. DISTURBED AREAS AROUND STRUCTURE ADJUSTMENTS ARE TO BE TAMPED AND FILLED WITH 4,000 PSI "HIGH EARLY" PORTLAND CEMENT CONCRETE.
D. ALL DAMAGED OR MISALIGNED VALVE BOXES ARE TO BE REPORTED TO INSPECTOR, OTHERWISE CONTRACTOR ASSUMES RESPONSIBILITY FOR DAMAGE OR MISALIGNMENT.
E. IF THE VERTICAL ADJUSTMENT CAUSES LESS THAN ONE INCH OVERLAP BETWEEN TOP SECTION AND RISER PIPE, CONTRACTOR WILL REMOVE AND REPLACE RISER PIPE FROM BOTTOM SECTION TO TOP TO PROVIDE 3" OF OVERLAP IN TOP SECTION FOR TYPE A OR IF THE VERTICAL ADJUSTMENT CAUSES LESS THAN ONE INCH OVERLAP BETWEEN TOP SECTION AND BOTTOM SECTION, CONTRACTOR WILL REMOVE AND RESET BOTTOM SECTION TO PROVIDE A MINIMUM OF 3" OVERLAP AT TOP SECTION/BOTTOM SECTION JOINT SECTION & BOTTOM SECTION/RISER PIPE JOINT FOR TYPE B.
F. ALL CONCRETE SHALL BE VIBRATED IN ACCORDANCE WITH N.C. DEPARTMENT OF TRANSPORTATION SPECIFICATIONS.
G. TOP & BOTTOM SECTION TO BE CENTERED OVER NUT, NOT TO BEAR ON VALVE BODY.
H. PROVIDE CLEARANCE BETWEEN VALVE BOX/BRICK AND THE VALVE.
I. VALVE BOX ASSEMBLY SHALL CONSIST OF NO MORE THAN 3 VERTICAL SECTIONS - 1 TOP SECTION, 1 - BOTTOM SECTION AND 1 - PIPE RISER SECTION.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

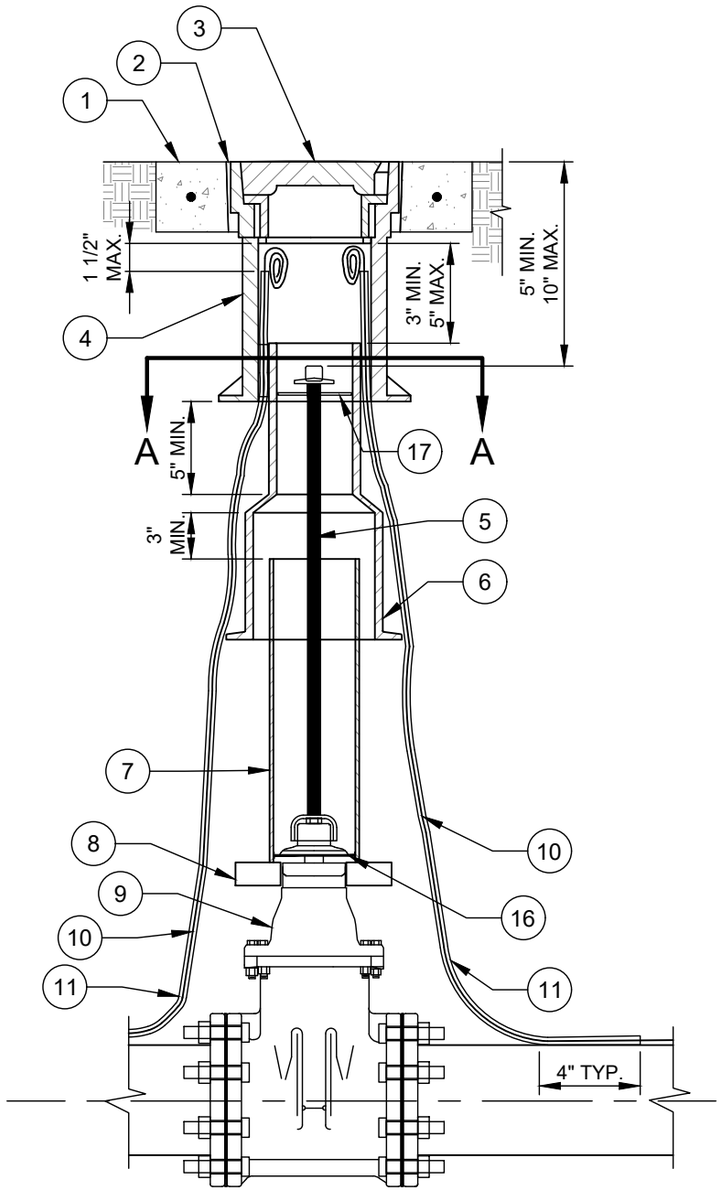
VERTICAL VALVE BOX ADJUSTMENT FOR PAVEMENT RESURFACING

NO SCALE

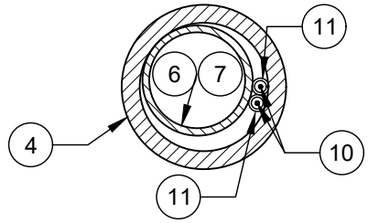
VERSION 1.0

DATE 04/2024

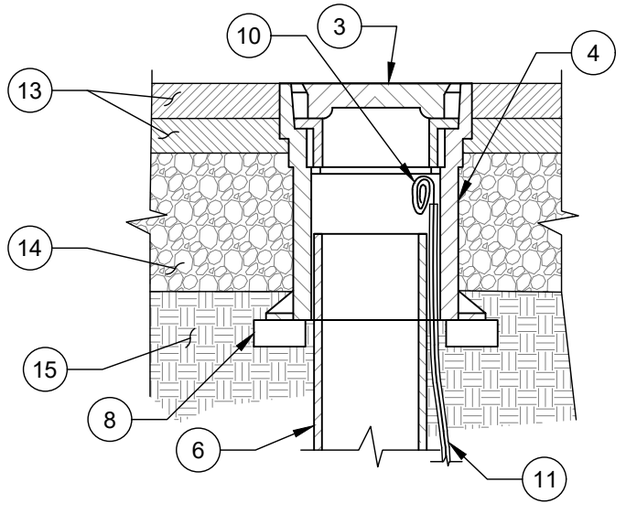
DETAIL 10.1.2



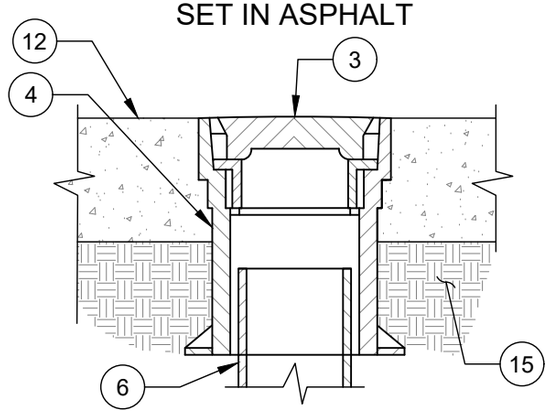
USING PVC OR DIP STANDPIPE



SECTION A-A



ALTERNATE A
SET IN ASPHALT



ALTERNATE B
CAST IN CONCRETE

NO. DESCRIPTION:

1. 24" X 24" PRECAST (OR CAST IN PLACE) CONCRETE PAD OR 24" DIAMETER PRECAST PAD.
2. NON - SHRINK GROUT - FILL ANNULAR SPACE.
3. VALVE BOX COVER.
4. CAST IRON VALVE BOX.
5. EXTENSION STEM AS REQUIRED. SEE NOTES.
6. VALVE BOX BOTTOM SECTION.
7. 6" DIP OR C900 PVC STANDPIPE.
8. STANDARD CONCRETE BRICK - 2 EACH.
9. GATE VALVE (OR BALL VALVE, AS APPLICABLE).
10. AWG #12 GAUGE COPPER TRACER WIRE WITH 30 MIL HDPE BLUE INSULATION, TERMINATE WITH 24 INCH EXCESS WIRE (COILED) AT VALVE BOX (TYP.).
11. 1/4" OR 3/8" ID CONDUIT - SDR 10 PEX TUBING - ASTM F 976.
12. CONCRETE (ROADWAY, DRIVEWAY OR SIDEWALK).
13. ASPHALT PAVEMENT.
14. COMPACTED AGGREGATE BASE COURSE (CABC) OR ASPHALT BASE COURSE.
15. COMPACTED SUBGRADE.
16. PLASTIC VALVE CENTERING DISK (EX: PLASTIC POSI-CAP VALVE BOX ALIGNER DISK) REQUIRED TO KEEP VALVE BOX ALIGNED DURING BACK FILLING.
17. ALUM OR STEEL CENTERING DISK.

NOTES:

A. STANDPIPE TO BE CENTERED OVER VALVE NUT AND SHALL NOT BEAR ON VALVE BODY.
B. PROVIDE CLEARANCE BETWEEN BRICK AND THE VALVE.
C. WHEN OPERATING NUT DEPTH EXCEEDS 3' BELOW FINISHED GRADE, PROVIDE EXTENSION STEM WITH STANDARD 2" SQUARE OPERATING NUT IN TOP SECTION OF VALVE BOX. SEE STANDARD DETAIL.
D. VALVE BOX ASSEMBLY SHALL CONSIST OF NO MORE THAN 2 VERTICAL SECTIONS - 1 VALVE BOX, AND 1 - STANDPIPE RISER SECTION.
E. CONCRETE PADS SHALL NOT BE USED IN PAVEMENT (CONCRETE OR ASPHALT), SIDEWALKS OR DRIVEWAYS.
F. VALVE BOX ASSEMBLY SHALL BE INSTALLED SO IT DOES NOT APPLY IMPACT LOADING TO THE VALVE.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

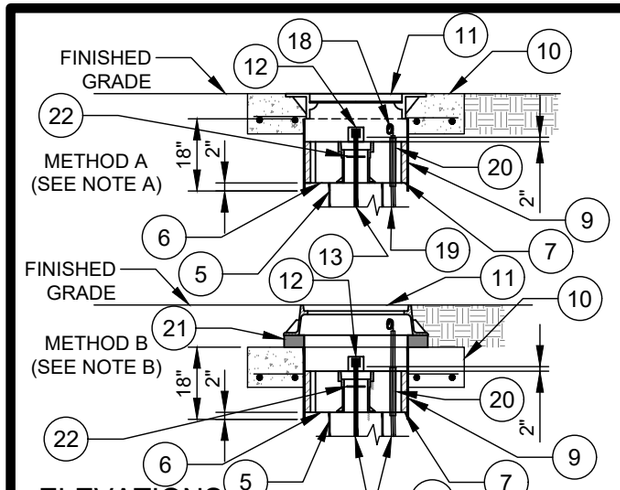
VALVE BOX ASSEMBLY INSTALLATION- 12" AND SMALLER VALVES

NO SCALE

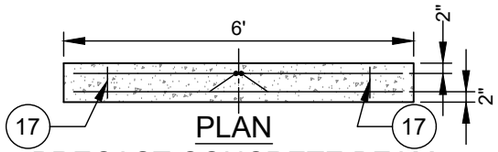
VERSION 1.0

DATE 04/2024

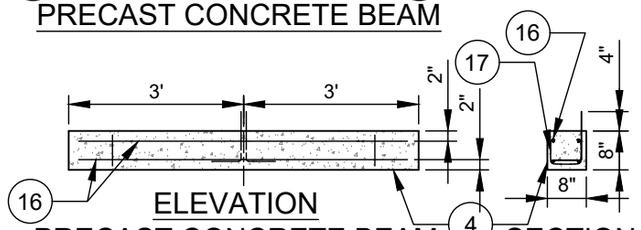
DETAIL 10.1.3



ELEVATIONS

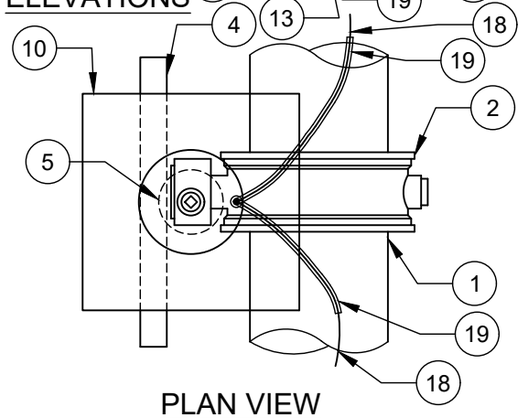


PLAN
PRECAST CONCRETE BEAM

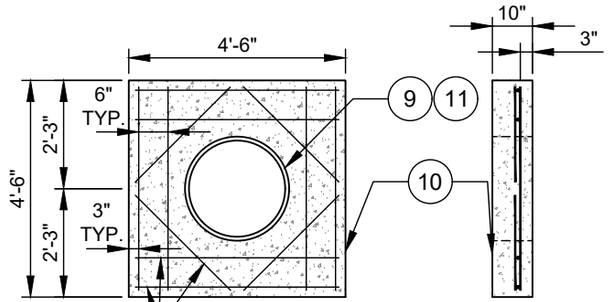


ELEVATION
PRECAST CONCRETE BEAM

SECTION

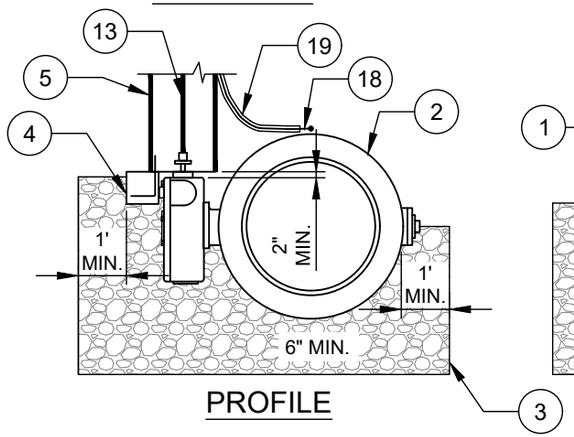


PLAN VIEW

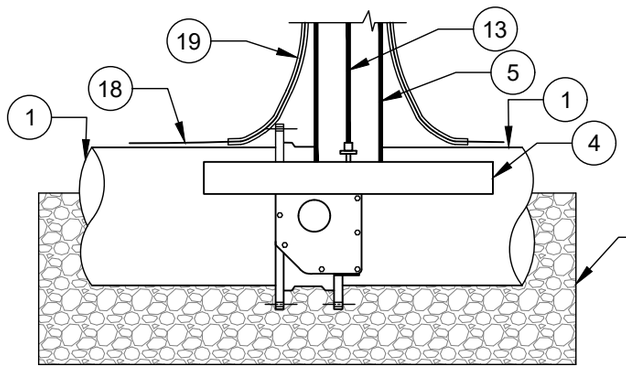


PLAN
PRECAST CONCRETE PAD

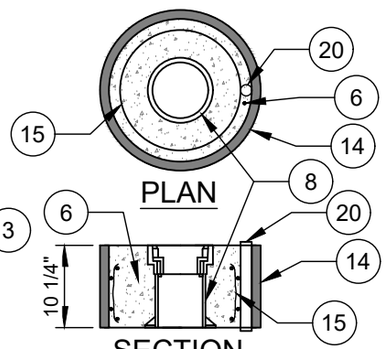
SECTION



PROFILE



SIDE



PLAN

SECTION
PRECAST CONCRETE FLOOR

NO. DESCRIPTION:

1. WATER MAIN.
2. DIRECT BURY BUTTERFLY VALVE.
3. WASHED #57 STONE - MINIMUM 6' EACH SIDE OF VALVE.
4. PRECAST CONCRETE BEAM (REINFORCED).
5. 12" (MIN.) DIP (OR C900 PVC) RISER PIPE 20" MAXIMUM.
6. PRECAST CONCRETE FLOOR (REINFORCED).
7. 1/2-INCH EXPANSION MATERIAL (CONSTRUCTION JOINT).
8. STANDARD VALVE BOX (W/COVER), CAST IN CONCRETE FLOOR NO. 6.
9. 24" PVC PIPE - C900 - DR18, OR DIP - CAST IN.
10. PRECAST CONCRETE PAD (REINFORCED).
11. FRAME AND COVER - SEE CLTW STD. DETAILS.
12. VALVE LOCK BOX - FURNISHED BY CLTW.
13. EXTENSION STEM ASSEMBLY - SEE CLTW STD. DETAIL.
14. 20" PVC PIPE - C900 - DR18, DR21, OR DR25.
15. WELDED WIRE FABRIC (WWF) - 6 X 6, W2.9/W2.9, 16" DIAMETER, OR 2 EACH #3 REBARS - 16" DIAMETER.
16. #4 REBARS - AS SHOWN.
17. #2 OR #3 REBARS - STIRRUPS - AS SHOWN.
18. AWG #12 GAUGE SOLID COPPER TRACER WIRE WITH 30 MILS HDPE BLUE INSULATION, TERMINATE WITH 24" EXCESS WIRE (COILED) IN VALVE BOX (TYP.).
19. 1/4" OR 3/8" ID CONDUIT - SDR 9 PEX TUBING - ASTM F876.
20. 3/4" DIAMETER X 12" SCH 40 PVC CONDUIT.
21. GRADE / SLOPE ADJUSTMENT RING - PRECAST CONCRETE OR RECYCLED RUBBER.
22. ALUM OR STEEL CENTERING DISK.

NOTES:

A. METHOD A SHALL BE REQUIRED IN WATER MAIN EASEMENTS, OR WHEN VALVE IS BACK OF ROAD DITCH.
B. METHOD B SHALL BE REQUIRED WHEN VALVE IS IN MAINTAINED LAWNS, ON ROAD SHOULDER, IN PAVEMENT DRIVEWAYS OR SIDEWALKS.
C. DIAMETER OF RISER MAY VARY AS REQUIRED BY VALVE ACTUATOR, AS APPROVED BY CLTW.
D. EXTENSION STEM REQUIRED REGARDLESS OF DEPTH. SEE CLTW STD. EXTENSION STEM DETAIL.
E. PROVIDE 2" CLEARANCE IN ALL DIRECTIONS BETWEEN RISER AND VALVE/ACTUATOR (SEE NOTE C).
F. DIRECT BURY BUTTERFLY VALVES SHALL ONLY BE USED WHEN APPROVED BY CLTW.
G. VALVE BOX ASSEMBLY SHALL BE INSTALLED SO IT DOES NOT APPLY IMPACT LOADING TO THE VALVE.

DESIGN REQUIREMENTS:

a. CONCRETE - f'c = 3,600 PSI (MIN.)
b. REBARS - GRADE 60, ASTM A615
c. WELDED WIRE FABRIC - ASTM A185, A82

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

VALVE BOX ASSEMBLY INSTALLATION
DIRECT BURY BUTTERFLY VALVES
36-INCH AND LARGER MAINS

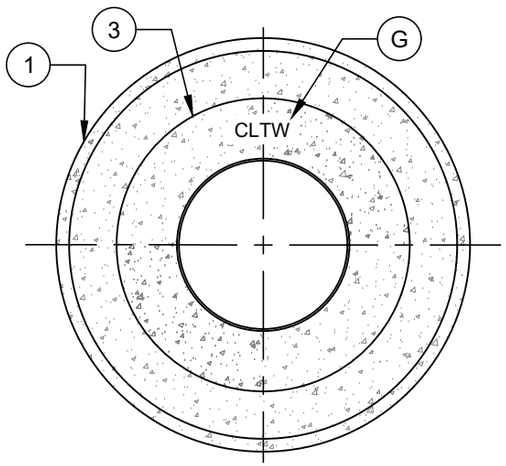
NO SCALE

VERSION 1.0

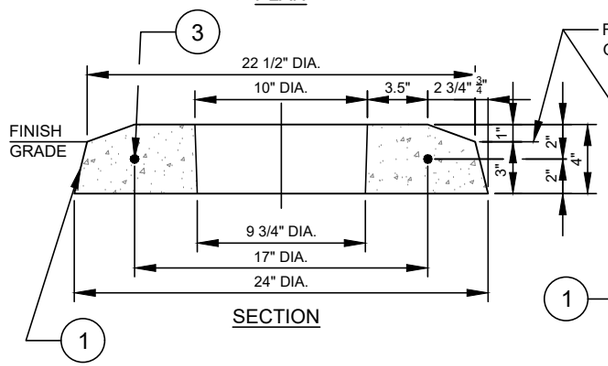
DATE 04/2024

DETAIL 10.1.4

TYPE A - VALVE PAD
PRECAST ONLY

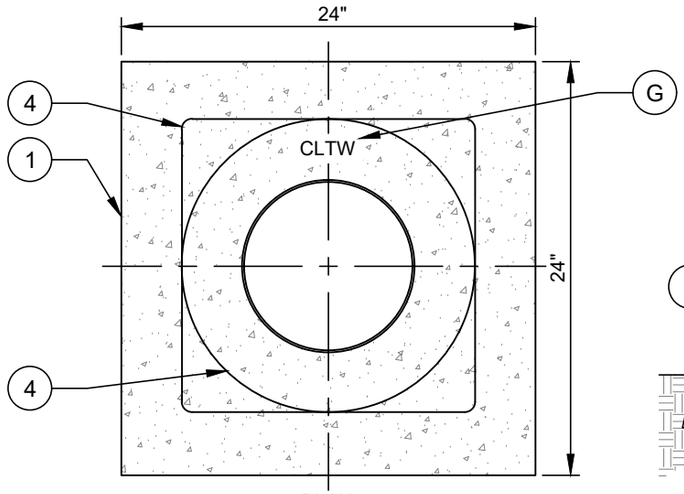


PLAN

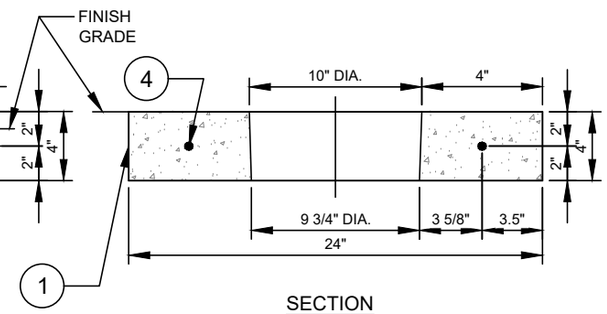


SECTION

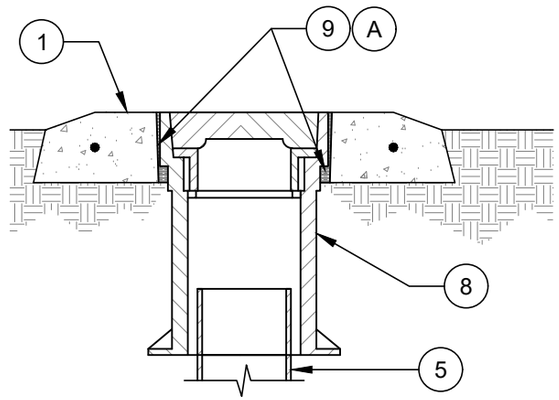
TYPE B - VALVE PAD
PRECAST OR CAST IN PLACE



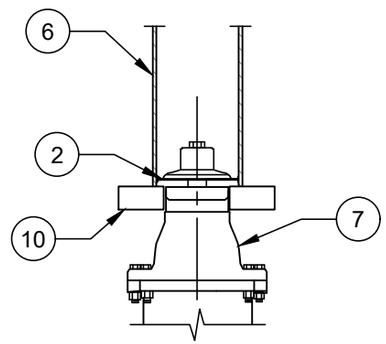
PLAN



SECTION



INSTALLATION DETAIL ONE
SECTION VIEW



INSTALLATION DETAIL TWO
SECTION VIEW

NO.	DESCRIPTION:
1.	CONCRETE VALVE PAD.
2.	PLASTIC VALVE CENTERING DISK (EX: PLASTIC POSI-CAP VALVE BOX ALIGNER DISK) REQUIRED TO KEEP VALVE BOX ALIGNED DURING BACK FILLING. REQUIRED FOR ALL VALVES.
3.	#4 REBAR – 17" DIAMETER.
4.	#4 REBAR – LENGTH = 68", OR (ALTERNATE -17" DIAMETER).
5.	VALVE BOX BOTTOM SECTION.
6.	6" DIAMETER C900 PVC PIPE.
7.	GATE VALVE – 12" OR SMALLER.
8.	TOP SECTION OF VALVE BOX.
9.	FILL ANNULAR SPACE WITH NON SHRINK GROUT.
10.	CONCRETE SUPPORT BRICK - 2 EACH.

NOTES:

A. FOR PRECAST CONC. VALVE PADS – FILL VOID BETWEEN CONC. VALVE PADS AND CAST IRON VALVE BOX TOP SECTION WITH NON-SHRINK GROUT.
B. FOR CAST-IN-PLACE VALVE PADS – TOP SECTION OF CAST IRON VALVE BOX SHALL BE CAST IN THE CONCRETE.
C. TYPE A VALVE PAD SHALL BE REQUIRED ON ROAD SHOULDERS WITHOUT CURB.
D. FOR INSTALLATION DETAIL TWO – ONLY ONE VALVE BOX ASSEMBLY (NO. 5 OR NO. 6) SHALL BE REQUIRED. VALVE BOX ASSEMBLY SHALL NOT REST ON THE VALVE, AND SHALL BE CENTERED ON THE VALVE OPERATING NUT AS SHOWN.
E. TOP SECTION/LID SHALL BE FLUSH WITH VALVE PAD TO AVOID TRIPPING HAZARD.
F. FOR LOCATIONS WHERE A STANDARD PRECAST VALVE PAD DOES NOT FIT, IT CANNOT BE CUT TO FIT AND A CAST IN PLACE CONCRETE PAD MUST BE POURED IN PLACE.
G. "CLTW" BLOCK LETTERING, MINIMUM 2 INCH HIGH, ETCHED OR STAMPED INTO WET CONCRETE.

DESIGN REQUIREMENTS:

a. CONCRETE – f'c = 4,000 PSI (PRECAST), OR 3,600 PSI (CAST-IN-PLACE).
b. STEEL REINFORCEMENT – REBARS – GRADE 60 (60,000 PSI) – ASTM A-615, OR WELDED WIRE FABRIC – ASTM A-185.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

VALVE BOX - CONCRETE VALVE PADS (12" AND SMALLER VALVES - ONLY) (2" AIR RELEASES AND BLOW OFFS)

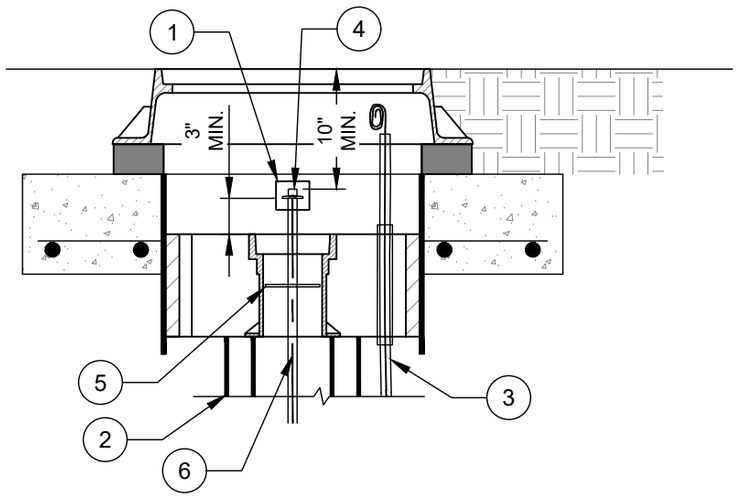
NO SCALE

VERSION 2.0

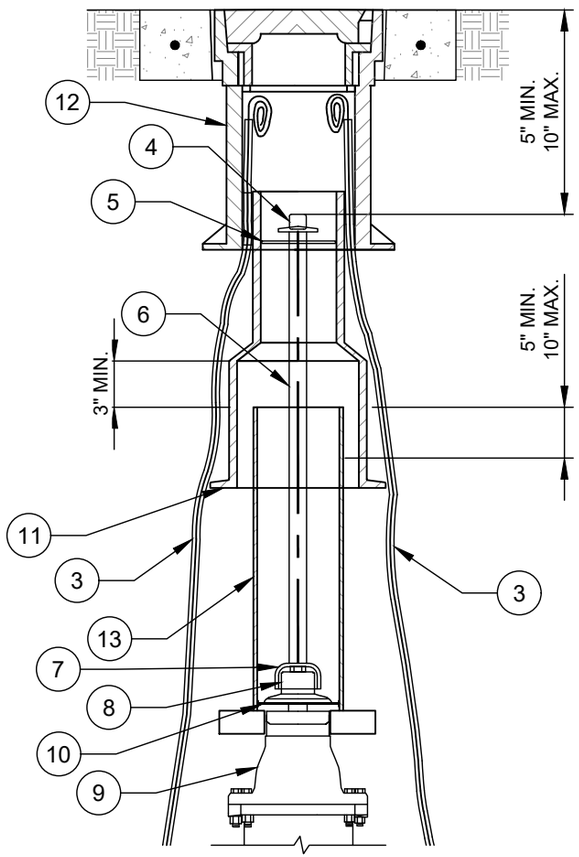
DATE 01/2026

DETAIL 10.1.5

16" AND LARGER GATE VALVE EXTENSION STEMS



12" AND SMALLER GATE VALVE EXTENSION STEM ASSEMBLY



NO.	DESCRIPTION:
1.	VALVE LOCK BOX - FURNISHED BY CLTW.
2.	12"-20" DIP STANDPIPE.
3.	TRACER WIRE CONDUIT.
4.	STANDARD VALVE OPERATING NUT (2" SQUARE OPERATING NUT) PAINTED RED FOR OPEN RIGHT OR BLACK FOR OPEN LEFT, WITH OPEN OPERATION ARROW.
5.	ALUMINUM 1/4" S.S. PLATE, 4 1/2" DIAMETER CENTERING COLLAR. LOCATE THE CENTERING COLLAR INTO THE VALVE BOX AS SHOWN.
6.	1 1/4" SQUARE S.S. STEM (LENGTH VARIES, NO JOINTS ALLOWED).
7.	STANDARD OR S.S. OPERATING SOCKET WITH FOUR 3/8" SET SCREWS.
8.	VALVE OPERATING NUT WITH SET SCREW DIMPLES.
9.	VALVE.
10.	PLASTIC VALVE CENTERING COLLAR. PLASTIC VALVE CENTERING DISK (EX: PLASTIC POSI-CAP VALVE BOX ALIGNER DISK) REQUIRED TO KEEP VALVE BOX ALIGNED DURING BACK FILLING.
11.	BOTTOM SECTION VALVE BOX.
12.	TOP SECTION OF VALVE BOX.
13.	6" C900 PVC OR DIP STANDPIPE.

NOTES:

A. EXTENSION REQUIRED IF DEPTH IS GREATER THAN THREE FEET.

B. EXTENSION MUST BE ONE SOLID PIECE FROM NUT TO COUPLING.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

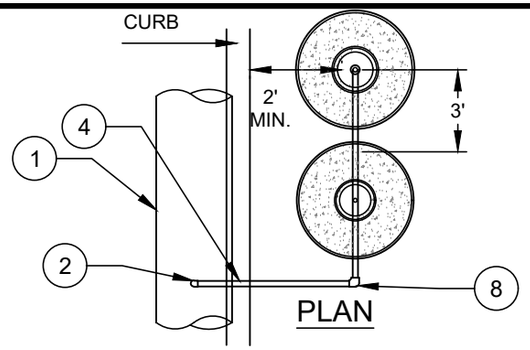
DIRECT BURY VALVE EXTENSION STEM ASSEMBLY

NO SCALE

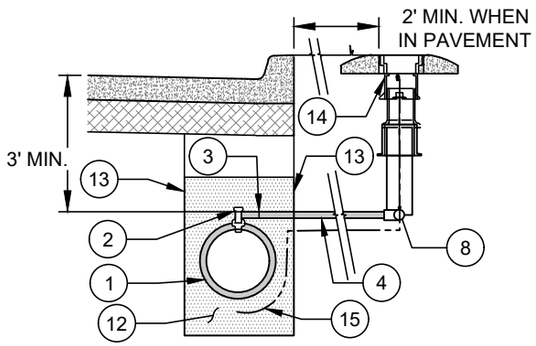
VERSION
1.0

DATE
04/2024

DETAIL
10.1.6

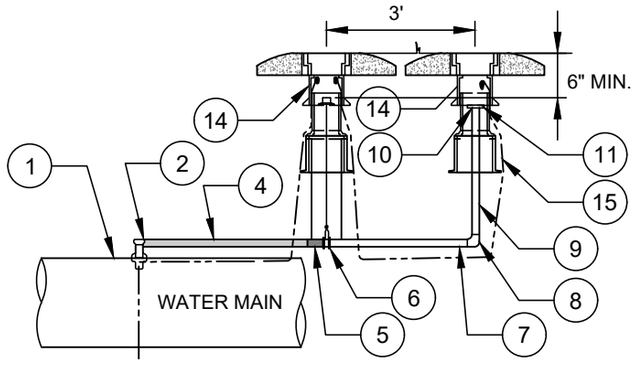


PLAN



FRONT ELEVATION

6"-16" MAIN



SIDE ELEVATION

ITEM LIST FOR 2" AIR RELEASE

NO. DESCRIPTION:

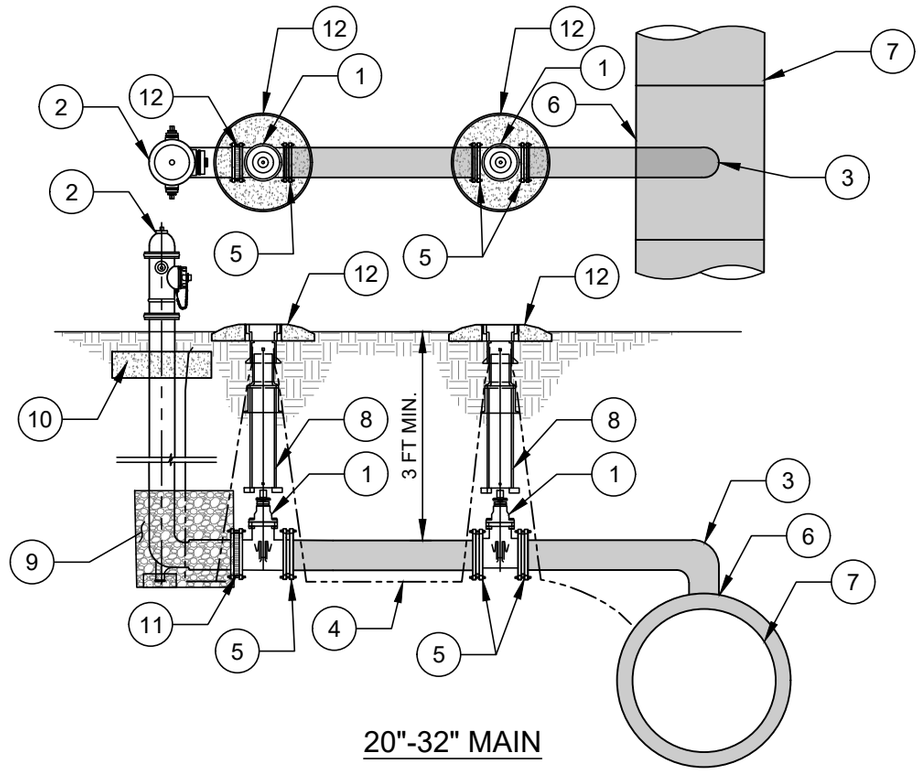
1. HDPE WATER MAIN.
2. 2" HDPE TAPPING TEE BY ELECTROFUSION ONLY.
3. HDPE BUTT FUSION JOINT.
4. 2" SDR-9 HDPE TUBING (IPS).
5. 2" HDPE PLAIN END X S.S. MNPT ADAPTOR.
6. 2" GATE VALVE (FNPT X FNPT).
7. 2" RED BRASS NIPPLE - SCH 40 - (MNPT X MNPT), MINIMUM 30" LONG.
8. 2" RED BRASS 90° BEND (FNPT X FNPT).
9. 2" RED BRASS NIPPLE - SCH 40 - (MNPT X MNPT), LENGTH AS REQUIRED.
10. 2" DUCTILE IRON (FUSION BONDED EPOXY COATED), RED BRASS, OR S.S. THREADED COUPLING (FNPT).
11. 2" MNPT PVC PLUG (HAND TIGHT).
12. HDPE EMBEDMENT MATERIAL.
13. TRENCH LIMITS.
14. VALVE BOX ASSEMBLY - SEE STANDARD DETAIL.
15. TRACER WIRE - CONTINUOUS AWG #12 GAUGE SOLID COPPER TRACER WIRE WITH 30 MILS THICK BLUE HDPE INSULATION.

NOTES:

A. AIR RELEASE VALVE ASSEMBLIES FOR 20" AND LARGER MAINS SHALL BE 6".
B. 2" BALL VALVES MAY NOT BE SUBSTITUTED FOR GATE VALVES.

NOTES TO DESIGNER

A. INSTALL AIR RELEASE VALVES AT ALL HIGH POINTS AS APPROVED BY SEALING ENGINEER.
B. INSTALL AIR RELEASE VALVES ON THE LOW SIDE OF 16" AND LARGER VALVES AS APPROVED BY SEALING ENGINEER.
C. VALVE AND B.O. SHALL NOT BE PLACED IN ROAD DITCH.
D. AIR RELEASE SHALL NOT BE LOCATED IN ROADWAY PAVEMENT.



20"-32" MAIN

ITEM LIST FOR 6" AIR RELEASE

NO. DESCRIPTION:

1. 6" GATE VALVE. SEE STANDARD DETAIL.
2. STANDARD FIRE HYDRANT ASSEMBLY PER STANDARD DETAIL (PAINTED BLUE).
3. 6" HDPE PIPE (90° BEND).
4. TRACER WIRE - CONTINUOUS AWG #12 GAUGE SOLID COPPER TRACER WIRE WITH 30 MILS THICK BLUE HDPE INSULATION.
5. RESTRAINED MJ ADAPTER WITH STAINLESS STEEL STIFFENER AND ACCESSORY KIT. SEE STANDARD DETAIL FOR TRANSITION DETAIL.
6. HDPE BUTT FUSION TEE.
7. HDPE WATER MAIN.
8. VALVE BOX ASSEMBLY. SEE STANDARD DETAIL.
9. #57 WASHED STONE-ENCASEMENT. ENCAPSULATE STONE WITH FILTER FABRIC.
10. CONCRETE HYDRANT COLLAR. CAST IN PLACE. 3' DIAMETER BY 8" THICK.
11. FOSTER ADAPTER.
12. 24-INCH DIAMETER REINFORCED CONCRETE PAD.

NOTES:

A. ALL PIPE, FITTINGS, ETC. SHALL BE RESTRAINED JOINT. BUTT FUSED AND ELECTROFUSED HDPE IS FULLY RESTRAINED.
B. SEE CONSTRUCTION PLANS FOR EXACT LOCATIONS OF VALVES AND FIRE HYDRANT.
C. HYDRANT EXTENSIONS SHALL BE LIMITED TO 1 EACH PER FIRE HYDRANT.
D. SEE FIRE HYDRANT STD DETAIL FOR INSTALLATION REQUIREMENTS.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

2" AND 6" AIR RELEASE VALVES FOR HDPE PIPE

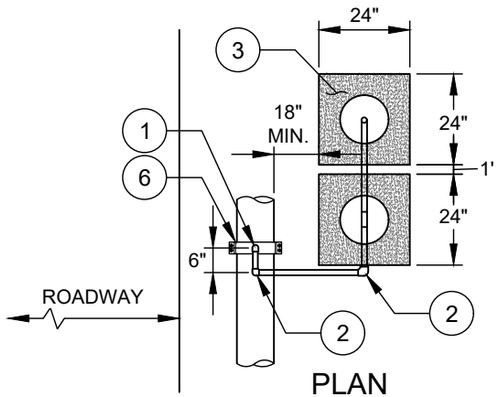
NO SCALE

VERSION 1.0

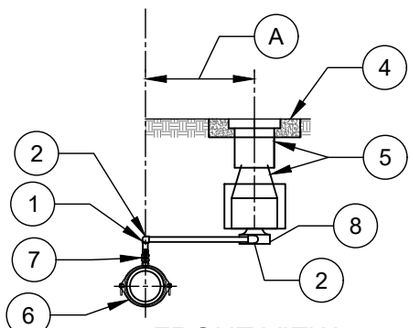
DATE 04/2024

DETAIL 10.2.1

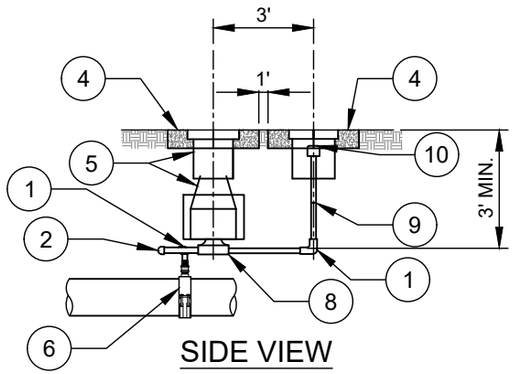
16" AND SMALLER MAIN



PLAN



FRONT VIEW ELEVATION



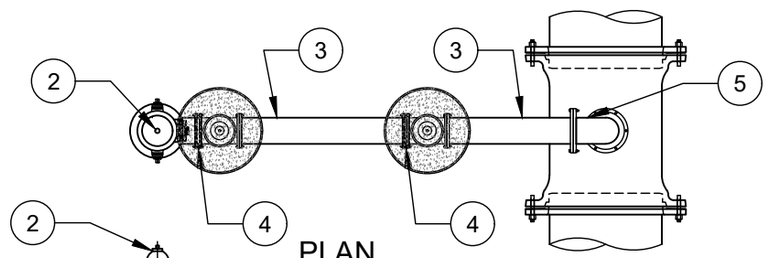
SIDE VIEW ELEVATION

NO.	DESCRIPTION:
1.	90° VERTICAL BEND - BRASS OR S.S..
2.	90° HORIZONTAL BEND - BRASS OR S.S..
3.	(2)-24" PADS OR PRECAST 24" CIRCULAR PADS.
4.	24" X 24" X 6" CONCRETE PAD VALVE OR 24" DIAMETER PRECAST PAD.
5.	VALVE BOX ASSEMBLY. SEE STANDARD DETAIL.
6.	2" SERVICE SADDLE W/ CC TAPER TREAD OUTLET.
7.	2" BALL CORPORATION STOP WITH TEE HEAD OPERATING NUT.
8.	2" GATE VALVE FOR 2" AIR RELEASE.
9.	2" PIPING - SCHEDULE 40 RED BRASS OR STAINLESS STEEL.
10.	2" DUCTILE IRON (FUSION BONDED EPOXY COATED) THREADED COUPLING (FNPT).

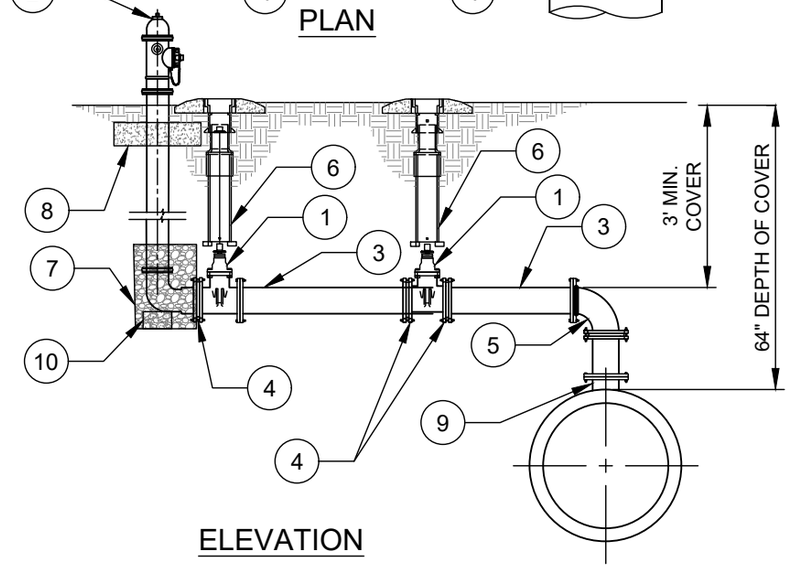
NOTES:

A. ARV TO BE PLACED A MIN. OF 18" OFFSET FROM THE WATER MAIN, AND SHALL BE BOC, IN PLANTING STRIP OR IN ROAD SHOULDER OR SIDEWALK, AND WITH VALVE BOX ASSEMBLIES PARALLEL TO THE ROAD.
B. AIR RELEASES TO BE INSTALLED AT ALL HIGH POINTS AS DIRECTED BY THE ENGINEER.
C. AIR RELEASE SHALL NOT BE LOCATED IN ROADWAY PAVEMENT.
D. ON 16" AND SMALLER PIPE, 2" ASSEMBLY REQUIRED.
E. ON 24" TO 30" PIPE, USE 6" AIR RELEASE HYDRANT. AT LEAST TWO VALVES REQUIRED - ONE AT TEE AND ONE AT. SEE ASSEMBLY ON RIGHT.
F. VALVE & B.O. SHALL NOT BE PLACED IN ROAD DITCH.
G. TRACER WIRE INSTALLED PER CLTW TRACER WIRE DETAIL AS APPLICABLE.

24"-30" MAIN



PLAN



ELEVATION

NO.	DESCRIPTION:
1.	6" MJ X MJ GATE VALVE.
2.	STANDARD 3 WAY FIRE HYDRANT ASSEMBLY PER STANDARD DETAIL (PAINTED BLUE).
3.	6" RJ DIP.
4.	FOSTER ADAPTER.
5.	6" RMJ 90° BEND (VERTICAL).
6.	VALVE BOX ASSEMBLY. SEE STANDARD DETAIL.
7.	#57 WASHED STONE-ENCASEMENT.
8.	CONCRETE HYDRANT COLLAR. CAST IN PLACE. 3' DIAMETER BY 8" THICK. REINFORCE WITH #4 REBARS.
9.	6" SWIVEL OUTLET FIRE HYDRANT TEE.
10.	CONCRETE BLOCK - 8" X 16" SOLID CONCRETE BLOCK.

NOTES:

A. AIR RELEASE HYDRANT SHALL BE PLACED PER THE FIRE HYDRANT STANDARD DETAIL REQUIREMENTS.
B. AIR RELEASES TO BE INSTALLED AT ALL HIGH POINTS AS DIRECTED BY THE ENGINEER.
C. ON 24" AND 30" PIPE, USE 6" AIR RELEASE HYDRANT.
D. TRACER WIRE INSTALLED PER CLTW TRACER WIRE DETAIL AS APPLICABLE.
E. SEE FIRE HYDRANT STD DETAIL FOR INSTALLATION REQUIREMENTS.
F. HYDRANT EXTENSIONS SHALL BE LIMITED TO 1 EACH PER HYDRANT.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

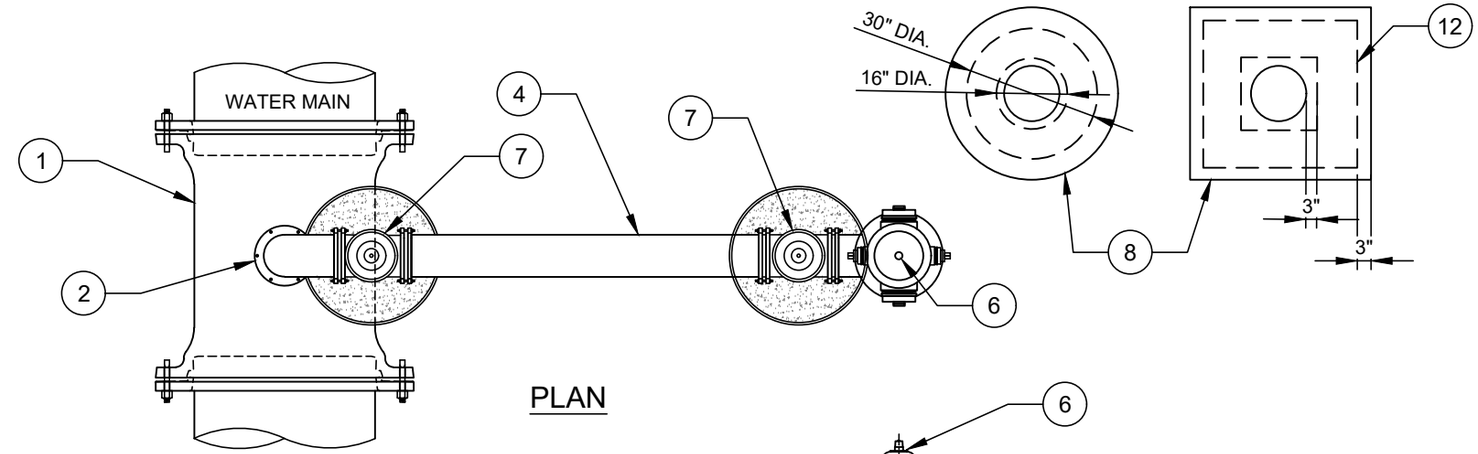
MANUAL 2" AND 6" AIR RELEASE FOR 6-INCH THROUGH 30-INCH DIAMETER MAINS

NO SCALE

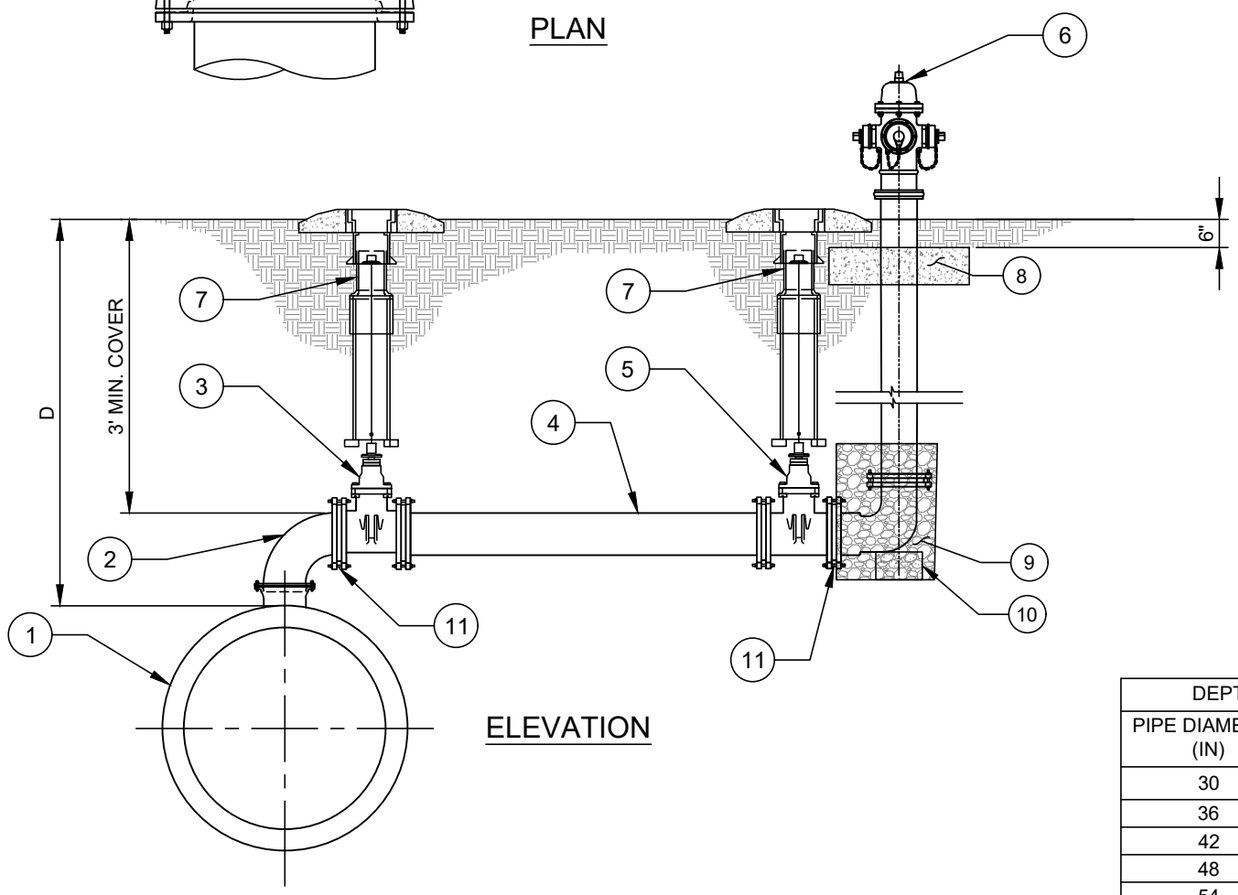
VERSION 1.0

DATE 04/2024

DETAIL 10.2.2



PLAN



ELEVATION

DEPTH OF COVER (D)	
PIPE DIAMETER (IN)	MINIMUM DEPTH (FT)
30	5.0
36	5.0
42	5.5
48	5.5
54	5.5
60	5.5
64	5.5

NO.	DESCRIPTION:
1.	RUN X 8" SWIVEL OR RMJ OUTLET TEE.
2.	8" 90° BEND (RMJ).
3.	8" RMJ GATE VALVE WITH FOSTER ADAPTOR.
4.	8" RJ DIP.
5.	8" RMJ GATE VALVE AT FH WITH FOSTER ADAPTOR.
6.	HIGH VELOCITY FIRE HYDRANT, 6' BOC OR 4' BACK OF DITCH CENTERLINE. FIRE HYDRANT SHALL BE PAINTED OSHA SAFETY BLUE. PUMP NOZZLES SHALL BE PARALLEL TO THE ROADWAY / CURB.
7.	VALVE BOX ASSEMBLY. SEE STANDARD DETAIL.
8.	CONCRETE HYDRANT COLLAR. CAST IN PLACE. 3' DIAMETER BY 8" THICK. REINFORCE WITH #4 REBARS.
9.	MINIMUM 9 CUBIC FEET OF #57 WASHED STONE PROPORTIONALLY AROUND FH SHOE. DO NOT COVER WEEP HOLE. ENCAPSULATE WASHED STONE WITH FILTER FABRIC.
10.	8" X 16" SOLID CONCRETE BLOCK.
11.	FOSTER ADAPTER.
12.	#4 REBARS

NOTES:

A. ALL PIPE AND FITTINGS TO BE RESTRAINED JOINT DIP WITH FACTORY RESTRAINED JOINT FITTINGS OR MJ FITTINGS WITH WEDGE ACTION RESTRAINT.

B. REFERENCE STANDARD DETAIL FOR AWG. #12 GAUGE SOLID COPPER TRACER WIRE WITH BLUE 30 MILS HDPE INSULATION.

C. SEE CONSTRUCTION PLANS FOR LOCATION OF HYDRANTS.

D. AIR RELEASE HYDRANTS SHALL BE INSTALLED AT ALL HIGH POINTS AS DIRECTED BY THE ENGINEER.

E. EXTENSION KITS REQUIRE THE APPROVAL OF THE ENGINEER. HYDRANT EXTENSION KITS SHALL BE LIMITED TO 1 EACH PER HYDRANT. DO NOT CAST THE CONRETE COLLAR ON THE EXTENSION JOINT.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

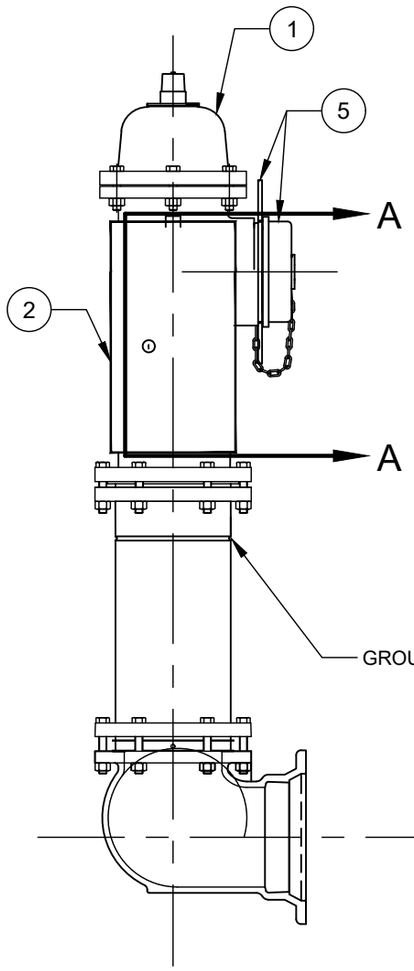
8-INCH MANUAL AIR RELEASE AND FH FOR 30-INCH THROUGH 64-INCH DIAMETER MAINS

NO SCALE

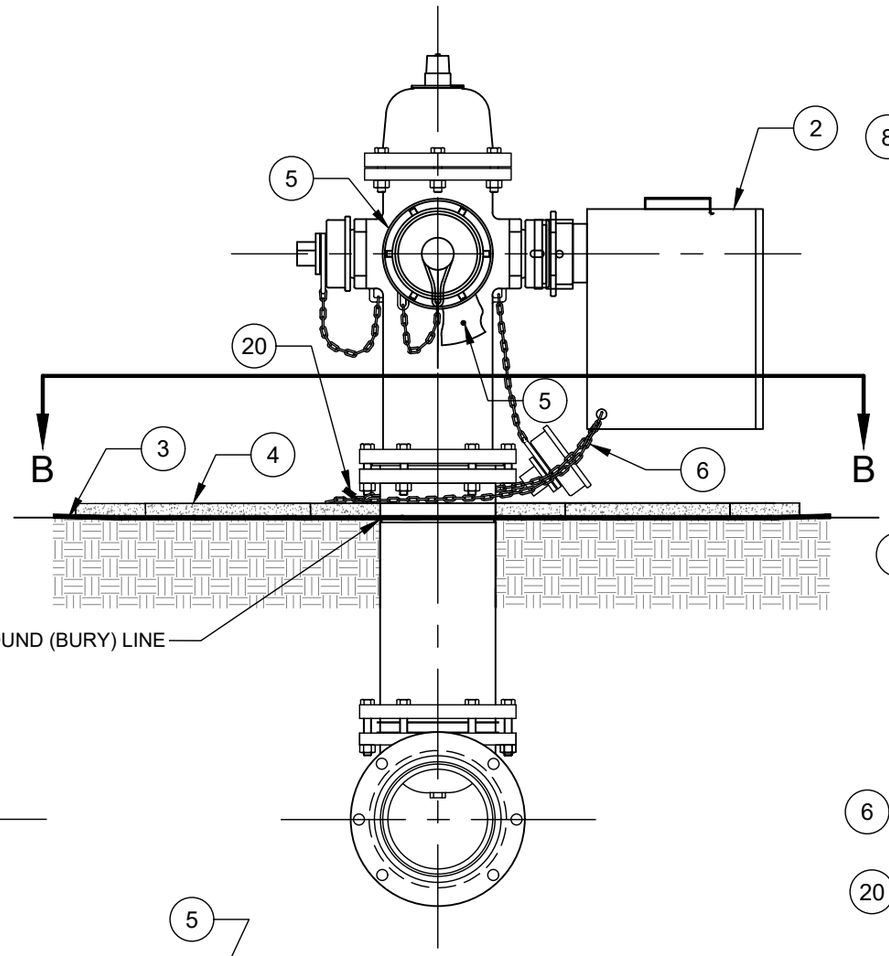
VERSION 1.0

DATE 04/2024

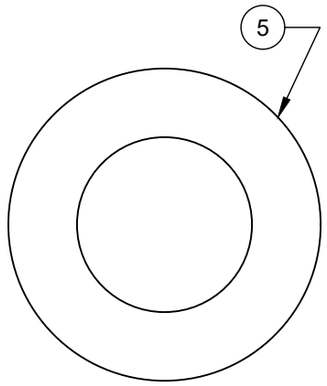
DETAIL 10.2.3



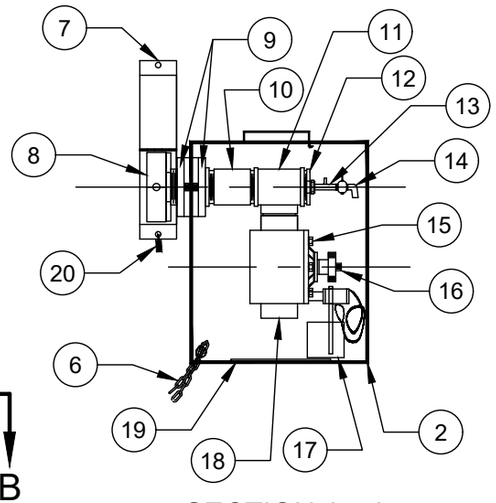
SIDE ELEVATION



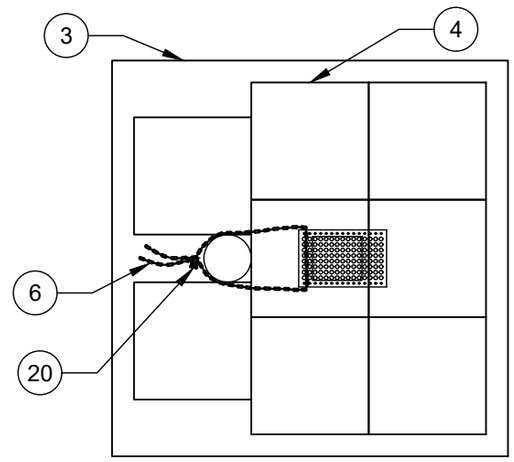
FRONT ELEVATION



RING DETAIL



SECTION A - A



SECTION B - B

NOTES:

A. AUTO FLUSHER IS INTENDED FOR WARM WEATHER USE. ASSEMBLY SHOULD BE REMOVED DURING COLD WEATHER MONTHS TO AVOID DAMAGE DUE TO FREEZING.

B. MANUAL FLUSHING REQUIRED TO MAINTAIN WATER QUALITY DURING COLD WEATHER MONTHS.

C. SHOWN AS TEMPORARY APPLICATION - IF PERMANENT INSTALLATION - REPLACE NO. 3 AND NO. 4 WITH CAST IN PLACE CONCRETE PAD - MIN. 4' X 4' X 4" THICK WITH WIRE REINFORCEMENT, FLUSH WITH FINISH GRADE.

NO.	DESCRIPTION:
1.	FIRE HYDRANT.
2.	KUPFERLE #9700-Y HYDRANT AUTO FLUSHER (YELLOW) (INCLUDING #8-19).
3.	6 MILS HDPE PLASTIC FILM (54" X 54") - SEE NOTE C.
4.	16" X 16" X 2" PATIO PAVERS - CONCRETE - 8 EA - SEE NOTE C.
5.	HYDRANT STORZ NOZZLE W/RED OUT-OF-SERVICE RING (O.D. = 12.5", I.D. = 7.0", t = 0.05").
6.	CAMPBELL BLU-KROME 1/4" PROOF COIL CHAIN 5 LF.
7.	LOCKING NOZZLE COLLAR - KUPFERLE #9708-Y WITH PADLOCK.
8.	2 1/2" FIRE HYDRANT NOZZLE COUPLING.
9.	KUPFERLE ADAPTER.
10.	2" THREADED NIPPLE.
11.	2" X 2" X 2" TEE FIP THREAD.
12.	PLUG/TAP.
13.	WATER SAMPLE VALVE.
14.	BRASS WATER SAMPLING BIBB.
15.	2" SOLENOID CONTROL VALVE; P-220 SERIES.
16.	MANUAL FLOW CONTROL KNOB.
17.	HUNTER DIGITAL PROGRAMMABLE CONTROLLER WITH 9 VOLT LITHIUM BATTERY.
18.	2" FIP OUTLET (MAY BE HARD PIPED FOR DISCHARGE).
19.	REMOVABLE DIFFUSER PLATE WITH 4 BOLTS/NUTS.
20.	PADLOCK (PROVIDED BY CLTW).

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

AUTOMATIC FLUSHER-HYDRANT

NO SCALE

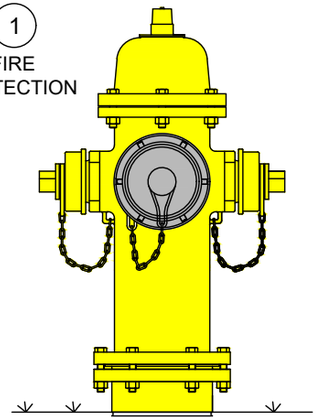
VERSION 1.0

DATE 04/2024

DETAIL 10.3.1

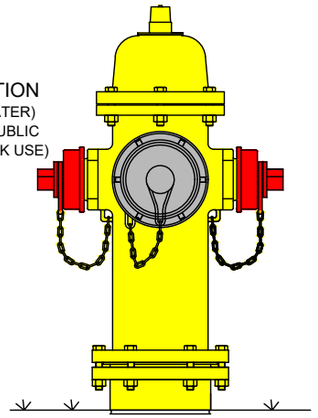
CLTW PUBLIC FIRE HYDRANTS

1
FIRE PROTECTION



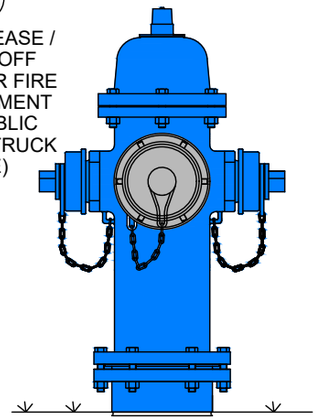
YELLOW / YELLOW

2
FIRE PROTECTION
(MUDDY WATER)
(NOT FOR PUBLIC WATER TRUCK USE)



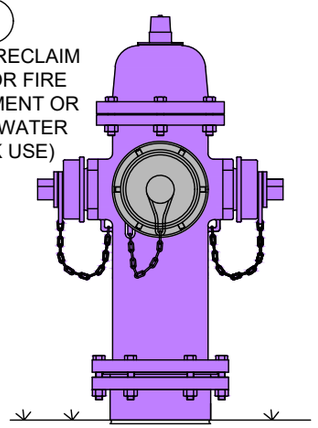
YELLOW / RED

3
AIR RELEASE / BLOW-OFF (NOT FOR FIRE DEPARTMENT OR PUBLIC WATER TRUCK USE)



BLUE / BLUE

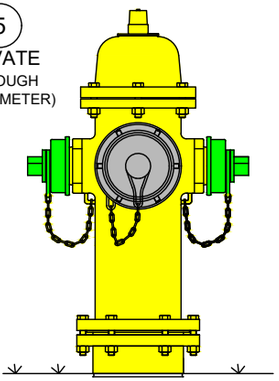
4
REUSE / RECLAIM (NOT FOR FIRE DEPARTMENT OR PUBLIC WATER TRUCK USE)



PURPLE / PURPLE
(PUMPER NOZZLE FACES AWAY FROM STREET)

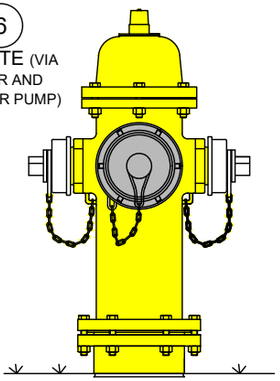
PRIVATE FIRE HYDRANTS (NOT FOR PUBLIC WATER TRUCK USE)

5
PRIVATE
(THROUGH WATER METER)



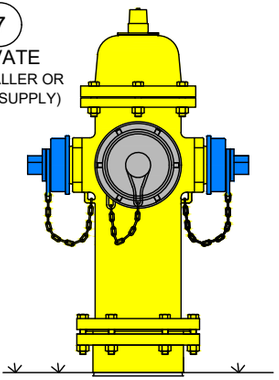
YELLOW / GREEN

6
PRIVATE (VIA METER AND BOOSTER PUMP)



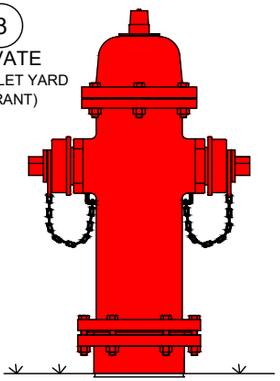
YELLOW / WHITE

7
PRIVATE
(6" & SMALLER OR LIMITED SUPPLY)



YELLOW / BLUE

8
PRIVATE
(2.5" OUTLET YARD HYDRANT)



RED / RED

CLTW / CFD COLOR LEGEND	
COLOR:	SHADE:
OSHA SAFETY YELLOW	
OSHA SAFETY BLUE	
OSHA SAFETY PURPLE	
OSHA SAFETY RED	
OSHA SAFETY GREEN	
OSHA SAFETY WHITE	

NOTES:
A. PUBLIC FIRE HYDRANTS ARE (1) CONNECTED DIRECTLY TO CLTW DISTRIBUTION SYSTEM, (2) OWNED AND MAINTAINED BY CLTW, AND (3) LOCATED WITHIN THE ROAD RIGHT-OF-WAY OR CLTW MAIN EASEMENT.
B. PRIVATE FIRE HYDRANTS ARE NON-PUBLIC FIRE HYDRANTS, INCLUDING HYDRANTS (1) SERVED VIA CLTW METER, (2) SERVED VIA PRIVATE WATER SYSTEM, AND ARE (3) LOCATED OUTSIDE THE ROAD RIGHT-OF-WAY AND (4) PRIVATELY OWNED AND MAINTAINED.

CLTW AND CHARLOTTE FIRE DEPARTMENT STANDARDS
COLOR SCHEME FOR CLTW PUBLIC FIRE HYDRANTS

FIRE HYDRANT CLASSIFICATION:	BARREL	SQUARE TOP / BONNET	STORZ PUMPER NOZZLE	IRON PUMPER NOZZLE	IRON HOSE NOZZLE
1 - FIRE PROTECTION	OSHA SAFETY YELLOW	OSHA SAFETY YELLOW	NOT PAINTED	OSHA SAFETY YELLOW	OSHA SAFETY YELLOW
2 - FIRE PROTECTION MUDDY FLOW	OSHA SAFETY YELLOW	OSHA SAFETY YELLOW	NOT PAINTED	OSHA SAFETY RED	OSHA SAFETY RED
3 - AIR RELEASE	OSHA SAFETY BLUE	OSHA SAFETY BLUE	NOT PAINTED	OSHA SAFETY BLUE	OSHA SAFETY BLUE
3 - BLOW-OFF	OSHA SAFETY BLUE	OSHA SAFETY BLUE	NOT PAINTED	OSHA SAFETY BLUE	OSHA SAFETY BLUE
4 - REUSE / RECLAIM	OSHA SAFETY PURPLE	OSHA SAFETY PURPLE	NOT PAINTED	OSHA SAFETY PURPLE	OSHA SAFETY PURPLE

CHARLOTTE FIRE DEPARTMENT STANDARDS
COLOR SCHEME FOR PRIVATE FIRE HYDRANTS

CLASSIFICATION:	BARREL	TOP / BONNET	STORZ PUMPER NOZZLE	IRON PUMPER NOZZLE	IRON HOSE NOZZLE
5 - PRIVATE THROUGH WATER METER	OSHA SAFETY YELLOW	OSHA SAFETY YELLOW	NOT PAINTED	OSHA SAFETY GREEN	OSHA SAFETY GREEN
6 - PRIVATE via METER AND FIRE BOOSTER PUMP	OSHA SAFETY YELLOW	OSHA SAFETY YELLOW	NOT PAINTED	OSHA SAFETY WHITE	OSHA SAFETY WHITE
7 - PRIVATE (6-INCH AND SMALLER MAIN OR LIMITED SUPPLY)	OSHA SAFETY YELLOW	OSHA SAFETY YELLOW	NOT PAINTED	OSHA SAFETY BLUE	OSHA SAFETY BLUE
8 - PRIVATE (2.5-INCH OUTLET YARD HYDRANT)	OSHA SAFETY RED	OSHA SAFETY RED	N/A	N/A	OSHA SAFETY RED

INDUSTRY STANDARD - **NOT** ADOPTED OR USED BY CLTW/CFD
AWWA C-502 UNIFORM COLOR SCHEME FOR FIRE HYDRANTS
NFPA 291 RECOMMENDED PRACTICE FOR MARKING FIRE HYDRANTS

CLASSIFICATION:	FLOW CAPACITY (GPM AT 20 PSI RESIDUAL)	BARREL	TOP / BONNET	PUMPER NOZZLE	HOSE NOZZLE
CLASS AA	1500 OR GREATER	CHROME YELLOW	LIGHT BLUE	LIGHT BLUE	LIGHT BLUE
CLASS A	1000 TO 1499	CHROME YELLOW	GREEN	GREEN	GREEN
CLASS B	500 TO 999	CHROME YELLOW	ORANGE	ORANGE	ORANGE
CLASS C	LESS TO 500	CHROME YELLOW	RED	RED	RED

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

FIRE HYDRANT PAINT / COLOR SCHEMES
CLTW / CHARLOTTE FIRE DEPT. STANDARDS
PUBLIC AND PRIVATE HYDRANTS

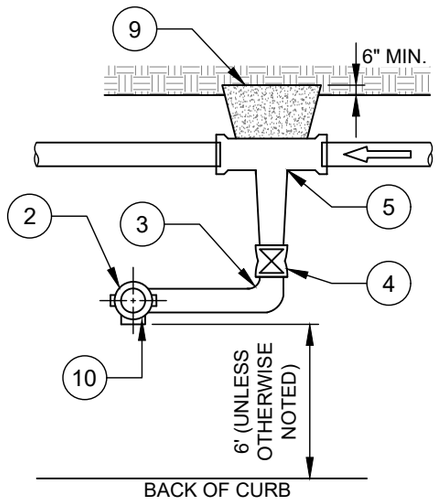
NO SCALE

VERSION 1.0

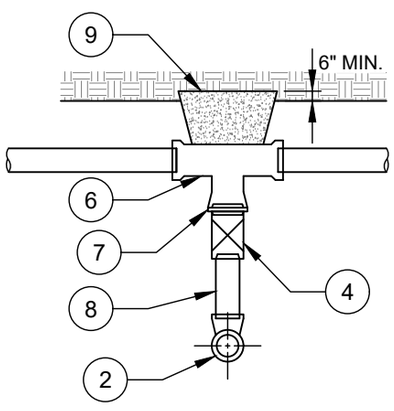
DATE 04/2024

DETAIL 10.3.2

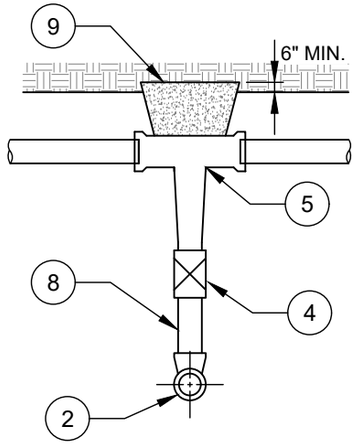
STANDARD FIRE HYDRANT WITH 8" PIPE



(1) PLAN VIEW

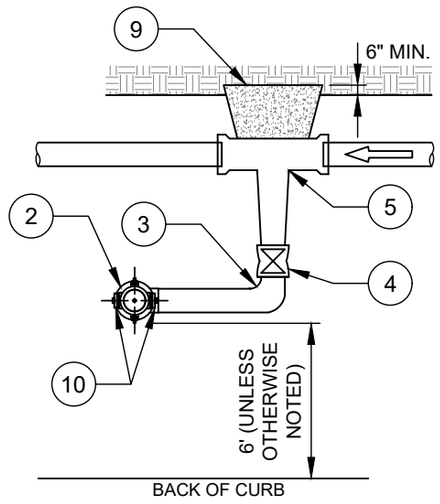


(2) PLAN VIEW

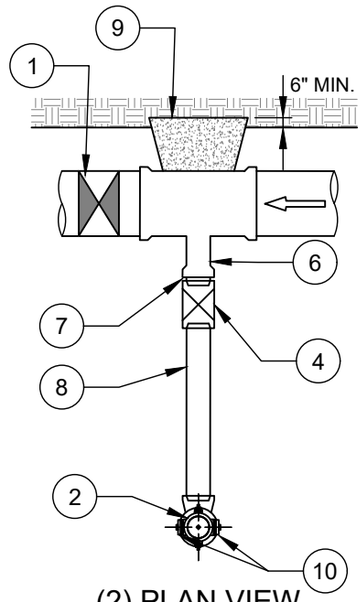


(3) PLAN VIEW

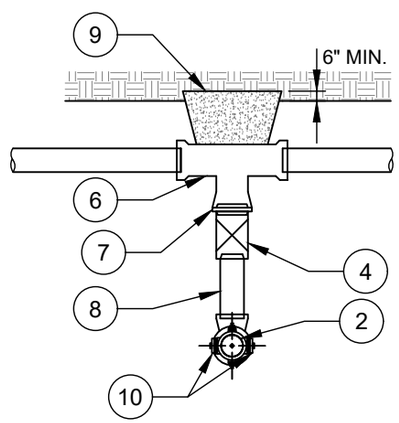
HIGH VELOCITY FIRE HYDRANT WITH 8" PIPE



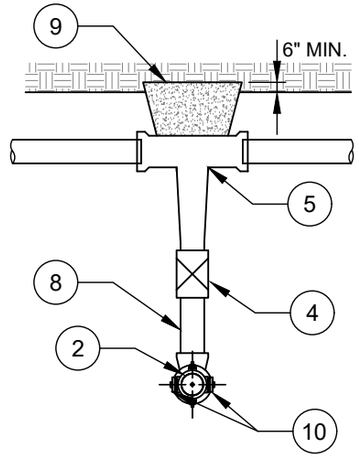
(1) PLAN VIEW



(2) PLAN VIEW



(3) PLAN VIEW



(4) PLAN VIEW

NO. DESCRIPTION:

1. MAIN LINE VALVE.
2. STANDARD FIRE HYDRANT ON 8" MAINS OR HIGH VELOCITY FIRE HYDRANT ON 12" AND LARGER MAINS.
3. 8" SWIVEL 90° BEND.
4. 8" RMJ GATE VALVE.
5. 8" OUTLET SWIVEL HYDRANT TEE.
6. 8" OUTLET RMJ TEE.
7. 8" FOSTER ADAPTER WHICH BOLTS VALVE DIRECTLY TO TEE OR FH.
8. RJ DIP.
9. 3,600 PSI CONCRETE THRUST BLOCKING.
10. PUMPER NOZZLE.

NOTES:

A. HYDRANT LOCATION: ON ROADS WITH CURB AND GUTTER, USE DETAIL (1) (THIS SHEET) IN ALL CASES UNLESS OTHERWISE APPROVED BY ENGINEER.
B. HYDRANT BURIAL TO BE MINIMUM 3'-6" UNLESS OTHERWISE APPROVED BY THE ENGINEER.
C. FOR HYDRANTS ON DEAD END LINES, MAIN LINE VALVES ARE LOCATED DOWNSTREAM OF HYDRANT.
D. EXTENSIONS REQUIRED AS APPROVED BY THE ENGINEER. NO MORE THAN ONE HYDRANT EXTENSION IS ALLOWED. IF EXTENSION IS USED, DO NOT CAST HYDRANT COLLAR ON EXTENSION JOINT.
E. PUMPER NOZZLE TO FACE THE ROADWAY ON STANDARD FIRE HYDRANTS. PUMPER NOZZLES SHALL BE PARALLEL WITH ROAD ON HIGH VELOCITY FIRE HYDRANTS.
F. CONCRETE BLOCKING TO EXTEND TO UNDISTURBED EARTH, AMOUNT APPROVED BY THE ENGINEER.
G. SEE CLTW STANDARD DETAIL FOR PLACEMENT OF FIRE HYDRANT IN NCDOT R/W.
H. ALL HYDRANT PIPING SHALL BE RESTRAINED JOINT DIP.
I. FLOW DIRECTION ARROW IS THE PRIMARY WATER FLOW DIRECTION BASED ON HYDRAULICS OR DEAD END PIPE AND CONTROLS THE VALVE LOCATION.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

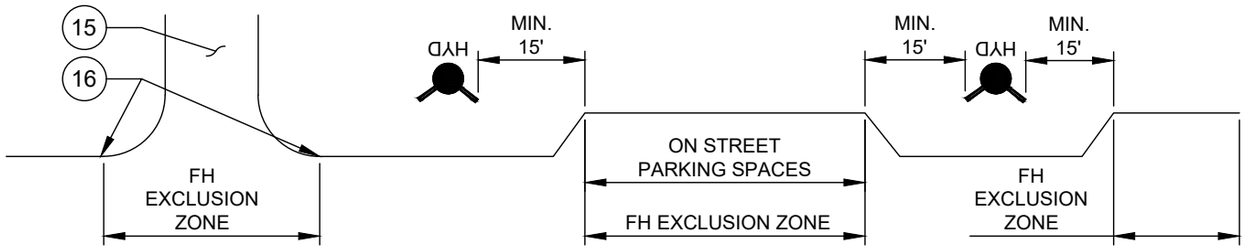
FIRE HYDRANT DETAIL

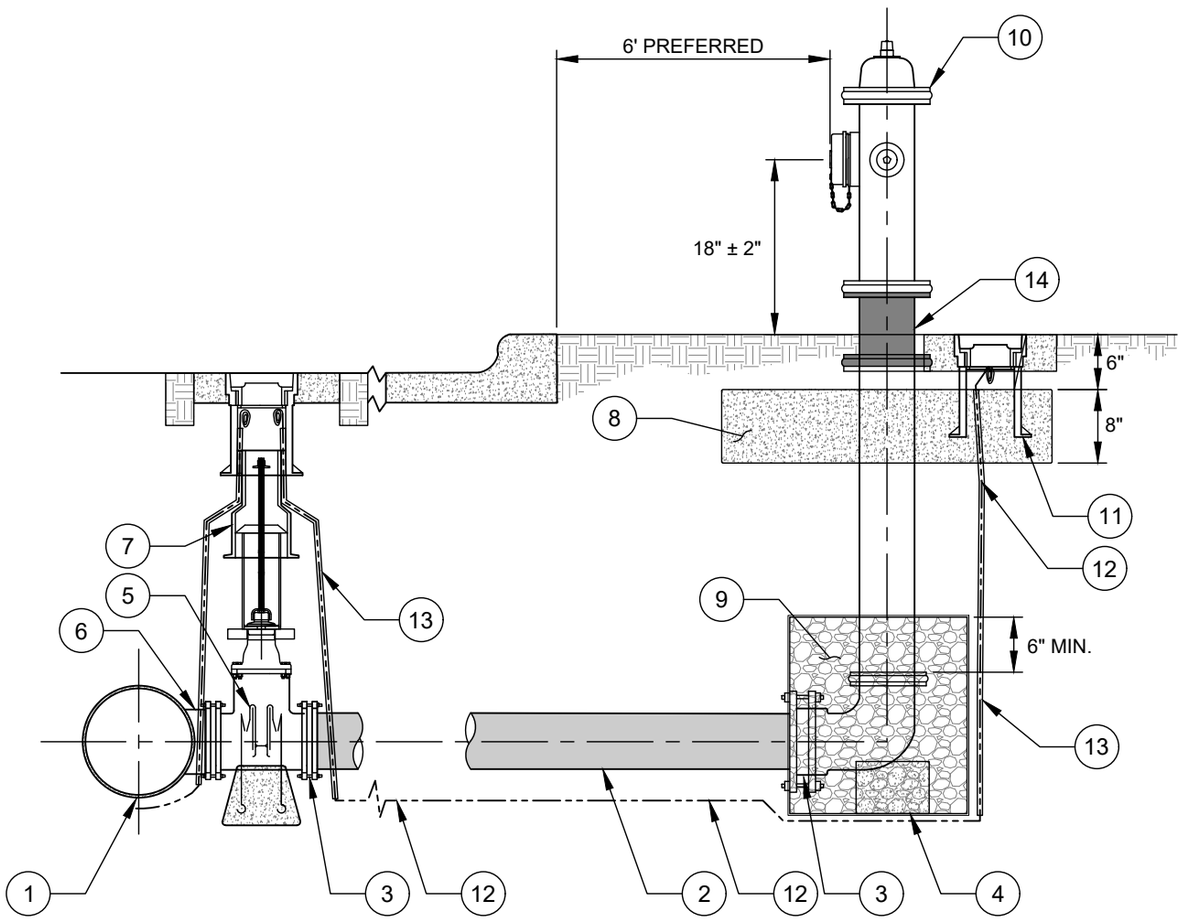
NO SCALE

VERSION 2.0

DATE 01/2026

DETAIL 10.3.3





NOTES:

A. HYDRANT LOCATION: ON ROADS WITH CURB AND GUTTER, USE EXISTING CLTW STANDARD DETAIL FOR FIRE HYDRANTS IN ALL CASES UNLESS OTHERWISE NOTED BY THE ENGINEER.

B. HYDRANT BURIAL TO BE MINIMUM 3'-6" UNLESS OTHERWISE APPROVED BY THE ENGINEER.

C. EXTENSIONS REQUIRED AS APPROVED BY THE ENGINEER. NO MORE THAN ONE HYDRANT EXTENSION IS ALLOWED. IF EXTENSION IS USED, DO NOT CAST HYDRANT COLLAR ON EXTENSION JOINT.

D. ON ROADS WITHOUT SIDE DITCH OR CURB, HYDRANT SHALL BE LOCATED ONE FOOT INSIDE THE ROAD RIGHT OF WAY OR 1 FT OUTSIDE THE DOT CLEAR RECOVERY ZONE.

E. ON ROADS WITH SIDE DITCH, FIRE HYDRANT SHALL BE LOCATED A MINIMUM OF FOUR FEET BACK OF SIDE DITCH CENTERLINE.

NO.	DESCRIPTION:
1.	HDPE WATER MAIN.
2.	HDPE PIPE.
3.	ELECTROFUSION COUPLING OR RESTRAINED MJ ADAPTER WITH STAINLESS STEEL STIFFENER AND ACCESSORY KIT. SEE STANDARD DETAIL FOR TRANSITION DETAIL.
4.	CONCRETE BLOCK - 8" X 16" SOLID CONCRETE BLOCK.
5.	RESILIENT SEAT GATE VALVE WITH CONCRETE SUPPORT.
6.	FOR CONNECTION TO NEW CONSTRUCTION, REFER TO APPROPRIATE STANDARD DETAIL. FOR CONNECTION TO EXISTING MAIN, REFER TO APPROPRIATE STANDARD DETAIL.
7.	VALVE BOX ASSEMBLY - SEE CLTW STANDARD DETAIL.
8.	CONCRETE LATERAL THRUST COLLAR. CAST IN PLACE. 3' DIAMETER BY 8" THICK. REINFORCE WITH #4 REBARS.
9.	MINIMUM 9 CUBIC FEET OF #57 WASHED STONE PROPORTIONALLY AROUND BASE. DO NOT COVER WEEP HOLE. ENCAPSULATE FILTER FABRIC AROUND WASHED STONE.
10.	STANDARD HYDRANT PER CLTW SPECIFICATIONS.
11.	SEE CLTW TRACER WIRE STANDARD DETAILS FOR TERMINATION METHOD.
12.	AWG #12 GAUGE SOLID COPPER TRACER WIRE WITH BLUE 30 MILS HDPE INSULATION.
13.	ALL VERTICAL WIRE SHALL BE PLACED IN 1/4" OR 3/8" ID CONDUIT SDR 9 PEX TUBING - ASTM F876 (TYP.).
14.	EXTENSION KIT FROM FIRE HYDRANT MANUFACTURER.
15.	STREET OR DRIVEWAY.
16.	CURB/PAVEMENT RADIUS POINT.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

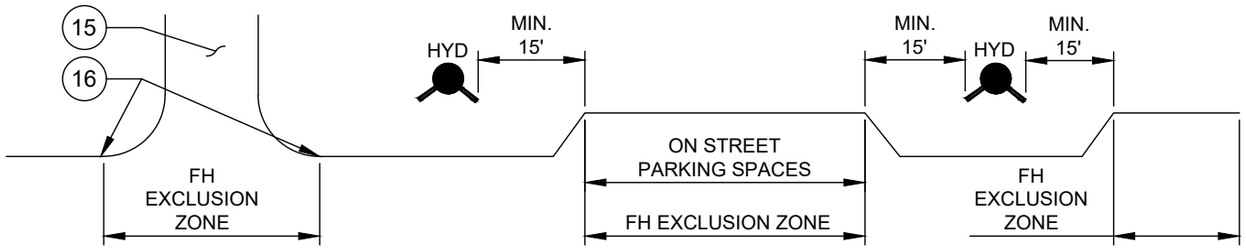
HYDRANT CONNECTION FOR HDPE PIPE

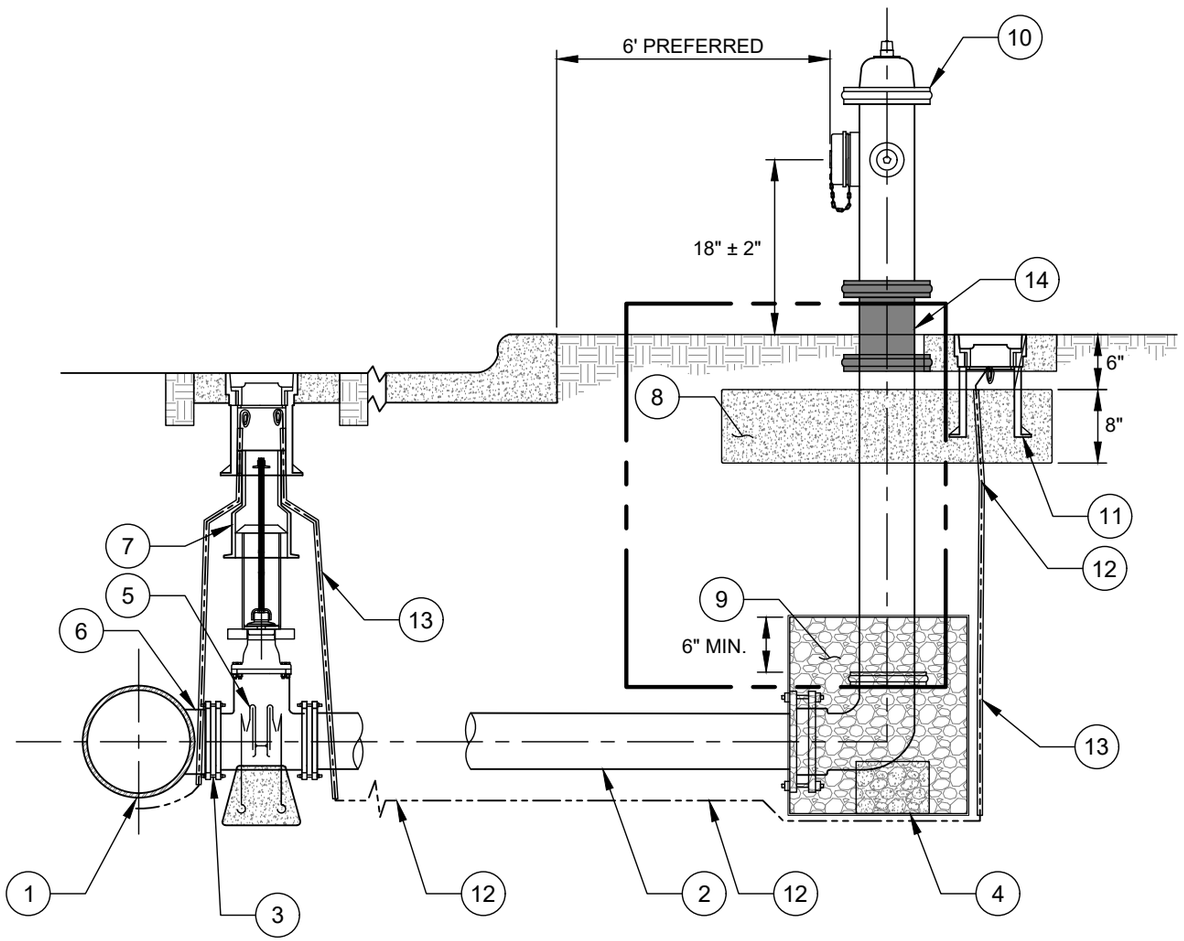
NO SCALE

VERSION
1.0

DATE
04/2024

DETAIL
10.3.4





NOTES:

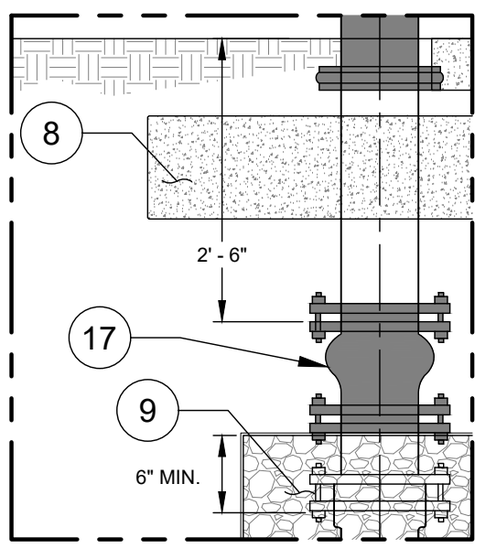
A. HYDRANT LOCATION: ON ROADS WITH CURB AND GUTTER, USE EXISTING CLTW STANDARD DETAIL FOR FIRE HYDRANTS IN ALL CASES UNLESS OTHERWISE NOTED BY THE ENGINEER.

B. HYDRANT BURIAL TO BE MINIMUM 3'-6" UNLESS OTHERWISE APPROVED BY THE ENGINEER.

C. EXTENSIONS REQUIRED AS APPROVED BY THE ENGINEER. NO MORE THAN ONE HYDRANT EXTENSION IS ALLOWED. IF EXTENSION IS USED, DO NOT CAST HYDRANT COLLAR ON EXTENSION JOINT.

D. ON ROADS WITHOUT SIDE DITCH OR CURB, HYDRANT SHALL BE LOCATED ONE FOOT INSIDE THE ROAD RIGHT OF WAY OR 1 FT OUTSIDE THE DOT CLEAR RECOVERY ZONE.

E. ON ROADS WITH SIDE DITCH, FIRE HYDRANT SHALL BE LOCATED A MINIMUM OF FOUR FEET BACK OF SIDE DITCH CENTERLINE.



OPTIONAL

NO.	DESCRIPTION:
1.	WATER MAIN.
2.	DIP WITH MJ RESTRAINED JOINTS.
3.	FOSTER ADAPTER.
4.	CONCRETE BLOCK - 8" X 16" SOLID CONCRETE BLOCK.
5.	RESILIENT SEAT GATE VALVE WITH CONCRETE SUPPORT.
6.	FOR CONNECTION TO NEW CONSTRUCTION, REFER TO APPROPRIATE STANDARD DETAIL. FOR CONNECTION TO EXISTING MAIN, REFER TO APPROPRIATE STANDARD DETAIL.
7.	VALVE BOX ASSEMBLY - SEE CLTW STANDARD DETAIL.
8.	CONCRETE LATERAL THRUST COLLAR. CAST IN PLACE. 3' DIAMETER BY 8" THICK. REINFORCE WITH #4 REBARS.
9.	MINIMUM 9 CUBIC FEET OF #57 WASHED STONE PROPORTIONALLY AROUND BASE. DO NOT COVER WEEP HOLE. ENCAPSULATE FILTER FABRIC AROUND WASHED STONE.
10.	STANDARD HYDRANT PER CLTW SPECIFICATIONS.
11.	SEE CLTW TRACER WIRE STANDARD DETAILS FOR TERMINATION METHOD.
12.	AWG #12 GAUGE SOLID COPPER TRACER WIRE WITH BLUE 30 MILS HDPE INSULATION.
13.	ALL VERTICAL WIRE SHALL BE PLACED IN 1/4" OR 3/8" ID CONDUIT SDR 9 PEX TUBING - ASTM F876 (TYP.).
14.	EXTENSION KIT FROM FIRE HYDRANT MANUFACTURER.
15.	STREET OR DRIVEWAY.
16.	CURB/PAVEMENT RADIUS POINT.
17.	VERTICAL FLANGE SHOE (OPTIONAL).

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

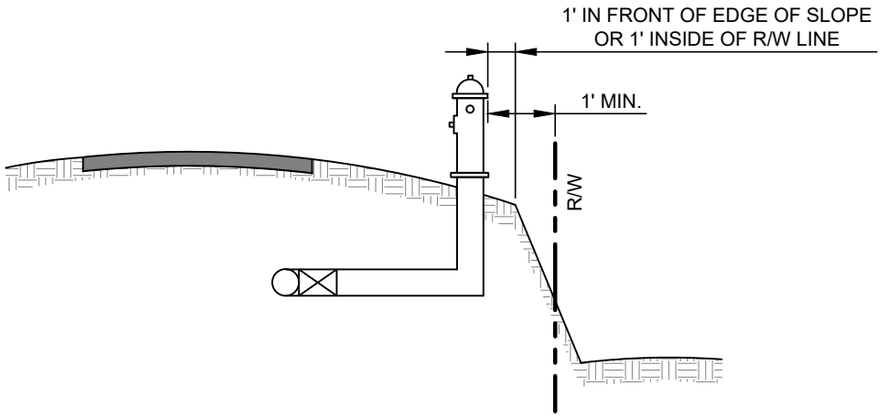
STANDARD HYDRANT CONNECTION

NO SCALE

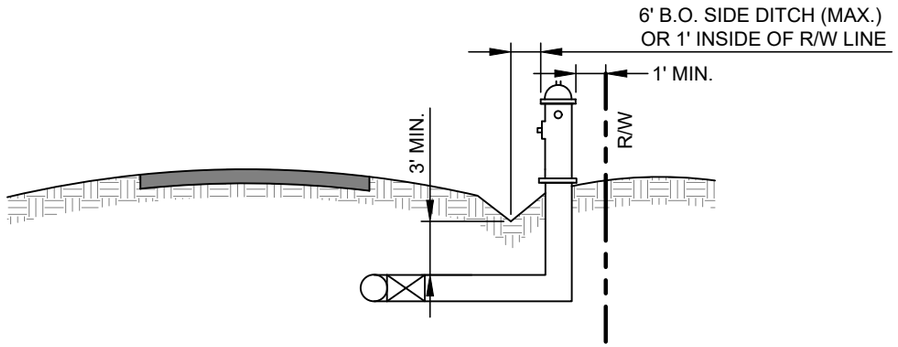
VERSION
1.0

DATE
04/2024

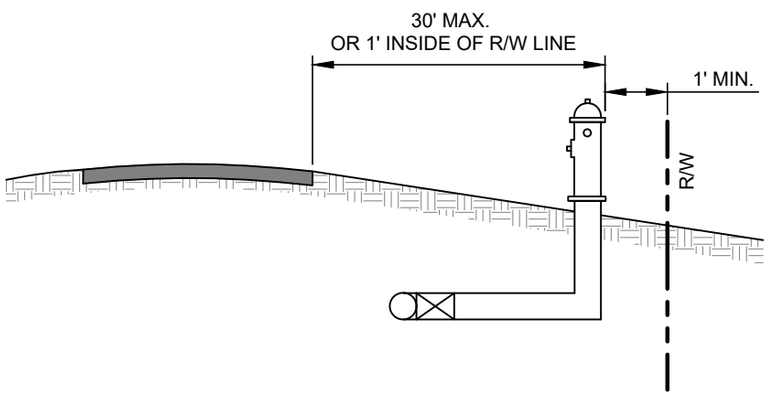
DETAIL
10.3.5



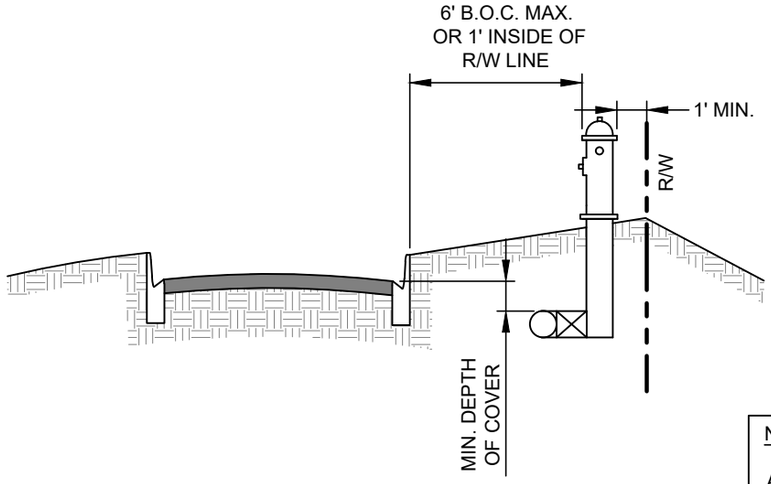
ROAD IN FILL SECTION



ROAD WITH SIDE DITCH



ROAD WITH NO SIDE DITCH



ROAD WITH CURB AND GUTTER

NOTES:

A. IN ALL CASES FIRE HYDRANT SHALL BE A MINIMUM OF 1' INSIDE ROAD R/W.

B. MAINLINE VALVES, GUARD VALVE, AND FIRE HYDRANT SHALL NOT BE PLACED IN DITCHLINE.

C. HYDRANT SHALL BE UNOBSTRUCTED.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

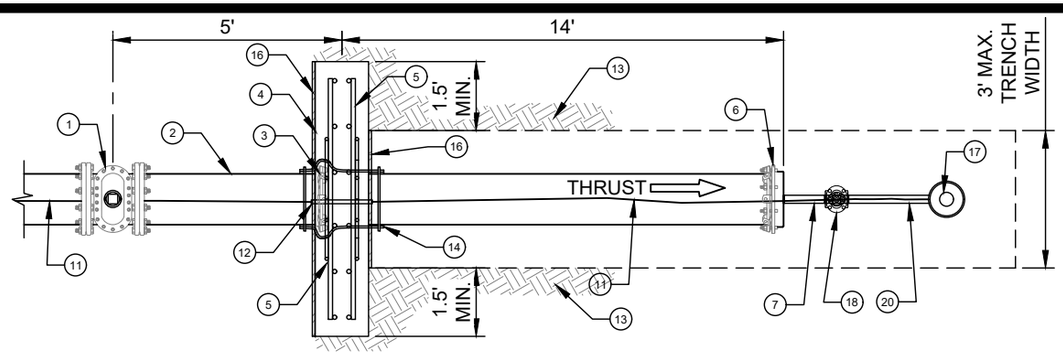
FIRE HYDRANT IN NCDOT R/W

NO SCALE

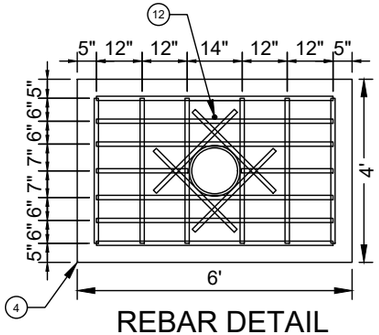
VERSION 2.0

DATE 01/2026

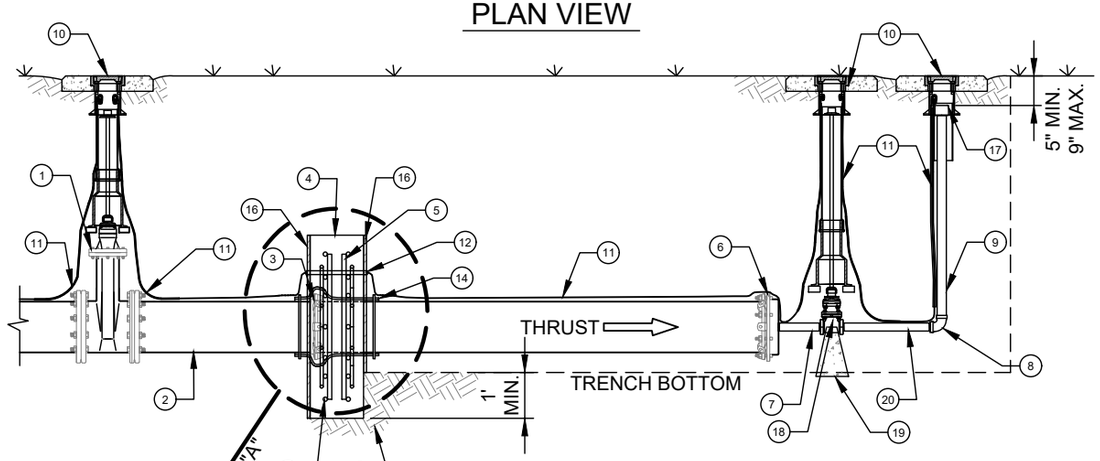
DETAIL 10.3.6



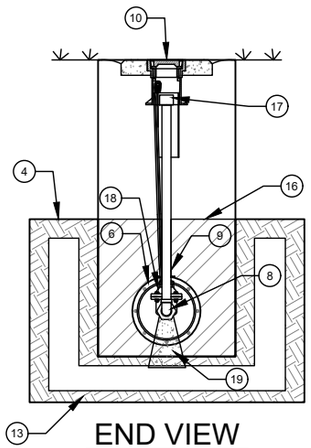
PLAN VIEW



REBAR DETAIL



ELEVATION VIEW

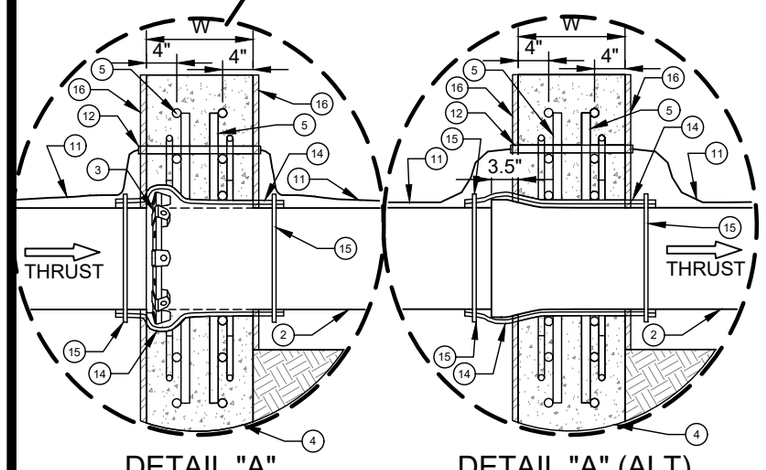


END VIEW

NO.	DESCRIPTION:
1.	END OF LINE GATE VALVE (MJ X MJ). SEE NOTE E.
2.	DIP - (PE X PE) - REMOVE BELL - LENGTH = 19 FT.
3.	WEDGE ACTION THRUST RESTRAINT GLAND.
4.	CONCRETE WALL BLOCK (f'c = 3,600 PSI MIN.) 6' X 4' X WIDTH (W).
5.	REBARS - GRADE 60 PER ASTM A615 - SEE REBAR SCHEDULES.
6.	MJ CAP - WITH WEDGE ACTION RESTRAINT GLAND, TAP 2" THREADED OUTLET (FNPT).
7.	2" RED BRASS (OR 304 S.S.) NIPPLE SCH 40 (MNPT X MNPT) - LENGTH = 12 INCH.
8.	2" RED BRASS (OR 304 S.S.) 90° BEND (FNPT X FNPT).
9.	2" RED BRASS (OR 304 S.S.) NIPPLE SCH 40 (MNPT X MNPT) - LENGTH AS REQUIRED.
10.	STANDARD VALVE BOX ASSEMBLY - SEE DETAIL.
11.	AWG #12 GAUGE COPPER TRACER WIRE - WITH BLUE INSULATION (30 MILS HDPE) TERMINATE WITH 24" EXCESS WIRE (COILED) IN VALVE BOX (TYP.).
12.	1" SCH 40 PVC ELECTRICAL CONDUIT - LENGTH AS REQUIRED.
13.	UNDISTURBED SOIL.
14.	HIGH DENSITY CROSS LAMINATED POLYETHYLENE FILM TUBE (HDCLPE) AWWA C105 - 4 MILS EACH X 2 LAYER - 8 MILS TOTAL.
15.	HDPE ADHESIVE TAPE OR HDPE ZIP LOCK TIES.
16.	PLYWOOD FORM.
17.	2" SCH. 40 RED BRASS OR 2" DUCTILE IRON (FUSION BONDED EPOXY COATED) THREADED COUPLING (FNPT) OR 304 S.S. THREADED COUPLING.
18.	2" GATE VALVE (FNPT X FNPT)
19.	CAST-IN-PLACE CONCRETE SUPPORT PAD
20.	2" RED BRASS OR 304 S.S. NIPPLE SCH 40 (MNPT X MNPT) - LENGTH = 36" (MIN.)

NOTES:

A. WHEN DIRECTED BY THE ENGINEER, THE CONCRETE WALL BLOCK SIZE MAY BE ADJUSTED, BASED ON ACTUAL SOIL CLASSIFICATION AND PIPE DIAMETER.
B. FULLY RESTRAINED JOINT PIPE MAY BE USED IN LIEU OF THIS DETAIL AS CALCULATED BY ENGINEER. LENGTH OF RESTRAINT SHALL BE BASED UPON ACTUAL SOIL CONDITIONS. LENGTH OF RESTRAINT SHALL BE CALLED OUT ON PLANS - SEE RESTRAINED JOINT PIPE DETAILS.
C. ALTERNATE DETAIL "A" (USING A REVERSED BELL) MAY BE USED IN LIEU OF DETAIL "A".
D. 2" PIPE AND FITTINGS TO BE ALL BRASS OR ALL STAINLESS STEEL, DO NOT MIX MATERIALS.
E. MAIN LINE VALVE MAY BE ELIMINATED AT CHARLOTTE WATER DIRECTION AND AT ITS SOLE DIRECTION IF REASONABLY CLOSE TO ANOTHER LINE VALVE.



DETAIL "A"

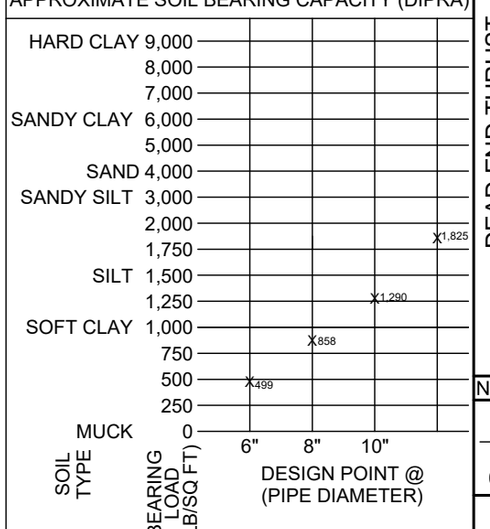
DETAIL "A" (ALT)

APPROX. DEAD END THRUST (DIPRA) AT 200 PSI WATER PRESSURE		UNDISTURBED SOIL BEARING AREA	APPROX. SOIL PRESSURE	W (WIDTH) (MINIMUM)	CONCRETE VOLUME (APPROXIMATE)	
PIPE DIAMETER (INCHES)	TOTAL THRUST (POUNDS)	SQUARE FEET	BEARING LOAD (LB/SQ FT)	INCHES	FT^3	CY
6	7,478	15	499	10	20	0.74
8	12,866	15	858	12	24	0.89
10	19,354	15	1,290	12	24	0.89
12	27,370	15	1,825	14	28	1.04

REBAR SCHEDULE		
TYPE	LENGTH (INCHES)	NUMBER REQUIRED
VERTICAL	38	6
HORIZONTAL	62	6
HORIZONTAL	24	2
DIAGONAL	30	4

REBAR DIAMETER SCHEDULE				
PIPE DIAMETER	BAR SIZE	TOTAL REBAR LENGTH (FT)	TOTAL REBAR WEIGHT (LB) ONE MAT	TOTAL REBAR WEIGHT (LB) TWO MATS
6"	#5	64	67	134
8"	#5	64	67	134
10"	#5	64	67	134
12"	#5	64	67	134

APPROXIMATE SOIL BEARING CAPACITY (DIPRA)



CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

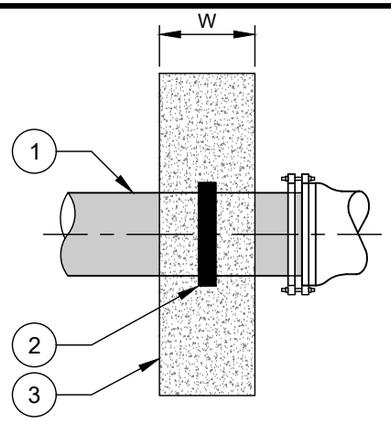
DEAD END THRUST - WALL BLOCKING
AND 2-INCH BLOW-OFF ASSEMBLY 6-INCH
THROUGH 12-INCH MAINS

NO SCALE

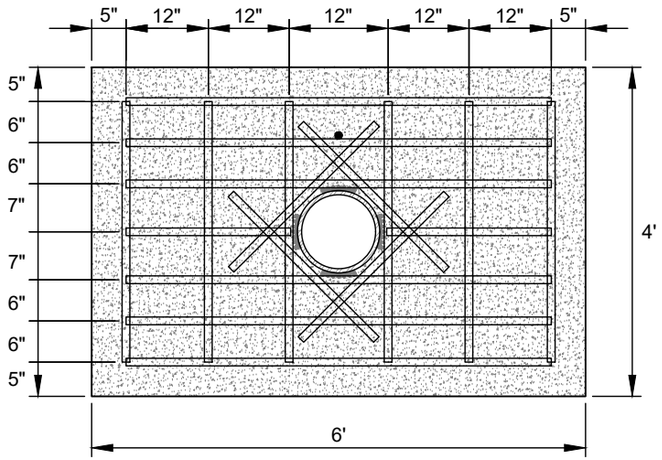
VERSION 3.0

DATE 01/2026

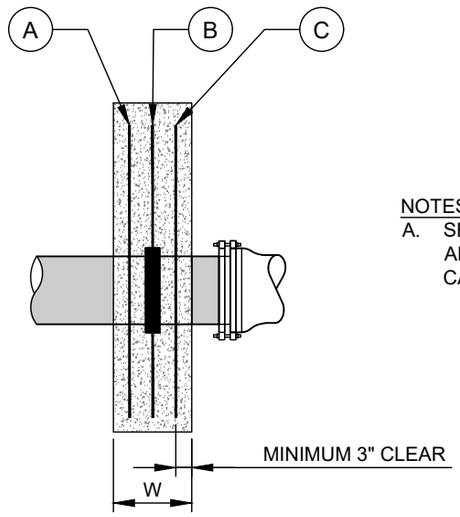
DETAIL 10.4.1



ELEVATION VIEW



REBAR DETAIL: FRONT VIEW



REBAR DETAIL: SIDE VIEW

MINIMUM NUMBER OF FLEX RESTRAINTS BY PIPE SIZE	
HDPE NOMINAL PIPE SIZE (INCHES)	NUMBER OF FLEX RESTRAINTS
4 THROUGH 8	2
10 THROUGH 12	3

NOTES TO DESIGNER

A. SEALING ENGINEER TO CONFIRM ADEQUATE SOIL PRESSURE BEARING CAPACITY FOR THRUST BLOCK.

NO.	DESCRIPTION:
1.	HDPE PIPE.
2.	ELECTROFUSED HDPE FLEX RESTRAINT OR WALL ANCHOR.
3.	CONCRETE WALL BLOCKING - f'c = MINIMUM 3,600 PSI.
4.	FLEX RESTRAINTS FOR HDPE PIPE. SEE TABLE FOR REQUIRED NUMBER OF FLEX RESTRAINTS BY PIPE SIZE. COMPLY WITH MANUFACTURERS INSTRUCTIONS FOR NUMBER OF FLEX RESTRAINTS IF GREATER THAN SHOWN IN TABLE.
5.	AWG #12 GAUGE SOLID COPPER TRACER WIRE WITH BLUE 30 MILS HDPE INSULATION.

NOTES:

A. WHEN DIRECTED BY THE SEALING ENGINEER, THE CONCRETE WALL BLOCK SIZE MAY BE ADJUSTED, BASED ON ACTUAL SOIL CLASSIFICATION AND PIPE DIAMETER.

B. FLEX RESTRAINTS MUST BE RATED AT 8,000 LBS OF FORCE OR HIGHER.

REBAR NOTES:

a. FOR 4" TO 10" PIPE, PLACE ONE REBAR MAT AT LOCATION B ON THE REBAR DETAIL: SIDE VIEW.

b. FOR 12" PIPE, PLACE TWO REBAR MATS - ONE AT LOCATION "A" AND ONE AT LOCATION "C" ON THE REBAR DETAIL: SIDE VIEW.

REBAR SCHEDULE			
TYPE	LENGTH (INCHES)	NUMBER REQUIRED FOR ONE MAT	NUMBER REQUIRED FOR TWO MATS
VERTICAL	38	6	12
HORIZONTAL	62	6	12
DIAGONAL	30	4	8
HORIZONTAL	24	2	4

REBAR DIAMETER SCHEDULE				
HDPE NOMINAL PIPE DIAMETER (INCHES)	BAR SIZE	TOTAL REBAR LENGTH (FT)	TOTAL REBAR WEIGHT (LB) ONE MAT	TOTAL REBAR WEIGHT (LB) TWO MATS
4	#5	64	67	134
6	#5	64	67	134
8	#5	64	67	134
10	#5	64	67	134
12	#5	64	67	134

APPROX. DEAD END THRUST AT 200 PSI WATER PRESSURE		UNDISTURBED SOIL BEARING AREA (SQUARE FEET)	APPROX. SOIL PRESSURE	W MINIMUM WIDTH (INCHES)	APPROXIMATE CONCRETE VOLUME	
HDPE NOMINAL PIPE DIAMETER (INCHES)	TOTAL THRUST (POUNDS)		BEARING LOAD (LB/SQ FT)		(CUBIC FEET)	(CUBIC YARD)
4	2,130	15	142	10	20	0.74
6	4,616	15	308	10	20	0.74
8	7,823	15	522	12	24	0.89
10	12,153	15	810	12	24	0.89
12	17,094	15	1,140	14	28	1.04

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

CONCRETE WALL BLOCKING FOR HDPE PIPE (4-INCH TO 12-INCH)

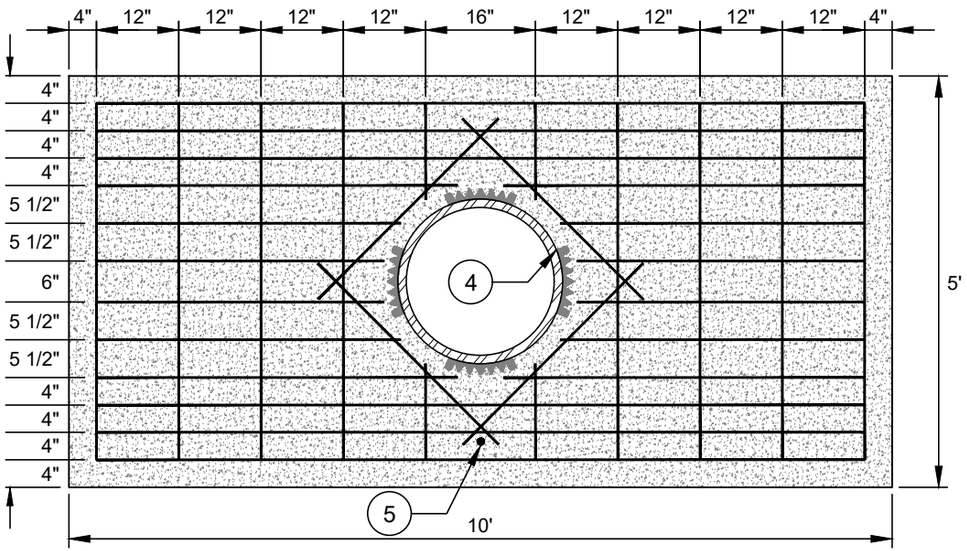
NO SCALE

VERSION 1.0

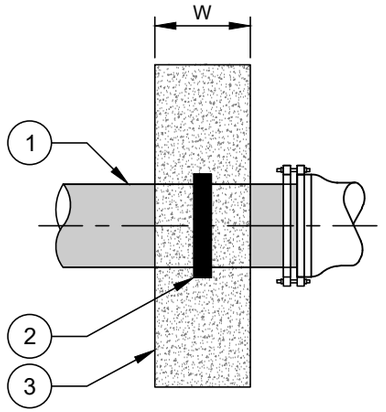
DATE 04/2024

DETAIL 10.4.2

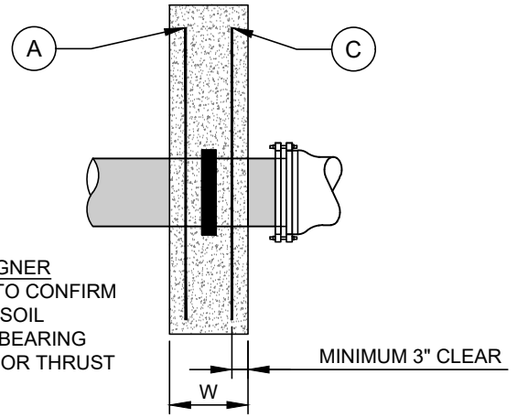
MINIMUM NUMBER OF FLEX RESTRAINTS BY PIPE SIZE	
HDPE NOMINAL PIPE SIZE (INCHES)	NUMBER OF FLEX RESTRAINTS
14	4
16	6
18	7
24	10
32	17



REBAR DETAIL: FRONT VIEW



ELEVATION VIEW



NOTES TO DESIGNER

A. ENGINEER TO CONFIRM ADEQUATE SOIL PRESSURE BEARING CAPACITY FOR THRUST BLOCK.

REBAR DETAIL: SIDE VIEW

NO.	DESCRIPTION:
1.	HDPE PIPE.
2.	ELECTROFUSED HDPE FLEX RESTRAINT OR WALL ANCHOR.
3.	CONCRETE WALL BLOCKING - f'c = MINIMUM 3,600 PSI.
4.	FLEX RESTRAINTS FOR HDPE PIPE. SEE TABLE FOR REQUIRED NUMBER OF FLEX RESTRAINTS BY PIPE SIZE. COMPLY WITH MANUFACTURERS INSTRUCTIONS FOR NUMBER OF FLEX RESTRAINTS IF GREATER THAN SHOWN IN TABLE.
5.	AWG #12 GAUGE SOLID COPPER TRACER WIRE WITH BLUE 30 MIL HDPE INSULATION.

NOTES:

A. WHEN DIRECTED BY THE SEALING ENGINEER, THE CONCRETE WALL BLOCK SIZE MAY BE ADJUSTED, BASED ON ACTUAL SOIL CLASSIFICATION AND PIPE DIAMETER.

B. FLEX RESTRAINTS MUST BE RATED AT 8,000 LBS OF FORCE OR HIGHER.

REBAR NOTES:

a. FOR 14" TO 32" PIPE, PLACE REBAR MATS BOTH AT LOCATION "A" AND LOCATION "C" ON THE REBAR DETAIL: SIDE VIEW.

REBAR SCHEDULE			
TYPE	LENGTH (INCHES)	NUMBER REQUIRED FOR ONE MAT	NUMBER REQUIRED FOR TWO MATS
VERTICAL	52	8	16
VERTICAL	10	4	8
HORIZONTAL	112	6	12
HORIZONTAL	48	4	8
DIAGONAL	48	4	8

REBAR DIAMETER SCHEDULE				
HDPE NOMINAL PIPE DIAMETER (INCHES)	BAR SIZE	TOTAL LENGTH OF REBAR (FT)	TOTAL REBAR WEIGHT (LB) ONE MAT	TOTAL REBAR WEIGHT (LB) TWO MATS
14	#5	126	131	262
16	#5	126	131	262
18	#5	126	131	262
20	#5	126	131	262
24	#5	126	131	262
30	#7	126	257	514
32	#7	126	257	514

APPROX. DEAD END THRUST AT 200 PSI WATER PRESSURE		UNDISTURBED SOIL BEARING AREA (SQUARE FEET)	APPROX. SOIL PRESSURE	W MINIMUM WIDTH (INCHES)	APPROXIMATE CONCRETE VOLUME	
HDPE NOMINAL PIPE DIAMETER (INCHES)	TOTAL THRUST (POUNDS)		BEARING LOAD (LB/SQ FT)		(CUBIC FEET)	(CUBIC YARD)
14	20,608	30	687	14	58	2.16
16	26,915	30	897	16	67	2.47
18	34,073	30	1,136	16	67	2.47
20	42,063	30	1,402	18	75	2.78
24	60,566	30	2,019	18	75	2.78
30	94,641	30	3,155	22	92	3.40
32	107,678	30	3,589	22	92	3.40

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

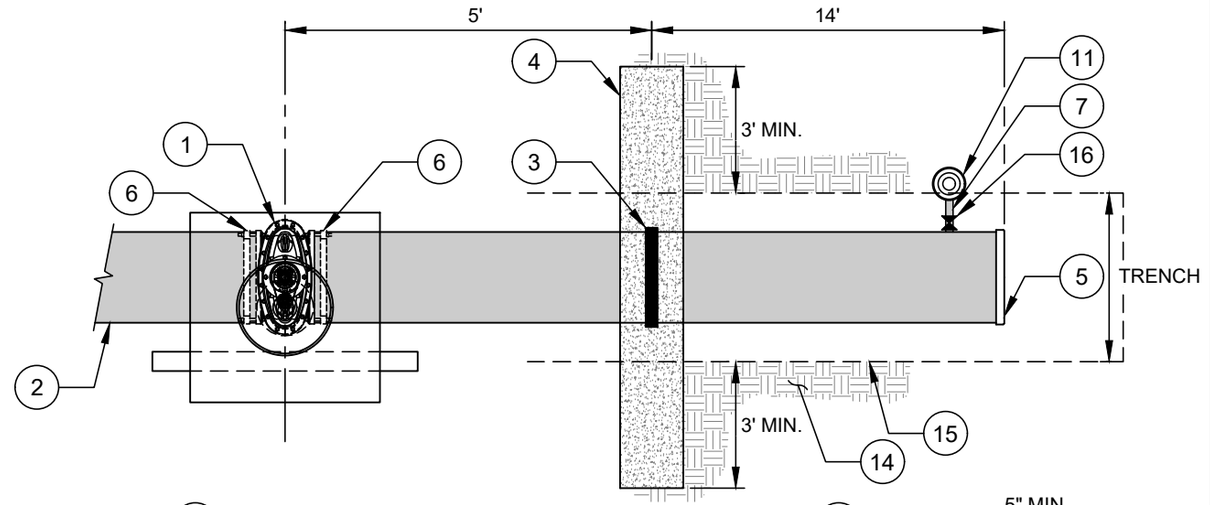
CONCRETE WALL BLOCKING FOR HDPE PIPE (14-INCH TO 32-INCH)

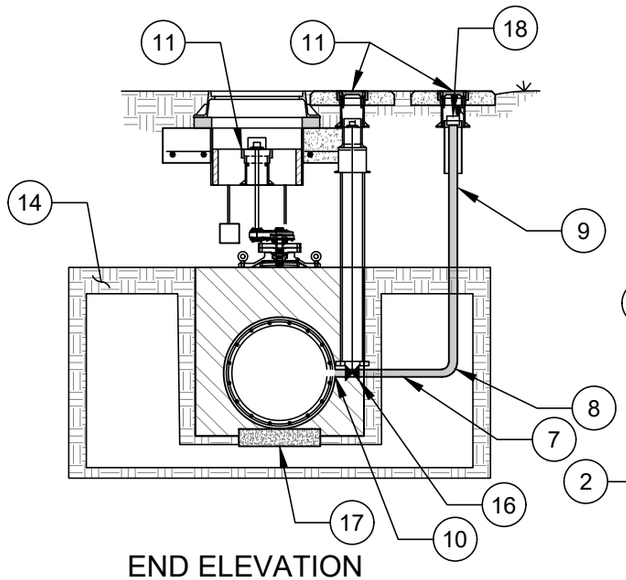
NO SCALE

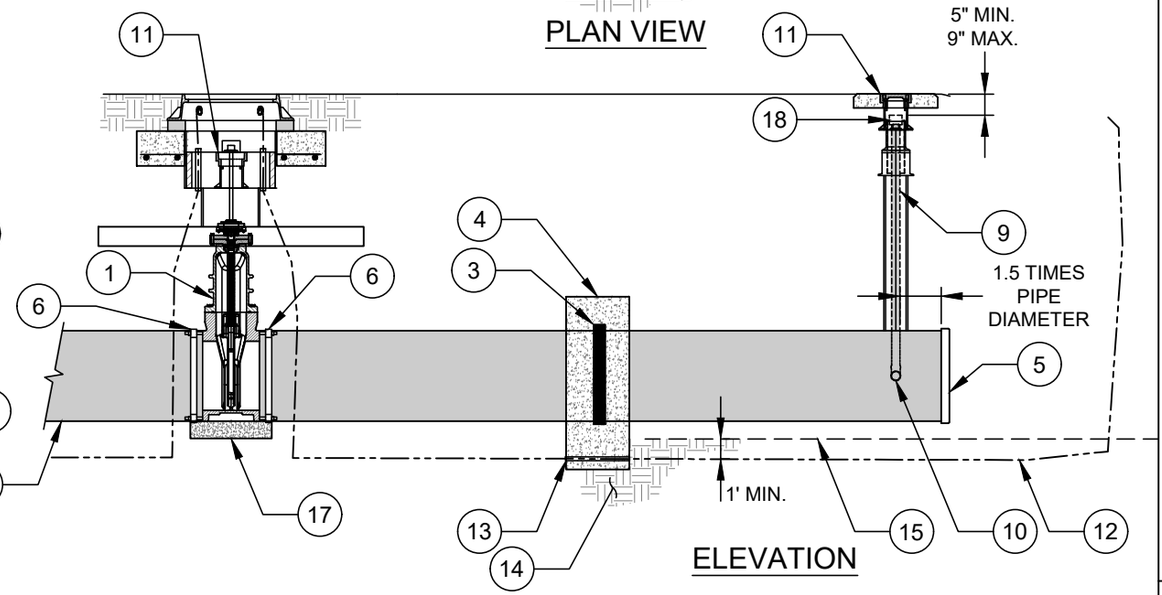
VERSION 1.0

DATE 04/2024

DETAIL 10.4.3







NOTES TO DESIGNER

A. SEALING ENGINEER TO CONFIRM ADEQUATE SOIL PRESSURE BEARING CAPACITY FOR THRUST BLOCK.
B. AUTOMATIC FLUSHING DEVICE AS DIRECTED BY CLTW MAY BE REQUIRED.

OUTLET SIZE TABLE		
MAIN DIAMETER (INCH)	OUTLET NOMINAL DIAMETER (INCH)	CONTROL VALVE
6 to 20	2"	2" GATE VALVE
22 to 32	4"	4" GATE VALVE

NO.	DESCRIPTION:
1.	GATE VALVE.
2.	HDPE WATER MAIN.
3.	FLEX RESTRAINTS FOR HDPE PIPE. SEE STANDARD DETAIL.
4.	REINFORCED CONCRETE WALL BLOCKING - f'c = MINIMUM 3,600 PSI. SEE APPROPRIATE STANDARD DETAIL.
5.	BUTT FUSED HDPE END CAP.
6.	BUTT FUSED MALE HDPE MJ ADAPTER WITH STAINLESS STEEL STIFFENER AND ACCESSORY KIT OR BUTT FUSION JOINT AS APPROPRIATE TO VALVE.
7.	2" OR 4" HDPE PIPE.
8.	2" OR 4" HDPE 90° BEND.
9.	2" OR 4" HDPE NIPPLE - LOCATE BACK OF CURB OR IN SHOULDER - LENGTH AS REQUIRED.
10.	2" OR 4" TAPPING TEE OR 4" SADDLE.
11.	VALVE BOX ASSEMBLY - SEE CLTW STANDARD DETAIL.
12.	TRACER WIRE - CONTINUOUS AWG #12 GAUGE SOLID COPPER TRACER WIRE WITH 30 MILS THICK BLUE HDPE INSULATION.
13.	1-INCH SCH 40 PVC ELECTRICAL CONDUIT. LENGTH AS REQUIRED.
14.	UNDISTURBED SOIL.
15.	TRENCH LIMITS.
16.	2" OR 4" GATE VALVE.
17.	CONCRETE BEARING BLOCK.
18.	2" OR 4" HDPE BUTT FUSION X 304 S.S. THREADED ADAPTOR - FNPT THREADS.

NOTES:

A. SEALING ENGINEER MAY MODIFY WALL BLOCK SIZE BASED ON ACTUAL SOIL CLASSIFICATION AND PIPE DIAMETER.

B. FOR IN-DITCH FUSION, MINIMUM TRENCH WIDTH TO ACCOMMODATE EQUIPMENT ALLOWED.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

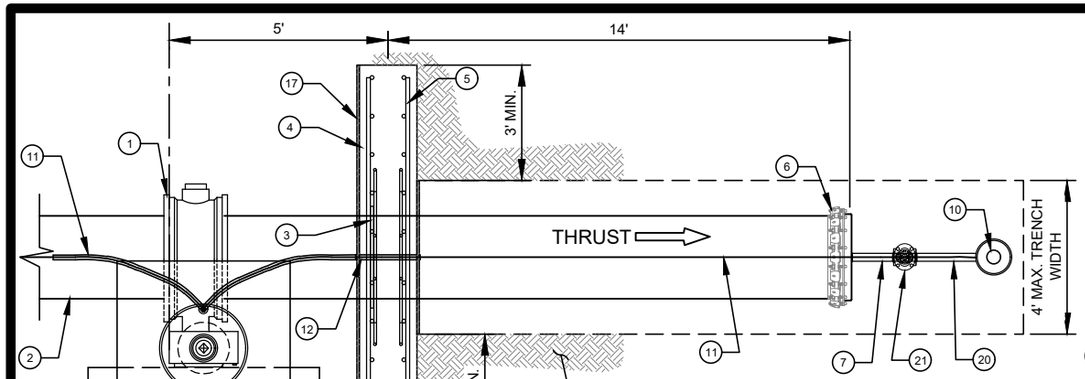
DEAD END WALL BLOCKING FOR HDPE PIPE

NO SCALE

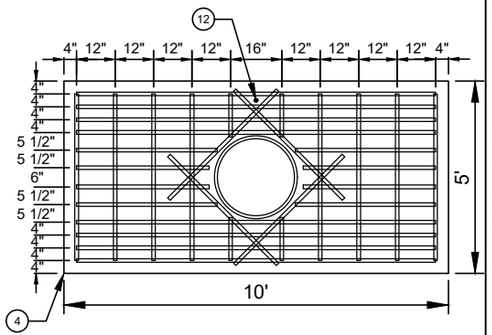
VERSION 2.0

DATE 01/2026

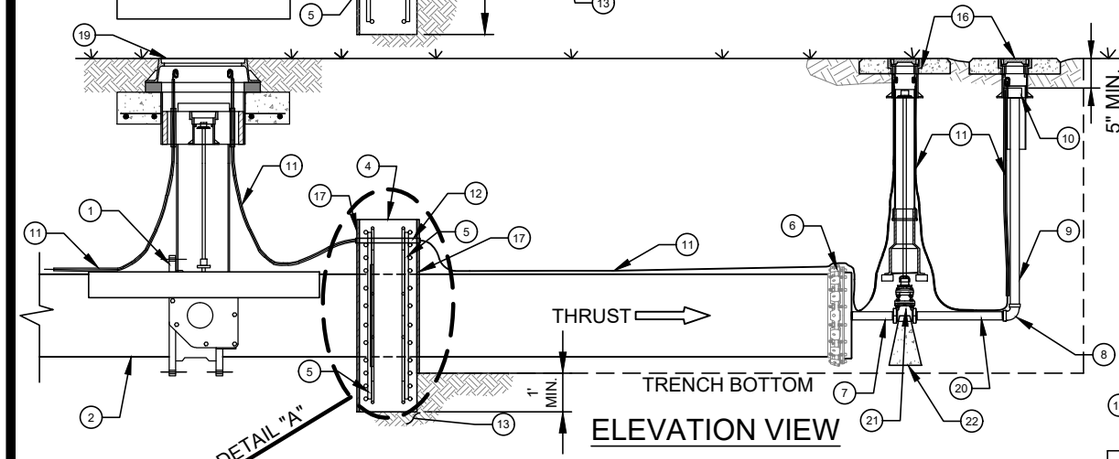
DETAIL 10.4.4



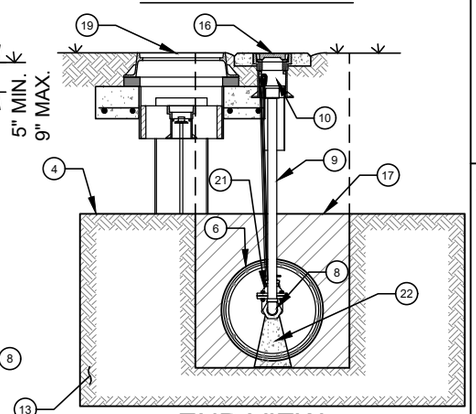
PLAN VIEW



REBAR DETAIL



ELEVATION VIEW



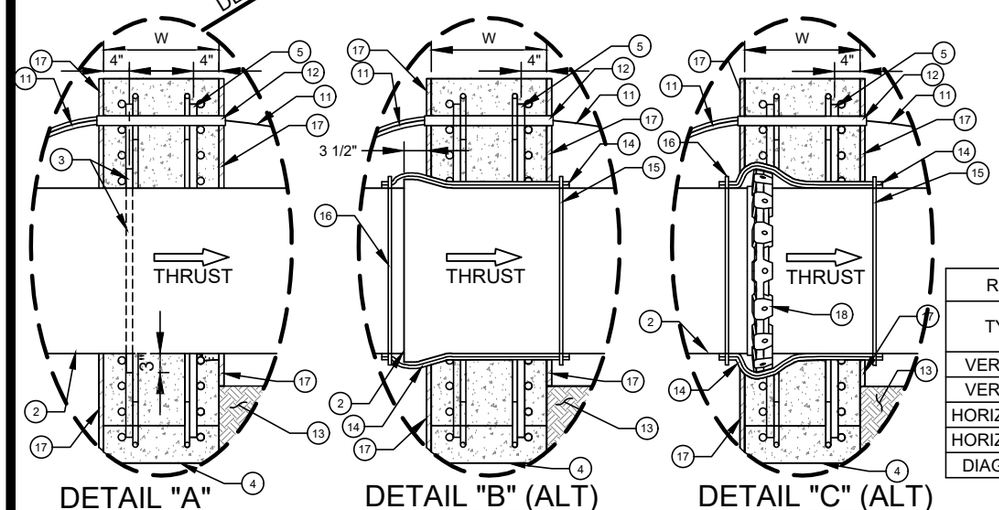
END VIEW

NO.	DESCRIPTION:
1.	END OF LINE VALVE - GATE VALVE (MJ X MJ).
2.	DIP - (PE X PE) - REMOVE BELL - LENGTH = 17' ~ 19'.
3.	1" THICK X 3" WIDE STEEL THRUST RING - FACTORY WELDED TO PIPE.
4.	CONCRETE WALL BLOCK (F'c = 3,600 PSI MIN.) 10' X 5' X WIDTH (W).
5.	REBARS - GRADE 60 PER ASTM A615 - SEE REBAR SCHEDULES, CUT WHEN REQUIRED.
6.	MJ CAP - WITH WEDGE ACTION RESTRAINT GLAND, TAP 2" THREADED OUTLET (FNPT).
7.	2" RED BRASS (OR 304 S.S.) NIPPLE SCH 40 (MNPT X MNPT) - LENGTH = 12".
8.	2" RED BRASS (OR 304 S.S.) 90° BEND (FNPT X FNPT).
9.	2" RED BRASS (OR 304 S.S.) NIPPLE SCH 40 (MNPT X MNPT) - LENGTH AS REQUIRED.
10.	2" SCH 40 RED BRASS OR 2" DUCTILE IRON (FUSION BONDED EPOXY COATED) THREADED COUPLING (FNPT).
11.	AWG #12 GAUGE SOLID COPPER TRACER WIRE - WITH BLUE INSULATION (30 MILS HDPE) TERMINATE WITH 24" EXCESS WIRE (COILED) IN VALVE BOX (TYP.).
12.	1" ALUMINUM ELECTRICAL CONDUIT - LENGTH AS REQUIRED.
13.	UNDISTURBED SOIL.
14.	HIGH DENSITY CROSS LAMINATED POLYETHYLENE FILM TUBE (HDCLPE) AWWA C105 - 4 MILS EACH X 2 LAYER - 8 MILS TOTAL.
15.	HDPE ADHESIVE TAPE OR HDPE ZIP LOCK TIES.
16.	STANDARD VALVE BOX ASSEMBLY - SEE DETAIL.
17.	PLYWOOD FORM.
18.	WEDGE ACTION THRUST RESTRAINT GLAND.
19.	LARGE VALVE BOX FRAME AND COVER ASSEMBLY, PER STD DETAIL.
20.	2" RED BRASS OR 304 S.S. NIPPLE SCH 40 (MNPT X MNPT) - LENGTH = 36" (MIN.)
21.	2" GATE VALVE (FNPT X FNPT).
22.	CAST-IN-PLACE CONCRETE SUPPORT PAD.

NOTES:

A. WHEN DIRECTED BY THE ENGINEER, THE CONCRETE WALL BLOCK SIZE MAY BE ADJUSTED, BASED ON ACTUAL SOIL CLASSIFICATION AND PIPE DIAMETER.
B. FULLY RESTRAINED JOINT PIPE MAY BE USED IN LIEU OF THIS DETAIL AS CALCULATED BY ENGINEER. LENGTH OF RESTRAINT SHALL BE BASED UPON ACTUAL SOIL CONDITIONS. LENGTH OF RESTRAINT SHALL BE CALLED OUT ON PLANS - SEE RESTRAINED JOINT PIPE DETAILS.
C. ALTERNATE DETAIL "B" (USING A REVERSED BELL) MAY BE USED IN LIEU OF DETAIL "A".
D. ALTERNATE DETAIL "C" (USING WEDGE ACTION RESTRAINT GLAND) MAY BE USED IN LIEU OF DETAIL "A".
E. 2" PIPE AND FITTINGS TO BE ALL BRASS OR ALL STAINLESS STEEL, DO NOT MIX MATERIAL.

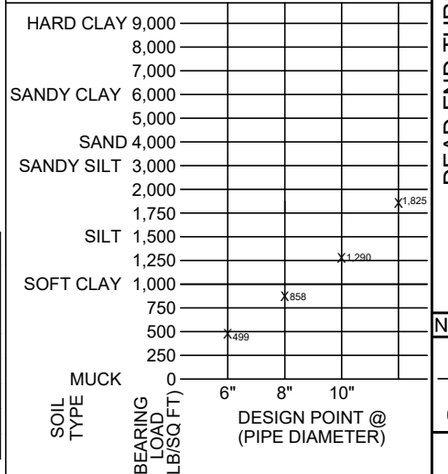
APPROX. DEAD END THRUST (DIPRA) AT 200 PSI WATER PRESSURE		UNDISTURBED SOIL BEARING AREA	APPROX. SOIL PRESSURE	W (WIDTH) (MINIMUM)	CONCRETE VOLUME (APPROXIMATE)	
PIPE DIAMETER (INCHES)	TOTAL THRUST (POUNDS)	SQUARE FEET	BEARING LOAD (LB/SQ FT)	INCHES	FT^3	CY
16	47,558	30	1,585	16	32	1.19
18	59,730	30	1,991	16	32	1.19
20	73,288	30	2,443	18	36	1.33
24	104,558	30	3,485	18	36	1.33
30	160,850	30	5,362	20	40	1.48



DETAIL "A" | DETAIL "B" (ALT) | DETAIL "C" (ALT)

REBAR SCHEDULE PER MAT		
TYPE	LENGTH (INCHES)	NUMBER REQUIRED
VERTICAL	52	6
VERTICAL	20	4
HORIZONTAL	112	10
HORIZONTAL	48	4
DIAGONAL	48	4

REBAR DIAMETER SCHEDULE				
PIPE DIAMETER	BAR SIZE	TOTAL REBAR LENGTH (FT)	TOTAL REBAR WEIGHT (LB) ONE MAT	TOTAL REBAR WEIGHT (LB) TWO MATS
16"	#5	158	165	330
18"	#5	158	165	330
20"	#5	158	165	330
24"	#5	158	165	330
30"	#7	158	323	646



CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

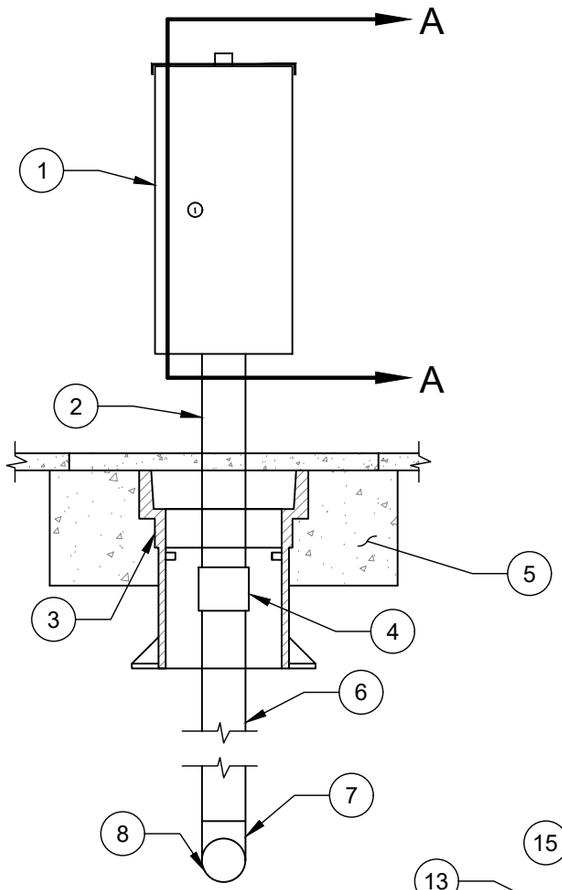
DEAD END THRUST - WALL BLOCKING AND 2-INCH BLOW-OFF ASSEMBLY 14-INCH THROUGH 30-INCH MAINS

NO SCALE

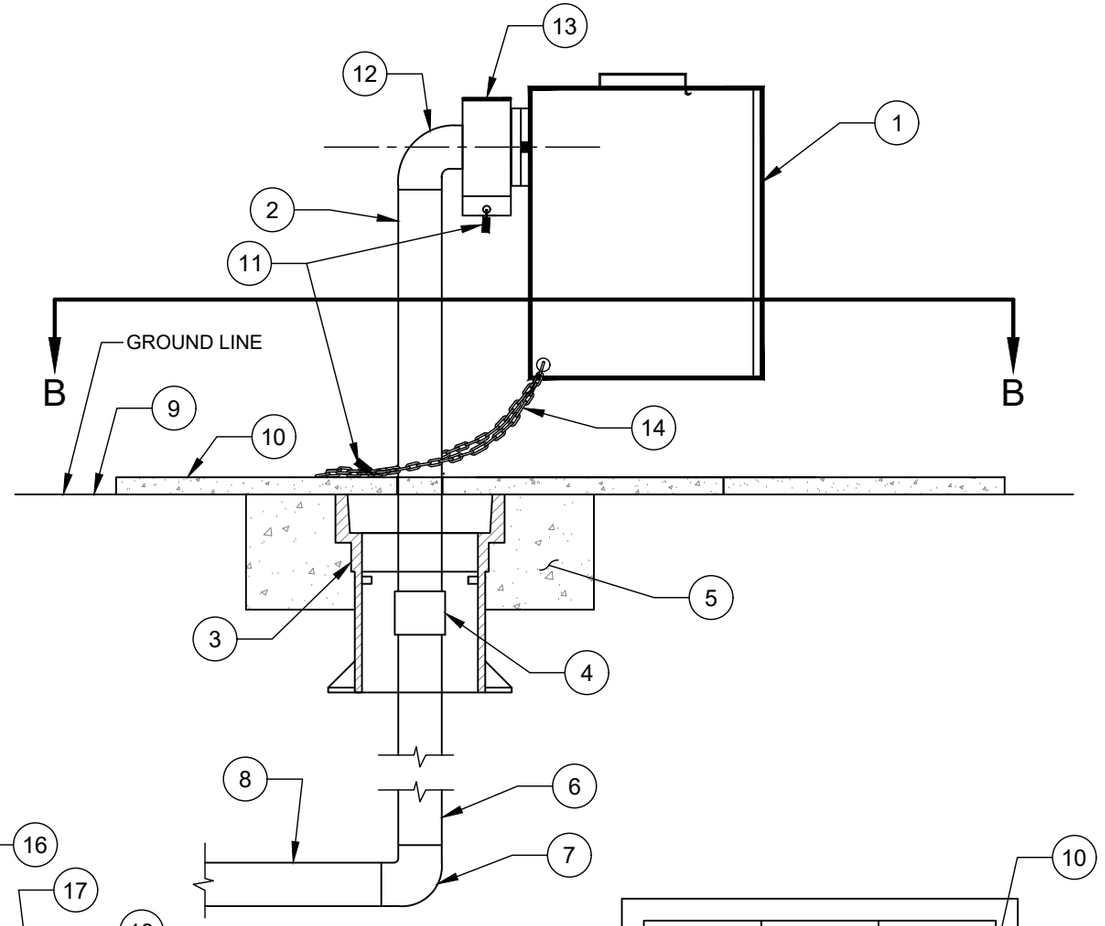
VERSION 2.0

DATE 01/2026

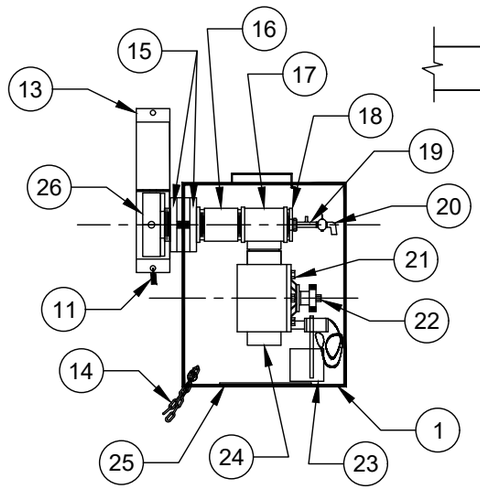
DETAIL 10.4.5



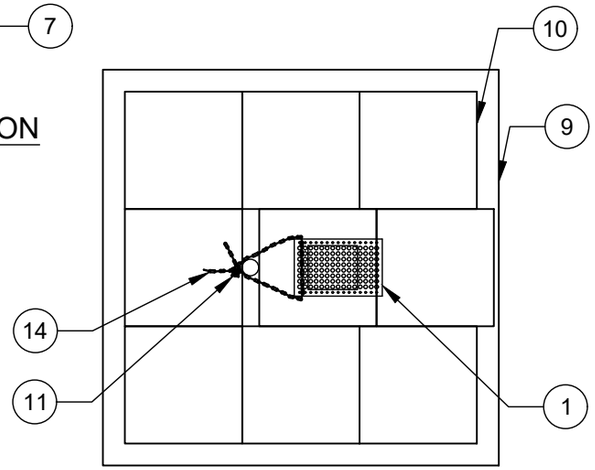
SIDE ELEVATION



FRONT ELEVATION



SECTION A - A



SECTION B - B

NO.	DESCRIPTION:
1.	KUPFERLE #9700-Y HYDRANT AUTO FLUSHER - YELLOW (INCLUDES #15-26).
2.	2" GALVANIZED STEEL PIPE (SCH 80).
3.	TOP SECTION WATER VALVE BOX.
4.	2" S.S. OR RED BRASS (SCH 40), OR 2" DUCTILE IRON (FUSION BONDED EPOXY COATED) THREADED COUPLING (FNPT).
5.	18" X 18" X 6" CONCRETE PAD.
6.	2" S.S. OR RED BRASS PIPE (SCH 40).
7.	2" 90° S.S. OR RED BRASS BEND (SCH 40).
8.	2" S.S. OR RED BRASS PIPE (SCH 40).
9.	6 MIL HDPE PLASTIC FILM (54"X54").
10.	16" X 16" X 2" PATIO PAVERS CONCRETE (9 EACH).
11.	PAD LOCK (PROVIDED BY CLTW).
12.	KUPFERLE #X707 BRASS 2" FNPT X 2 1/2" MNST HOSE NOZZLE.
13.	LOCKING NOZZLE COLLAR - KUPFERLE #9708-Y.
14.	CAMPBELL BLU-KROME 1/4" PROOF COIL CHAIN 5 LF.
15.	KUPFERLE ADAPTOR.
16.	2" THREADED NIPPLE.
17.	2" X 2" X 2" TEE FIP THREAD.
18.	PLUG/TAP.
19.	WATER SAMPLE VALVE.
20.	BRASS SAMPLING BIBB.
21.	2" SOLENOID CONTROL VALVE; P-220 SERIES.
22.	MANUAL FLOW CONTROL KNOB.
23.	HUNTER DIGITAL PROGRAMMABLE CONTROLLER WITH 9 VOLT LITHIUM BATTERY.
24.	2" FIP OUTLET (MAY BE HARD PIPE FOR DISCHARGES).
25.	REMOVABLE DIFFUSER PLATE WITH 4 BOLTS/NUTS.
26.	2 1/2" FIRE HYDRANT NOZZLE COUPLING.

NOTES:

A. AUTO FLUSHER IS INTENDED FOR WARM WEATHER USE. ASSEMBLY SHOULD BE REMOVED DURING COLD WEATHER MONTHS TO AVOID DAMAGE DUE TO FREEZING.

B. MANUAL FLUSHING REQUIRED TO MAINTAIN WATER QUALITY DURING COLD WEATHER MONTHS.

C. PADLOCK PROVIDED BY CLTW.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

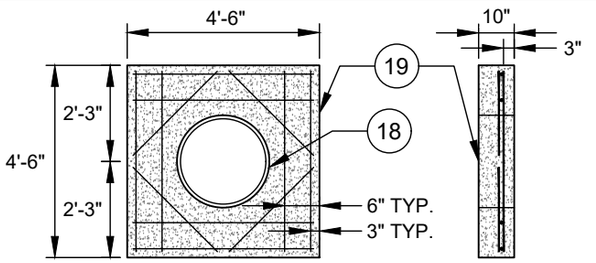
AUTOMATIC FLUSHER - 2" BLOW-OFF

NO SCALE

VERSION 1.0

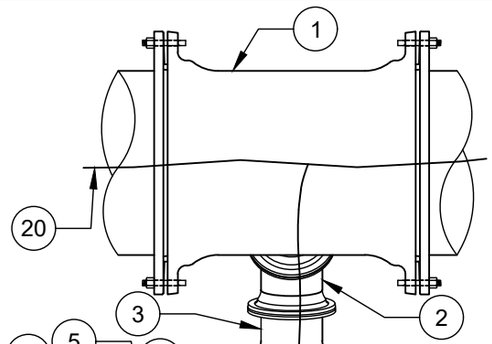
DATE 04/2024

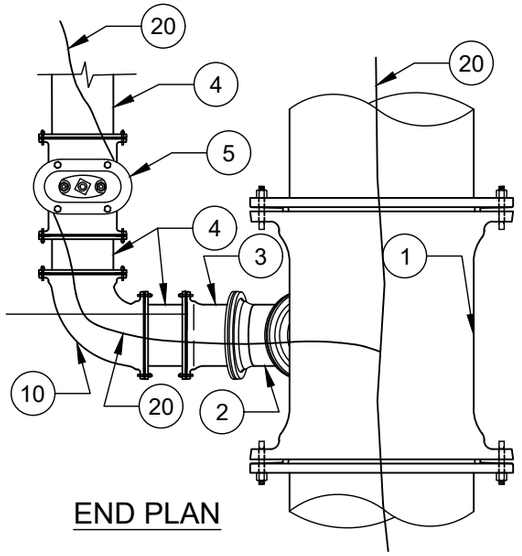
DETAIL 10.5.1



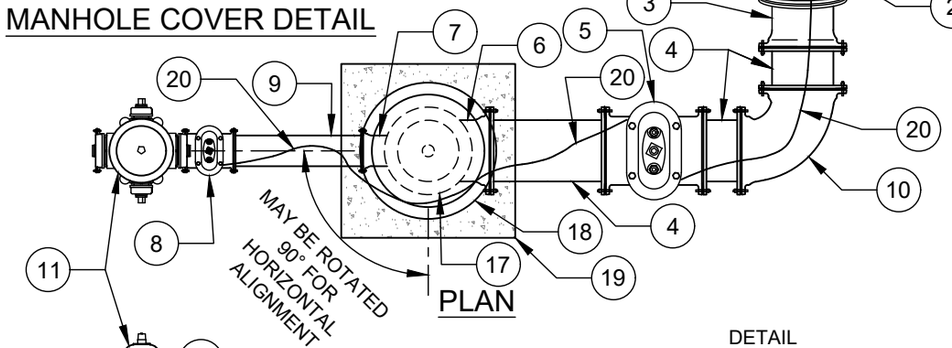
PLAN VIEW SECTION VIEW

MANHOLE COVER DETAIL

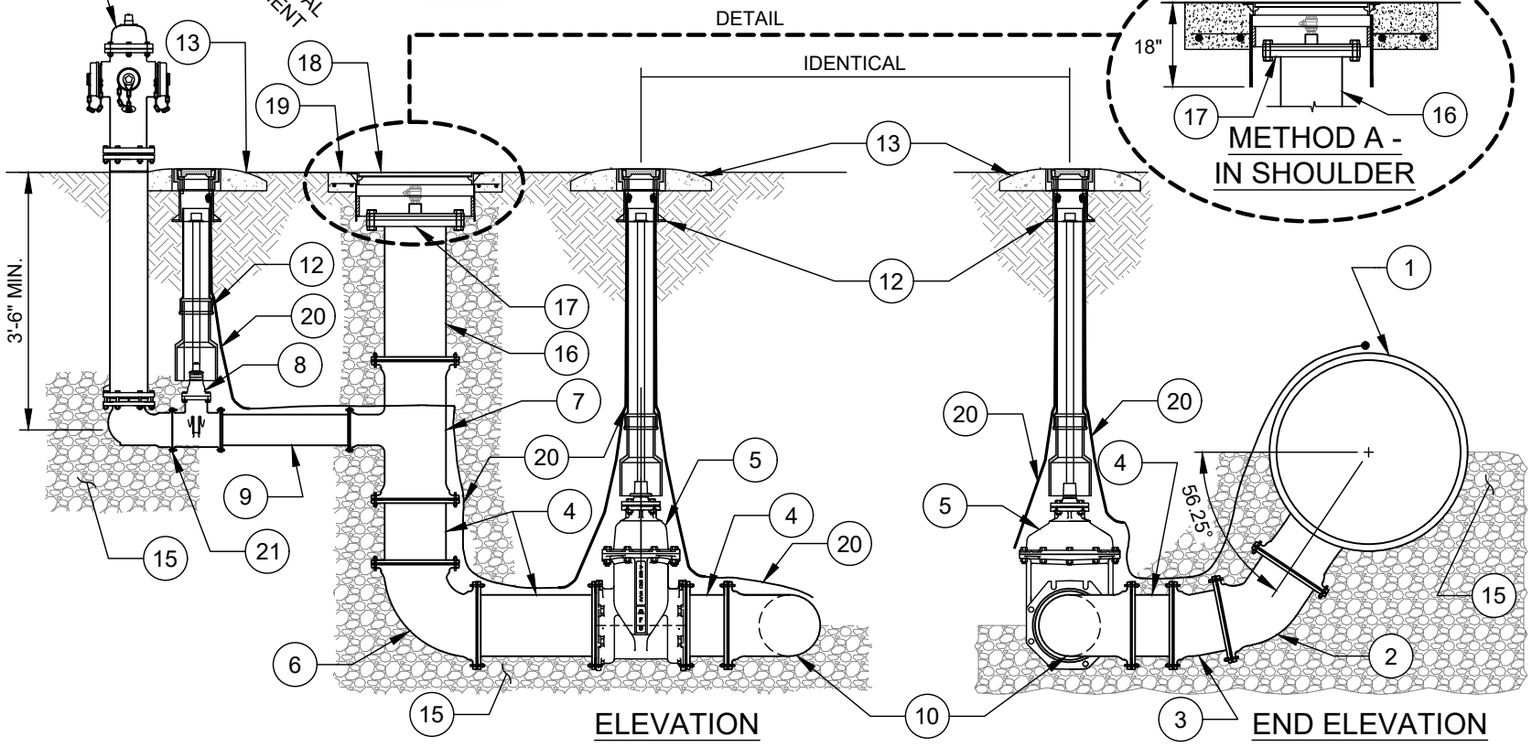




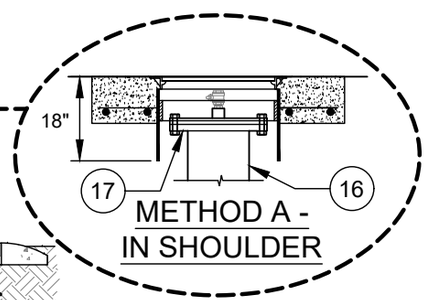
END PLAN



PLAN



ELEVATION END ELEVATION

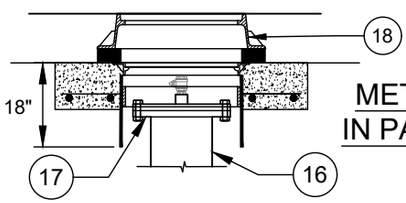


METHOD A - IN SHOULDER

NO.	DESCRIPTION:
1.	RUN X 12" TEE (MJ - MJ) - ROTATE DOWN 56°.
2.	12" 45° BEND (MJ - PE).
3.	12" 11 1/4° BEND (MJ - PE).
4.	12" DIP (PE-PE) LENGTHS AS REQ'D.
5.	12" GATE VALVE (MJ - MJ).
6.	12" 90° BEND (MJ - MJ) - VERTICAL.
7.	12" X 12" X 8" TEE (MJ - MJ) - VERTICAL.
8.	8" GATE VALVE (MJ - MJ).
9.	8" DIP (PE-PE) LENGTHS AS REQ'D.
10.	12" 90° BEND (MJ - MJ) - HORIZONTAL - MAY BE DELETED FOR STRAIGHT INSTALLATION.
11.	HIGH VELOCITY HYDRANT PAINTED OSHA SAFETY BLUE. INSTALLATION PER THE FIRE HYDRANT STD DETAIL.
12.	STANDARD VALVE BOX ASSEMBLY W/VALVE EXTENSION / STEM (AS REQUIRED) PER CLTW STANDARD DETAILS.
13.	REINFORCED CONCRETE VALVE PAD - 24" DIA.
14.	#57 WASHED STONE AT FH BASE - 10 CUBIC FEET.
15.	#57 WASHED STONE - TYPE II BEDDING FOR PIPE & COMPLETE VERTICAL PIPE ENCASEMENT TO UNDERSIDE OF FRAME AND COVER.
16.	12" DIP - FLANGE X PLAIN END.
17.	BLIND FLANGE TAPPED WITH A 2" BALL CORPORATION STOP.
18.	20.5" CLEAR OPENING MANHOLE FRAME AND COVER.
19.	PRECAST CONCRETE PAD (REINFORCED).
20.	AWG #12 GAUGE SOLID COPPER TRACER WIRE WITH 30 MILS BLUE HDPE INSULATION, TERMINATE WITH 24 INCH EXCESS WIRE (COILED) AT VALVE BOX (TYP.).
21.	FOSTER ADAPTOR.

NOTES:

A. ALL FITTINGS SHALL BE FACTORY RESTRAINED JOINTS OR RMJ FITTINGS WITH FOSTER ADAPTERS.
B. ALL FLANGED HARDWARE (BOLT/WASHER/NUT) SHALL BE TYPE 304 STAINLESS STEEL WITH ANTI SEIZE COMPOUND.
C. 90° BEND NO. 10 MAY BE OMITTED FOR STRAIGHT INSTALLATION.
D. TEE NO. 7 MAY BE ROTATED 90° FOR HORIZONTAL ALIGNMENT WITH FH NO. 11 AT ROAD RIGHT-OF-WAY.
E. SEE CONSTRUCTION PLANS FOR EXACT LOCATIONS OF VALVES, CLTW ACCESS POINT, AND FIRE HYDRANT.
F. HYDRANT EXTENSIONS SHALL BE LIMITED TO ONE EACH PER FIRE HYDRANT.
G. SEE FIRE HYDRANT STD DETAIL FOR INSTALLATION REQUIREMENTS.



METHOD B - IN PAVEMENT

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

12" BLOW-OFF ASSEMBLY (24" - 64" MAINS) MANUAL STAND PIPE WITH FIRE HYDRANT

NO SCALE

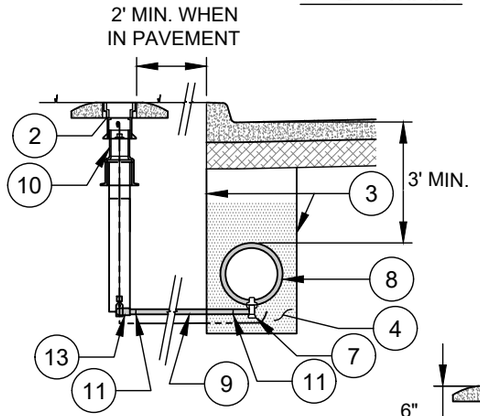
VERSION 1.0

DATE 04/2024

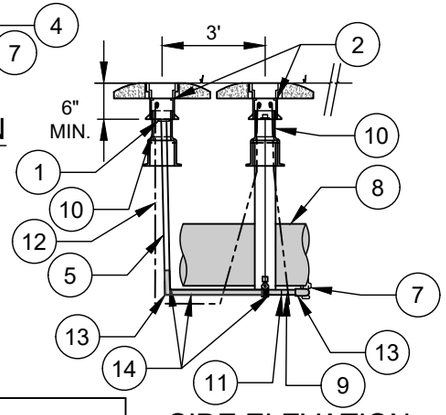
DETAIL 10.5.2

NO.	DESCRIPTION:
1.	2" NPT CAP (HAND TIGHT).
2.	VALVE BOX (TOP SECTION) - ASSEMBLY.
3.	TRENCH LIMITS.
4.	HDPE EMBEDMENT MATERIAL.
5.	2" RED BRASS NIPPLE - SCH 40 - (MNPT X MNPT).
6.	2" GATE VALVE (FNPT X FNPT).
7.	HDPE TAPPING TEE BY ELECTROFUSION ONLY.
8.	HDPE WATER MAIN.
9.	2" SDR-9 HDPE PIPE (IPS).
10.	VALVE BOX ASSEMBLY. SEE STANDARD DETAIL.
11.	HDPE BUTT FUSION JOINT.
12.	TRACER WIRE-CONTINUOUS AWG #12 GAUGE SOLID COPPER TRACER WIRE WITH 30 MILS THICK BLUE HDPE INSULATION.
13.	2" SDR-9 HDPE 90° BEND.
14.	2" HDPE PLAIN END X S.S. MNPT ADAPTOR.

6"-20" MAIN

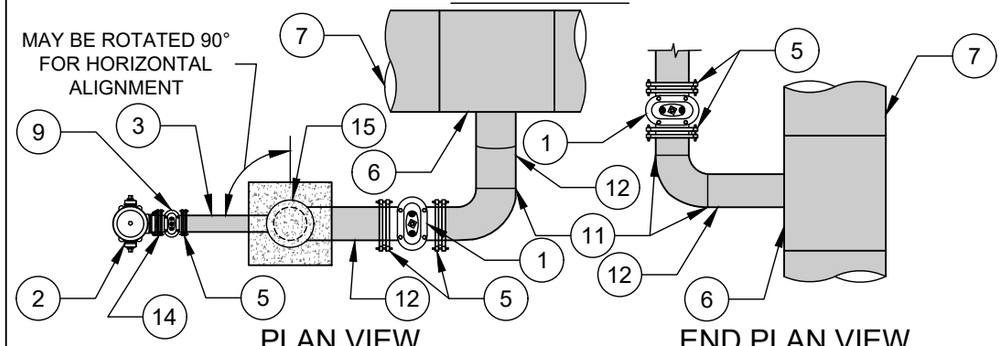


FRONT ELEVATION



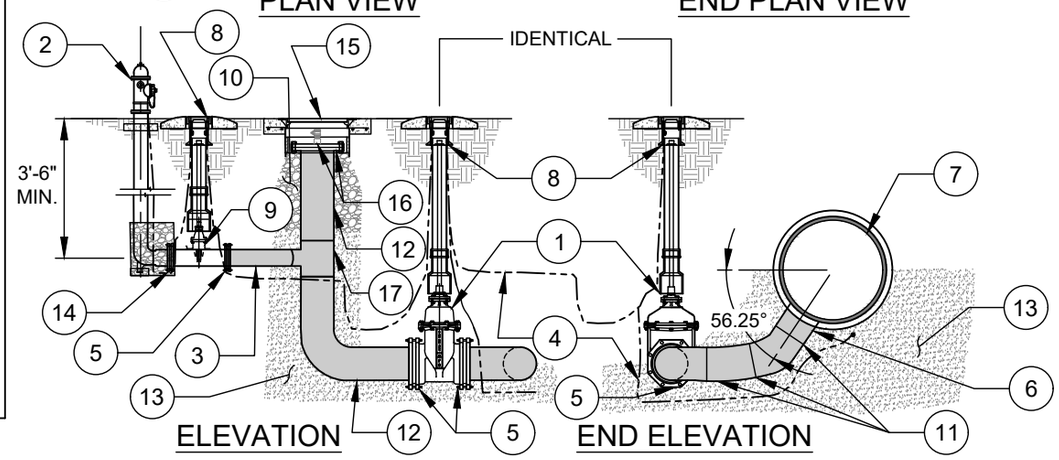
SIDE ELEVATION

22"-32" MAIN



PLAN VIEW

END PLAN VIEW



ELEVATION

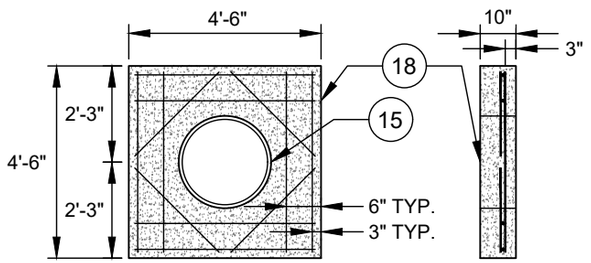
END ELEVATION

NO.	DESCRIPTION:
1.	12" GATE VALVE. SEE STANDARD DETAIL.
2.	STANDARD FIRE HYDRANT ASSEMBLY PER STANDARD DETAIL.
3.	6" HDPE PIPE.
4.	TRACER WIRE - CONTINUOUS AWG #12 GAUGE SOLID COPPER TRACER WIRE WITH 30 MILS THICK BLUE HDPE INSULATION.
5.	MALE MJ ADAPTER WITH STAINLESS STEEL STIFFENER AND ACCESSORY KIT. SEE STANDARD DETAIL FOR TRANSITION DETAIL.
6.	HDPE TEE - 12" OUTLET.
7.	HDPE WATER MAIN.
8.	VALVE BOX ASSEMBLY. SEE STANDARD DETAIL.
9.	6" GATE VALVE. SEE STANDARD DETAIL.
10.	#57 WASHED STONE-ENCASEMENT.
11.	HDPE FITTING BUTT FUSION JOINT.
12.	12" HDPE PIPE.
13.	HDPE EMBEDMENT MATERIAL.
14.	FOSTER ADAPTOR.
15.	20.5" CLEAR OPENING MANHOLE FRAME AND COVER.
16.	BLIND FLANGE TAPPED WITH A 2" BALL CORPORATION STOP.
17.	12" X 12" X 6" HDPE BUTT FUSED TEE.
18.	PRECAST CONCRETE PAD (REINFORCED).

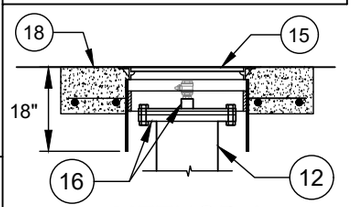
NOTES:
- A. ALL PIPE, FITTINGS, ETC. SHALL BE RESTRAINED JOINT. BUTT FUSED AND ELECTROFUSED HDPE IS FULLY RESTRAINED.
- B. ALL VALVES OPEN RIGHT (CLOCKWISE).
- C. SEE CONSTRUCTION PLANS FOR EXACT LOCATIONS OF VALVES, CLTW ACCESS POINT, AND FIRE HYDRANT.
- D. HYDRANT EXTENSIONS SHALL BE LIMITED TO 1 EACH PER FIRE HYDRANT.
- E. SEE FIRE HYDRANT STD DETAIL FOR INSTALLATION REQUIREMENTS.

NOTES TO DESIGNER
- A. BLOW OFFS TO BE INSTALLED AT LOW POINTS IF REQUIRED BY SEALING ENGINEER.
- B. VALVE AND B.O. SHALL NOT BE PLACED IN ROAD DITCH.

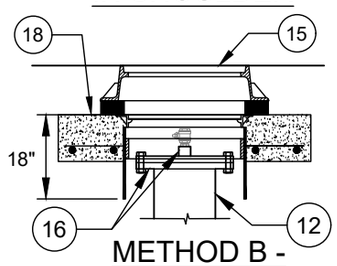
CONCRETE PAD DETAIL



PLAN VIEW SECTION VIEW



METHOD A - IN SHOULDER



METHOD B - IN PAVEMENT

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

BLOW OFF ASSEMBLIES FOR HDPE PIPE

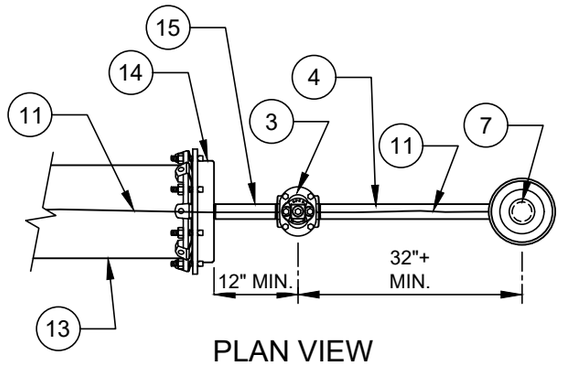
NO SCALE

VERSION 1.0

DATE 04/2024

DETAIL 10.5.3

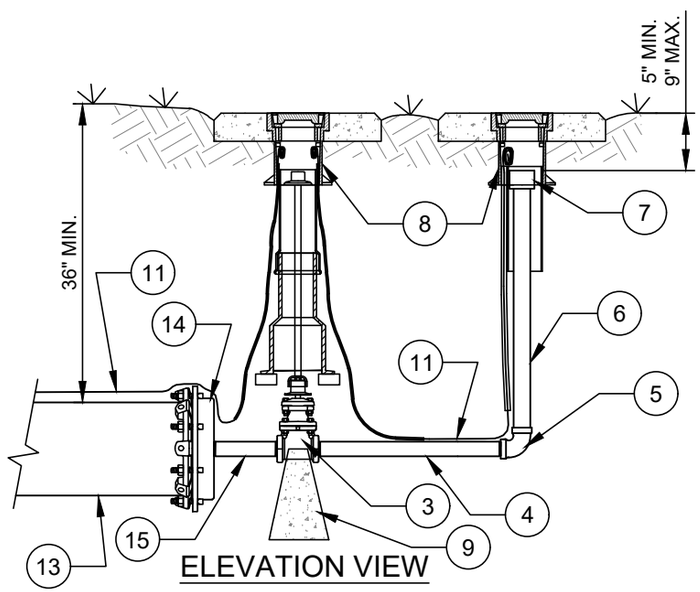
6" THROUGH 12" WATER MAINS



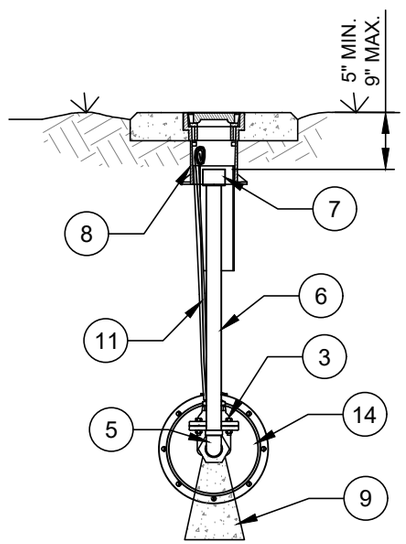
PLAN VIEW

RESTRAINED PIPE LENGTH REQUIREMENTS		
PIPE DIAMETER (INCHES)	REQUIRED RESTRAINED LENGTH:	
	BARE DIP (FEET)	POLYWRAPPED DIP (FEET)
6	169	242
8	219	312
10	264	377
12	309	441

DESIGN BASIS:
DIPRA "THRUST RESTRAINT DESIGN FOR DIP"
VERSION 3.3 DATED 05/09/2003
LAYING CONDITION: TYPE 2
SOIL DESIGNATION: SILT 1
DEPTH OF COVER: 3' MINIMUM
DESIGN PRESSURE: 200 PSI
SAFETY FACTOR: 2.0



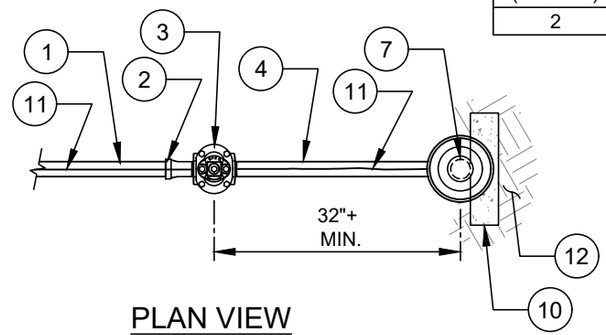
ELEVATION VIEW



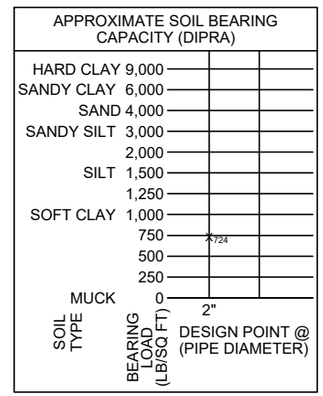
END VIEW

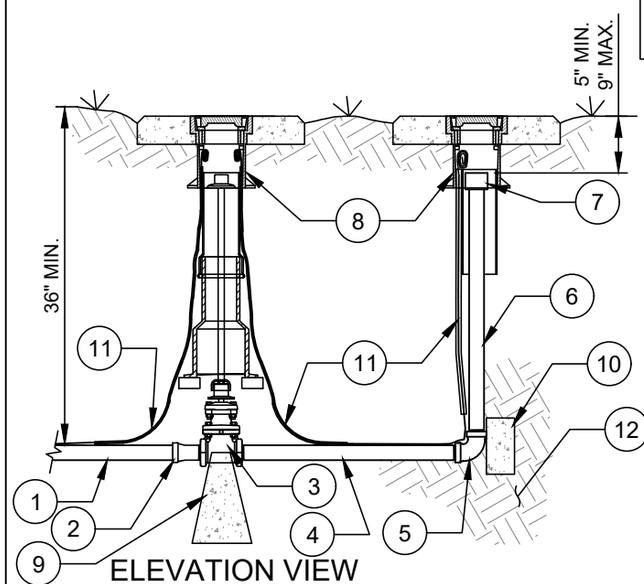
2" WATER MAINS

APPROX. DEAD END THRUST (DIPRA) AT 200 PSI WATER PRESSURE		UNDISTURBED SOIL BEARING AREA	APPROX. SOIL PRESSURE
PIPE DIAMETER (INCHES)	TOTAL THRUST (POUNDS)	SQUARE FEET	BEARING LOAD (LBS/SQ FT)
2	724	0.89	813

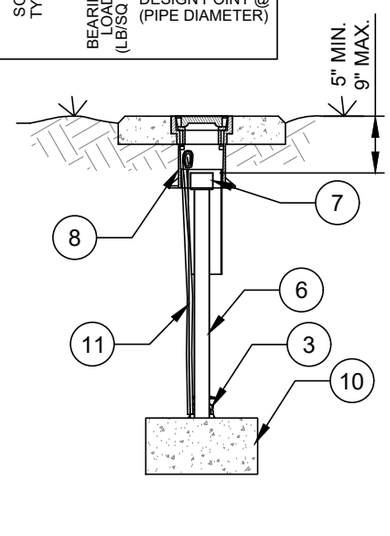


PLAN VIEW





ELEVATION VIEW



END VIEW

NO. DESCRIPTION:

1. 2" SDR 9 HDPE PIPE OR PVC (IPS)
2. 2" BUTT FUSED HDPE X S.S. THREADED ADAPTOR OR FOR PVC USE 2" HARCO MALE ADAPTER (BELL X MALE NPT)
3. 2" GATE VALVE (FNPT X FNPT).
4. 2" RED BRASS OR S.S. NIPPLE - SCH 40 - (MNPT X MNPT), L = 36" (MIN).
5. 2" RED BRASS OR S.S. 90° BEND (FNPT X FNPT).
6. 2" RED BRASS OR S.S. NIPPLE - SCH 40 - (MNPT X MNPT) - LENGTH AS REQUIRED.
7. 2" THREADED COUPLING (FNPT X FNPT) - RED BRASS OR S.S. OR DUCTILE IRON (F.B.E.).
8. STANDARD VALVE BOX ASSEMBLY - SEE CLTW STD. DETAIL.
9. CAST-IN-PLACE CONCRETE SUPPORT PAD.
10. PRECAST CONCRETE SOLID BLOCK (16" X 8" X 4").
11. AWG #12 GAUGE SOLID COPPER TRACER WIRE WITH BLUE INSULATION (30MIL HDPE) - TERMINATE WITH 24" EXCESS WIRE (COILED) IN VALVE BOX (TYP.).
12. UNDISTURBED OR COMPACTED SOIL - 100% STANDARD PROCTOR.
13. DUCTILE IRON PIPE - RESTRAINED - LENGTH AS REQUIRED - SEE CLTW STD. DETAILS.
14. MJ CAP WITH WEDGE ACTION RESTRAINT GLAND, TAP 2" THREADED OUTLET (FNPT).
15. 2" RED BRASS OR S.S. NIPPLE - SCH 40 (MNPT X MNPT), L = 12" (MIN).

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

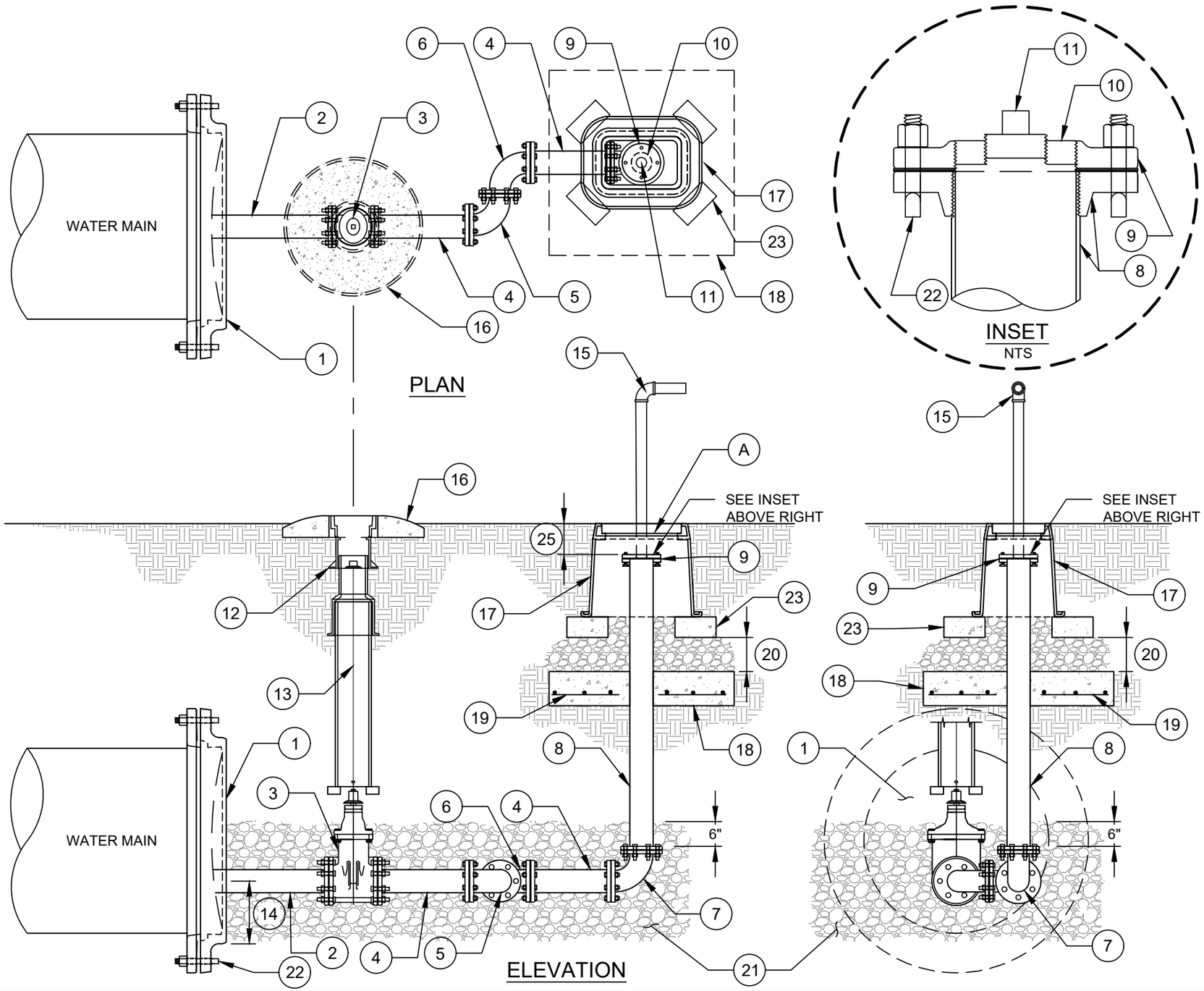
2-INCH BLOW OFF ASSEMBLY (DEAD END OF MAIN) WITH 2-INCH GATE VALVE
2-INCH THROUGH 12-INCH MAINS

NO SCALE

VERSION 2.0

DATE 01/2025

DETAIL 10.5.4



NO. DESCRIPTION:

1. RESTRAINED MJ CAP W/4" NPT THREADED OUTLET OR WATER MAIN SIZE BY 4" ECCENTRIC REDUCER.
2. 4" SCH 40 S.S. NIPPLE (NPT THREADED-FL) 12".
3. 4" GATE VALVE (FL-MJ) RESTRAINED.
4. 4" DIP SHORT (PE-PE) 12".
5. 4" 90° BEND (MJ-PE) RESTRAINED.
6. 4" 90° BEND (MJ-MJ) RESTRAINED.
7. 4" 90° BEND (MJ-MJ) RESTRAINED.
8. 4" DIP (PE- SCREW-ON FL) RESTRAINED.
9. 4" FLANGE W/4" NPT THREADED OUTLET.
10. 4" X 2" NPT THREADED BRASS BUSHING.
11. 2" PVC SCREW-IN PLUG-NPT THREADED.
12. STD VALVE BOX ASSEMBLY.
13. VALVE EXTENSION AS REQUIRED (SEE APPROPRIATE STD. DETAILS).
14. DISTANCE TO CENTERLINE OF 4" THREADED OUTLET MAY VARY FROM CENTER WITH SIZE, MANUFACTURER, AND TYPE OF CAP OR PLUG.
15. 2" GSP STAND PIPE 90° BEND W/ 6" SHORT THREADED PIPE.
16. CONCRETE PAD (SEE APPROPRIATE STD. DETAIL) - OMIT WHEN IN PAVEMENT.
17. PLASTIC METER BOX PER STD. DETAIL - RELACE W/ REINFORCED CONCRETE PAD W/ WATER FRAME & COVER PER APPROPRIATE STD. DETAILS WHEN IN PAVEMENT.
18. CONCRETE THRUST COLLAR (3' X 3' X 6").
19. REINFORCE W/ #4 BARS @ 6" O.C. EACH WAY.
20. 6" #57 CRUSHED STONE.
21. #57 CRUSHED STONE BEDDING.
22. ALL THREAD T-HEAD BOLT (LOOKING UP).
23. 4 (QTY.) NCDOT STD. CONCRETE BRICK ON DIAGONAL AT EA. MB CORNER - OMIT WHEN FRAME & COVER IS USED.
24. PIPE & FITTINGS SHALL BE RESTRAINED.
25. 5" (MIN.) - 9" (MAX.).

#10 THROUGH #25, EXCLUDING #22, SHALL BE "SAME" ON ALTERNATE MATERIALS LIST.

NO. HDPE ALTERNATE MATERIALS:

1. SAME.
2. 4" SDR9 NIPPLE (S.S. NPT THREADED-MALE MJ ADAPTOR) 12".
3. 4" GATE VALVE (MJ-MJ).
4. 4" SDR9 NIPPLE (MALE MJ ADAPTOR-MALE MJ ADAPTOR) 24".
5. OMIT.
6. OMIT.
7. 4" 90° BEND (MJ-MJ) RESTRAINED.
8. 4" SDR9 SHORT (MALE MJ ADAPTOR - FEMALE S.S. NPT THREADED ADAPTOR).
9. OMIT.

NOTES:

A. BASED ON PROJECT SPECIFIC REQUIREMENT, TEMPORARY FIRE HYDRANT TO BE PAINTED BLUE. IF PERMANENT FIRE HYDRANT INSTALLED WITH TEE PER STANDARD DETAIL.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

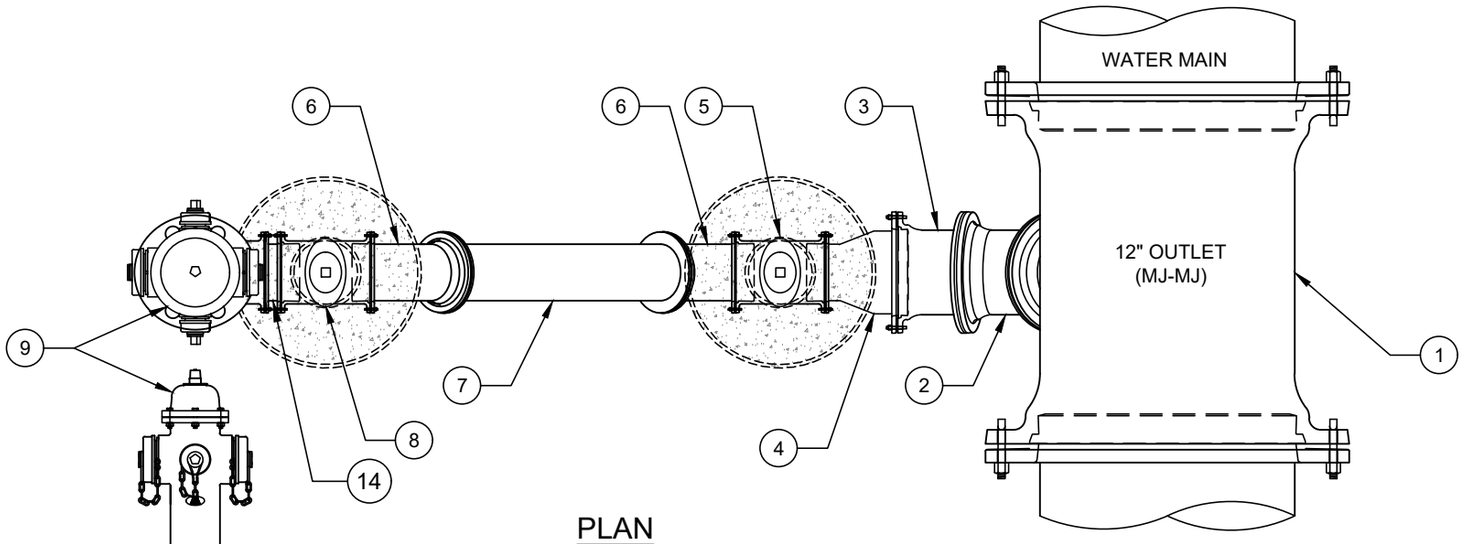
4-INCH BLOWOFF ASSEMBLY FOR 16-INCH THROUGH 24-INCH DIAMETER MAINS

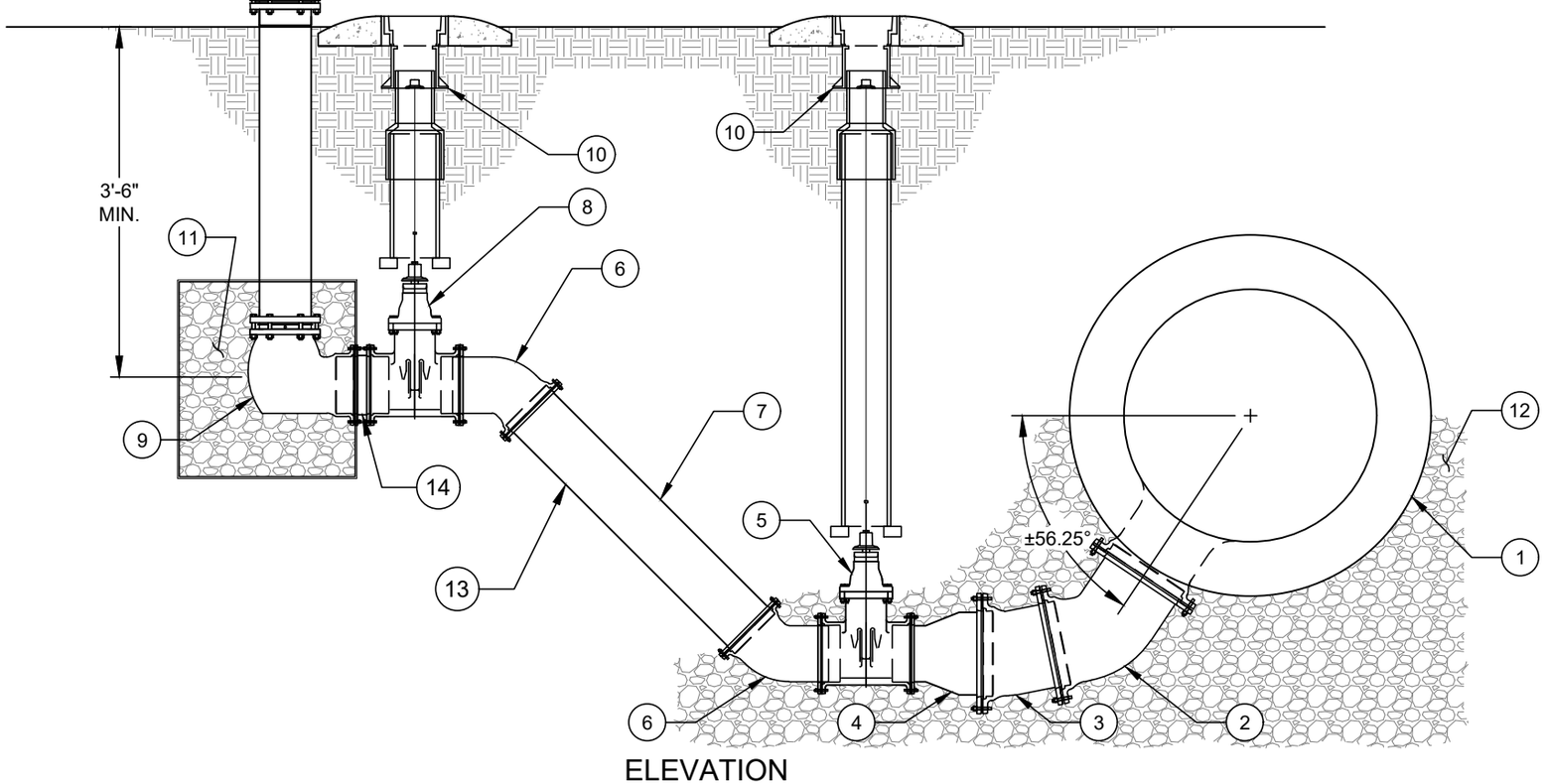
NO SCALE

VERSION 2.0

DATE 01/2026

DETAIL 10.5.5





NO.	DESCRIPTION:
1.	RUN X 12" RMJ TEE.
2.	12" 45° BEND MJ-MJ FITTINGS WITH FOSTER ADAPTORS (ROTATE AS REQ'D).
3.	12" 11¼° BEND MJ-MJ FITTINGS WITH FOSTER ADAPTORS.
4.	12" X 8" REDUCER MJ-MJ FITTINGS WITH FOSTER ADAPTORS (OR) 8" X 18" DIP SHORT (OR) 8" X 13" SWIVEL ADAPTER.
5.	8" GATE VALVE (RMJ-RMJ).
6.	8" 45° BEND MJ-MJ FITTINGS WITH FOSTER ADAPTOR.
7.	8" RJ DIP (PE-PE) LENGTH AS REQ'D.
8.	8" GATE VALVE (RMJ-RMJ).
9.	HIGH VELOCITY FIRE HYDRANT PAINTED OSHA SAFETY BLUE - W/TWO HOSE & TWO STORZ PUMPER NOZZLES AND 8" SHOE CONNECTION (INSTALLATION PER THE FH STANDARD DETAIL).
10.	VALVE BOX ASSEMBLY W/ VALVE EXTENSION ASSEMBLY (AS REQ'D) PER CLTW STD. DETAILS.
11.	MINIMUM 9 CUBIC FEET OF #57 WASHED STONE PROPORTIONALLY AROUND BASE. DO NOT COVER WEEP HOLE. ENCAPSULATE FILTER FABRIC AROUND WASHED STONE.
12.	COMPACTED BEDDING STONE - #57 WASHED STONE TO MIDPOINT OF MAIN & 6" ABOVE B.O. PIPING.
13.	ALL PIPE & FITTINGS SHALL BE RESTRAINED. FITTINGS 12" & SMALLER SHALL CONFORM TO AWWA C-153 FOR COMPACT FITTINGS.
14.	FOSTER ADAPTOR.

NOTES:

A. RJ PIPE AND FITTINGS MAY BE FACTORY RESTRAINED JOINTS IN PLACE OF MJ FITTINGS.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

BLOW-OFF ASSEMBLY WITH FIRE HYDRANT FOR ≥ 30-INCH MAINS

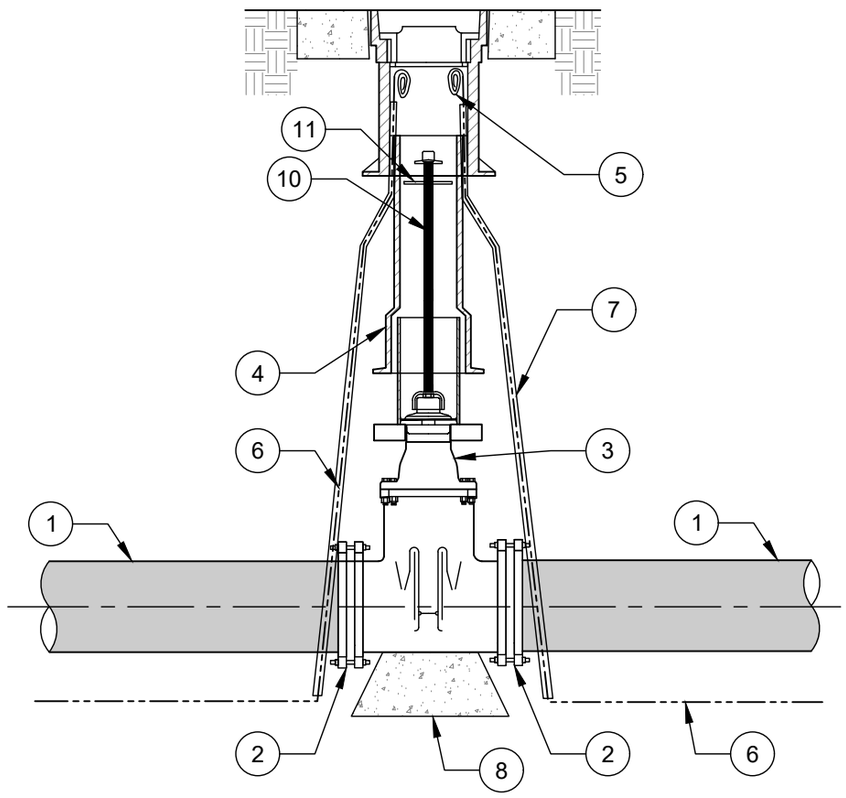
NO SCALE

VERSION 3.0

DATE 01/2026

DETAIL 10.5.6

1.5"-12" PIPE



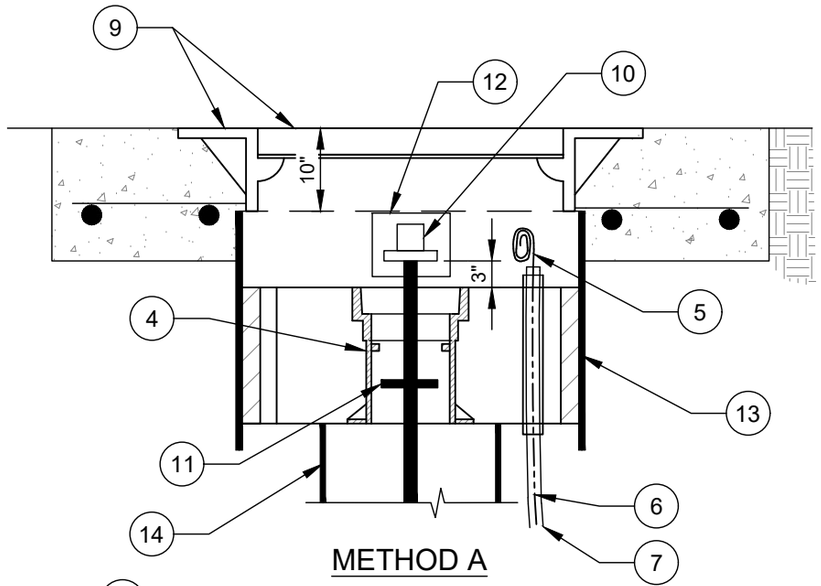
NOTES TO DESIGNER

A. SEALING ENGINEER IS RESPONSIBLE FOR DESIGN OF PAVEMENT REPAIR AND FOR A DESIGN THAT DOES NOT ALLOW LOADING TRANSFER TO VALVE.

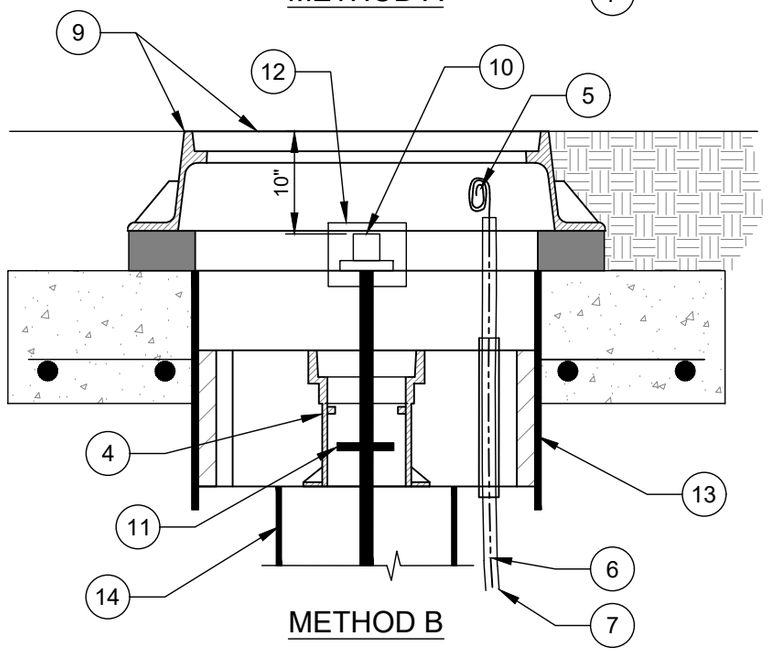
B. SEALING ENGINEER TO SPECIFY SIZE OF BEARING PAD BASED ON GEOTECHNICAL REPORT OF SOIL CONDITIONS.

16" AND LARGER PIPE

(USE FRAME AND COVER)



METHOD A



METHOD B

NO.	DESCRIPTION:
1.	HDPE WATER MAIN.
2.	BUTT FUSED JOINT OR RESTRAINED MJ ADAPTER WITH STAINLESS STEEL STIFFENER AND ACCESSORY KIT. SEE APPROPRIATE STANDARD DETAIL FOR TRANSITION.
3.	GATE VALVE/BALL VALVE.
4.	VALVE BOX ASSEMBLY - SEE CLTW STANDARD DETAIL.
5.	TRACER WIRE TERMINATION WITH 24" NEATLY COILED WIRE.
6.	TRACER WIRE - CONTINUOUS AWG #12 GAUGE SOLID COPPER TRACER WIRE WITH 30 MILS THICK BLUE HDPE INSULATION.
7.	ALL VERTICAL WIRE SHALL BE PLACED IN 1/4" OR 3/8" ID CONDUIT SDR 9 PEX TUBING - ASTM F876 (TYP.).
8.	CONCRETE BEARING BLOCK FOR 10-INCH AND LARGER GATE VALVES. POLYETHYLENE WRAP BARRIER SHALL BE PRESENT BETWEEN BEARING BLOCK AND VALVE. WRAP SHALL BE MINIMUM TWO LAYERS OF 4 MILS THICK HDCLPE.
9.	FRAME AND COVER. REFER TO APPROPRIATE STANDARD DETAILS.
10.	EXTENSION STEM ASSEMBLY. SEE APPROPRIATE STANDARD DETAIL.
11.	CENTERING COLLAR.
12.	VALVE LOCK BOX - FURNISHED BY CLTWATER.
13.	24" PVC PIPE - C900 - DR19, OR DIP - CAST IN.
14.	12" (MIN.) DIP (OR C900 PVC) RISER PIPE 20" MAXIMUM.

NOTES:

A. MJ ADAPTER KIT SHALL INCLUDE BOLTS AND NUTS, GRADE 3 OR HIGHER AND LONG ENOUGH TO ACCOMMODATE THE ADDED LENGTH OF HDPE FITTING TO ATTACH TO VALVES.

B. CLTW ALLOWS THE INSTALLATION OF DIFFERENT PIPE MATERIALS ON EITHER SIDE OF THE GATE VALVE. INSTALL TRANSITIONS PER APPROPRIATE STANDARD DETAIL FOR HDPE.

C. IF VALVE OPERATING NUT IS MORE THAN 3' BELOW FINISHED GRADE, PROVIDE EXTENSION STEM WITH STANDARD 2" SQUARE OPERATING NUT IN TOP SECTION OF VALVE BOX. SEE STANDARD DETAIL.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

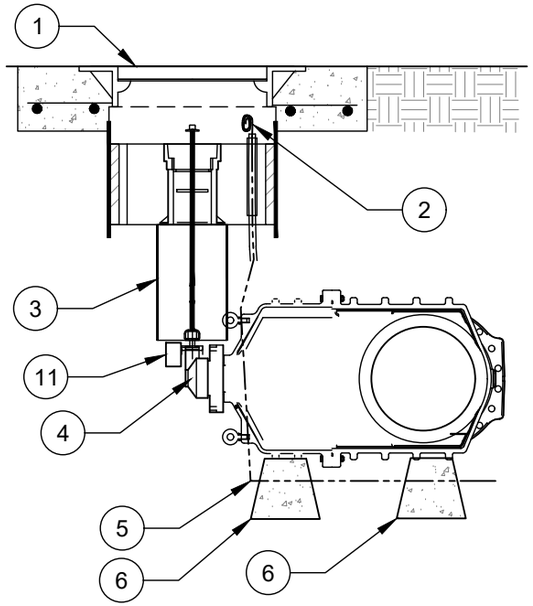
GATE VALVE FOR HDPE PIPE (1.5-INCH TO 32-INCH)

NO SCALE

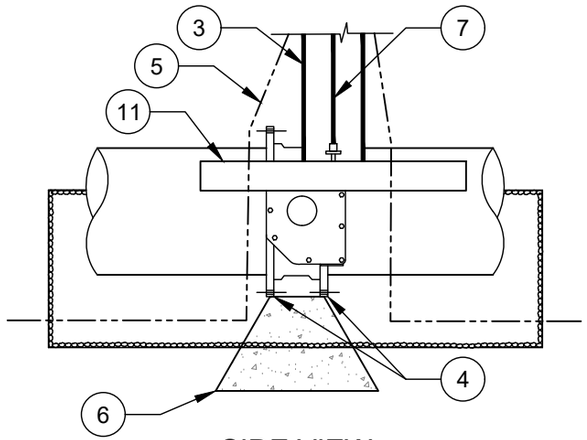
VERSION 1.0

DATE 04/2024

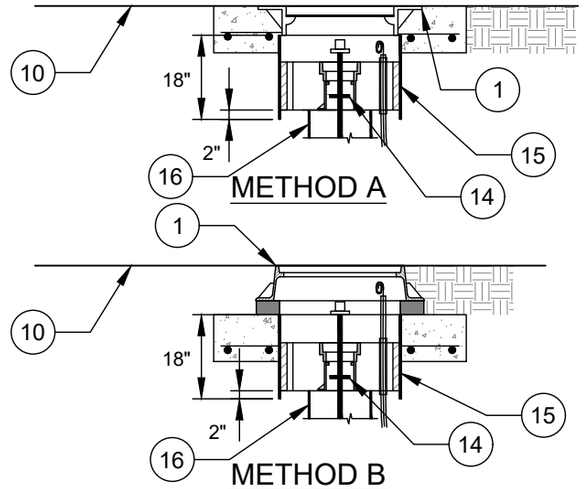
DETAIL 10.6.1



PROFILE VIEW



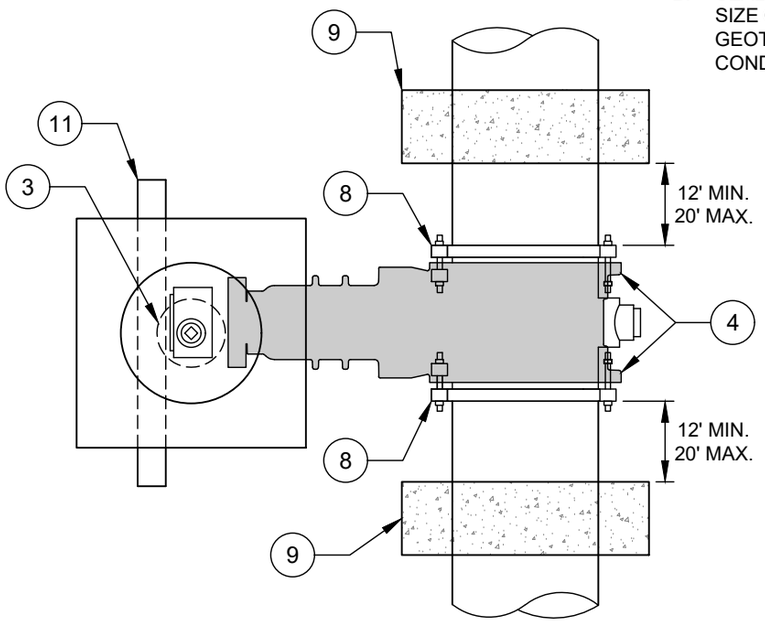
SIDE VIEW



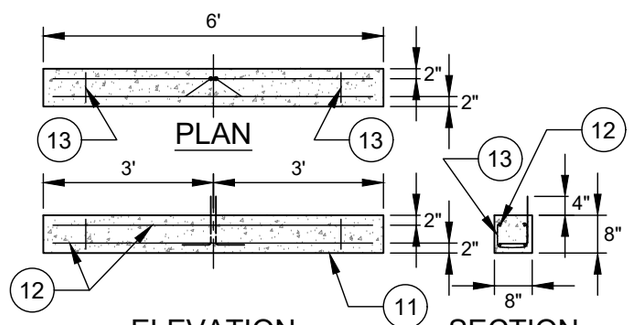
ELEVATIONS

NOTES TO DESIGNER

A. SEALING ENGINEER IS RESPONSIBLE FOR DEPTH REQUIREMENTS.
B. SEALING ENGINEER TO SPECIFY SIZE OF BEARING PAD BASED ON GEOTECHNICAL REPORT OF SOIL CONDITIONS.

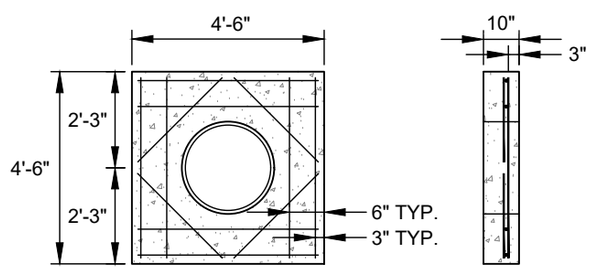


PLAN VIEW



ELEVATION SECTION

PRECAST CONCRETE BEAM



PLAN VIEW SECTION VIEW

PRECAST CONCRETE PAD

NO.	DESCRIPTION:
1.	FRAME AND COVER ASSEMBLY. SEE APPROPRIATE STANDARD DETAILS.
2.	TRACER WIRE TERMINATION WITH 24" NEATLY COILED WIRE.
3.	DUCTILE IRON STANDPIPE, MIN. 10" DIAMETER.
4.	GATE VALVE WITH 90° BEVEL GEAR OPERATOR.
5.	TRACER WIRE - CONTINUOUS AWG #12 GAUGE SOLID COPPER TRACER WIRE WITH 30 MILS THICK BLUE HDPE INSULATION.
6.	CONCRETE BEARING BLOCK FOR 10" AND LARGER GATE VALVES. POLYETHYLENE WRAP BARRIER SHALL BE PRESENT BETWEEN BEARING BLOCK AND VALVE. WRAP SHALL BE TWO LAYERS OF 4 MILS THICK HDCLPE.
7.	EXTENSION STEM ASSEMBLY. SEE APPROPRIATE STANDARD DETAIL.
8.	RESTRAINED MJ ADAPTER WITH STAINLESS STEEL STIFFENER AND ACCESSORY KIT.
9.	THRUST BLOCK. SEE APPROPRIATE STANDARD DETAIL.
10.	FINISHED GRADE.
11.	REINFORCED CONCRETE SUPPORT BEAM.
12.	#4 REBARS - AS SHOWN.
13.	#2 OR #3 REBARS - STIRRUPS - AS SHOWN.
14.	CENTERING COLLAR.
15.	24" PVC PIPE - C900 - DR18, OR DIP - CAST IN.
16.	12" (MIN.) DIP (OR C900 PVC) RISER PIPE 20" MAXIMUM.

NOTES:

A. CONNECT VALVE TO HDPE LINE WITH RESTRAINED MJ ADAPTER WITH STAINLESS STEEL STIFFENER AND ACCESSORY KIT. SEE STANDARD DETAIL FOR TRANSITION DETAIL.

B. MJ ADAPTER KIT SHALL INCLUDE BOLTS AND NUTS, GRADE 3 OR HIGHER AND LONG ENOUGH TO ACCOMMODATE THE ADDED LENGTH OF HDPE FITTING TO ATTACH TO VALVES.

C. CLTW ALLOWS THE INSTALLATION OF DIFFERENT PIPE MATERIALS ON EITHER SIDE OF THE GATE VALVE. INSTALL TRANSITIONS PER STANDARD DETAIL FOR HDPE.

D. IF VALVE OPERATING NUT IS MORE THAN 3' BELOW FINISHED GRADE, PROVIDE EXTENSION STEM WITH STANDARD 2" SQUARE OPERATING NUT IN TOP SECTION OF VALVE BOX. SEE STANDARD DETAIL.

E. STANDPIPE SHALL NOT INDUCE LOADING ON THE VALVE.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

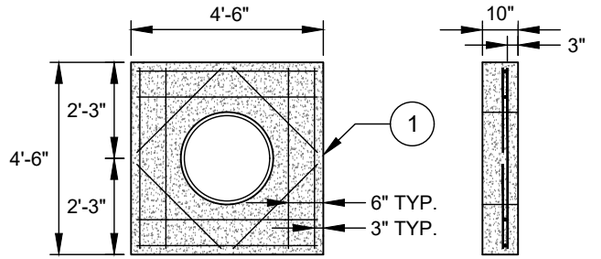
HORIZONTAL INSTALLATION OF GATE VALVES FOR HDPE PIPE (16-INCH TO 30-INCH)

NO SCALE

VERSION 1.0

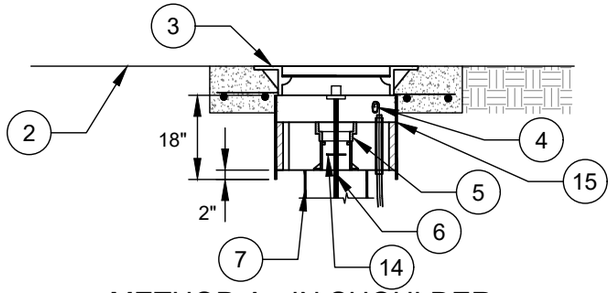
DATE 04/2024

DETAIL 10.6.2

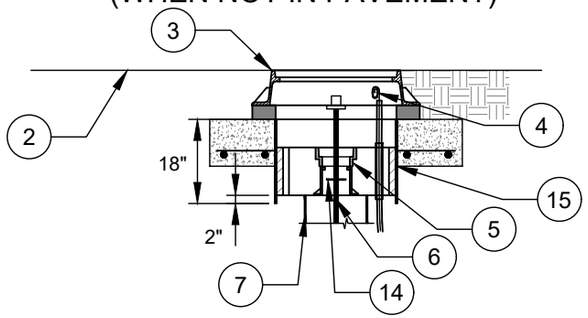


PLAN VIEW SECTION VIEW

PRECAST CONCRETE PAD

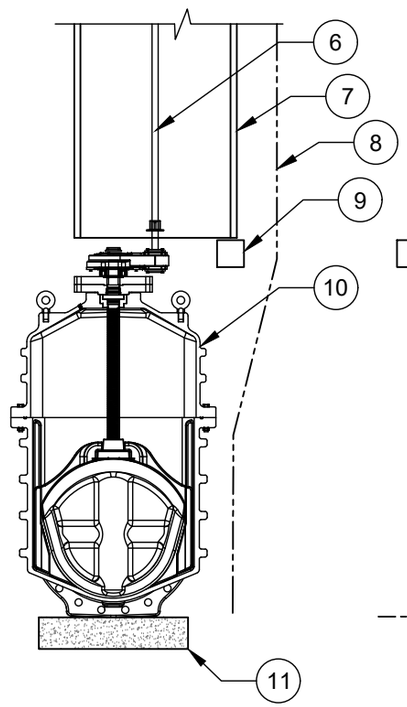


METHOD A - IN SHOULDER
(WHEN NOT IN PAVEMENT)

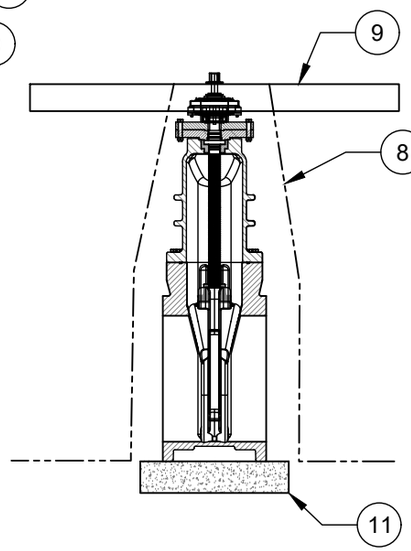


METHOD B - IN PAVEMENT

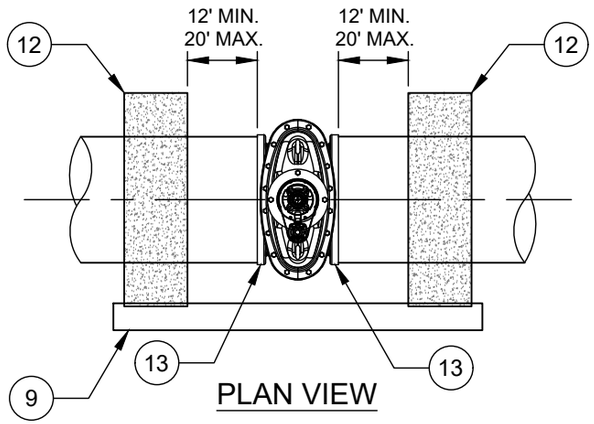
ELEVATIONS



PROFILE VIEW



SIDE VIEW



PLAN VIEW

NO.	DESCRIPTION:
1.	PRECAST CONCRETE PAD (REINFORCED). SEE STANDARD DETAIL.
2.	FINISHED GRADE.
3.	FRAME AND COVER ASSEMBLY. SEE APPROPRIATE STANDARD DETAILS.
4.	TRACER WIRE TERMINATION WITH 24" NEATLY COILED WIRE.
5.	VALVE BOX ASSEMBLY - SEE CLTW STANDARD DETAIL.
6.	EXTENSION STEM ASSEMBLY. REFER TO STANDARD DETAIL.
7.	12" (MINIMUM) DIP RISER PIPE 20" MAXIMUM.
8.	TRACER WIRE - CONTINUOUS AWG #12 GAUGE SOLID COPPER TRACER WIRE WITH 30 MILS THICK BLUE HDPE INSULATION.
9.	PRECAST CONCRETE SUPPORT BEAM.
10.	GATE VALVE - VERTICALLY ORIENTED.
11.	BEARING BLOCK FOR VALVE.
12.	THRUST BLOCK. REFER TO STANDARD DETAIL.
13.	RESTRAINED MJ ADAPTER WITH STAINLESS STEEL STIFFENER AND ACCESSORY KIT.
14.	CENTERING COLLAR.
15.	24" PVC PIPE - C900 - DR18, OR DIP - CAST IN.

NOTES:

A. CONNECT VALVE TO HDPE LINE WITH RESTRAINED MJ ADAPTER WITH STAINLESS STEEL STIFFENER AND ACCESSORY KIT. SEE STANDARD DETAIL FOR TRANSITION DETAIL.
B. CLTW ALLOWS THE INSTALLATION OF DIFFERENT PIPE MATERIALS ON EITHER SIDE OF THE GATE VALVE. INSTALL TRANSITIONS PER STANDARD DETAIL FOR HDPE.
C. IF VALVE OPERATING NUT IS MORE THAN 3' BELOW FINISHED GRADE, PROVIDE EXTENSION STEM ASSEMBLY. SEE STANDARD DETAIL.
D. REFER TO STANDARD DETAIL FOR MANHOLE FRAME AND COVER.
E. RISER PIPE SHALL NOT INDUCE LOADING ON THE VALVE.

NOTES TO DESIGNER

A. SEALING ENGINEER IS RESPONSIBLE FOR DEPTH REQUIREMENTS.
B. SEALING ENGINEER IS RESPONSIBLE FOR BEARING BLOCK STRUCTURAL DESIGN.
C. SEALING ENGINEER TO SPECIFY SIZE OF BEARING BLOCK BASED ON GEOTECHNICAL REPORT OF SOIL CONDITIONS.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

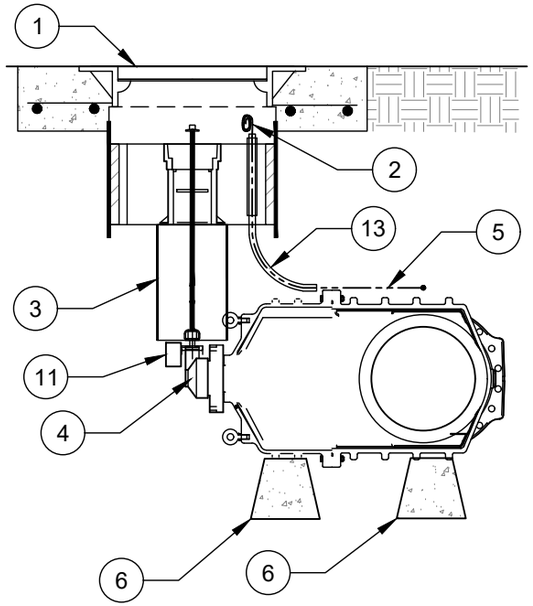
VERTICAL INSTALLATION OF GATE VALVES FOR HDPE PIPE (16-INCH TO 30-INCH)

NO SCALE

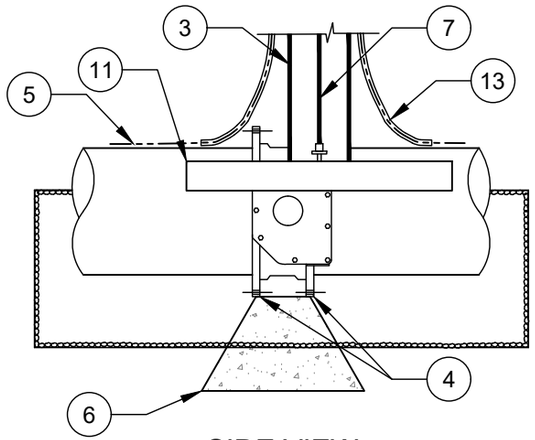
VERSION 1.0

DATE 04/2024

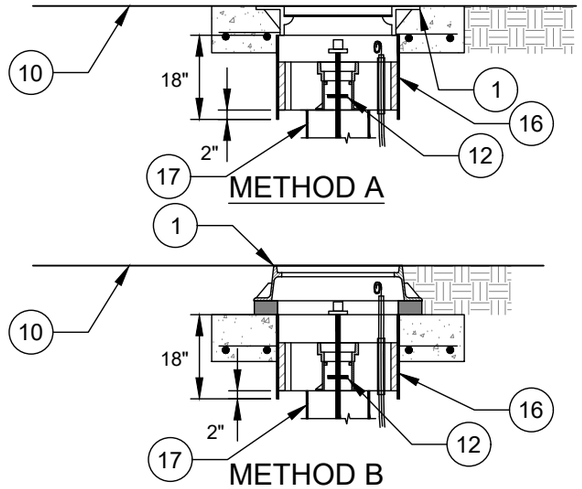
DETAIL 10.6.3



PROFILE VIEW



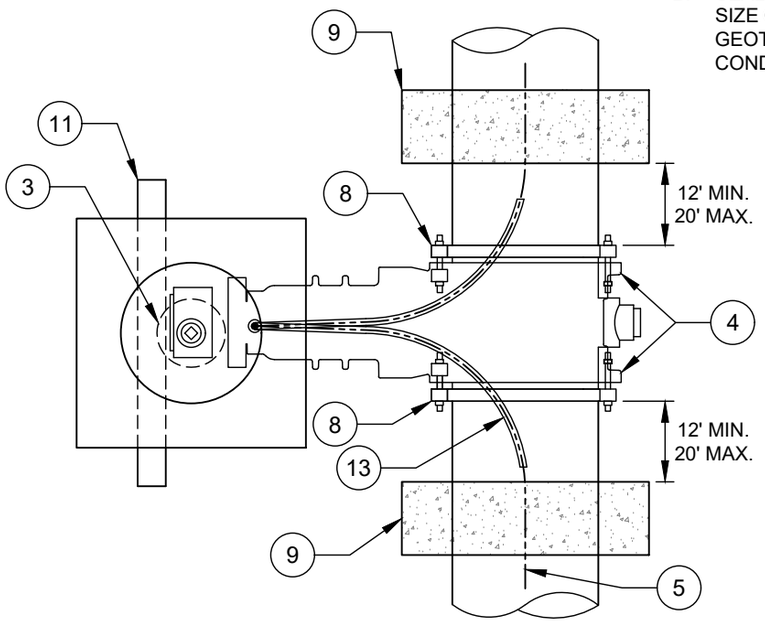
SIDE VIEW



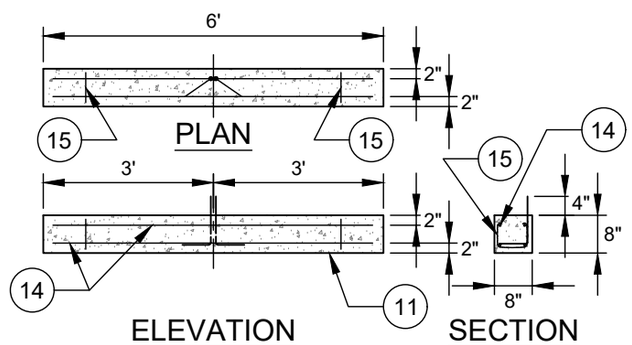
ELEVATIONS

NOTES TO DESIGNER

A. SEALING ENGINEER IS RESPONSIBLE FOR DEPTH REQUIREMENTS.
B. SEALING ENGINEER TO SPECIFY SIZE OF BEARING PAD BASED ON GEOTECHNICAL REPORT OF SOIL CONDITIONS.

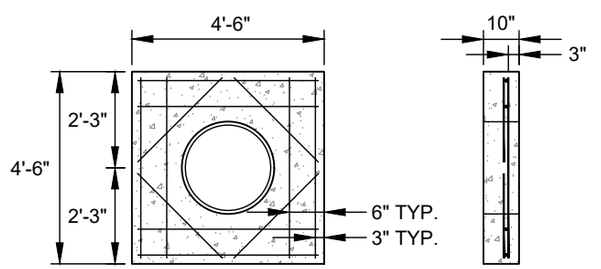


PLAN VIEW



ELEVATION SECTION

PRECAST CONCRETE BEAM



PLAN VIEW SECTION VIEW

PRECAST CONCRETE PAD

NO. DESCRIPTION:

1. 20.5" CLEAR OPENING FRAME AND COVER ASSEMBLY. SEE APPROPRIATE STANDARD DETAILS.
2. TRACER WIRE TERMINATION WITH 24" NEATLY COILED WIRE.
3. DUCTILE IRON STANDPIPE, MIN. 10" DIAMETER.
4. GATE VALVE WITH 90° BEVEL GEAR OPERATOR.
5. TRACER WIRE - CONTINUOUS AWG #12 GAUGE SOLID COPPER TRACER WIRE WITH 30 MILS THICK BLUE HDPE INSULATION.
6. CONCRETE BEARING BLOCK FOR 10" AND LARGER GATE VALVES. POLYETHYLENE WRAP BARRIER SHALL BE PRESENT BETWEEN BEARING BLOCK AND VALVE. WRAP SHALL BE TWO LAYERS OF 4 MILS THICK HDCLPE.
7. EXTENSION STEM ASSEMBLY. SEE APPROPRIATE STANDARD DETAIL.
8. MECHANICAL JOINT ENDS.
9. THRUST BLOCK. SEE APPROPRIATE STANDARD DETAIL.
10. FINISHED GRADE.
11. REINFORCED CONCRETE SUPPORT BEAM.
12. CENTERING COLLAR.
13. 1/4" OR 3/8" ID CONDUIT - SDR 9 PEX TUBING - ASTM F876.
14. #4 REBARS - AS SHOWN.
15. #2 OR #3 REBARS - STIRRUPS - AS SHOWN.
16. 24" PVC PIPE - C900 - DR18, OR DIP - CAST IN.
17. 12" (MIN.) DIP (OR C900 PVC) RISER PIPE 20" MAXIMUM.

NOTES:

A. CLTW ALLOWS THE INSTALLATION OF DIFFERENT PIPE MATERIALS ON EITHER SIDE OF THE GATE VALVE. INSTALL TRANSITIONS PER STANDARD DETAIL.

B. IF VALVE OPERATING NUT IS MORE THAN 3' BELOW FINISHED GRADE, PROVIDE EXTENSION STEM WITH STANDARD 2" SQUARE OPERATING NUT IN TOP SECTION OF VALVE BOX. SEE STANDARD DETAIL.

C. STANDPIPE SHALL NOT INDUCE LOADING ON THE VALVE.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

HORIZONTAL INSTALLATION OF GATE VALVES FOR NON-HDPE PIPE (16-INCH TO 30-INCH)

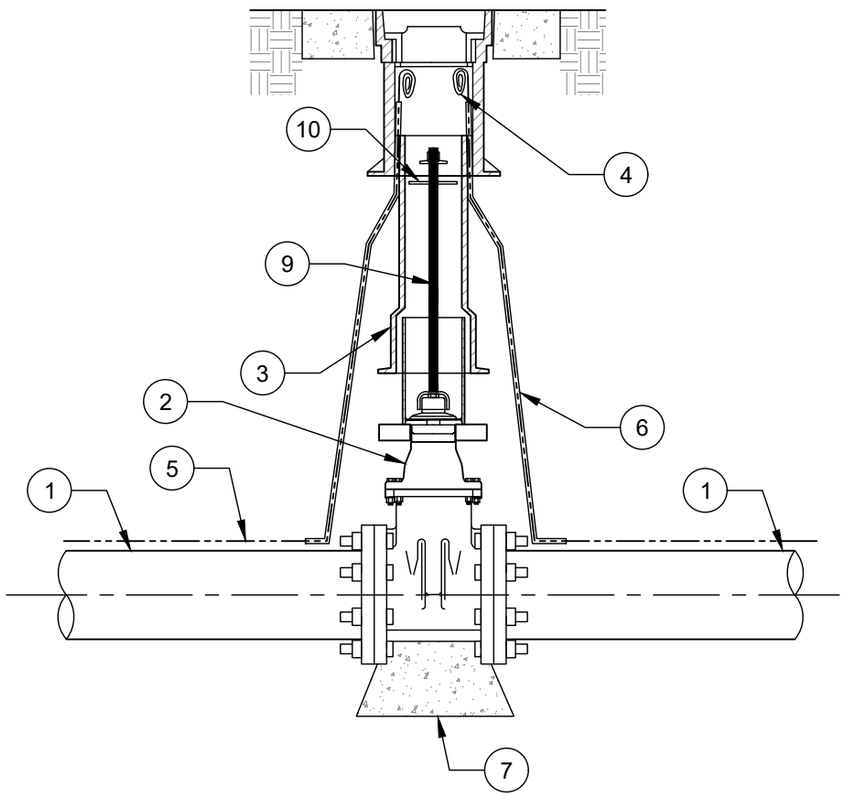
NO SCALE

VERSION 1.0

DATE 04/2024

DETAIL 10.6.4

1.5"-12" PIPE



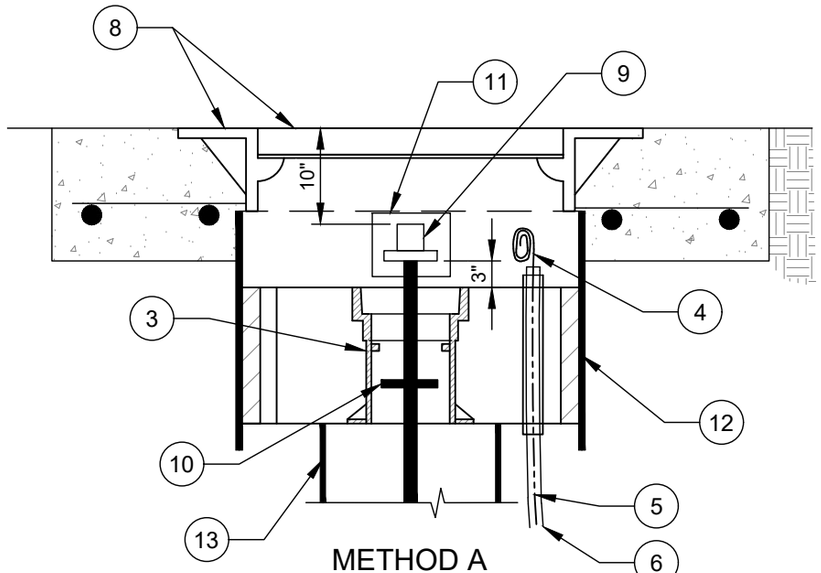
NOTES TO DESIGNER

A. SEALING ENGINEER IS RESPONSIBLE FOR DESIGN OF PAVEMENT REPAIR AND FOR A DESIGN THAT DOES NOT ALLOW LOADING TRANSFER TO VALVE.

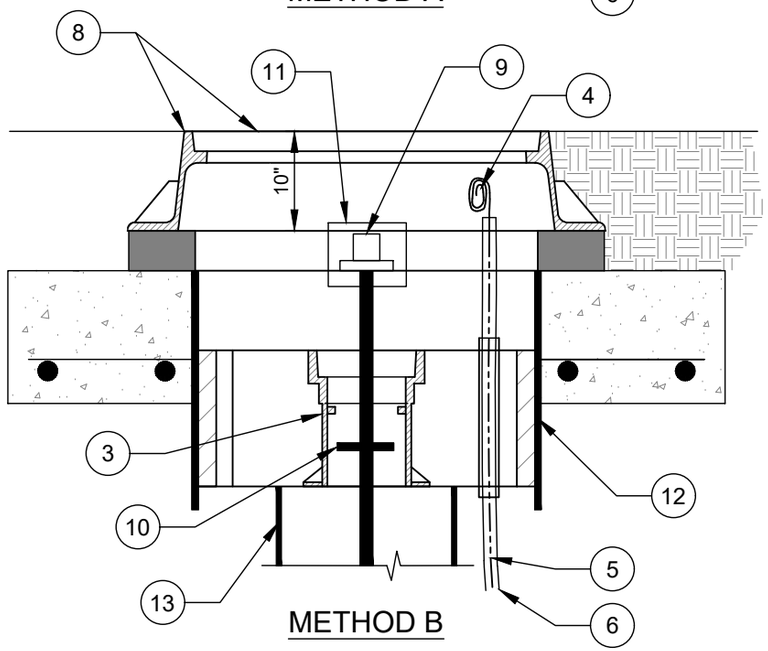
B. SEALING ENGINEER TO SPECIFY SIZE OF BEARING PAD BASED ON GEOTECHNICAL REPORT OF SOIL CONDITIONS.

16" AND LARGER PIPE

(USE FRAME AND COVER)



METHOD A



METHOD B

NO.	DESCRIPTION:
1.	WATER MAIN.
2.	GATE VALVE (OR BALL VALVE, AS APPLICABLE) FOR 1.5"-2" WATER LINES.
3.	VALVE BOX ASSEMBLY - SEE CLTW STANDARD DETAIL.
4.	TRACER WIRE TERMINATION WITH 24" NEATLY COILED WIRE.
5.	TRACER WIRE - CONTINUOUS AWG #12 GAUGE SOLID COPPER HDPE INSTALLATION TRACER WIRE WITH 30 MILS BLUE INSULATION.
6.	ALL VERTICAL WIRE SHALL BE PLACED IN 1/4" OR 3/8" ID CONDUIT SDR 9 PEX TUBING - ASTM F876 (TYP.).
7.	CONCRETE BEARING BLOCK FOR 10-INCH AND LARGER GATE VALVES. POLYETHYLENE WRAP BARRIER SHALL BE PRESENT BETWEEN BEARING BLOCK AND VALVE. WRAP SHALL BE MINIMUM TWO LAYERS OF 4 MILS THICK HDCLPE.
8.	FRAME AND COVER. REFER TO APPROPRIATE STANDARD DETAILS.
9.	EXTENSION STEM ASSEMBLY. SEE APPROPRIATE STANDARD DETAIL.
10.	CENTERING COLLAR.
11.	VALVE LOCK BOX - FURNISHED BY CLTWATER.
12.	24" PVC PIPE - C905 - DR18, OR DIP - CAST IN.
13.	12" (MIN.) DIP (OR C900 PVC0 RISER PIPE 20" MAXIMUM.

NOTES:

A. MJ ADAPTER KIT SHALL INCLUDE BOLTS AND NUTS, GRADE 3 OR HIGHER.

B. CLTW ALLOWS THE INSTALLATION OF DIFFERENT PIPE MATERIALS ON EITHER SIDE OF THE GATE VALVE. INSTALL TRANSITIONS PER APPROPRIATE STANDARD DETAIL.

C. IF VALVE OPERATING NUT IS MORE THAN 3' BELOW FINISHED GRADE, PROVIDE EXTENSION STEM WITH STANDARD 2" SQUARE OPERATING NUT IN TOP SECTION OF VALVE BOX. SEE STANDARD DETAIL.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

GATE VALVE FOR NON-HDPE PIPE (1.5-INCH TO 30-INCH)

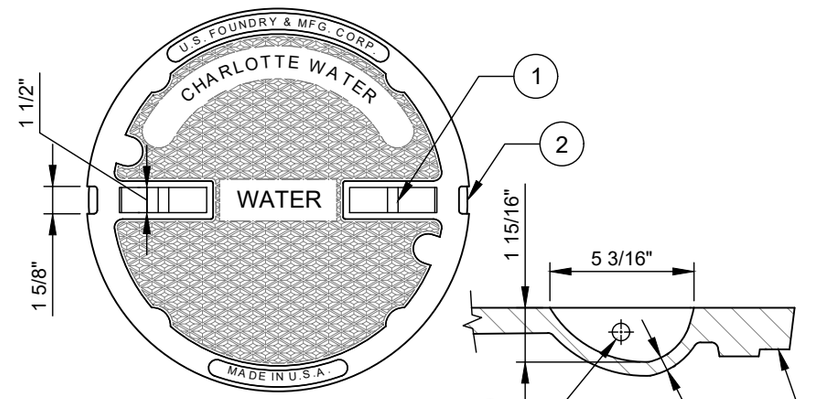
NO SCALE

VERSION 1.0

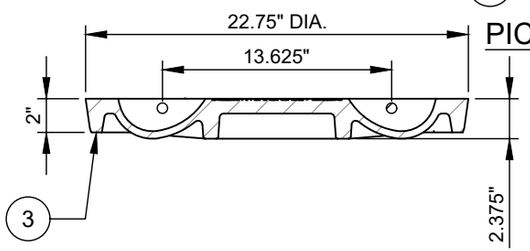
DATE 04/2024

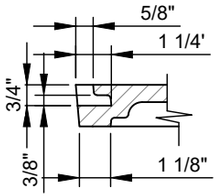
DETAIL 10.6.5

U.S. FOUNDRY & MFG. CORP.

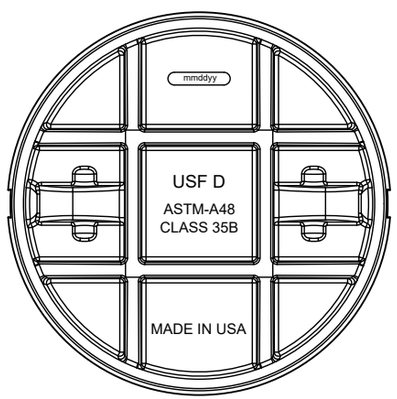


PICK BAR DETAIL



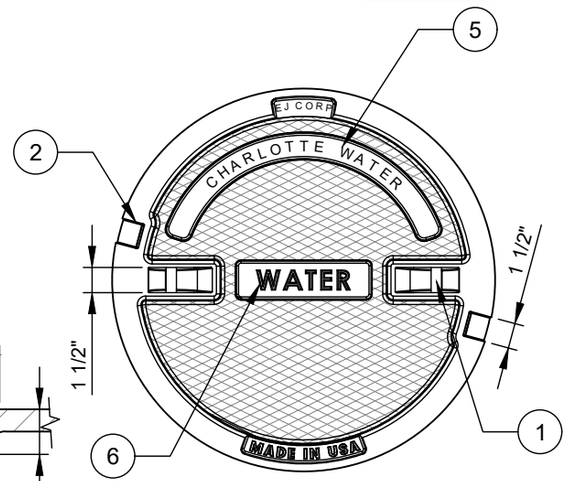


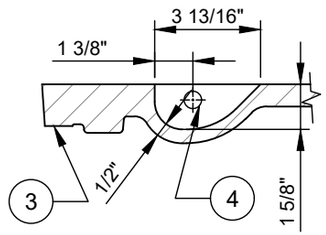
PICK HOLE DETAIL



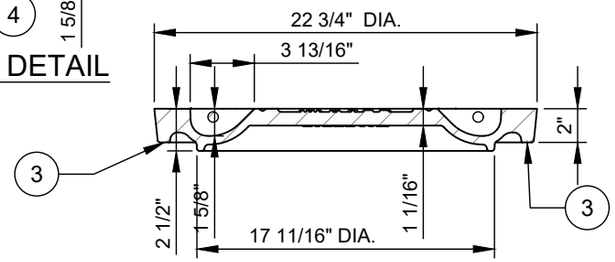
WEIGHT - 130 LB. MIN., 0% MINUS TOLERANCE

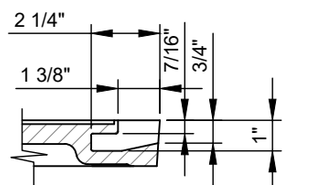
EJ CORP



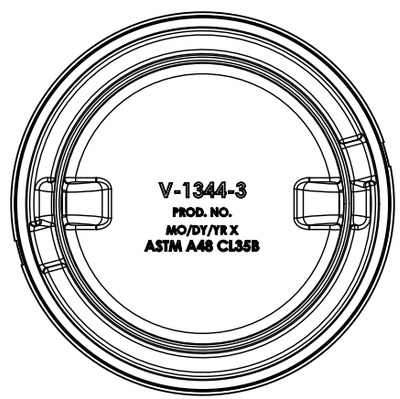


PICK BAR DETAIL





PICK HOLE DETAIL



WEIGHT - 130 LB. MIN., 0% MINUS TOLERANCE

NO.	DESCRIPTION:
1.	(2) - LIFTING S.S. BARS.
2.	(2) - NONPENETRATING PICK HOLES.
3.	MACHINED SURFACE.
4.	5/8" TYPE 304 S.S. ROD.
5.	1/2" RAISED LETTERING (RECESSED).
6.	1" RAISED LETTERING (RECESSED).

NOTES:

A. LOAD RATING - HEAVY DUTY.

B. MATERIAL - ASTM A48 - CLASS 35 GRAY IRON.

C. COATING - UNDIPPED.

D. COVER SHALL CONFORM TO DIMENSION AND WEIGHT REQUIREMENTS.

E. COVER SHALL NOT BE OUT OF ROUND.

F. THIS SHALL NOT BE USED ON VALVES IN VAULTS.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

TYPE 7 MANHOLE COVER
20.5-INCH DIAMETER (CLEAR OPENING)
USE WITH 16-30 INCH DIRECT BURY GATE VALVES

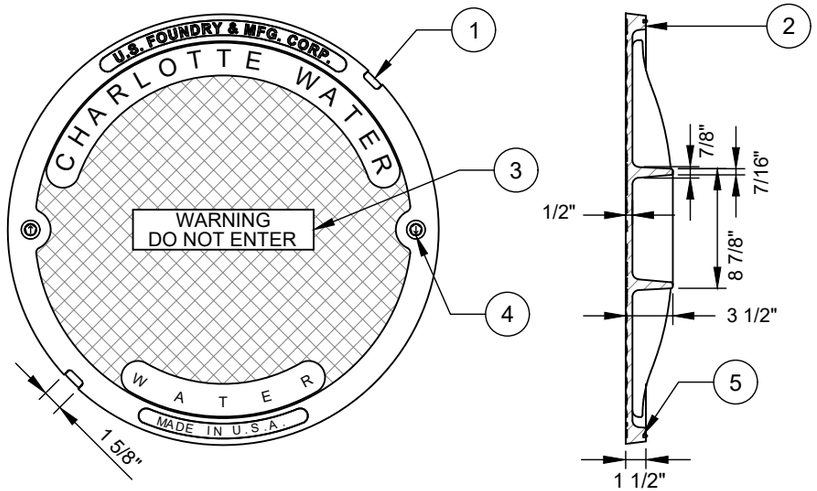
NO SCALE

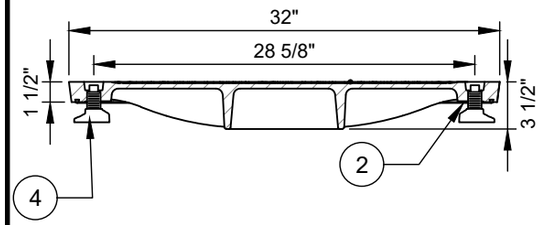
VERSION
1.0

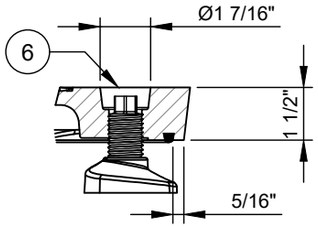
DATE
04/2024

DETAIL
10.7.1

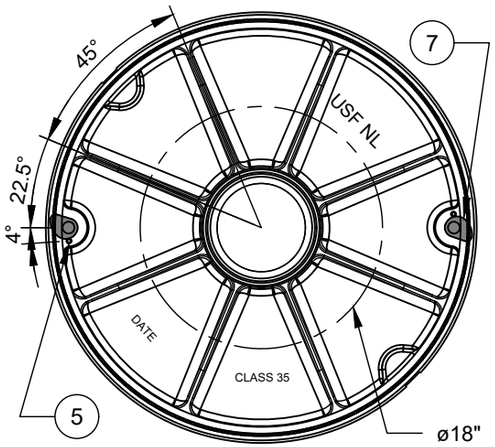
U.S. FOUNDRY & MFG. CORP.

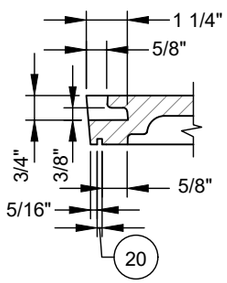






CAM ASSEMBLY DETAIL



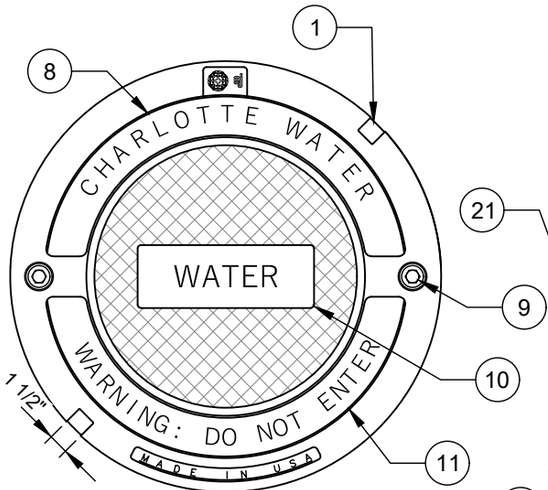


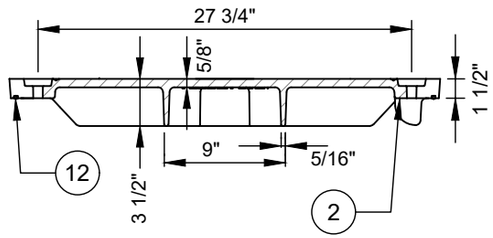
PICK HOLE DETAIL

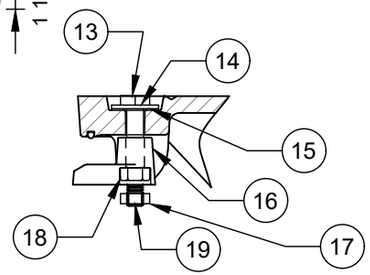
WEIGHT - 165 LB. MIN., 0% MINUS TOLERANCE

MATERIAL - ASTM A48 CLASS 35 - CAST IRON

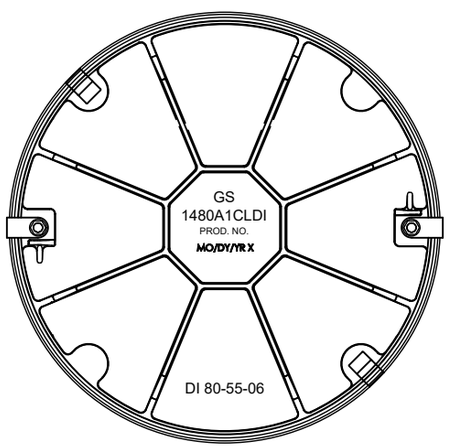
EJ CORP

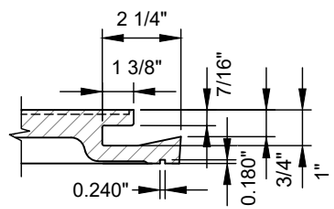






CAM ASSEMBLY DETAIL





PICK HOLE DETAIL

WEIGHT - 150 LB. MIN., 0% MINUS TOLERANCE

MATERIAL - ASTM A536 DUCTILE IRON - GRADE 80-55-06

NO.	DESCRIPTION:
1.	(2)-NON PENETRATING PICKHOLES.
2.	MACHINED SURFACE.
3.	1 INCH ARIAL STYLE TEXT TYP.
4.	WEDGE CAM LOCK. SEE ASSEMBLY DETAIL.
5.	ORS GASKET NEOPRENE RUBBER 60 DUROMETER.
6.	USF WEDGE LOC 5/8" HEX HEAD BOLT ALL GRADE S.S. TYPE 304.
7.	7/8" DIAMETER CAM LOCK HOLE @ 28 5/8" DIAMETER.
8.	1 INCH SHARP FACE GOTHIC TEXT.
9.	(2) CAMS (SEE DETAIL).
10.	1 3/4" SHARP FACE GOTHIC TEXT.
11.	1 INCH SHARP FACE GOTHIC TEXT.
12.	1/4" NEOPRENE GASKET.
13.	5/8"-11 X 3 1/2" LG TYPE 304 SS HEX BOLT.
14.	5/8" I.D. 1 1/2" O.D. TYPE 304 SS FLAT WASHER.
15.	5/8" I.D. 1 1/2" O.D. RUBBER WASHER.
16.	BRONZE LOCK LUG.
17.	5/8" HEX JAM NUT TYPE 304 SS.
18.	5/8"-11 TYPE 304 SS NYLOK NUT.
19.	WELD ON JAM NUT OR PEEN END THREADS ON BOLT.
20.	3/16" DOVETAIL GROOVE.
21.	31 1/4" (OUTSIDE OF GROOVE).

NOTES:

A. LOAD RATING - HEAVY DUTY.

B. MATERIAL - DUCTILE IRON OR CAST IRON AS INDICATED IN THE DETAIL.

C. COATING - UNDIPPED.

D. COVER SHALL CONFORM TO DIMENSION AND WEIGHT REQUIREMENTS.

E. COVER SHALL NOT BE OUT OF ROUND.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

TYPE 8 MANHOLE COVER
30-INCH DIAMETER (CLEAR OPENING)

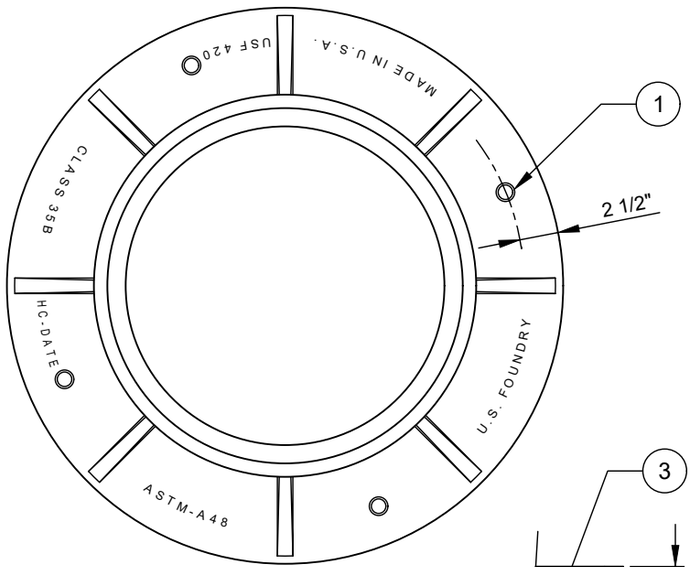
NO SCALE

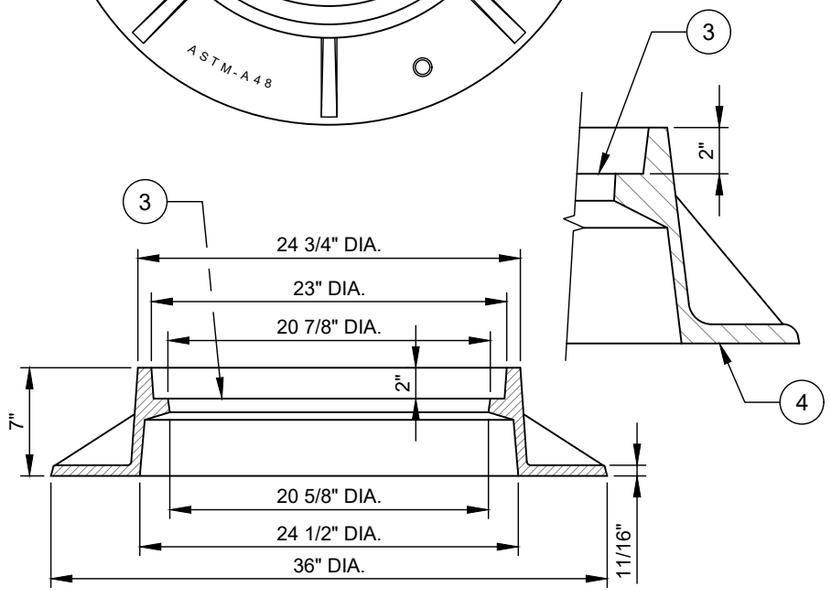
VERSION 1.0

DATE 04/2024

DETAIL 10.7.2

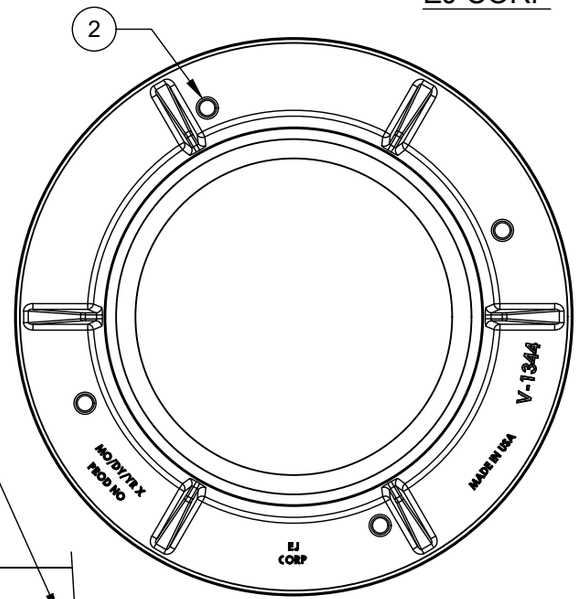
U.S. FOUNDRY & MFG. CORP.

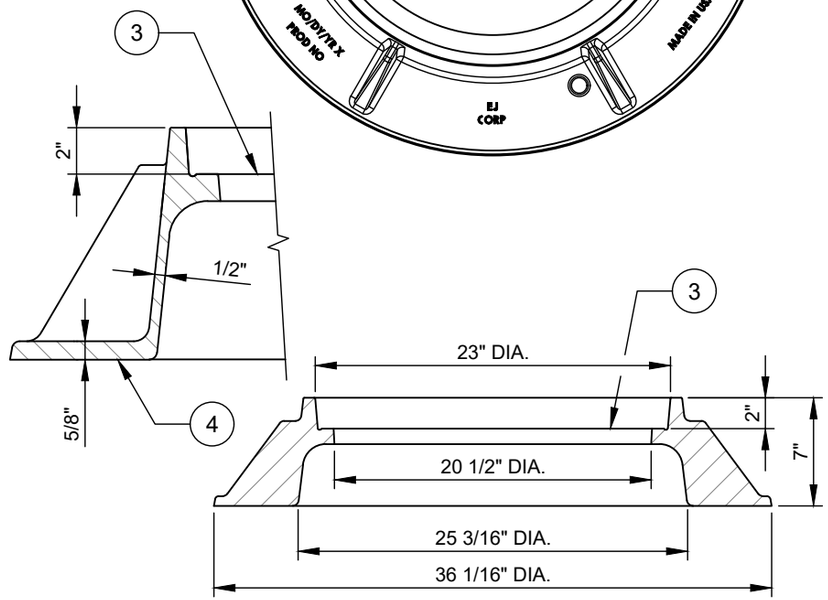




WEIGHT - 240 LB. MIN., 0% MINUS TOLERANCE

EJ CORP





WEIGHT - 164.50 LB. MIN., 0% MINUS TOLERANCE

NO.	DESCRIPTION:
1.	(4)-1" DIAMETER ANCHOR HOLES ON A 31" BOLT CIRCLE DIAMETER (B.C.D.).
2.	(4)-1" DIAMETER HOLES ON 29 1/4" B.C.D..
3.	MACHINED SURFACE.
4.	FRAME.

NOTES:

A. LOAD RATING - HEAVY DUTY.

B. MATERIAL - ASTM A48 - CLASS 35 GRAY IRON.

C. COATING - UNDIPPED.

D. FRAME SHALL CONFORM TO DIMENSION AND WEIGHT REQUIREMENTS.

E. FRAME SHALL NOT BE OUT OF ROUND.

F. THIS SHALL NOT BE USED ON VAULTS.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

TYPE F MANHOLE FRAME
20.5-INCH DIAMETER (CLEAR OPENING) 7-INCH TALL
USE WITH 16-30 INCH GATE VALVES

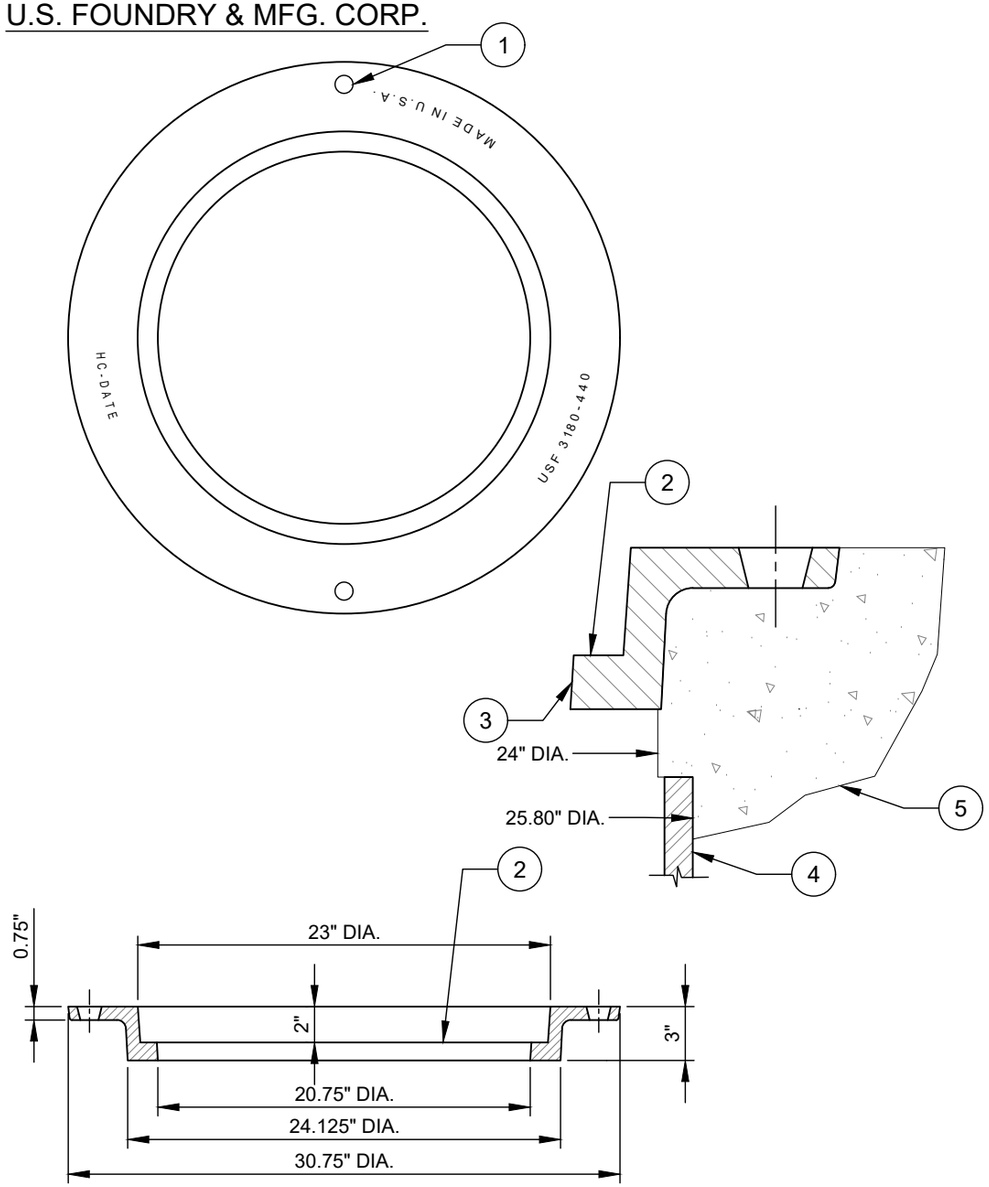
NO SCALE

VERSION 1.0

DATE 04/2024

DETAIL 10.7.3

U.S. FOUNDRY & MFG. CORP.



WEIGHT - 105 LB. MIN., 0% MINUS TOLERANCE

EJ CORP

TO BE DETERMINED

NO.	DESCRIPTION:
1.	(2)-1" DIAMETER ANCHOR HOLES.
2.	MACHINED SURFACE.
3.	TYPE G FRAME.
4.	24" DIP - SEE INSTALLATION STANDARD DETAIL.
5.	CONCRETE VALVE PAD - SEE INSTALLATION STANDARD DETAIL.

NOTES:

A. ROAD RATING - HEAVY DUTY.

B. MATERIAL - ASTM A48 - CLASS 35 GRAY IRON.

C. COATING - UNDIPPED.

D. FRAME SHALL CONFORM TO DIMENSION AND WEIGHT REQUIREMENTS.

E. FRAME SHALL NOT BE OUT OF ROUND.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

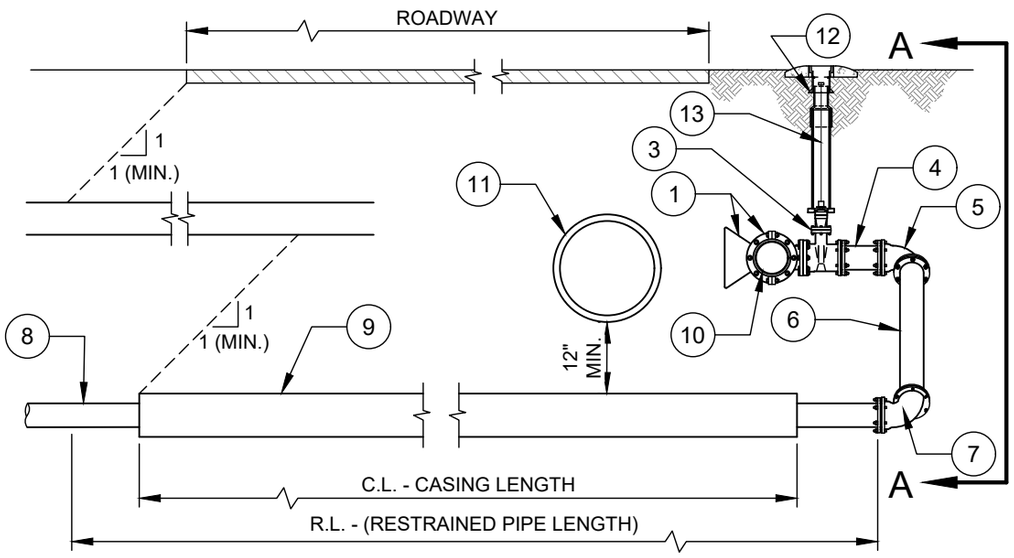
TYPE G MANHOLE FRAME
20.5-INCH DIAMETER (CLEAR OPENING)
3-INCH TALL - INVERTED (CAST-IN-PLACE)

NO SCALE

VERSION
1.0

DATE
04/2024

DETAIL
10.7.4



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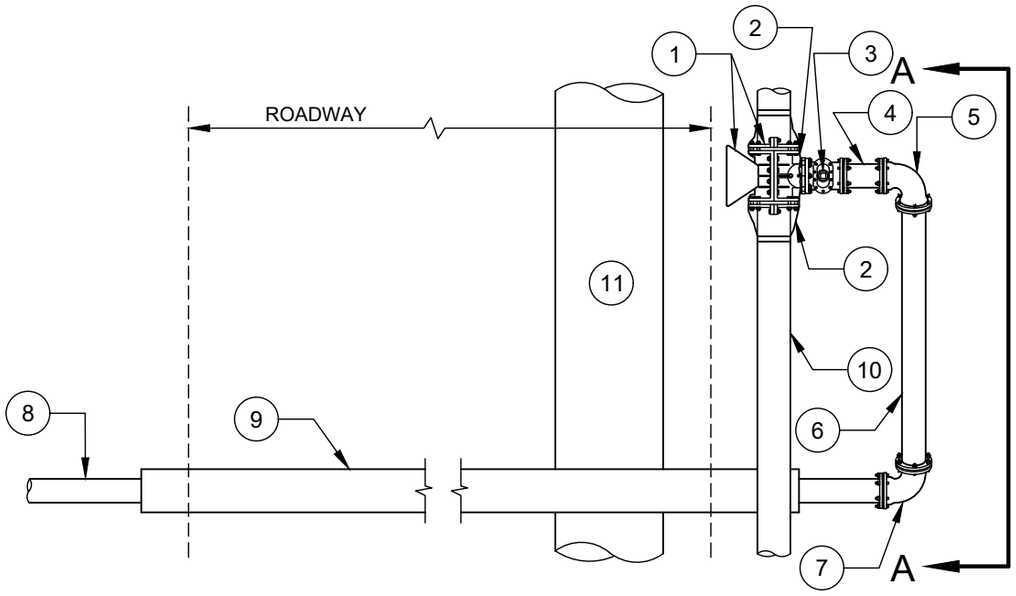


PLAN

CHART A - RESTRAINED LENGTH REQUIREMENTS

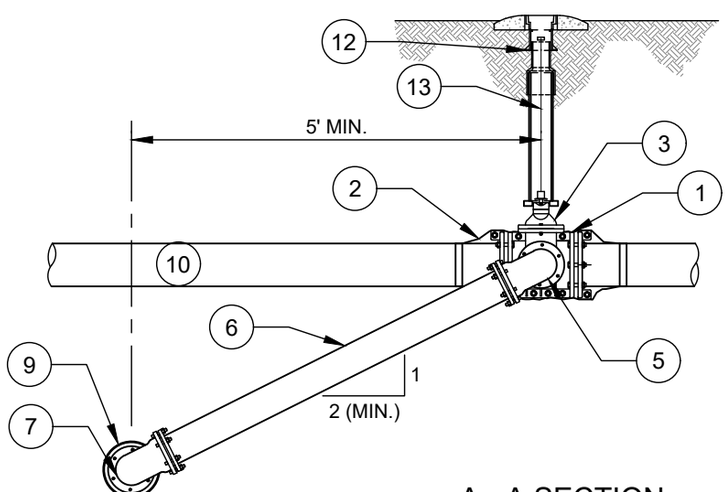
PIPE DIA. (INCHES)	TOTAL RESTRAINED LENGTH - R.L. - (FT)
3"	64' + CASING LENGTH (C.L.)
4"	77' + CASING LENGTH (C.L.)
6"	109' + CASING LENGTH (C.L.)
8"	140' + CASING LENGTH (C.L.)
10"	169' + CASING LENGTH (C.L.)
12"	196' + CASING LENGTH (C.L.)
16"	249' + CASING LENGTH (C.L.)

CONCRETE THRUST BLOCK (WRAP BEND PER NO. 2) REQUIRED AT BOTTOM BEND NO. 7, IF REQUIRED RESTRAINED LENGTH (R.L.) CAN NOT BE COMPLETELY INSTALLED.

CHART B - ROADWAY CASING REQUIREMENTS

PIPE DIA. (INCHES)	CASING MIN. DIA. (INCHES)	CASING WALL THICKNESS MIN. (INCHES)
3"	8"	0.25"
4"	8"	0.25"
6"	12.75"	0.25"
8"	16"	0.25"
10"	18"	0.25"
12"	20"	0.25"
16"	24"	0.25"

LARGER DIAMETER CASING MAY BE REQUIRED DUE TO LENGTH OF CROSSINGS AND RESTRAINED JOINT DIMENSIONS. SEE PLANS AND SPECIFICATIONS.



A - A SECTION

NO. DESCRIPTION:

1. TAPPING SLEEVE WITH CONCRETE THRUST BLOCKING (REQUIRED). SEE SPECIFICATIONS FOR APPROVED MODELS. SIZE ON SIZE TAPPING SLEEVES SHALL BE MECHANICAL JOINT FULL BODY DUCTILE ONLY.
2. WRAP TAPPING SLEEVE WITH 2 LAYERS HDPE PLASTIC FILM (HDCLPE PER AWWA C-105) - 4 MILS. EACH LAYER - EXTEND HDPE 3' EACH WAY FROM FITTINGS - DUCT TAPE ENDS.
3. TAPPING VALVE - FLANGE X RMJ.
4. DUCTILE IRON PIPE SHORT L ≥18".
5. RMJ DUCTILE IRON 90° BEND - ROTATE DOWN, AS APPROVED.
6. DUCTILE IRON PIPE - RESTRAINED.
7. RMJ DUCTILE IRON 90° BEND - ROTATE UP, AS APPROVED, CONCRETE THRUST BLOCKING MAY ALSO BE REQUIRED. SEE NOTE IN CHART A.
8. DUCTILE IRON PIPE - RESTRAINED - SEE CHART A.
9. STEEL CASING - SEE CHART B.
10. EXISTING WATER MAIN.
11. EXISTING INFRASTRUCTURE THAT PREVENTS FRONT SIDE TAP - BACKSIDE TAP WILL BE PERMITTED ONLY WHERE EXISTING INFRASTRUCTURE PREVENTS FRONT SIDE TAP, AND REQUIRES CLTW APPROVAL.
12. VALVE BOX ASSEMBLY PER CLTW STD. DETAIL.
13. VALVE EXTENSION (WHEN OPERATING NUT IS GREATER THAN 3' DEEP).

NOTE:

A. TRACER WIRE INSTALLED PER CLTW TRACER WIRE DETAIL.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

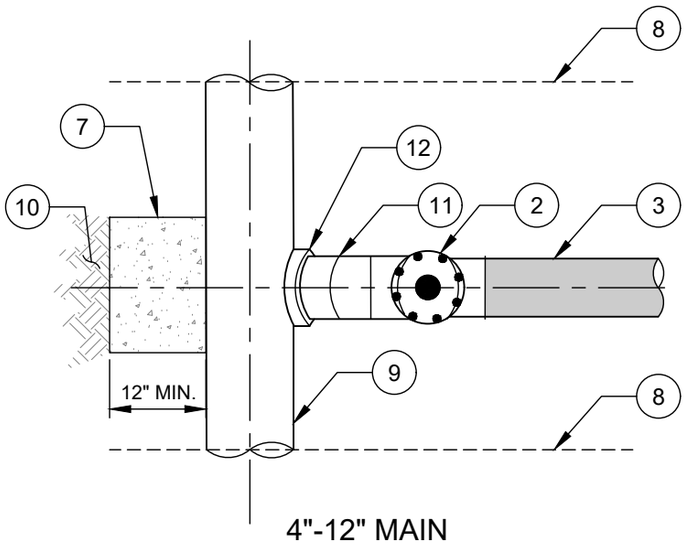
BACK SIDE TAP
16" AND SMALLER MAINS

NO SCALE

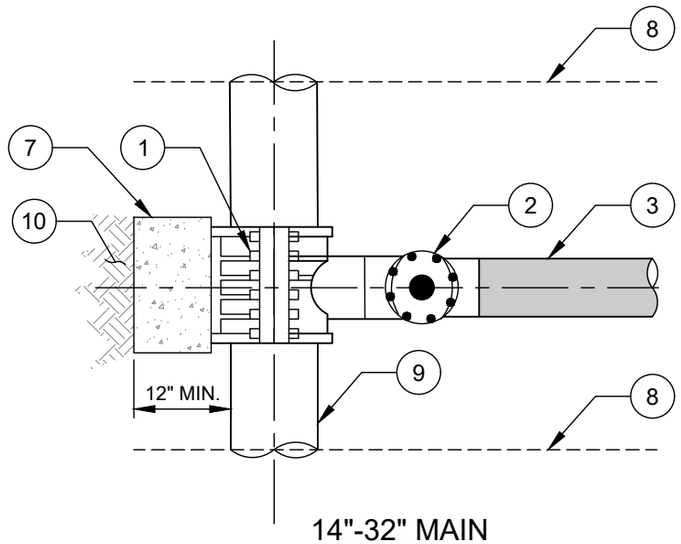
VERSION 1.0

DATE 04/2024

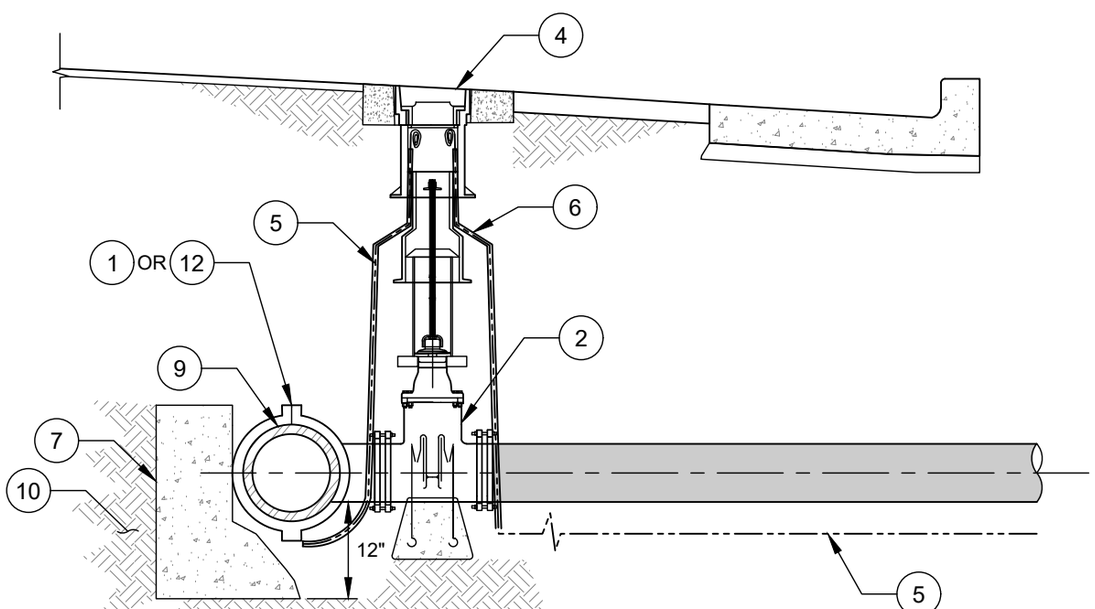
DETAIL 10.8.1



4"-12" MAIN



14"-32" MAIN



THRUST BLOCK TABLE	
TYPE OF FITTING	TEE OR DEAD END
TAP SIZE (INCHES)	TOTAL REQUIRED BEARING AREA (FT^2)
4	1.3
6	2.9
8	5.1
10	7.9
12	11.4
14	15.7
16	20.1
18	25.8
20	31.4
24	45.3
30	70.7
32	80.4

NO. DESCRIPTION:

1. ELECTROFUSION TAPPING SADDLE OR STAINLESS STEEL TAPPING SLEEVE WITH OUTLET SEAL GASKET.
2. FL X MJ TAPPING VALVE. REFER TO APPROPRIATE STANDARD DETAIL WITH CONCRETE SUPPORT.
3. HDPE PIPE.
4. STANDARD VALVE BOX ASSEMBLY.
5. AWG #12 GAUGE SOLID COPPER TRACER WIRE WITH BLUE 30 MILS HDPE INSULATION.
6. ALL VERTICAL WIRE SHALL BE PLACED IN 1/4" OR 3/8" ID CONDUIT SDR 9 PEX TUBING - ASTM F876 (TYP.).
7. CONCRETE THRUST BLOCK (SEE TABLE FOR SIZING).
8. TRENCH LIMITS.
9. EXISTING HDPE WATER MAIN.
10. UNDISTURBED NATIVE SOIL.
11. HDPE PIPE BUTT FUSION JOINT.
12. BUTT FUSED BRANCH SADDLE.

NOTES:

A. BRANCH LARGER THAN THE EXISTING MAIN IS NOT ALLOWED.

B. FOR EXISTING HDPE MAIN, USE ELECTROFUSION TAPPING SADDLE OR BUTT FUSED BRANCH SADDLE.

THRUST BLOCK NOTES:

A. THRUST BLOCKS TO BE 3,600 PSI CONCRETE.
B. THRUST BLOCKS TO BE POURED AGAINST UNDISTURBED SOIL.
C. JOINTS TO BE KEPT FREE OF CONCRETE. ALLOW WORKING ROOM AROUND NUTS AND BOLTS. WRAP FITTING WITH 2 LAYERS HDPE FILM (HDCLPE PER AWWA C-105). EACH LAYER MINIMUM 4 MILS THICK.
D. AREAS GIVEN ARE FOR DR 9 PIPE AT TEST PRESSURE OF 200 PSI IN SOIL WITH 2,000 PSI BEARING CAPACITY. CHANGES SUBJECT TO FIELD CONDITIONS AND APPROVAL OF THE SEALING ENGINEER.
E. TAPPING SLEEVES SHALL HAVE THRUST BLOCKS SIZED BASED ON TAP SIZE.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

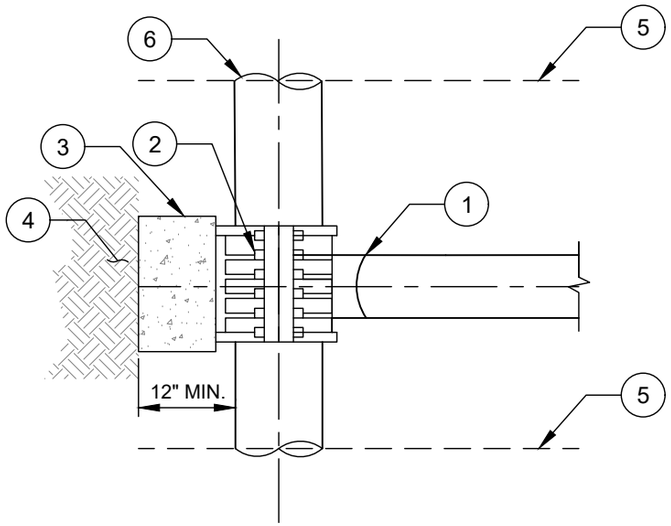
TAPPING SLEEVE AND VALVE FOR HDPE PIPE (4-INCH TO 32-INCH)

NO SCALE

VERSION 1.0

DATE 04/2024

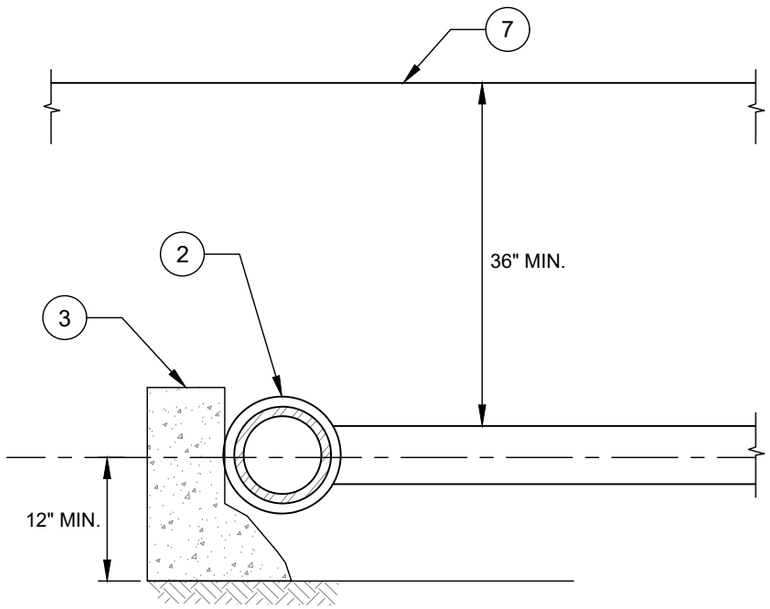
DETAIL 10.8.2

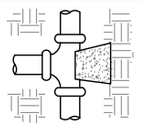


MECHANICAL JOINT TEE PLAN VIEW
NTS

NOTES TO DESIGNER

A. SEALING ENGINEER WILL SPECIFY EITHER ROUND BASE BRANCH SADDLE OR MECHANICAL JOINT SADDLE.



THRUST BLOCK TABLE	
TYPE OF FITTING	TEE OR DEAD END
TYPICAL PLAN VIEW	
MAIN SIZE (INCHES)	TOTAL REQUIRED BEARING AREA (FT^2)
4	2
6	3
8	5.5
10	8
12	11.5
14	14
16	18
18	22.5
20	27.5
24	40
30	62

NO. DESCRIPTION:

1. HDPE PIPE BUTT FUSION JOINT.
2. FULL BODY STAINLESS STEEL MJ BRANCH SLEEVE WITH OUTLET SEAL GASKET.
3. CONCRETE THRUST BLOCK (SEE TABLE FOR SIZING).
4. UNDISTURBED NATIVE SOIL.
5. TRENCH LIMITS.
6. EXISTING HDPE WATER MAIN.
7. PROPOSED GROUND SURFACE.

NOTES:

A. BRANCH LARGER THAN MAIN IS NOT ALLOWED.

B. IF COMPLETE SHUT OFF IS POSSIBLE ON EXISTING HDPE MAIN, USE BUTT FUSION MOLDED TEE. IF SHUT OFF IS NOT POSSIBLE, CONFIRM WITH CLTW INSPECTOR THAT MECHANICAL JOINT TEE OPTION IS ALLOWED.

THRUST BLOCK NOTES:

A. THRUST BLOCKS TO BE 3,600 PSI CONCRETE.

B. THRUST BLOCKS TO BE POURED AGAINST UNDISTURBED SOIL.

C. JOINTS TO BE KEPT FREE OF CONCRETE. ALLOW WORKING ROOM AROUND NUTS AND BOLTS. WRAP FITTING WITH 2 LAYERS HDPE FILE (HDCLPE PER AWWA C-105). EACH LAYER MINIMUM 4 MILS THICK.

D. AREAS GIVEN ARE FOR SDR 9 PIPE AT TEST PRESSURE OF 200 PSI IN SOIL WITH 2,000 PSF BEARING CAPACITY. A SAFETY FACTOR OF 1.5 IS INCLUDED IN CALCULATIONS. CHANGES SUBJECT TO FIELD CONDITIONS AND APPROVAL OF THE SEALING ENGINEER.

E. TAPPING SLEEVES SHALL HAVE THRUST BLOCKS SIZED THE SAME AS TEES.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

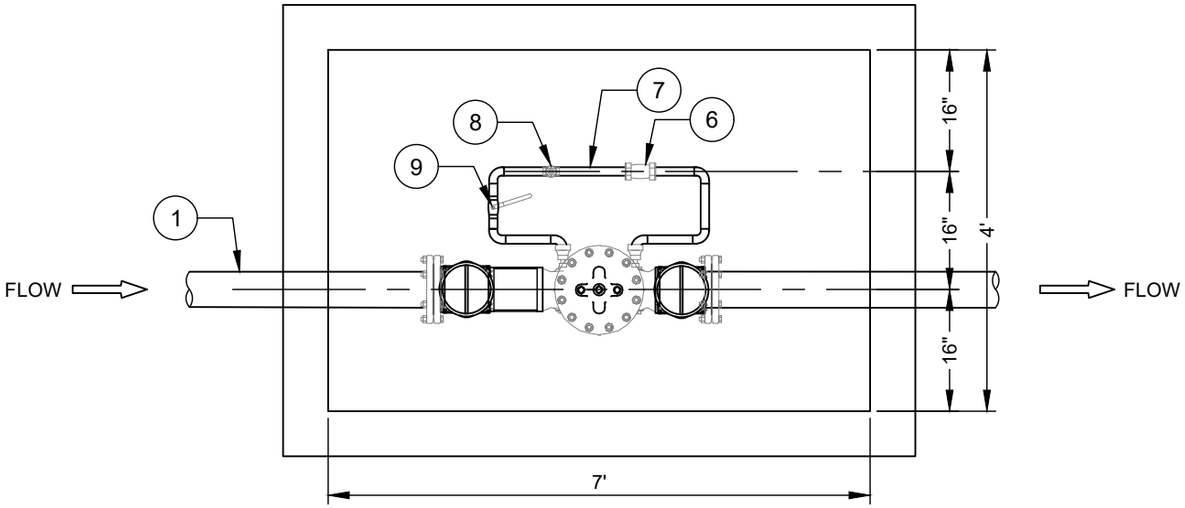
CUT-IN TEE FOR EXISTING HDPE PIPE (4-INCH TO 32-INCH)

NO SCALE

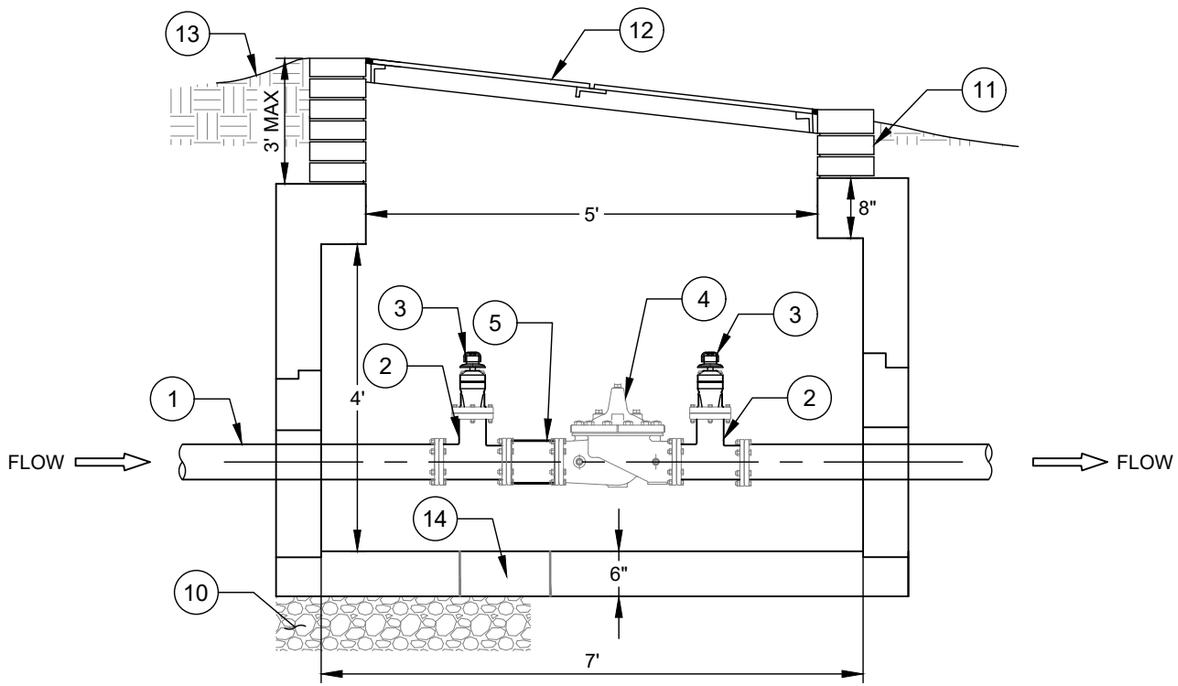
VERSION 1.0

DATE 04/2024

DETAIL 10.8.3



PLAN VIEW



ELEVATION VIEW

NO.	DESCRIPTION:
1.	4" WATER MAIN.
2.	4" X 4" TEE (TYP.).
3.	4" GATE VALVE (TYP.).
4.	4" PRV.
5.	4" DISMANTLING JOINT.
6.	1" GATE VALVE (TYP.).
7.	1" BRASS PIPE.
8.	1" PRV.
9.	1" BALL VALVE.
10.	#57 WASHED STONE.
11.	MINIMUM OF 3 STANDARD BRICK COURSES LOCATED UNDER FRAME, OR UNDER FLAT SLAB TOP.
12.	5' X 4' DOUBLE LEAF STEEL COVER, HINGED & LOCKABLE. SEE STD. DETAIL.
13.	FINISHED GRADE TO DRAIN AWAY FROM COVER.
14.	12" DIAMETER SUMP.

NOTES:

A. ALL PIPING SHALL BE MINIMUM CLASS 53 FLANGE DUCTILE IRON WITH FULL FACE GASKETS.
B. ALL FLANGE HARDWARE (BOLT/WASHER/NUT) SHALL BE STAINLESS STEEL - TYPE 304 WITH ANTI-SEIZE COMPOUND.
C. ALL PIPE SHALL BE RESTRAINED FROM TAP TO PROPERTY LINE VALVE.
D. VAULT SHALL BE RATED FOR NCDOT HS-20 LOADING - SUBMIT SHOP DRAWINGS/P.E. SEALED FOR REVIEW.
E. ALL CONCRETE SHALL BE MINIMUM 3,600 PSI COMPRESSIVE STRENGTH.
F. DESIGN SHALL CONFORM TO ASTM C858 - SPECIFICATIONS FOR "UNDERGROUND PRECAST CONCRETE UTILITY STRUCTURE".
G. STEEL REINFORCING DESIGN SHALL CONFORM TO ASTM C857.
H. REBARS SHALL BE GRADE 60 PER ASTM A615.
I. WELDED WIRE FABRIC SHALL CONFORM TO ASTM A185.
J. DIAGONAL REINFORCING SHALL BE ADDED AT ALL OPENINGS.
K. PIPE PENETRATIONS SHALL BE SEALED WITH FLEXIBLE CONNECTERS (MANHOLE BOOTS) OR WITH 4" OF BRICK & MORTAR (AND 1/2-INCH THICK CONSTRUCTION EXPANSION MATERIAL AROUND THE PIPE).
L. FRAME TO BE FLUSH WITH GROUND OR CONCRETE SIDEWALK, GROUND SHALL SLOPE AWAY FROM VAULT.
M. ALL JOINTS SHALL BE MADE WATERTIGHT USING 2 RINGS OF BUTYL RUBBER JOINT MASTIC.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

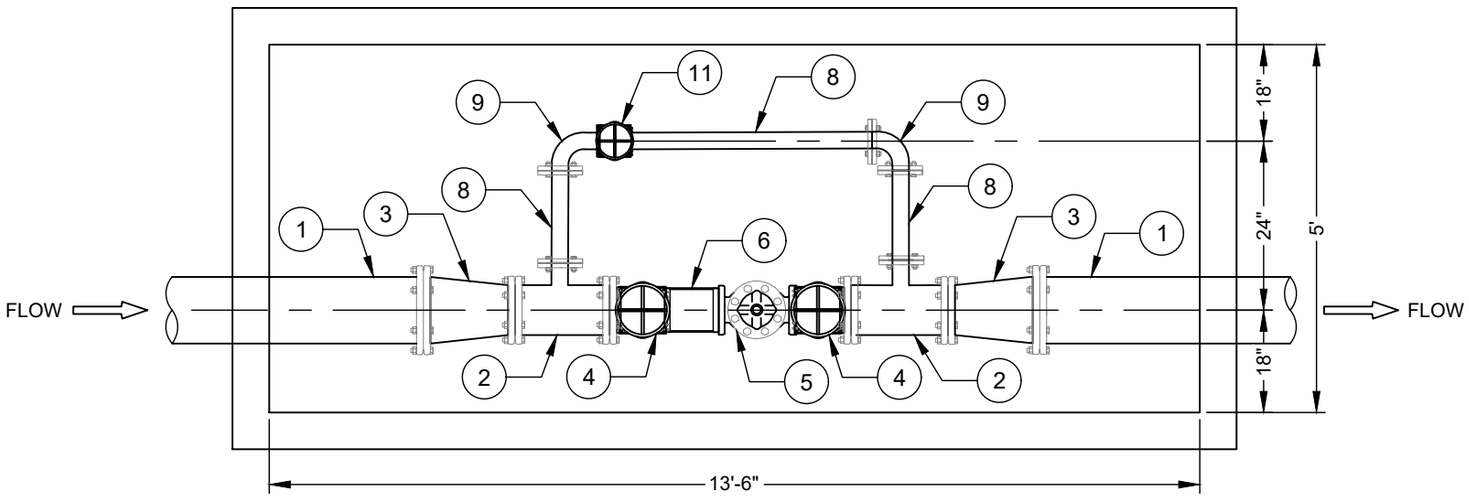
4-INCH PRESSURE REDUCER VALVE

NO SCALE

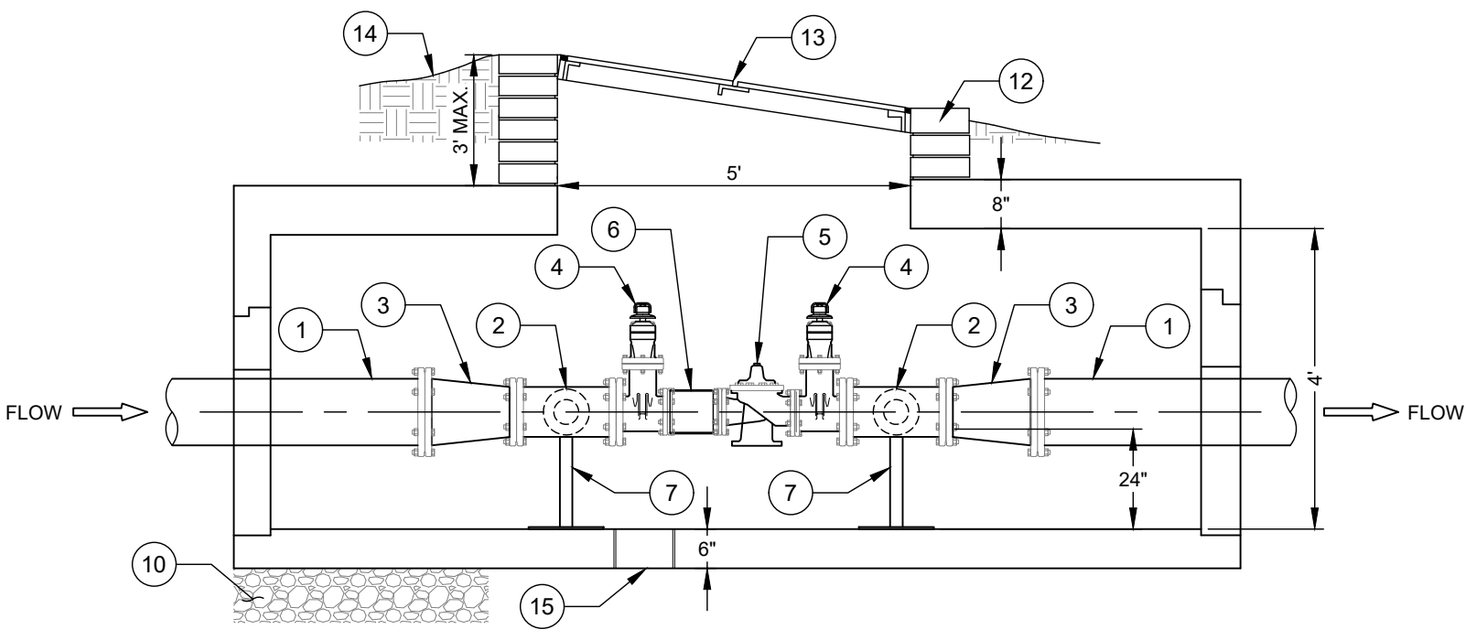
VERSION 1.0

DATE 04/2024

DETAIL 10.8.4



PLAN VIEW



ELEVATION VIEW

NO.	DESCRIPTION:
1.	6" OR 8" WATER MAIN.
2.	6" X 2" TEE (TYP.).
3.	8" X 6" REDUCER (TYP.).
4.	6" GATE VALVE (TYP.).
5.	6" PRV WITH 2" BYPASS CLA-VAL MODEL 6" 90-99.
6.	6" DISMANTLING JOINT.
7.	2"/3" SUPPORT (TYP.).
8.	6" SPOOL PIECE.
9.	6" 90° BEND (TYP.).
10.	#57 WASHED STONE.
11.	2" GATE VALVE (TYP.).
12.	MINIMUM OF 3 STANDARD BRICK COURSES LOCATED UNDER FRAME, OR UNDER FLAT SLAB TOP.
13.	5' X 5' DOUBLE LEAF STEEL COVER, HINGED & LOCKABLE. SEE STD. DETAIL.
14.	FINISHED GRADE TO DRAIN AWAY FROM COVER.
15.	12" DIAMETER SUMP.

NOTES:

A. ALL PIPING SHALL BE MINIMUM CLASS 53 FLANGE DUCTILE IRON WITH FULL FACE GASKETS.
B. ALL FLANGE HARDWARE (BOLT/WASHER/NUT) SHALL BE STAINLESS STEEL - TYPE 304 WITH ANTI-SEIZE COMPOUND.
C. ALL PIPE SHALL BE RESTRAINED FROM TAP TO PROPERTY LINE VALVE.
D. VAULT SHALL BE RATED FOR NCDOT HS-20 LOADING - SUBMIT SHOP DRAWINGS/P.E. SEALED FOR REVIEW.
E. ALL CONCRETE SHALL BE MINIMUM 3,600 PSI COMPRESSIVE STRENGTH.
F. DESIGN SHALL CONFORM TO ASTM C858 - SPECIFICATIONS FOR "UNDERGROUND PRECAST CONCRETE UTILITY STRUCTURE".
G. STEEL REINFORCING DESIGN SHALL CONFORM TO ASTM C857.
H. REBARS SHALL BE GRADE 60 PER ASTM A615.
I. WELDED WIRE FABRIC SHALL CONFORM TO ASTM A185.
J. DIAGONAL REINFORCING SHALL BE ADDED AT ALL OPENINGS.
K. PIPE PENETRATIONS SHALL BE SEALED WITH FLEXIBLE CONNECTERS (MANHOLE BOOTS) OR WITH 4" OF BRICK & MORTAR (AND 1/2-INCH THICK CONSTRUCTION EXPANSION MATERIAL AROUND THE PIPE).
L. FRAME TO BE FLUSH WITH GROUND OR CONCRETE SIDEWALK, GROUND SHALL SLOPE AWAY FROM VAULT.
M. ALL JOINTS SHALL BE MADE WATERTIGHT USING 2 RINGS OF BUTYL RUBBER JOINT MASTIC.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

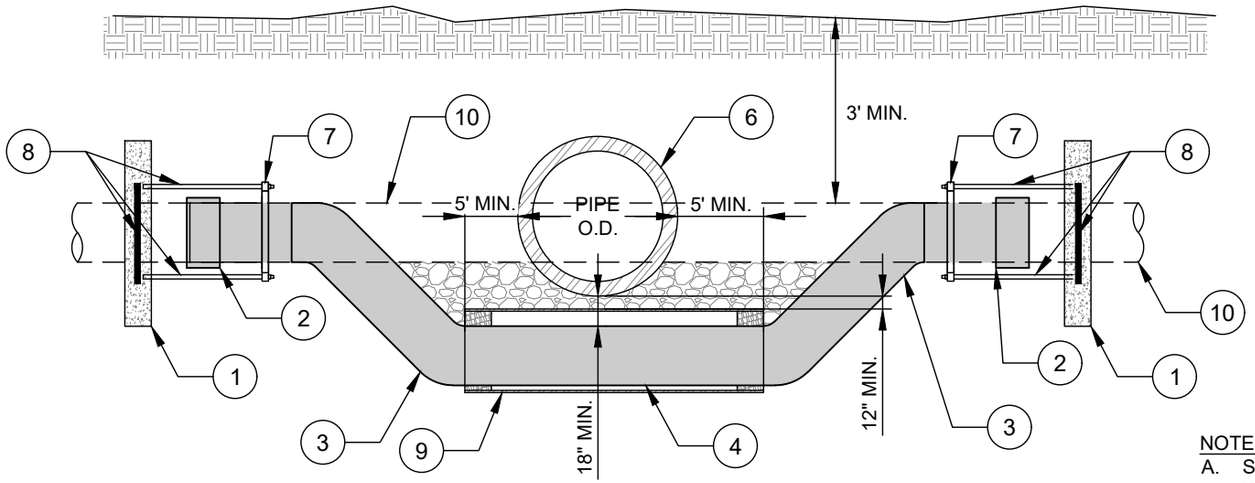
6-INCH PRESSURE REDUCER VALVE

NO SCALE

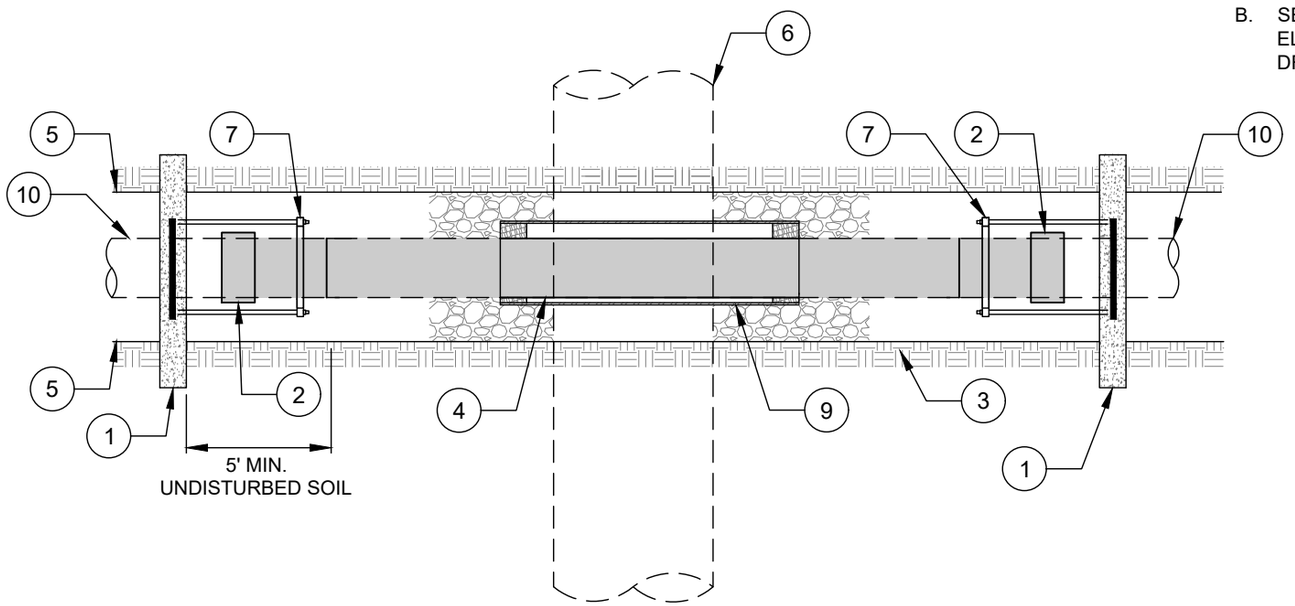
VERSION 1.0

DATE 04/2024

DETAIL 10.8.5



PROFILE VIEW



PLAN VIEW

NOTES TO DESIGNER

A. SEALING ENGINEER SHALL CONFIRM WATER LINE SEPARATION IS IN ACCORDANCE WITH GOVERNING BODY REGULATIONS. MODIFY DETAIL ACCORDINGLY.

B. SEALING ENGINEER TO ADD FINISH ELEVATIONS OF THE GROUND, STORM DRAIN, AND NEW WATER LINE.

BEND RADIUS TABLE	
MAIN SIZE (INCHES)	MINIMUM BEND RADIUS (FEET)
6	133
8	173
10	215
12	255
16	320

S.S. TIE ROD TABLE	
MAIN SIZE (INCHES)	TIE ROD SIZE (COUNT - DIA. X INCH LENGTH)
6	6 - 3/4 X 13
8	6 - 3/4 X 13
10	8 - 3/4 X 18
12	8 - 3/4 X 18
16	10 - 3/4 X 18

NO. DESCRIPTION:

1. CONCRETE WALL BLOCKING (REFER TO APPROPRIATE STANDARD DETAIL).
2. TRANSITION COUPLING IF REQUIRED (REFER TO APPROPRIATE STANDARD DETAIL).
3. TO PREVENT THE OVER-BENDING OF HDPE, A MINIMUM 1.5 TIMES THE MANUFACTURER SPECIFIED BEND RADIUS IS ALLOWED. IF BEND RADIUS REQUIREMENTS CANNOT BE MET, THEN BUTT FUSED LONG RADIUS BEND FITTINGS ARE ALLOWED.
4. NEW HDPE PIPE - MINIMUM LENGTH IS 10' PLUS DIAMETER OF STORM PIPE OF STRAIGHT RUN OF PIPE AND CENTERED UNDER STORM DRAIN PIPE.
5. TRENCH LIMITS.
6. STORM DRAIN (OR PROPOSED CONFLICT).
7. ROD BEND TO WALL BLOCK IF TRANSITION IS NOT SELF-RESTRAINED. TIE ROD MUST BE CORROSION-RESISTANT (S.S.) AND COVERED IN CORROSION INHIBITING SUBSTANCE.
8. THE CONNECTING TIE RODS THAT JOIN THE TWO ANCHOR RINGS SHALL BE MADE OF LOW ALLOY STEEL THAT CONFORMS TO ANSI/AWWA C111/A21.11.
9. STEEL CASING PIPE - REQUIRED IF STORM PIPE IS 72" DIAMETER OR LARGER OR REQUIRED IF STORM CONFLICT IS A BOX CULVERT. REFER TO STEEL CASING FOR HDPE PIPE STANDARD DETAIL.
10. EXISTING PIPE.

NOTES:

A. ALL HDPE PIPE SHALL HAVE BUTT FUSED JOINT OR ELECTROFUSED FITTINGS.

B. EMBEDMENT OF WATER MAIN SHALL BE PER APPROPRIATE STANDARD DETAIL.

C. IF THE EXISTING PIPE IS HDPE, CONTRACTOR MAY NOT DEFLECT PIPE AS-IS TO ACHIEVE LOWERING. HDPE FITTINGS OR NEW HDPE PIPE MUST BE INSTALLED TO PROVIDE THE EXTRA PIPE LENGTH NEEDED TO ACCOMMODATE A WATER MAIN LOWERING.

D. LOWERED PIPE MUST BE NEW MATERIAL. REUSE OF EXISTING PIPE IS NOT ALLOWED.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

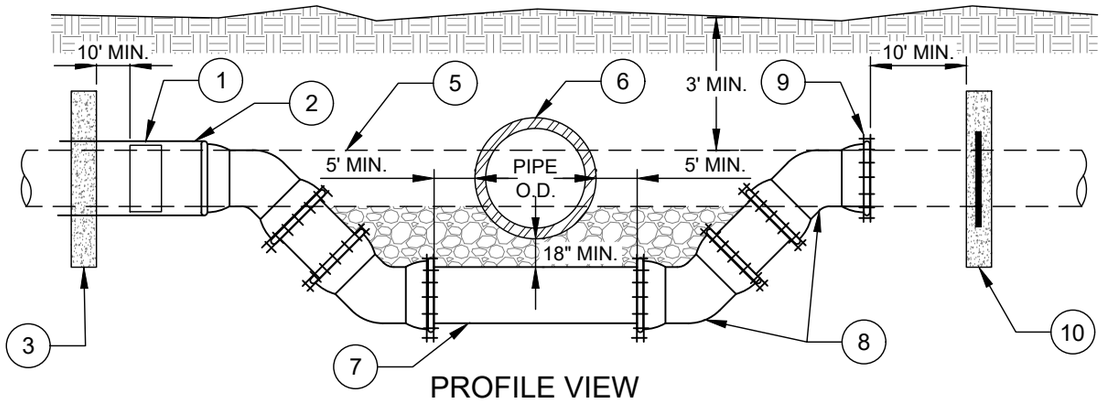
LOWERING OF 6-INCH TO 16-INCH WATER MAIN USING HDPE

NO SCALE

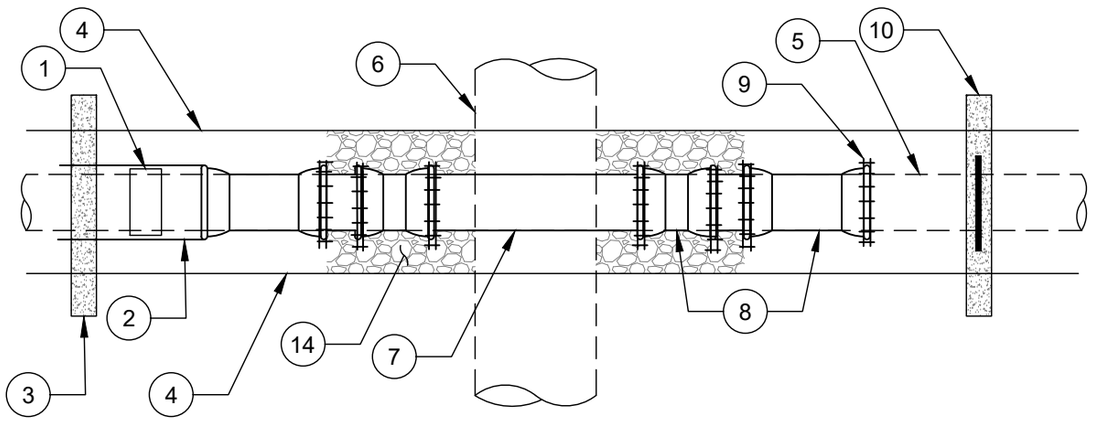
VERSION 1.0

DATE 04/2024

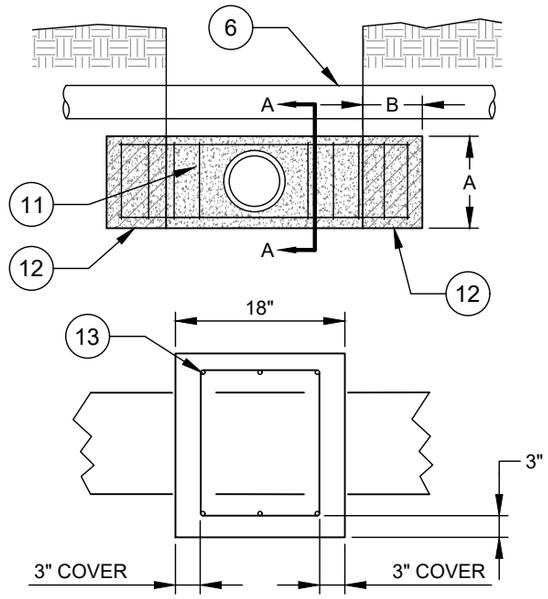
DETAIL 10.9.1



PROFILE VIEW



PLAN VIEW



SECTION A-A

THRUST BLOCK DETAIL

NO.	DESCRIPTION:
1.	TRANSITION COUPLING (IF REQUIRED).
2.	ROD BEND TO THRUST BLOCK.
3.	CONCRETE THRUST WALL BLOCKING.
4.	TRENCH LIMITS.
5.	EXISTING PIPE.
6.	STORM PIPE.
7.	NEW DUCTILE IRON PIPE, WITH LENGTH CENTERED UNDER STORM DRAIN PIPE.
8.	11.25° OR 22.5° RJ BENDS ROTATE AS REQUIRED.
9.	WEDGE ACTION RESTRAINT GLANDS.
10.	CONCRETE THRUST WALL BLOCKING WITH ANCHOR RING. SEE NOTE C.
11.	STIRRUPS (TYPICAL) SPACING 6" MINIMUM, 12" MAXIMUM.
12.	BEARING AREA.
13.	#4 BAR (TYPICAL).
14.	BACKFILL WITH WASHED STONE (#57) BETWEEN TWO PIPES.

NOTES:

A. FITTINGS SHALL BE RESTRAINED USING WEDGE ACTION RESTRAINT, STAINLESS STEEL TIE RODS, OR RESTRAINED JOINT PIPE, AS APPROVED BY ENGINEER.

B. BEARING AREAS (A X B) DETERMINED BY ACTUAL SOIL CONDITIONS. SHOULD BE BASED ON 200 PSI TEST PRESSURE. SEE CHART BELOW.

C. DO NOT USE ANCHOR RING ON PVC, CIP, OR AC PIPE. ANCHOR RING NOT REQUIRED IF THE TOP BEND IS RODDED.

RESULTANT THRUST AT FITTINGS AT 200 PSI WATER PRESSURE.
TOTAL POUNDS,

NOM. PIPE DIAMETER	11.25° BEND	22.5° BEND
6 INCH	1466	2918
8 INCH	2522	5020
10 INCH	3793	7552
12 INCH	5364	10680

THE FOLLOWING OFTEN-USED SOIL VALUES FOR THE DEPTHS OF 4' ARE LISTED ONLY AS A GUIDE*. THE ENGINEER SHOULD SELECT THESE BEARING VALUES FOR EACH SOIL TYPE AND DEPTH OF COVER ENCOUNTERED ON THE SPECIFIC PIPELINE PROJECT. APPROPRIATE SAFETY FACTORS SHOULD BE APPLIED TO COVER FUTURE CHANGES IN PIPE DEPTH, SOIL BEARING CAPACITIES, ETC.

SOIL	BEARING LOAD (LBS/SQ.FT.)
MUCK	0
SOFT CLAY	1,000
SILT	1,500
SANDY SILT	3,000
SAND	4,000
SANDY CLAY	6,000
HARD CLAY	9,000

*NO RESPONSIBILITY CAN BE ASSUMED FOR THE ACCURACY OF THE DATA IN THIS TABLE DUE TO THE WIDE VARIATION OF BEARING LOAD CAPABILITIES FOR EACH SOIL TYPE.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

LOWERING OF 6-INCH TO 12-INCH WATER MAIN

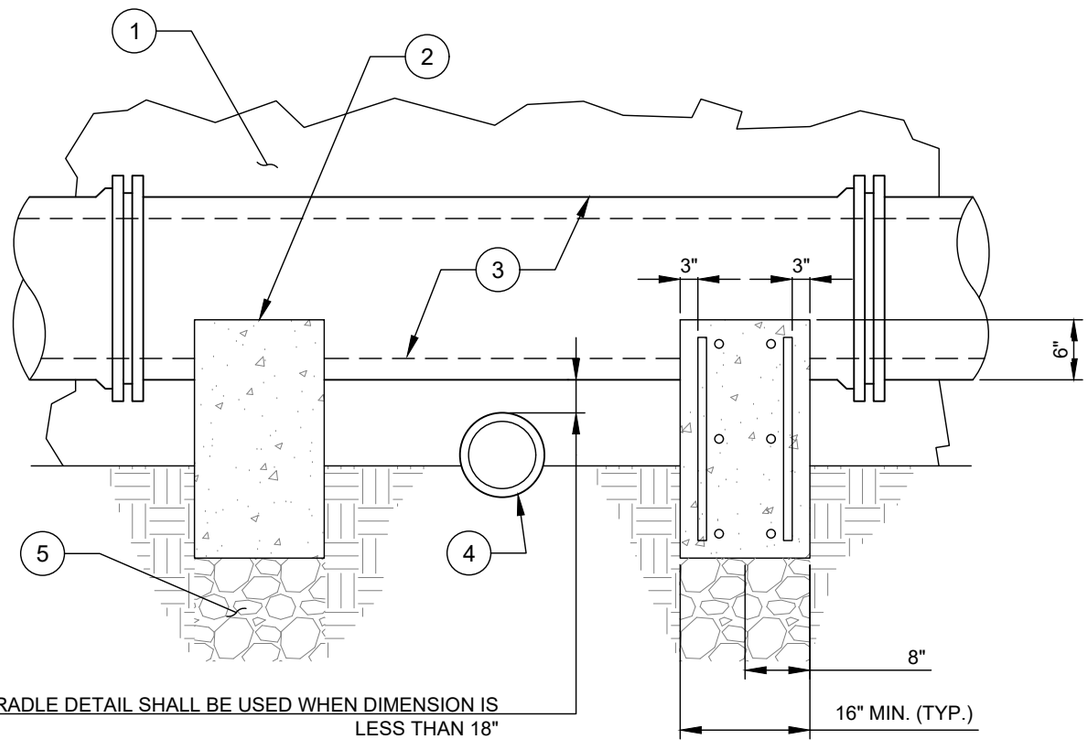
NO SCALE

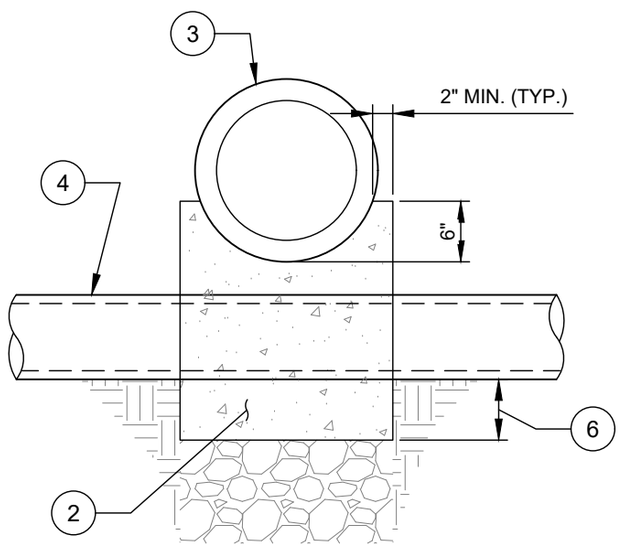
VERSION 1.0

DATE 04/2024

DETAIL 10.9.2

NO.	DESCRIPTION:
1.	CONTROLLED DENSITY FILL SURROUNDING BOT PIPES, MIN. 6" THICK.
2.	PROPOSED CONCRETE CRADLE NEAR JOINT (EACH SIDE). MINIMUM REBAR REINFORCEMENT (#4 REBAR). #4 BARS AT 12" CENTER-TO-CENTER EACH WAY, TYPICAL. 3" CLEAR FROM FACE OF CONCRETE.
3.	PIPE (ABOVE).
4.	PIPE (BELOW).
5.	MIN. 8" COMPACTED STONE BEDDING (#57).
6.	BOTTOM OF CRADLE TO BE AT LEAST 6" BELOW THE BOTTOM PIPE.





THIS CONCRETE CRADLE DETAIL SHALL BE USED WHEN DIMENSION IS LESS THAN 18"

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

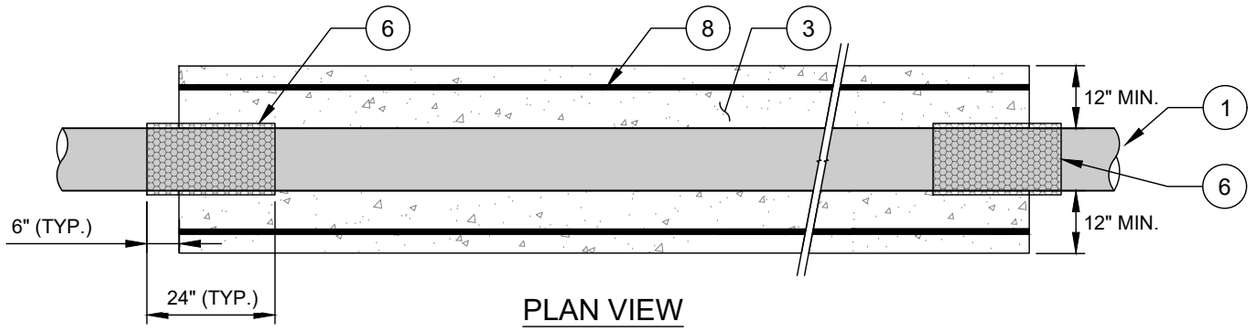
CONCRETE CRADLE DETAIL

NO SCALE

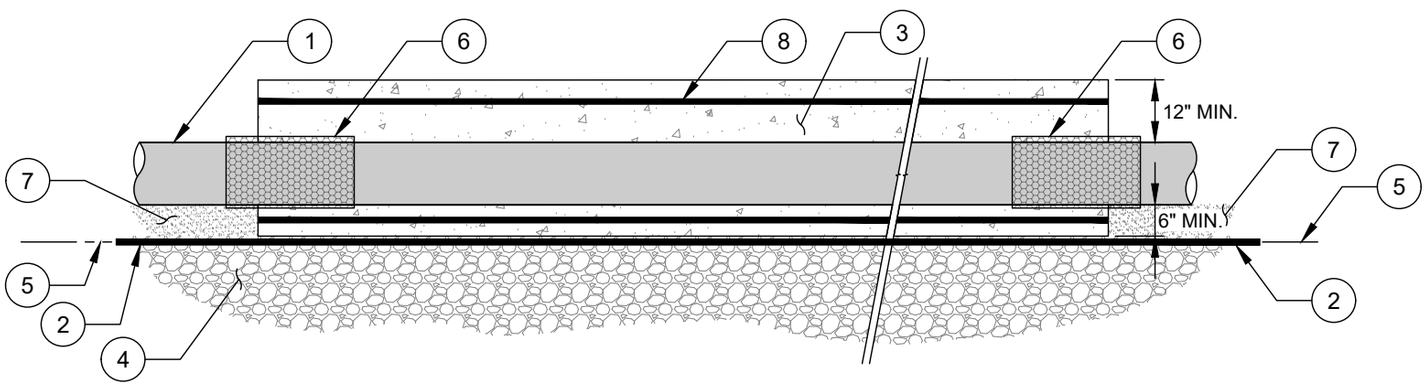
VERSION
1.0

DATE
04/2024

DETAIL
10.9.3



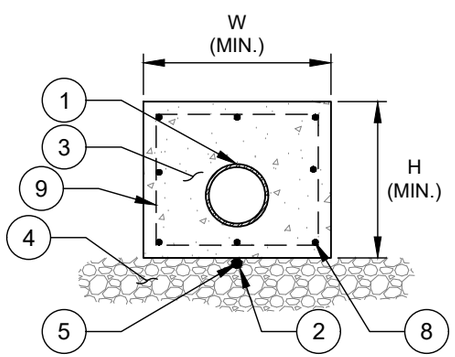
PLAN VIEW



ELEVATION VIEW

NOTES TO DESIGNER

A. CONCRETE AND REINFORCEMENT IS MINIMUM REQUIRED. SEALING ENGINEER SHALL DESIGN REINFORCEMENT APPROPRIATE TO SPECIFIC CONDITIONS AND LOADS.



SECTION VIEW

PIPE DIAMETER (INCHES)	MIN. W (INCHES)	MIN. H (INCHES)	CONCRETE VOLUME PER LF	
			FT^3 / LF	CY / LF
4	31	25	5.29	0.20
6	33	27	5.99	0.22
8	36	30	7.15	0.26
10	38	32	7.90	0.29
12	40	34	8.66	0.32
14	42	36	9.43	0.35
16	44	38	10.21	0.38
18	46	40	11.01	0.41
20	48	42	11.82	0.44
22	50	44	12.64	0.47
24	52	46	13.47	0.50
26	54	48	14.31	0.53
28	56	50	15.17	0.56
30	58	52	16.04	0.59
32	60	54	16.91	0.63

NO.	DESCRIPTION:
1.	HDPE PIPE.
2.	CONDUIT - 1 INCH STEEL ELECTRICAL CONDUIT TO CONTAIN TRACER WIRE.
3.	CONCRETE ENCASEMENT (f'c = 3,600 PSI MIN.).
4.	STONE STABILIZATION MATERIAL AS REQUIRED.
5.	TRACER WIRE - CONTINUOUS AWG #12 GAUGE SOLID COPPER TRACER WIRE WITH 30 MILS THICK, BLUE HDPE INSULATION AT THE BOTTOM OF THE UTILITY SAND EMBEDMENT LAYER.
6.	NEOPRENE FOAM PROTECTIVE WRAPPING, 1/4 TO 3/4-INCH THICKNESS.
7.	HDPE EMBEDMENT MATERIAL - FINE AGGREGATE ACCORDING TO ASTM C33 TABLE 1.
8.	#5 REBAR LONG (TYP.).
9.	#4 REBAR TIES (MAXIMUM SPACING OF 12") - MINIMUM 1.5" CLEARANCE TO PIPE, MINIMUM 3" COVER.

NOTES:

A. CONCRETE ENCASEMENT SHALL ONLY BE INSTALLED WHERE SHOWN ON APPROVED PLANS OR WITH PRIOR APPROVAL BY CLTW ENGINEER.

B. THIS RESTRICTION IS IN PLACE DUE TO THE INABILITY TO EASILY MAINTAIN/REPAIR OR TAP A MAIN ENCASED IN CONCRETE.

C. SEALING ENGINEER TO CONFIRM TEMPERATURE FROM CONCRETE CURING AT SITE WILL BE LESS THAN 260°F.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

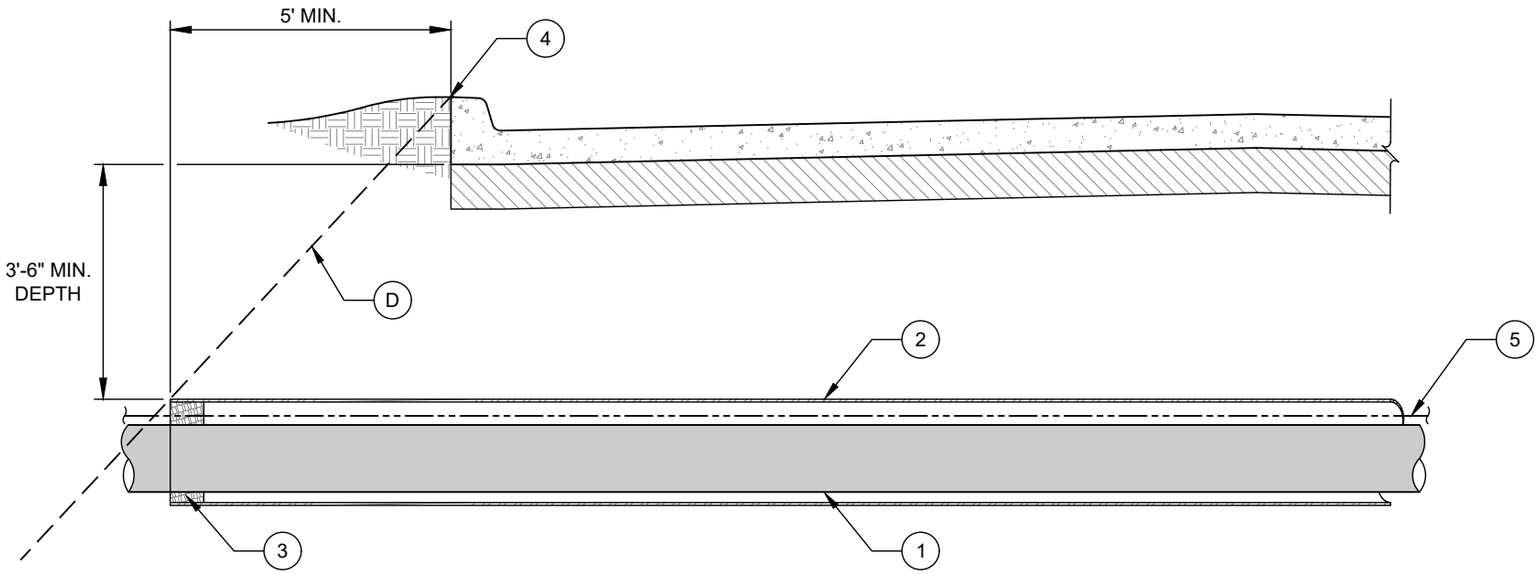
CONCRETE ENCASEMENT FOR HDPE PIPE

NO SCALE

VERSION 1.0

DATE 04/2024

DETAIL 10.10.1



MINIMUM SIZE AND THICKNESS STANDARDS FOR CASING PIPE				
NOMINAL CARRIER PIPE (INCHES)	DOT CASING DIAMETER (INCHES)	DOT CASING MIN. THICKNESS (INCHES)	RAILROAD CASING DIAMETER (INCHES)	RAILROAD MIN. THICKNESS (INCHES)
2	8	0.250	N/A	N/A
3	8	0.250	N/A	N/A
4	8	0.250	N/A	N/A
6	12.75	0.250	16	0.281
8	16	0.250	18	0.312
10	18	0.250	20	0.344
12	20	0.250	24	0.406
14	20	0.250	30	0.469
16	24	0.250	30	0.469
18	24	0.375	36	0.562
20	36	0.375	36	0.562
22	36	0.375	36	0.562
24	36	0.375	36	0.562
26	42	0.500	48	0.750
30	42	0.500	48	0.750
32	42	0.500	48	0.750

NO. DESCRIPTION:

1. HDPE WATER MAIN CARRIER PIPE.
2. STEEL CASING PIPE, MINIMUM 35,000 PSI MINIMUM YIELD STRENGTH STEEL. SEE TABLE FOR THICKNESS.
3. PLUG ENDS OF CASING WITH GROUT (8" MINIMUM WIDTH).
4. EDGE OF PAVEMENT OR BACK OF CURB.
5. TRACER WIRE - CONTINUOUS AWG #12 GAUGE SOLID COPPER TRACER WIRE WITH 30 MILS THICK COLOR-CODED HDPE INSULATION AT THE TOP OF CASING PIPE. ADD 3/4" ELECTRICAL CONDUIT SO TRACER WIRE IS NOT IN CONTACT WITH THE CARRIER PIPE.

NOTES:

A. CASING SPACERS ARE NOT ALLOWED FOR USE ON HDPE PIPE IN STEEL CASING.

B. SKIDS ARE ALLOWED FOR LONG INSTALLATIONS WITH APPROVAL OF THE SEALING ENGINEER.

C. ALLOWABLE TENSILE LOAD FOR PIPE MAY NOT BE EXCEEDED WHEN PULLING CARRIER PIPE THROUGH CASING.

D. 1:1 SLOPE LINE REQUIREMENT.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

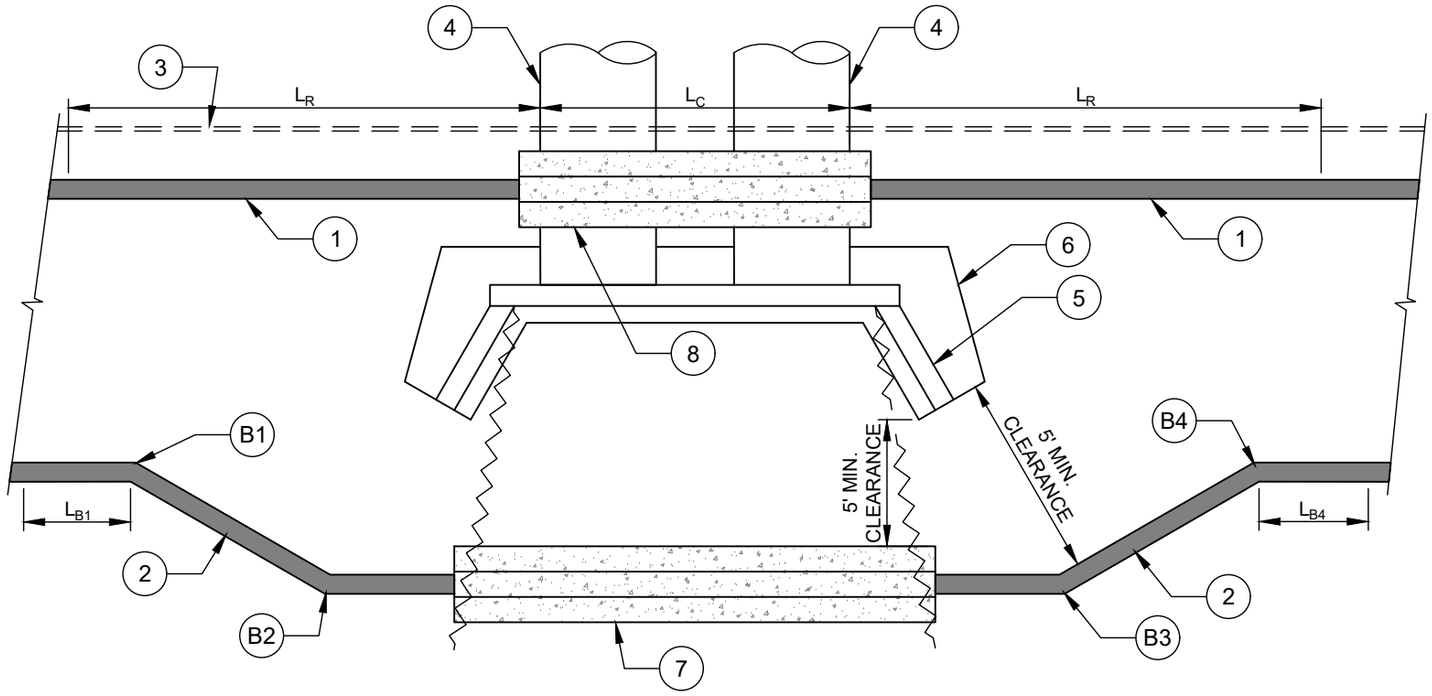
STEEL CASING FOR HDPE PIPE

NO SCALE

VERSION
1.0

DATE
04/2024

DETAIL
10.10.2



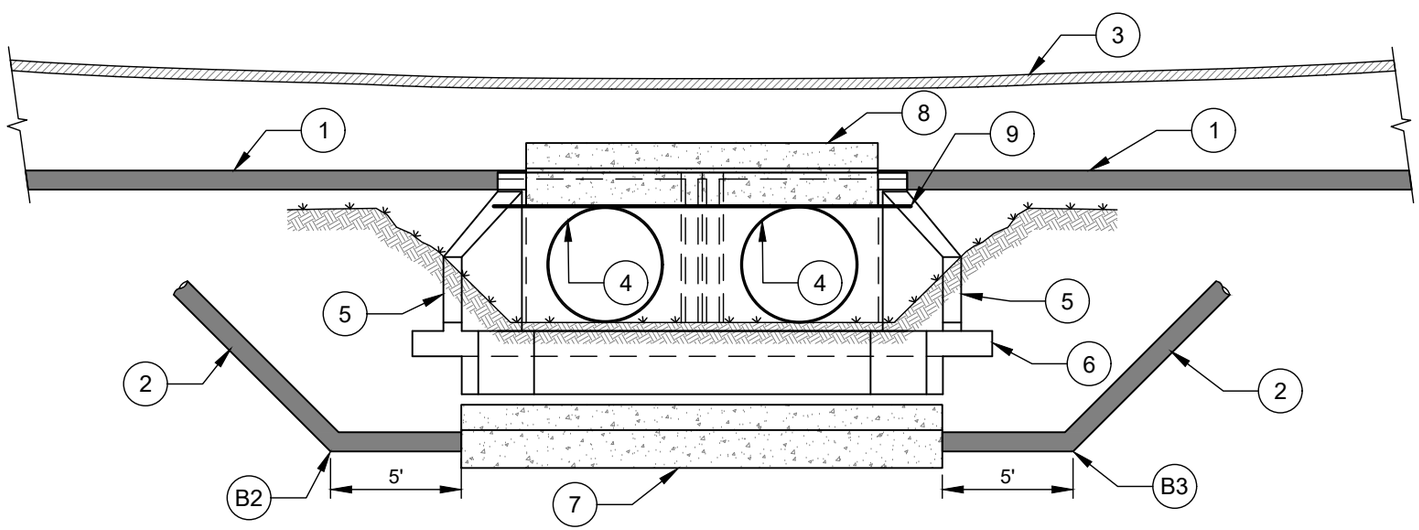
TYPICAL PLAN VIEW

NO.	DESCRIPTION:
1.	PROPOSED RJ DIP WATER MAIN - PREFERRED LOCATION.
2.	PROPOSED RJ DIP WATER MAIN - OPTIONAL LOCATION.
3.	ROAD WITH CURB AND GUTTER OR EDGE OF PAVEMENT.
4.	CULVERT - PIPE OR BOX.
5.	CULVERT WING WALL (CULVERT AND HEADWALL).
6.	CULVERT FOOTING.
7.	CONCRETE ENCASEMENT - SEE STANDARD DETAIL - REQUIRED.
8.	CONCRETE ENCASEMENT - SEE STANDARD DETAIL - REQUIRED WHEN 30" COVER ON PIPE CAN NOT BE MAINTAINED Lc (MIN.) OR AS DETERMINED BY THE ENGINEER.
9.	8 MILS HDPE PLASTIC FILM (HDCLPE PER ASTM C105-4MILS EACH LAYER) - SEPARATE CONCRETE ENCASEMENT FROM CULVERT AND HEADWALL.
10.	DISTANCE AS INDICATED ON CONSTRUCTION PLANS.
11.	PIPE MAY BE LOCATED TO 12" OF HEADWALL - CONCRETE ENCASEMENT SHALL NOT BOND TO CULVERT OR HEADWALL - SEE NO. 9.
12.	5' MINIMUM BELOW CREEK BED.
Bx.	BENDS - AS REQUIRED.

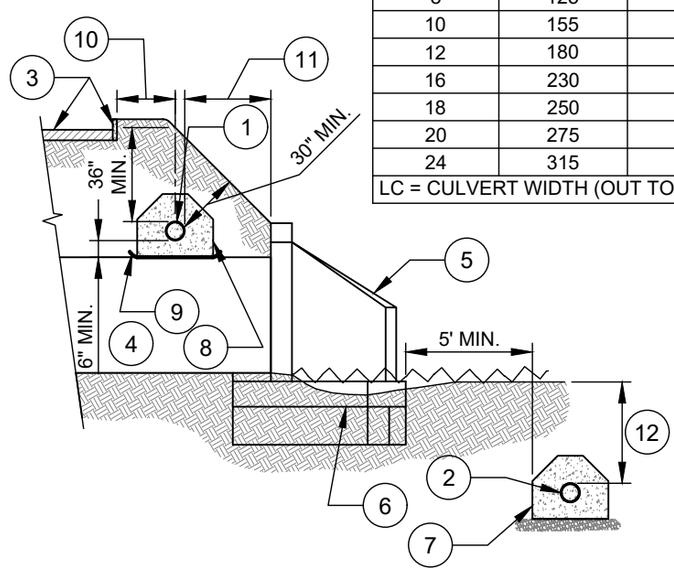
NOTES:

A. ALL PIPE SHALL BE RESTRAINED JOINT DUCTILE IRON PIPE FROM BEND B1 TO B4.
B. RESTRAINED LENGTHS LB1 AND LB4 SHALL BE DETERMINED BY THE ENGINEER.
C. CONCRETE ENCASEMENT NO. 8 MAY NOT BE REQUIRED WHEN MINIMUM COVERS ARE PROVIDED AS SHOWN IN SECTION VIEW.

MINIMUM RESTRAINED LENGTH FOR PREFERRED LOCATION #1		
PIPE DIAMETER (INCHES)	LR (FEET)	TOTAL RESTRAINED LENGTH (FEET)
6	100	200 + LC
8	125	250 + LC
10	155	310 + LC
12	180	360 + LC
16	230	460 + LC
18	250	500 + LC
20	275	550 + LC
24	315	630 + LC
LC = CULVERT WIDTH (OUT TO OUT) - FEET		



TYPICAL ELEVATION VIEW



SECTION VIEW

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

WATER MAIN LOCATIONS AT CULVERTS USING CONCRETE ENCASEMENT
6-INCH THROUGH 24-INCH MAINS

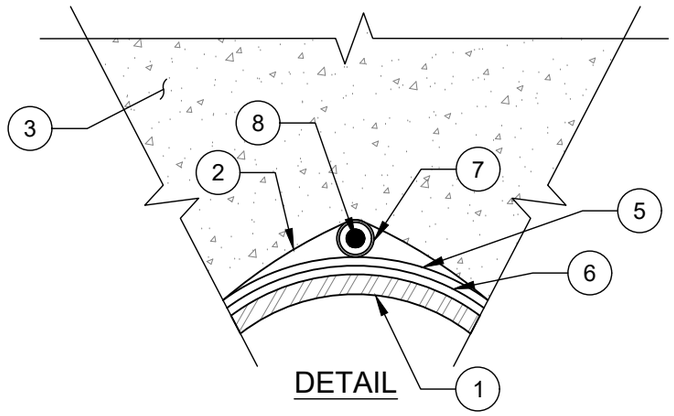
NO SCALE

VERSION 1.0

DATE 04/2024

DETAIL 10.10.3

PIPE DIAMETER (INCHES)	WIDTH (W) (MINIMUM) (INCHES)	HEIGHT (H) (MINIMUM) (INCHES)	CONCRETE VOLUME APPROX. PER L.F.	
			FT^3 / LF	CY / LF
4	31	25	4.26	0.16
6	33	27	4.93	0.18
8	36	30	6.05	0.22
10	38	32	6.77	0.25
12	40	34	7.49	0.28
16	44	38	8.96	0.33
20	49	43	11.09	0.41
24	53	47	12.67	0.47
30	60	54	15.91	0.59
36	66	60	18.50	0.69
42	74	68	23.14	0.86
48	80	74	26.04	0.96
54	88	82	31.04	1.15
60	92	86	33.24	1.23
64	96	90	35.48	1.31



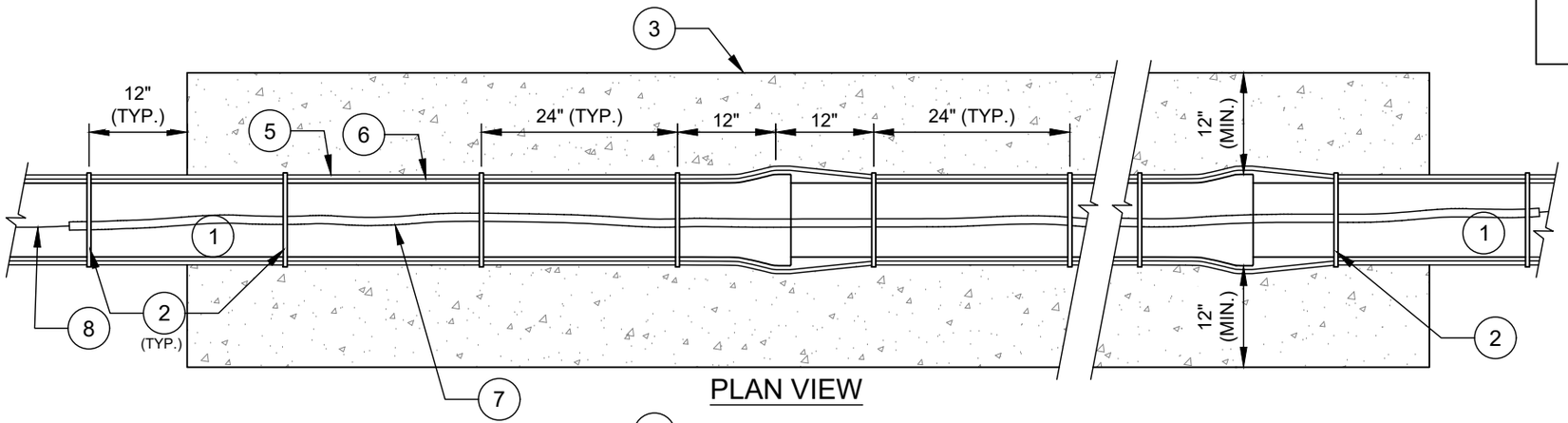
DETAIL

NO. DESCRIPTION:

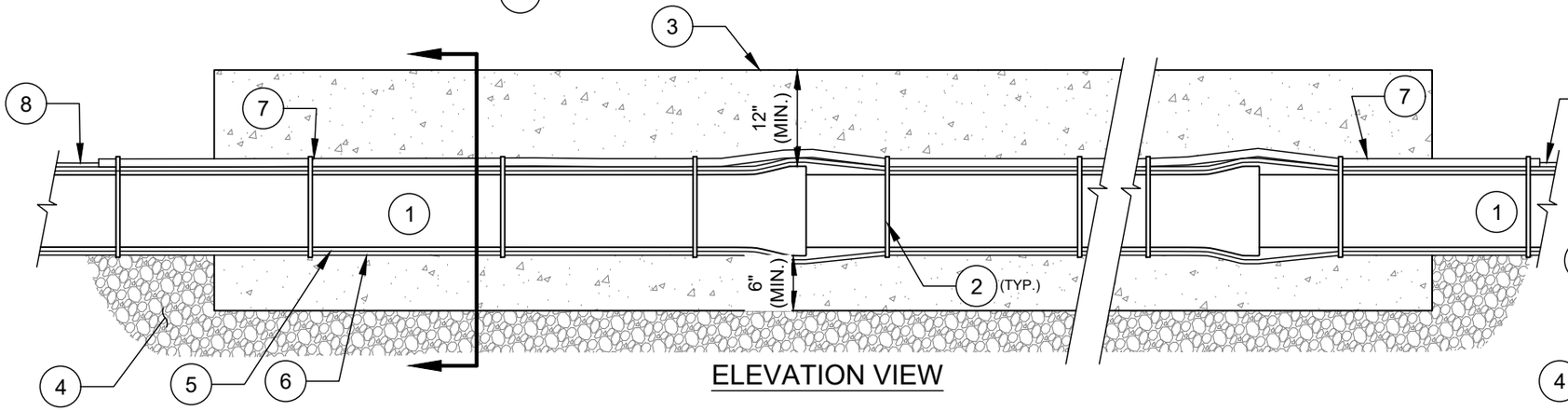
1. DUCTILE IRON PIPE.
2. HDPE ADHESIVE TAPE OR HDPE ZIPLOCK TIE.
3. CONCRETE ENCASEMENT (f 'c = 3,600 PSI MIN.).
4. STONE STABILIZATION MATERIAL - AS REQUIRED.
5. HIGH DENSITY CROSS LAMINATED POLYETHYLENE FILM (HDCLPE) - 4 MILS - TUBE - AWWA C105.
6. HIGH DENSITY CROSS LAMINATED POLYETHYLENE FILM (HDCLPE) - 4 MILS - TUBE - AWWA C105.
7. 1" DIAMETER SCH. 40 STEEL ELECTRICAL CONDUIT.
8. AWG #12 GAUGE SOLID COPPER TRACER WIRE WITH BLUE INSULATION - (30 MILS HDPE).

NOTES:

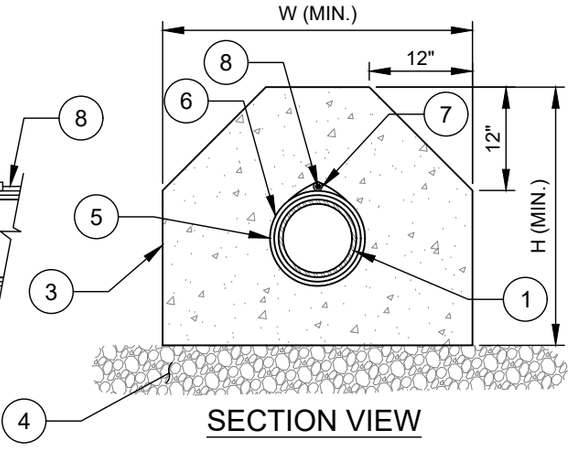
A. CONCRETE ENCASEMENT SHALL ONLY BE INSTALLED WHERE SHOWN ON APPROVED PLANS OR WITH PRIOR APPROVAL BY CLTW ENGINEER.
B. THIS RESTRICTION IS IN PLACE DUE TO THE INABILITY TO EASILY MAINTAIN / REPAIR OR TAP A MAIN ENCASED IN CONCRETE.



PLAN VIEW



ELEVATION VIEW



SECTION VIEW

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

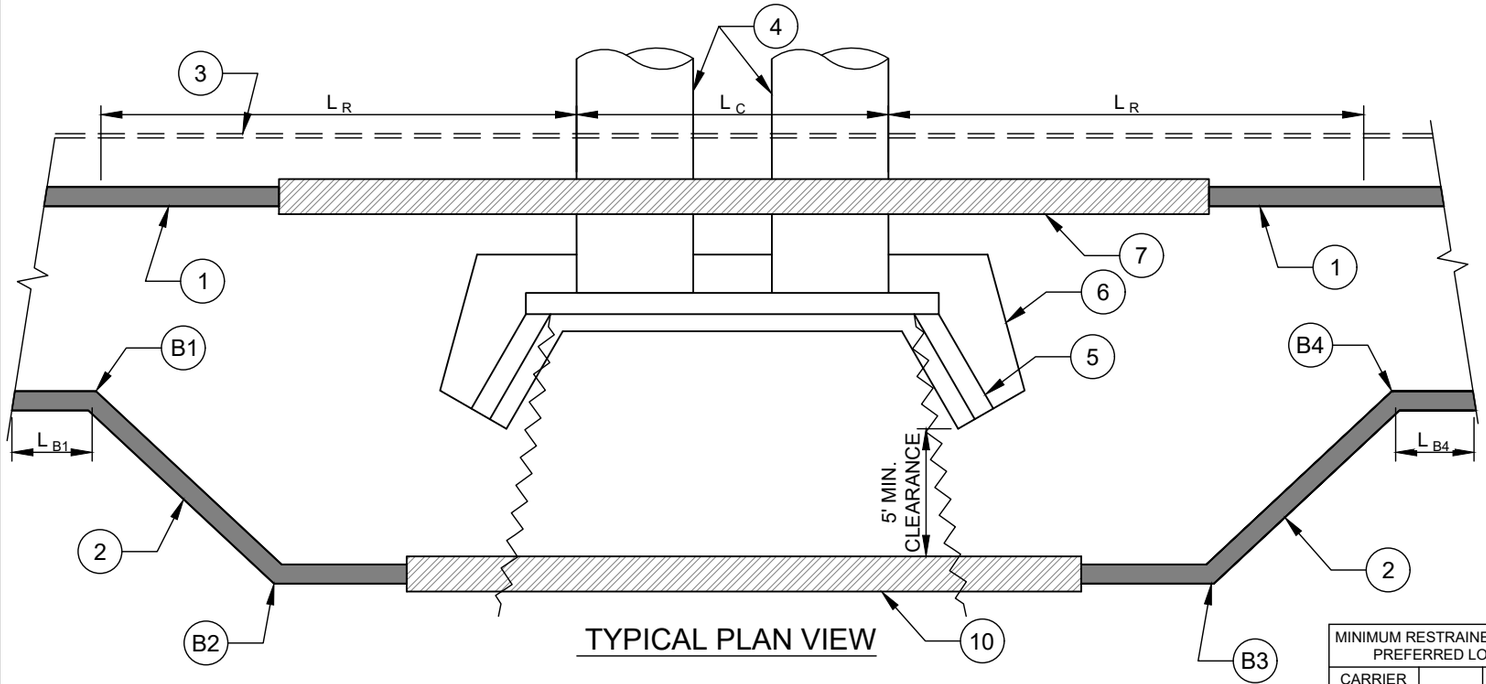
CONCRETE ENCASEMENT 6-INCH THROUGH 64-INCH MAINS

NO SCALE

VERSION 1.0

DATE 04/2024

DETAIL 10.10.4



TYPICAL PLAN VIEW

NO.	DESCRIPTION:
1.	PROPOSED RJ DIP WATER MAIN - PREFERRED LOCATION.
2.	PROPOSED RJ DIP WATER MAIN - OPTIONAL LOCATION.
3.	ROAD WITH CURB AND GUTTER OR EDGE OF PAVEMENT.
4.	CULVERT - PIPE OR BOX.
5.	CULVERT WING WALL.
6.	CULVERT FOOTING.
7.	STEEL ENCASEMENT PIPE.
8.	DISTANCE AS INDICATED ON CONSTRUCTION PLANS.
9.	5' MIN. BELOW CREEK BED - MINIMUM.
10.	STEEL ENCASEMENT PIPE - INSTALLATION BY DRY BORE METHOD OR HORIZONTAL DIRECTIONAL DRILL METHOD.
Bx.	BENDS - AS REQUIRED.

NOTES:

A. IN PREFERRED LOCATION (NO. 1), CASING PIPE (NO. 7) IS REQUIRED WITH LESS THAN 36" COVER AT PIPE CENTER LINE. MINIMUM COVER BASED ON PAVEMENT ELEVATION SHALL BE 24".

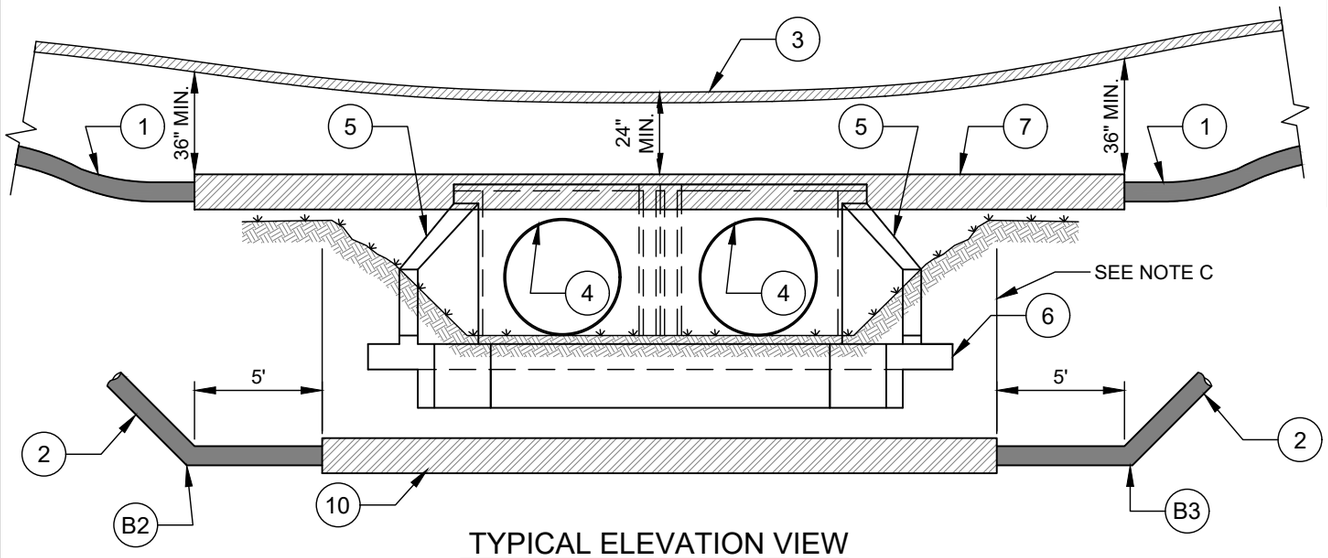
B. STEEL CASING PIPE (NO. 7) MAY NOT BE REQUIRED WHEN MINIMUM COVERS ARE PROVIDED FOR NORMAL PIPE INSTALLATION.

C. IN OPTIONAL LOCATION (NO. 2), CASING PIPE (NO. 10) SHALL EXTEND FROM TOP OF BANK TO TOP OF BANK - MINIMUM.

D. ALL PIPE SHALL BE RESTRAINED JOINT DIP FROM BEND B1 TO B4.

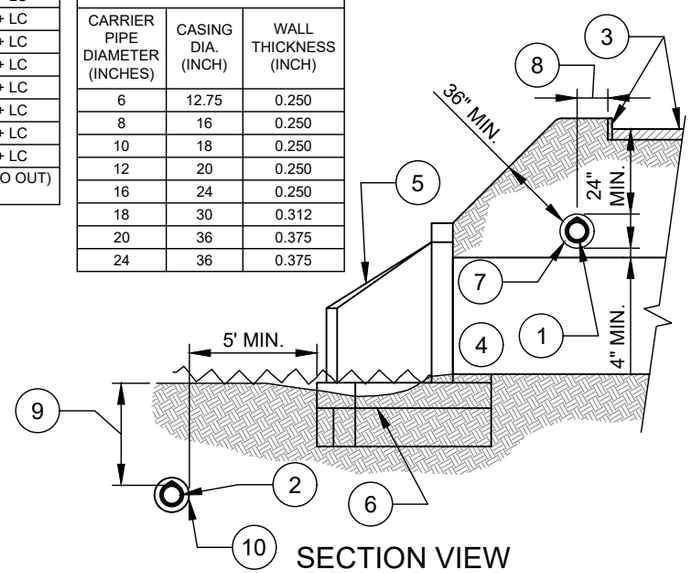
E. RESTRAINED LENGTHS LB1 AND LB4 SHALL BE DETERMINED BY THE ENGINEER.

MINIMUM RESTRAINED LENGTH FOR PREFERRED LOCATION #1		
CARRIER PIPE DIAMETER (INCHES)	LR (FEET)	TOTAL RESTRAINED LENGTH (FEET)
6	100	200 + LC
8	125	250 + LC
10	155	310 + LC
12	180	360 + LC
16	230	460 + LC
18	250	500 + LC
20	275	550 + LC
24	315	630 + LC
LC = CULVERT WIDTH (OUT TO OUT) - FEET		



TYPICAL ELEVATION VIEW

STEEL CASING PIPE		
CARRIER PIPE DIAMETER (INCHES)	CASING DIA. (INCH)	WALL THICKNESS (INCH)
6	12.75	0.250
8	16	0.250
10	18	0.250
12	20	0.250
16	24	0.250
18	30	0.312
20	36	0.375
24	36	0.375



SECTION VIEW

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

WATER MAIN LOCATIONS AT CULVERTS
USING STEEL CASING PIPE
6-INCH THROUGH 24-INCH MAINS

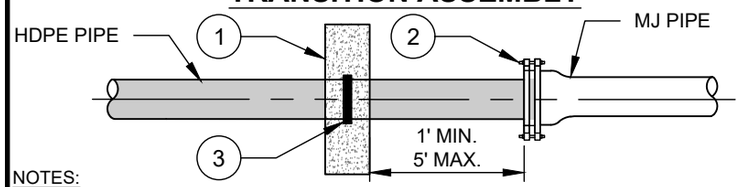
NO SCALE

VERSION
1.0

DATE
04/2024

DETAIL
10.10.5

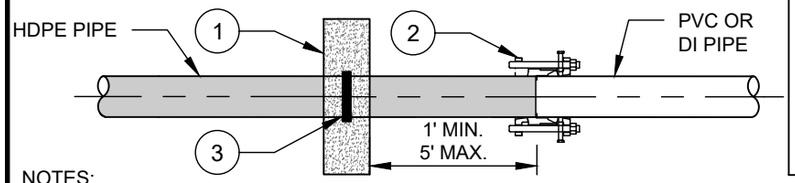
A HDPE TO DUCTILE IRON (4" TO 32" ONLY) TRANSITION ASSEMBLY



NO. DESCRIPTION:
1. WALL BLOCKING, REFER TO APPROPRIATE DETAILS.
2. IPS X DIPS RESTRAINED MJ ADAPTER WITH STEEL PIPE STIFFENER AND KIT.
3. WALL ANCHOR OR FLEX RESTRAINT, REFER TO APPROPRIATE DETAILS.

NOTES:
A. HIGH DENSITY POLYETHYLENE (HDPE) FITTINGS SHALL MEET THE REQUIREMENTS OF AWWA C906.
B. MECHANICAL FITTINGS SHALL BE SPECIFICALLY DESIGNED FOR USE WITH HDPE PIPE.
C. INSTALL STAINLESS STEEL INTERNAL STIFFENER IN THE END OF THE HDPE PIPE WHEN HDPE PIPE IS INSERTED INTO THE BELL END OF NON-HDPE PIPE, VALVE, FITTING, OR INTO THE HUB OF A MECHANICAL COUPLING.
D. INTERNAL STIFFENER CAN BE WEDGE TYPE OR SOLID BODY. STIFFENER WILL BE RATED FOR DR AND ID OF PIPE. FOR WATER, 304 OR 316 STAINLESS STEEL IS ALLOWED. FOR WASTEWATER, 316 SS IS REQUIRED.
E. MECHANICAL JOINT ADAPTERS SHALL BE PE4710 AND CAN BE MADE TO ASTM D 3261. IF MACHINED, ADAPTERS MUST MEET THE REQUIREMENTS OF ASTM F 2206. ADAPTERS SHALL HAVE A PRESSURE RATING EQUAL TO THE PIPE.
F. FIGURE ABOVE SHOWS TRANSITION TO BELL END OF DIP. FOR TRANSITION TO PLAIN END OF DIP, SEE PVC FIGURE.
G. EXTERNAL RESTRAINT DEVICES ARE NOT ALLOWED.

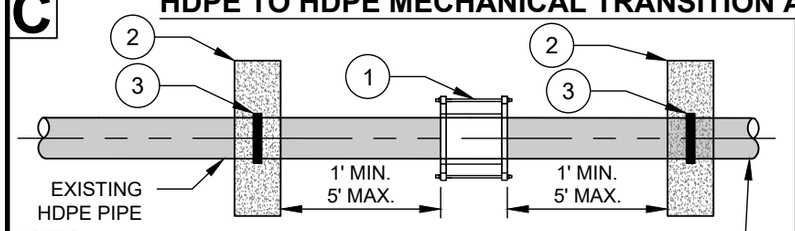
B HDPE TO PVC OR DI (4" TO 32" ONLY) TRANSITION ASSEMBLY



NO. DESCRIPTION:
1. WALL BLOCKING, REFER TO APPROPRIATE DETAILS.
2. BELL MJ ADAPTER WITH MECHANICAL RESTRAINT KIT.
3. WALL ANCHOR OR FLEX RESTRAINT, REFER TO APPROPRIATE DETAILS.

NOTES:
A. FITTINGS SHALL MEET THE REQUIREMENTS OF AWWA C906.
B. MECHANICAL FITTINGS USED SHALL BE SPECIFICALLY DESIGNED FOR USE WITH HDPE PIPE.
C. STAINLESS STEEL INTERNAL STIFFENERS SHALL BE INSTALLED IN THE END OF THE HDPE PIPE WHEN HDPE PIPE IS INSERTED INTO THE BELL END OF NON-HDPE PIPE, VALVE, FITTING, OR INTO THE HUB OF A BOLTED COUPLING
D. RESTRAINT COUPLER SLEEVE SHALL BE ASTM A513 WITH FUSION BONDED EPOXY. LOW ALLOY STEEL BOLTS CONFORM TO AWWA C111.4.
E. WHEN PVC BELL END IS ENCOUNTERED, FIELD CUT PVC TO FORM PLAIN END PER MANUFACTURER'S INSTRUCTIONS. WHEN DI BELL END IS ENCOUNTERED, USE DETAIL A ON THIS SHEET.

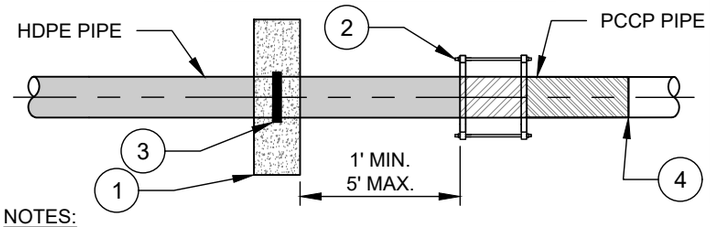
C HDPE TO HDPE MECHANICAL TRANSITION ASSEMBLY



NO. DESCRIPTION:
1. MECHANICAL HDPE COUPLING.
2. WALL BLOCKING, REFER TO APPROPRIATE DETAILS.
3. WALL ANCHOR OR FLEX RESTRAINT, REFER TO APPROPRIATE DETAIL.

NOTES:
A. ONLY ALLOWED WHEN BUTT FUSION IS NOT POSSIBLE.
B. FITTINGS SHALL MEET THE REQUIREMENTS OF AWWA C906.
C. MECHANICAL FITTINGS SHALL BE SPECIFICALLY DESIGNED FOR USE WITH HDPE PIPE.
D. INTERNAL STIFFENER CAN BE WEDGE TYPE OR SOLID BODY. STIFFENER WILL BE RATED FOR DR AND ID OF PIPE. FOR WATER, 304 OR 316 STAINLESS STEEL IS ALLOWED. FOR WASTEWATER 316 SS IS REQUIRED.

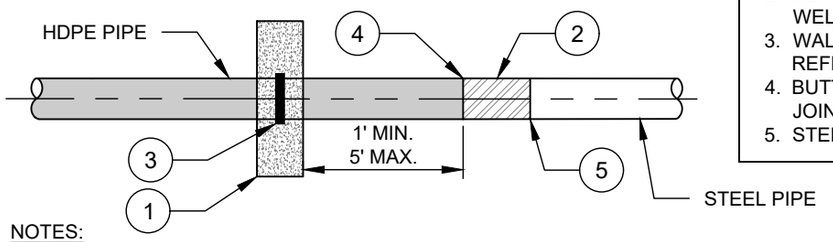
D HDPE TO PCCP (16" TO 32" ONLY) TRANSITION ASSEMBLY



NO. DESCRIPTION:
1. WALL BLOCKING, REFER TO APPROPRIATE DETAILS.
2. RESTRAINT COUPLER WITH STEEL PIPE STIFFENER.
3. WALL ANCHOR OR FLEX RESTRAINT, REFER TO APPROPRIATE DETAIL.
4. PCCP DEEP JOINT ADAPTER. INSTALL AT EXISTING JOINT. FIELD WELD PER MANUFACTURERS INSTRUCTIONS, IF PCCP IS RESTRAINED JOINT.

NOTES:
A. FITTINGS SHALL MEET THE REQUIREMENTS OF AWWA C906.
B. MECHANICAL FITTINGS SHALL BE SPECIFICALLY DESIGNED FOR USE WITH HDPE PIPE.
C. STAINLESS STEEL INTERNAL STIFFENERS SHALL BE INSTALLED IN THE END OF THE HDPE PIPE WHEN HDPE PIPE IS INSERTED INTO THE BELL END OF NON-HDPE PIPE, VALVE, FITTING, OR INTO THE HUB OF A BOLTED COUPLING.
D. INTERNAL STIFFENER CAN BE WEDGE TYPE OR SOLID BODY. STIFFENER WILL BE RATED FOR DR AND ID OF PIPE. FOR WATER, 304 OR 316 STAINLESS STEEL IS ALLOWED. FOR WASTEWATER 316 SS IS REQUIRED.
E. RESTRAINT COUPLER SLEEVE SHALL BE ASTM A513 WITH FUSION BONDED EPOXY. LOW ALLOY STEEL BOLTS CONFORM TO AWWA C111.4.

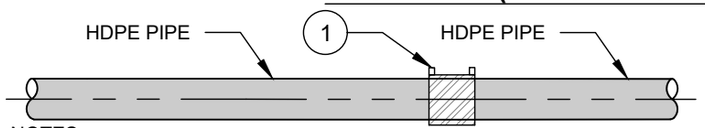
E HDPE TO STEEL (4" TO 32" ONLY) TRANSITION ASSEMBLY



NO. DESCRIPTION:
1. THRUST BLOCK, REFER TO APPROPRIATE DETAILS.
2. HDPE PLAIN END X STEEL PLAIN END WELD-ON TRANSITION FOR WATER.
3. WALL ANCHOR OR FLEX RESTRAINT, REFER TO APPROPRIATE DETAIL.
4. BUTT FUSION OR ELECTROFUSION JOINT.
5. STEEL WELD.

NOTES:
A. FITTINGS SHALL MEET THE REQUIREMENTS OF AWWA C906.
B. TRANSITION SHALL BE MANUFACTURED TO ASTM D2513 CATEGORY 1.
C. COAT INTERIOR AND EXTERIOR OF WELD PER MANUFACTURER'S INSTRUCTIONS.

F HDPE TO HDPE ELECTROFUSION TRANSITION ASSEMBLY (4" TO 24" ONLY)



NO. DESCRIPTION:
1. ELECTROFUSION COUPLING.

NOTES:
A. ONLY ALLOWED WHEN BUTT FUSION IS NOT POSSIBLE.
B. FITTINGS SHALL MEET THE REQUIREMENTS OF AWWA C906.
C. PROVIDE ELECTROFUSION RECORD TO CLTW INSPECTOR WITHIN ONE HOUR OF FUSION PER STANDARD SPECIFICATION.

NOTES TO DESIGNER
A. CLTW PREFERS JOINING HDPE USING BUTT FUSION. IF BUTT FUSION IS NOT POSSIBLE THEN ELECTROFUSION FITTINGS ARE ALLOWED. IF ELECTROFUSION FITTINGS ARE NOT POSSIBLE, THEN MECHANICAL FITTINGS ARE ALLOWED. CLTW DOES NOT ALLOW BURIED FLANGED JOINTS.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

TRANSITION FROM HDPE TO OTHER MATERIAL (4-INCH TO 32-INCH)

NO SCALE

VERSION 1.0

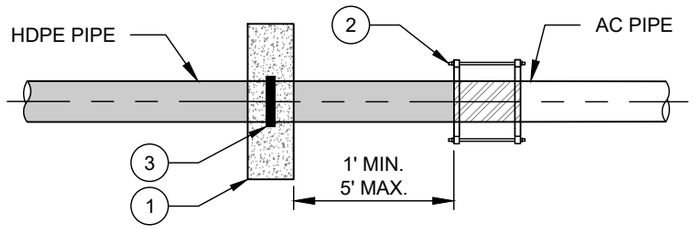
DATE 04/2024

DETAIL 10.11.1

NOTES TO DESIGNER

A. THIS DETAIL APPLIES ONLY TO 4" THROUGH 12" PIPE TRANSITIONS. LARGER DIAMETER TRANSITIONS REQUIRE SPECIFIC DESIGN AND APPROVAL.
B. CLTW PREFERS JOINING HDPE USING BUTT FUSION JOINING. IF BUTT FUSION IS NOT POSSIBLE THEN ELECTROFUSION FITTNGS ARE ALLOWED. IF ELECTROFUSION FITTINGS ARE NOT POSSIBLE, THEN MECHANICAL FITTINGS ARE ALLOWED. CLTW DOES NOT ALLOW BURIED FLANGED JOINTS.

HDPE TO ASBESTOS CEMENT PIPE (4" TO 12" ONLY) TRANSITION ASSEMBLY



NO. DESCRIPTION:

1. WALL BLOCKING, REFER TO APPROPRIATE STANDARD DETAIL.
2. RESTRAINED MECHANICAL COUPLING OR REDUCING MECHANICAL COUPLING. STEEL PIPE STIFFENER REQUIRED ON HDPE.
3. WALL ANCHOR OR FLEX RESTRAINT, REFER TO APPROPRIATE STANDARD DETAIL.

TRANSITION NOTES:

A. FITTINGS SHALL MEET THE REQUIREMENTS OF AWWA C906.
B. HIGH DENSITY POLYETHYLENE (HDPE) FITTINGS SHALL BE MOLDED OR FABRICATED BY PIPE MANUFACTURER.
C. MECHANICAL FITTINGS SHALL BE SPECIFICALLY DESIGNED FOR USE WITH HDPE PIPE.
D. STAINLESS STEEL INTERNAL STIFFENERS SHALL BE INSTALLED IN THE END OF THE HDPE PIPE WHEN HDPE PIPE IS INSERTED INTO THE BELL END OF NON-HDPE PIPE, VALVE, FITTING, OR INTO THE HUB OF A BOLTED COUPLING. INTERNAL STIFFENER CAN BE WEDGE TYPE OR SOLID BODY. STIFFENER WILL BE RATED FOR DR AND ID OF PIPE. FOR WATER, 304 OR 316 STAINLESS STEEL IS ALLOWED. FOR WASTEWATER, 316 IS REQUIRED.
E. MECHANICAL JOINT ADAPTERS SHALL BE PE4710 AND CAN BE MADE TO ASTM D3261. IF MACHINED, ADAPTERS MUST MEET THE REQUIREMENTS OF ASTM F2206. ADAPTERS SHALL HAVE A PRESSURE RATING EQUAL TO THE PIPE.
F. WHEN BELL END IS ENCOUNTERED, FIELD CUT PIPE TO FORM A PLAIN END.

ASBESTOS NOTES:

A. ASBESTOS CEMENT (AC) PIPE, ALSO KNOWN AS TRANSITE PIPE, IS KNOWN TO CONTAIN ASBESTOS CONTAINING MATERIAL (ACM). SPECIAL WASTE MANAGEMENT PROCEDURES AND HEALTH AND SAFETY REQUIREMENTS WILL BE APPLICABLE WHEN REMOVAL AND/OR DISTURBANCE OF THIS PIPE OCCURS.
B. WRITTEN NOTIFICATION TO THE NORTH CAROLINA DEPARTMENT OF HEALTH AND HUMAN SERVICES OR THE DEPARTMENT OF ENVIRONMENTAL PROTECTION OF MECKLENBURG COUNTY 10 DAYS PRIOR COMMENCING WITH THE REMOVAL OF AC PIPE IS REQUIRED. AT EACH LOCATION SHOWN IN THE PLANS AND/OR IDENTIFIED BY THE CONTRACTOR TO INVOLVE AC PIPE, THE CONTRACTOR WILL BE REQUIRED TO REMOVE THE NECESSARY AMOUNT OF AC PIPE TO MAKE THE CONNECTION WITHOUT CREATING ANY FRIABLE MATERIAL. THE CONTRACTOR SHALL REMOVE WHOLE SECTIONS OF AC PIPE AND MAKE THE TIE-IN AT THE NEAREST JOINT. CONTRACTOR WILL UNCOVER NO MORE THAN 20-FEET OF AC PIPE AT ANY TIME. CUTTING OF AC PIPE SHALL BE MINIMIZED. THE CONTRACTOR SHALL REMOVE ANY CUT AC PIPE AND STORE IT IN A SECURE, ENGINEER APPROVED LOCATION FOR EVENTUAL DISPOSAL BY CONTRACTOR. PRIOR TO PERFORMING THIS WORK, THE CONTRACTOR SHALL NOTIFY THE ENGINEER AND THE OWNER OF THE UTILITY OF THE WORK SCHEDULE 72 HOURS IN ADVANCE OF BEGINNING THE WORK.
C. WHEN WORKING WITH AC PIPES, CONTRACTOR WILL COMPLY WITH OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) AND NATIONAL EMISSIONS STANDARDS FOR HAZARDOUS AIR POLLUTANTS (NESHAP) REGULATIONS, INCLUDING BUT NOT LIMITED TO USE OF PERSONAL PROTECTIVE EQUIPMENT, SPECIALIZED TRAINING, ACCREDITATION, USE OF WET WORK PROCEDURES TO CUT AND REMOVE AC PIPE, AND HANDLING AND DISPOSAL OF AC PIPE AND MATERIAL INCLUDING CONTAMINATED SOIL.
D. AC PIPE WILL BE ABANDONED BY REMOVAL OR ABANDON IN PLACE BY GROUTING. ALL AC PIPE AND MATERIALS REMOVED WILL BECOME THE PROPERTY OF THE CONTRACTOR. THE CONTRACTOR WILL PROVIDE THE OWNER WITH DISPOSAL RECEIPTS SHOWING PROPER DISPOSAL AT AN AUTHORIZED FACILITY.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

TRANSITION FROM HDPE TO AC PIPE (4-INCH TO 12-INCH)

NO SCALE

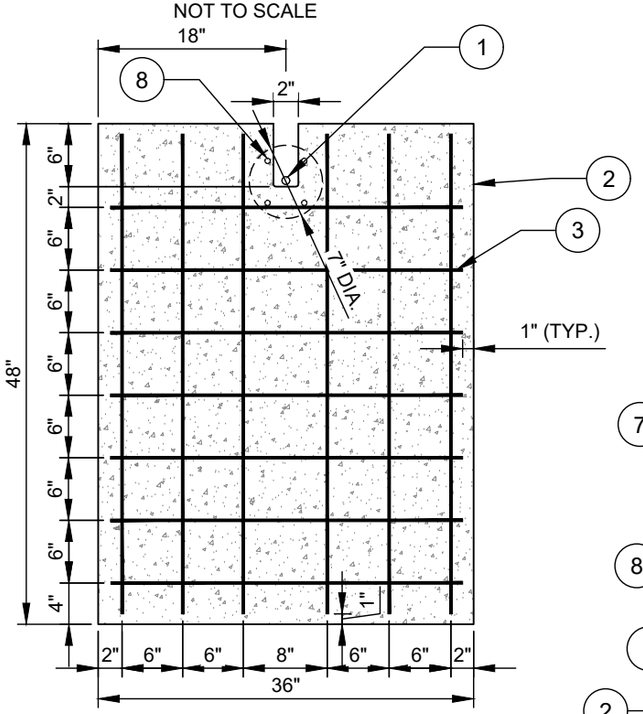
VERSION 1.0

DATE 04/2024

DETAIL 10.11.2

CONCRETE PAD WITH NOTCH

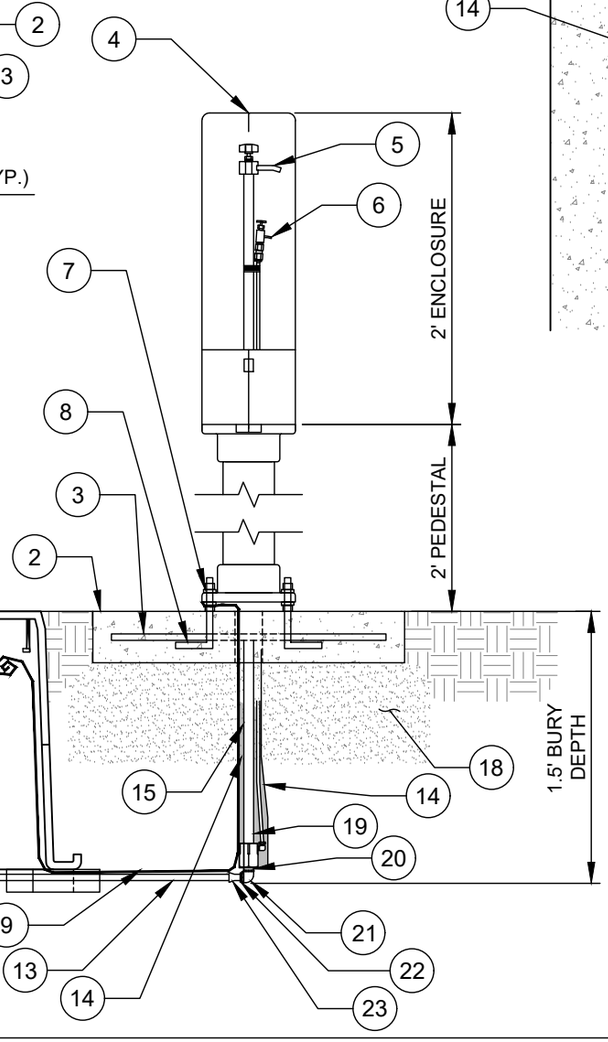
NOT TO SCALE



#4 REBARS TO TERMINATE 1" FROM EDGE OF PAD

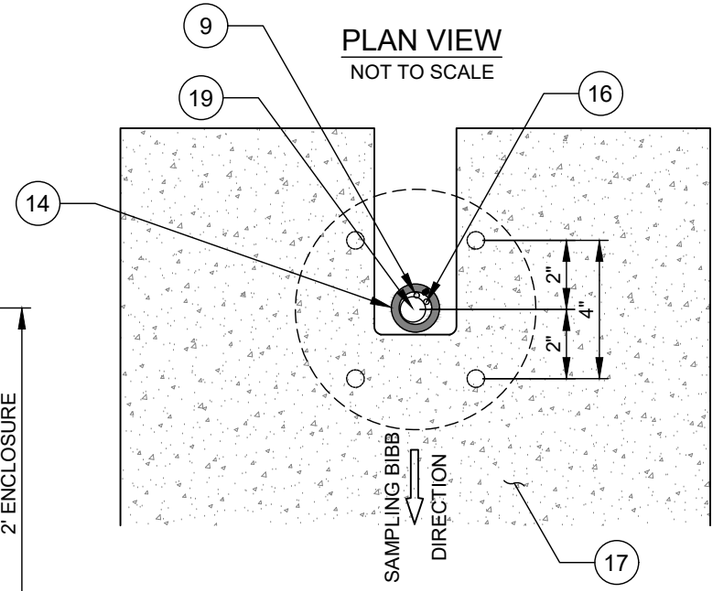
SECTION VIEW

NOT TO SCALE



PLAN VIEW

NOT TO SCALE



*TAP SHALL ONLY BE CONNECTED DIRECTLY TO A CLTW PUBLIC MAIN AND MAY NOT BE CONNECTED TO WATER SERVICE PIPING, FIRE HYDRANT FEEDER LEG, AIR RELEASE OR BLOW-OFF PIPING.

NO. DESCRIPTION:

1. 3/4" PIPE TO BE LOCATED AS CLOSE AS POSSIBLE TO INSIDE OF NOTCH. ANCHOR BOLTS TO BE LOCATED APPROPRIATELY.
2. PRECAST CONCRETE PAD (4' LONG X 3' WIDE X 4" THICK).
3. #4 REBAR, GRADE 60 (TYP.).
4. SAMPLE STATION SHALL BE TRUE TO PLUMB USING LEVELING BOLTS/NUTS.
5. SAMPLING BIBB.
6. PETCOCK.
7. STAINLESS STEEL 1/2" CLIPPED WASHER, STAINLESS STEEL 1/2" NUT, 2 EACH REQUIRED/BOLT.
8. STAINLESS STEEL ANCHOR BOLT (1/2" DIAMETER X 4" L).
9. TRACER WIRE.
10. SOLID STANDARD CONCRETE, BRICK-DIAGONAL AT CORNERS - 4 EACH (SEE IRRIGATION SERVICE DETAIL).
11. CLTW PLASTIC METER BOX AND LID PER STANDARD DETAIL.
12. SEE SHEET 2 OF 2 FOR SAMPLING STATION PLUMBING.
13. 3/4" TYPE K COPPER.
14. SELF SEALING P.E. FOAM PIPE INSULATION - FLANGE TO 90° BEND.
15. 3/4" S.S. DROP PIPE.
16. 1/4" S.S. TUBING.
17. CONCRETE.
18. 8" #57 WASHED STONE.
19. 3/4" S.S. STANDPIPE (MIPT).
20. 3/4" S.S. STANDPIPE (FIPT).
21. 3/4" SCH 80 PVC 90° BEND (FIP X FIP).
22. 3/4" X 2" SCH 80 PVC NIPPLE (MIP X MIP).
23. 3/4" BRASS STRAIGHT CONNECTOR (FIP X CTS COMPRESSION) MUELLER #H-15438N OR APPROVED EQUAL.

NOTES:

A. IN CORROSIVE SOILS, THE BURIED PIPE SHOULD BE PREPARED FOR ADDITIONAL RESISTANCE TO CORROSION. SPRAY ALL UNDERGROUND PIPING AND FITTINGS WITH BITUMINOUS SPRAY TAR, ALLOWING PROPER TIME TO DRY, AND THEN WRAPPING THE PARTS.
B. SAMPLING STATION SHALL BE 1.5' BURY, INSTALLED ON CONCRETE PAD WITH A 3/4" FIPT INLET, AND 7/16" UNTHREADED BLOW OFF AND 1/4" SAMPLING BIBB.
C. STATION SHALL BE ENCLOSED IN A LOCKABLE, NON-REMOVABLE ALUMINUM BOX WITH HINGED OPENINGS.
D. WHEN OPEN, THE STATION SHALL REQUIRE NO KEY FOR OPERATION, AND ALL WATER FLOW SHALL PASS THRU AN ALL STAINLESS STEEL WATERWAY.
E. ALL WORKING PARTS SHALL BE OF STAINLESS STEEL AND SERVICEABLE FROM ABOVE GROUND WITH NO DIGGING OR REPLACEMENT NEEDED.
F. A STAINLESS STEEL PETCOCK VALVE WILL BE LOCATED BELOW THE SAMPLING BIBB TO ALLOW PUMPING OF ANY WATER REMAINING INSIDE THE STATION TO ENSURE NON-FREEZING.
G. CONCRETE PAD SHALL DRAIN AWAY FROM SAMPLE STATION AND SHALL BE FLUSH WITH FINISHED GRADE #57 STONE BASE TO A DEPTH OF 8" UNDER PAD.
H. THE STATION SHALL BE MODEL #88-SS WITH 2' STEEL PEDESTAL AND EPOXY COATING WITHIN BOX FOR CORROSION PROTECTION AS MANUFACTURED BY THE KUPFERLE FOUNDRY, OR APPROVED EQUAL.
I. ANCHOR BOLTS - 304 STAINLESS STEEL, WITH NUTS AND CLIPPED WASHERS - 316 STAINLESS STEEL.
J. AWG #12 GAUGE SOLID COPPER TRACER WIRE-WITH 30 MILS BLUE HDPE INSULATION - TERMINATE IN METER BOX WITH 24" EXCESS WIRE (COILED), AND TERMINATE AT ANCHOR BOLT.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

WATER QUALITY SAMPLING STATION (1 OF 2)

NO SCALE

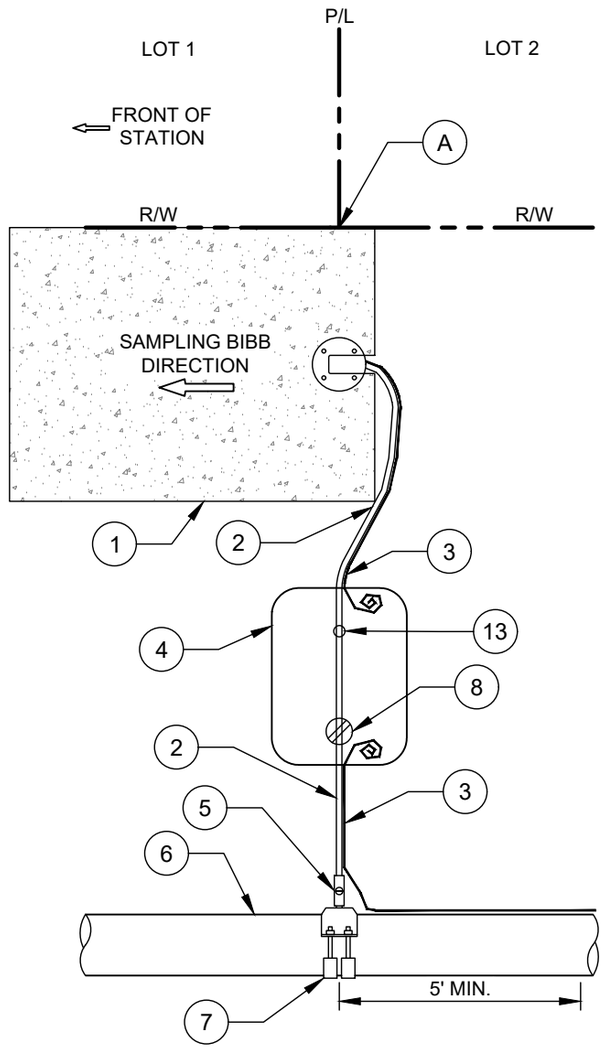
VERSION 1.0

DATE 04/2024

DETAIL 10.12.1

WATER MAIN CONNECTIONS

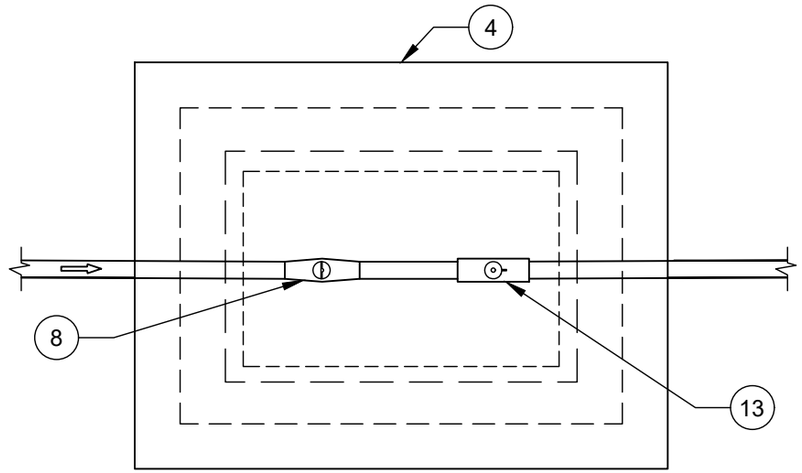
PLAN VIEW
NOT TO SCALE



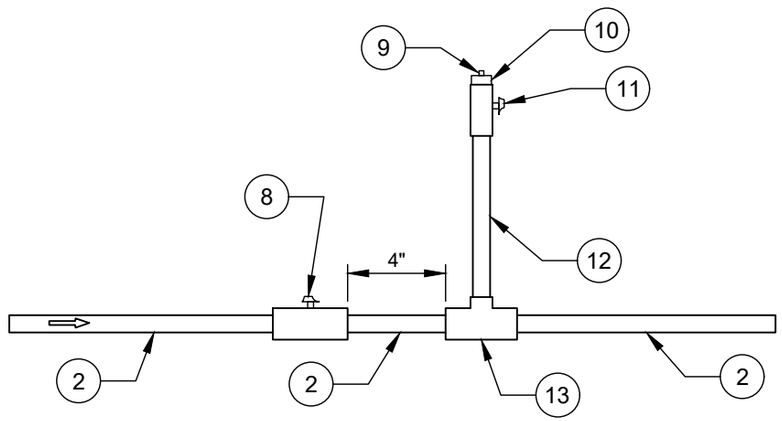
PRIMARY

*TAP SHALL ONLY BE CONNECTED DIRECTLY TO A CLTW PUBLIC MAIN AND MAY NOT BE CONNECTED TO WATER SERVICE PIPING, FIRE HYDRANT FEEDER LEG, AIR RELEASE OR BLOW-OFF PIPING.

SAMPLING STATION PLUMBING
NOT TO SCALE



PLAN VIEW
NOT TO SCALE



ELEVATION VIEW
NOT TO SCALE

NO.	DESCRIPTION:
1.	PRECAST CONCRETE PAD (4' LONG X 3' WIDE X 4" THICK) RESTING ON 8" WASHED STONE #57.
2.	3/4" COPPER TUBING, TYPE K.
3.	TRACER WIRE.
4.	CLTW PLASTIC METER BOX AND LID PER STANDARD DETAIL.
5.	3/4" BALL VALVE CORPORATION STOP.
6.	PUBLIC WATER MAIN.
7.	SERVICE SADDLE.
8.	3/4" BALL VALVE WITH LOCK WING (CTS COMP. X CTS COMP.) MUELLER #B-25146N OR APPROVED EQUAL. APPROX. 4" LENGTH.
9.	SOLID RED BRASS PLUG 1/4" MNPT GRAINGER 6RCZ4 OR APPROVED EQUAL.
10.	BRASS HEX BUSHING 3/4" X 1/4" FNPT GRAINGER 22UL39 OR APPROVED EQUAL.
11.	3/4" FIPT BALL VALVE WITH LOCK WING MUELLER B20200N OR APPROVED EQUAL LOCK VALVE IN CLOSED POSITION (SERIAL NUMBERED STUD LOCK - FURNISHED BY CLTW).
12.	3/4" x 4" BRASS NIPPLE (MIP X MIP).
13.	3/4" SERVICE TEE (CTS COMP. X CTS COMP. X FIPT) MUELLER #H-15391N, FORD #T444-333NL, OR MCDONALD #74764Q).

NOTES:

A. SAMPLING STATION TO BE LOCATED ON PROPERTY LINE BETWEEN TWO LOTS.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

WATER QUALITY SAMPLING STATION (2 OF 2)

NO SCALE

VERSION 1.0

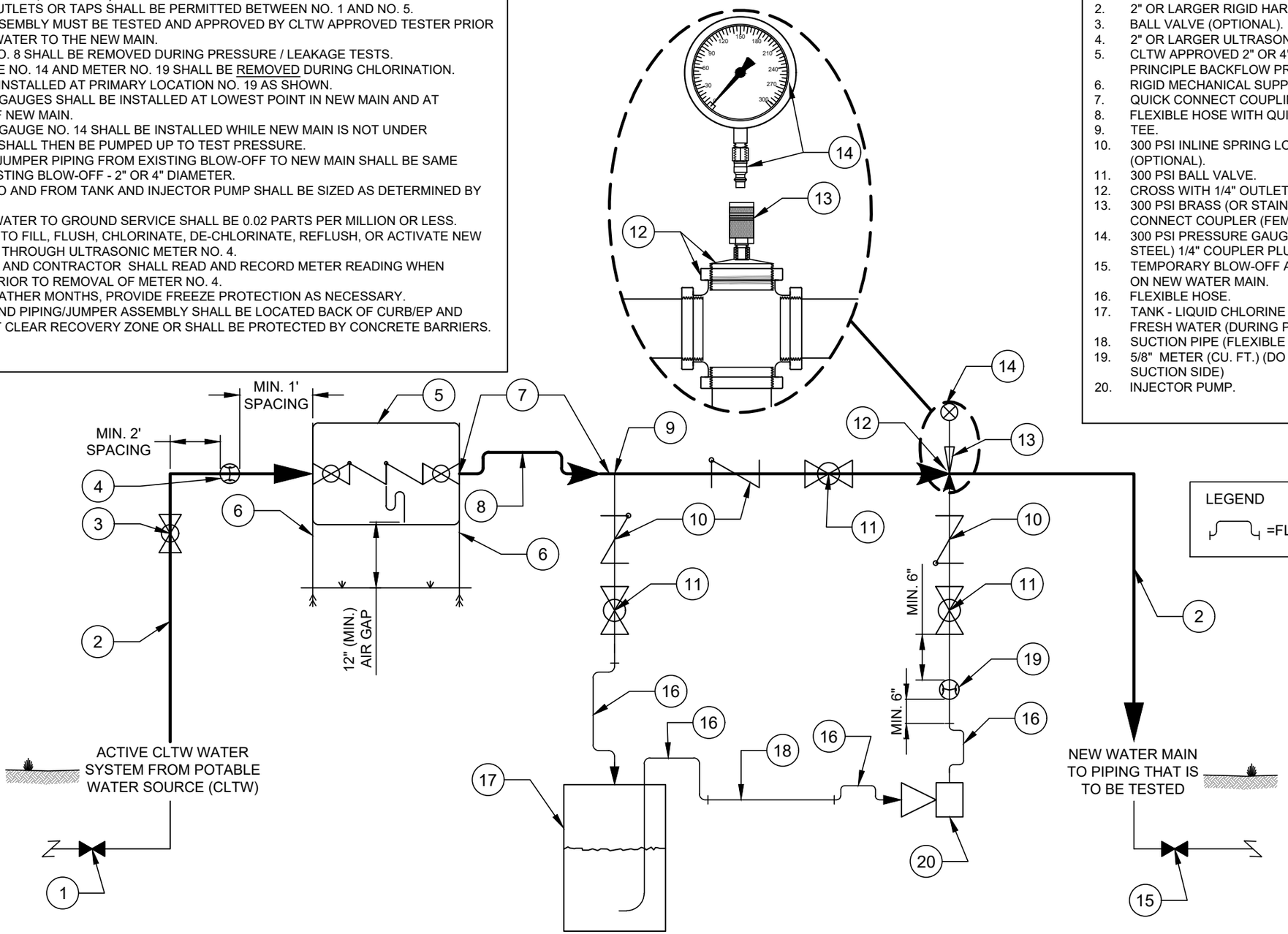
DATE 04/2024

DETAIL 10.12.2

NOTES:

A. ANY USE OF WATER REQUIRES THIS FULL ASSEMBLY (STATE STATUTE #143-355.4)(CHARLOTTE CITY CODE CHAPTER 23, ARTICLE 5).
B. NO BRANCHES, OUTLETS OR TAPS SHALL BE PERMITTED BETWEEN NO. 1 AND NO. 5.
C. RP BACKFLOW ASSEMBLY MUST BE TESTED AND APPROVED BY CLTW APPROVED TESTER PRIOR TO MOVING ANY WATER TO THE NEW MAIN.
D. FLEXIBLE HOSE NO. 8 SHALL BE REMOVED DURING PRESSURE / LEAKAGE TESTS.
E. PRESSURE GAUGE NO. 14 AND METER NO. 19 SHALL BE REMOVED DURING CHLORINATION.
F. METER SHALL BE INSTALLED AT PRIMARY LOCATION NO. 19 AS SHOWN.
G. CLTW PRESSURE GAUGES SHALL BE INSTALLED AT LOWEST POINT IN NEW MAIN AND AT OPPOSITE END OF NEW MAIN.
H. CLTW PRESSURE GAUGE NO. 14 SHALL BE INSTALLED WHILE NEW MAIN IS NOT UNDER PRESSURE. MAIN SHALL THEN BE PUMPED UP TO TEST PRESSURE.
I. ALL TEMPORARY JUMPER PIPING FROM EXISTING BLOW-OFF TO NEW MAIN SHALL BE SAME DIAMETER AS EXISTING BLOW-OFF - 2" OR 4" DIAMETER.
J. BRANCH PIPING TO AND FROM TANK AND INJECTOR PUMP SHALL BE SIZED AS DETERMINED BY CONTRACTOR.
K. ALL DISCHARGE WATER TO GROUND SERVICE SHALL BE 0.02 PARTS PER MILLION OR LESS.
L. ALL WATER USED TO FILL, FLUSH, CHLORINATE, DE-CHLORINATE, REFLUSH, OR ACTIVATE NEW MAIN SHALL PASS THROUGH ULTRASONIC METER NO. 4.
M. CLTW INSPECTOR AND CONTRACTOR SHALL READ AND RECORD METER READING WHEN INSTALLED AND PRIOR TO REMOVAL OF METER NO. 4.
N. DURING COLD WEATHER MONTHS, PROVIDE FREEZE PROTECTION AS NECESSARY.
O. ALL ABOVE GROUND PIPING/JUMPER ASSEMBLY SHALL BE LOCATED BACK OF CURB/EP AND OUTSIDE THE DOT CLEAR RECOVERY ZONE OR SHALL BE PROTECTED BY CONCRETE BARRIERS.

NO.	DESCRIPTION:
1.	EXISTING BLOW-OFF ASSEMBLY AND CONTROL VALVE ON EXISTING WATER MAIN.
2.	2" OR LARGER RIGID HARD PIPING.
3.	BALL VALVE (OPTIONAL).
4.	2" OR LARGER ULTRASONIC METER - (CU. FT.).
5.	CLTW APPROVED 2" OR 4" REDUCED PRESSURE PRINCIPLE BACKFLOW PREVENTION ASSEMBLY.
6.	RIGID MECHANICAL SUPPORT.
7.	QUICK CONNECT COUPLING.
8.	FLEXIBLE HOSE WITH QUICK CONNECT COUPLINGS.
9.	TEE.
10.	300 PSI INLINE SPRING LOADED CHECK VALVE (OPTIONAL).
11.	300 PSI BALL VALVE.
12.	CROSS WITH 1/4" OUTLET.
13.	300 PSI BRASS (OR STAINLESS STEEL) 1/4" QUICK CONNECT COUPLER (FEMALE).
14.	300 PSI PRESSURE GAUGE WITH BRASS (OR STAINLESS STEEL) 1/4" COUPLER PLUG (MALE).
15.	TEMPORARY BLOW-OFF ASSEMBLY AND CONTROL VALVE ON NEW WATER MAIN.
16.	FLEXIBLE HOSE.
17.	TANK - LIQUID CHLORINE (DURING CHLORINATION) OR FRESH WATER (DURING PRESSURE / LEAKAGE TESTS).
18.	SUCTION PIPE (FLEXIBLE HOSE OR RIGID PIPE).
19.	5/8" METER (CU. FT.) (DO NOT INSTALL ON THE PUMP SUCTION SIDE)
20.	INJECTOR PUMP.



CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

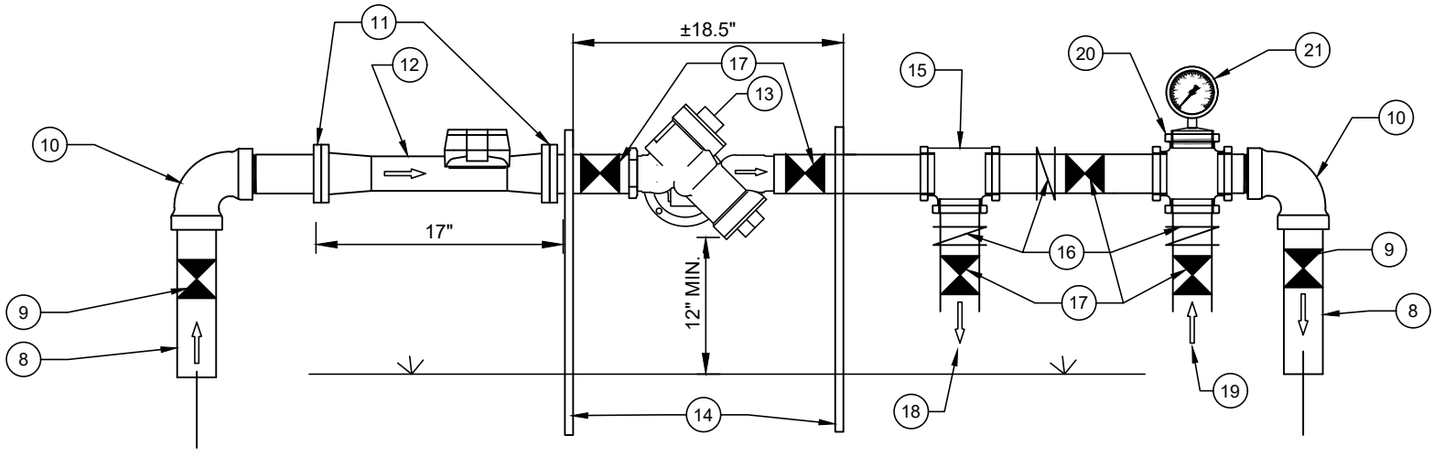
NEW WATER MAIN JUMPER SCHEMATIC FOR 2" OR LARGER MAINS

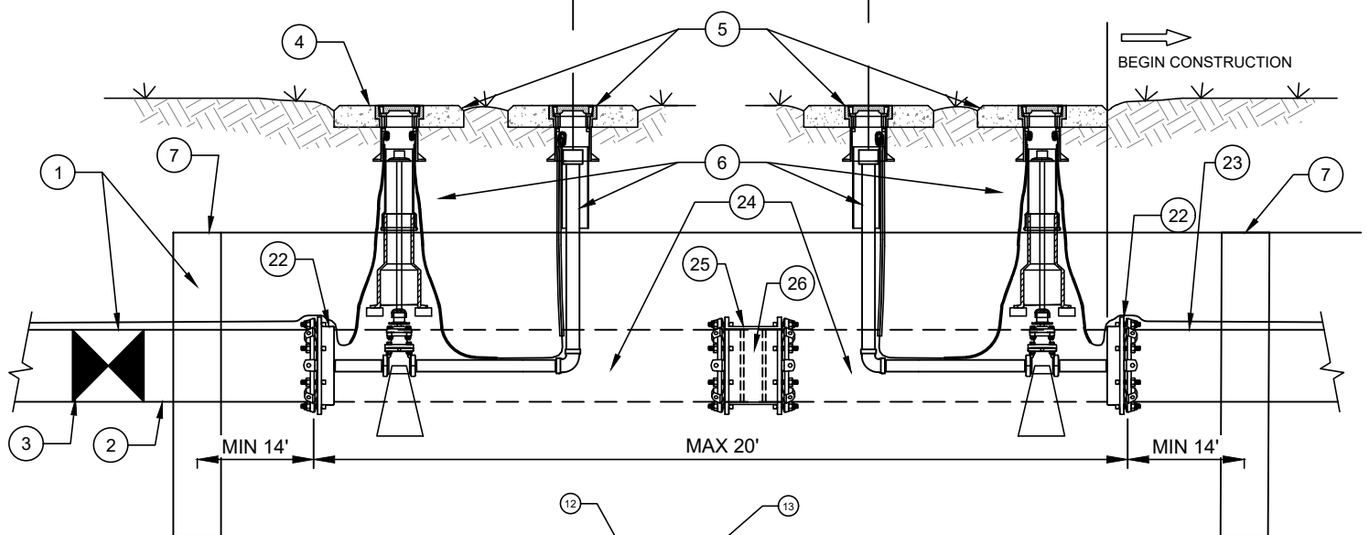
NO SCALE

VERSION 3.0

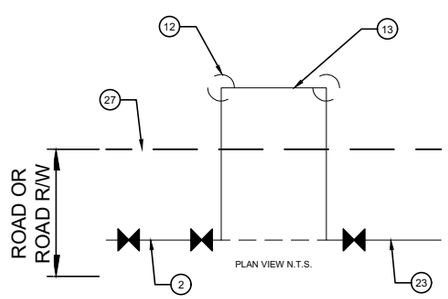
DATE 01/2026

DETAIL 10.13.1





TYPICAL LOCATION SCHEMATIC FOR MAINS & ROADWAYS



NO. DESCRIPTION:

1. VERIFY THRUST RESTRAINT AND IMPROVE AS NECESSARY
2. EXISTING WATER MAIN
3. EXISTING MAIN LINE VALVE
4. GATE VALVE AND VALVE BOX AND BLOW OFF ASSEMBLY REQUIRED IF NOT PRESENT ON EXISTING MAIN
5. VALVE BOX ASSEMBLIES
6. 2" SCH 40 304 S.S. OR RED BRASS BLOW OFF ASSEMBLIES PER STANDARD DETAIL
7. CONCRETE WALL THRUST BLOCKING PER STD DET.
8. 2" SCH 40 304 S.S. OR RED BRASS PIPING
9. 2" 304 S.S. OR BRASS BALL VALVE - 300 PSI (OPTIONAL)
10. 2" 304 S.S. OR BRASS 90 DEG BEND - FNPT
11. 2" BRASS ADAPTOR - MNPT X FLG.
12. 2" ULTRASONIC METER - FLG X FLG. W/ AMR
13. 2" BRASS CHARLOTTE WATER (CLTW) APPROVED REDUCED PRESSURE PRINCIPLE BACKFLOW PREVENTION ASSEMBLY
14. RIGID MECHANICAL PIPE SUPPORTS
15. 2" 304 S.S. OR BRASS TEE
16. 300 PSI INLINE SPRING LOADED CHECK VALVE
17. 300 PSI 304 S.S. OR BRASS BALL VALVE
18. POTABLE WATER SOURCE
19. INJECTION POINT - CHLORINE OR POTABLE WATER
20. 304 S.S. OR RED BRASS CROSS W/ PLUG W/ 1/4" FNPT OUTLET
21. 300 PSI PRESSURE GAUGE
22. RESTRAINED MECHANICAL JOINT (MJ) CAP W/ 2" FNPT OUTLET
23. PROPOSED 12" AND SMALLER DUCTILE IRON (DI) PIPE
24. FINAL CONNECTION CLOSURE DUCTILE IRON RESTRAINED JOINT (RJ) PIPES
25. CONNECT W/ RJ DUCTILE IRON LONG PATTERN SOLID SLEEVE
26. DI PIPE SPACER AS REQUIRED - MAX OPEN GAP BETWEEN PIPE ENDS IS 0.25 INCHES
27. PROPERTY LINE OR ROAD RIGHT OF WAY

NOTES:

A. THIS IS THE ONLY CONNECTION ALLOWED BETWEEN EXISTING WATER SYSTEM AND PROPOSED MAIN UNTIL ACTIVATION AND FINAL CONNECTIONS ARE APPROVED BY CLTW.
B. VALVES ON THE EXISTING WATER SYSTEM SHALL ONLY BE OPERATED BY CLTW EMPLOYEES
C. REFER TO APPROPRIATE STD. DETAIL WITH NEW WATER MAIN JUMPER SCHEMATIC FOR MORE INFORMATION ON INSTALLING AND OPERATION OF THE JUMPER.
D. WATER METER #12 SHALL BE REMOVED DURING PRESSURE/LEAKAGE TESTING
E. PRESSURE GAUGE #21 SHALL BE REMOVED DURING CHLORINATION
F. PRESSURE GAUGE #21 SHALL BE INSTALLED WHILE THE NEW MAIN IS NOT UNDER PRESSURE. NEW MAIN SHALL THEN BE PUMPED UP TO TEST PRESSURE
G. #18 AND #19 PIPING SHALL BE SIZED AS DETERMINED BY THE CONTRACTOR
H. ALL WATER USED TO FILL, FLUSH, CHLORINATE, DE-CHLORINATE, REFLUSH, OR ACTIVATE THE NEW MAIN SHALL PASS THROUGH THE ULTRASONIC METER #12
I. CONTRACTOR AND CLTW INSPECTOR SHALL READ AND RECORD THE METER READING WHEN INSTALLED AND PRIOR TO REMOVAL OF METER #12. READINGS SHALL ALSO BE RECORDED AT EACH PHASE OF WATER USE - FILL, FLUSH, CHLORINATE, ETC.
J. DURING COLD WEATHER MONTHS, PROVIDE FREEZE PROTECTION AS NECESSARY
K. ALL ABOVE GROUND PIPING/JUMPER ASSEMBLY SHALL BE LOCATED BACK OF CURB OR EDGE OF PAVEMENT AND OUTSIDE OF DOT CLEAR RECOVERY ZONE OR SHALL BE PROTECTED BY CONCRETE BARRIERS.
L. ANY USE OF WATER REQUIRES THIS FULL ASSEMBLY (STATE STATUTE #143-355.40)(CHARLOTTE CITY CODE CHAPTER 23, ARTICLE 5).
M. FLEXIBLE HOSE-APPROVED FOR USE WITH POTABLE WATER - MAY BE USED AS DETAILED IN STD DET. #10.13.1
N. AFTER EACH INSTALLATION OF THE BACKFLOW ASSEMBLY, THE CONTRACTOR SHALL HAVE A CLTW APPROVED TESTER COMPLETE THE REQUIRED BACKFLOW ASSEMBLY TEST AND PROVIDE A CERTIFICATION LETTER AND TEST REPORT TO THE CLTW INSPECTOR.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

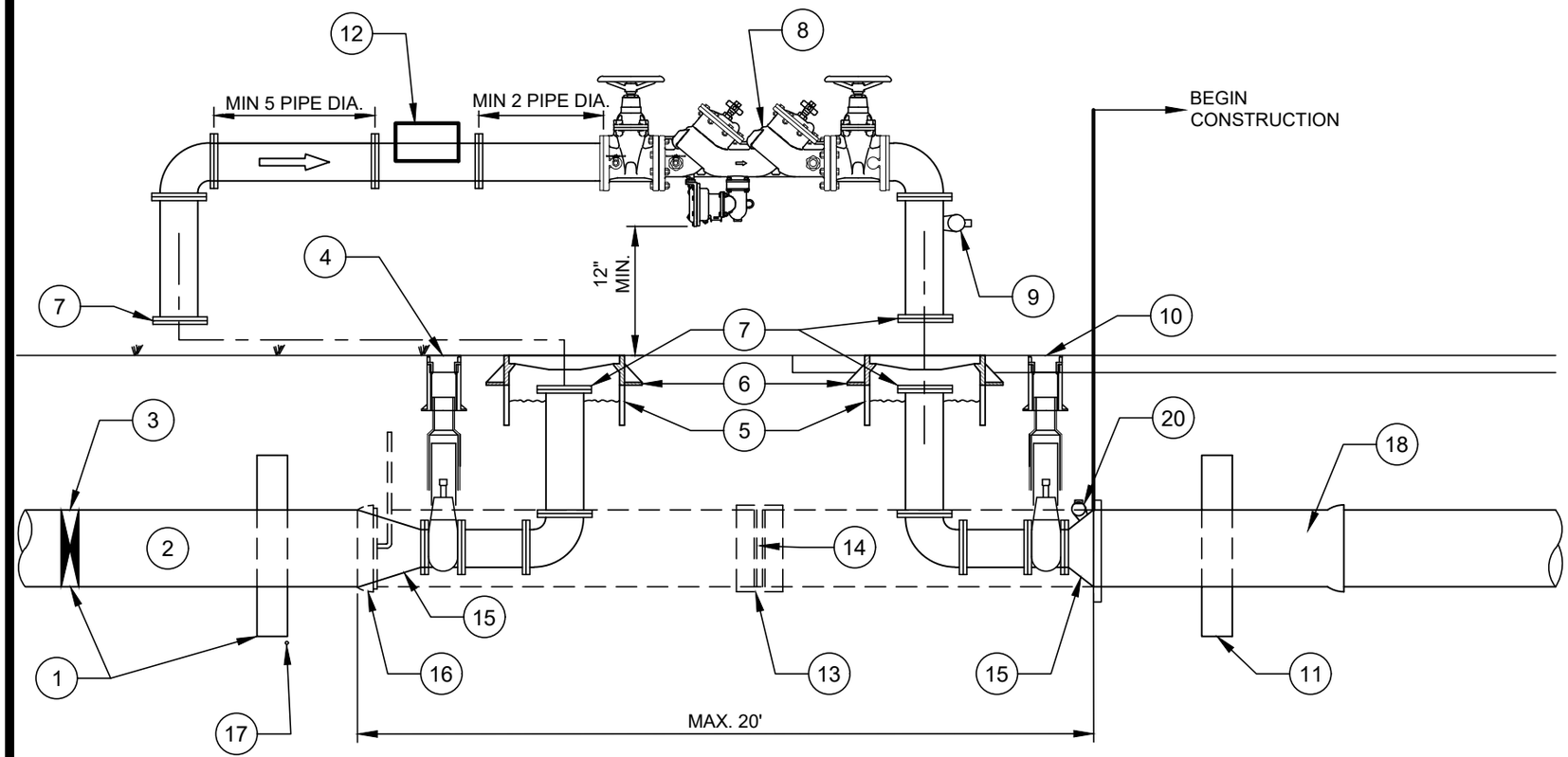
JUMPER CONNECTION DETAIL FOR 12-INCH AND SMALLER WATER MAINS

NO SCALE

VERSION 3.0

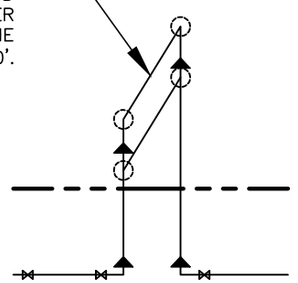
DATE 01/2026

DETAIL 10.13.2

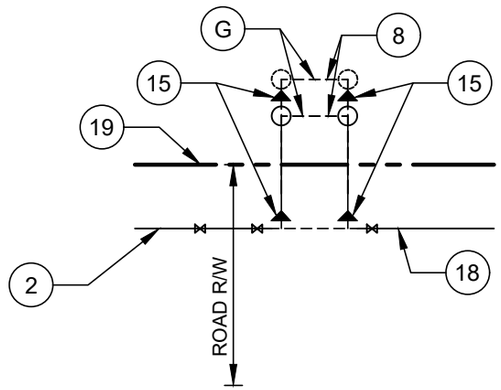


SECTION VIEW

THE VERTICAL 90s ALLOW ODD ALIGNMENT OF THE JUMPER ASSEMBLIES TO ACCOMMODATE THE MAX CONNECTIOM LENGTH OF 20'.



PLAN VIEW



TYPICAL LOCATION SCHEMATIC FOR LARGER MAINS

PLAN VIEW N.T.S.

NO.	DESCRIPTION:
1.	VERIFY THRUST RESTRAINT AND IMPROVE AS NECESSARY.
2.	EXISTING WATER MAIN.
3.	EXISTING MAINLINE VALVE.
4.	GATE VALVE AND VALVE BOX REQUIRED IF EXISTING STUB OUT HAS BEEN ACTIVATED.
5.	24" PVC PIPE OR PRECAST CONC. GRADE RINGS.
6.	FRAME AND COVER.
7.	WATERTIGHT CAPS REQUIRED WHEN RP IS NOT IN PLACE.
8.	4" TO 10" (VARIES WITH PIPE SIZE) REDUCED PRESSURE (RP) PRINCIPLE BACK FLOW PREVENTER(S), ABOVE GROUND.
9.	CORPORATION STOP - POTABLE WATER SOURCE
10.	GATE VALVE AND VALVE BOX REQUIRED.
11.	PROP. CONC. BLOCKING PER STD. DETAIL.
12.	4" TO 10" ULTRASONIC WATER METER(S)
13.	CLOSE WITH RJ LONG PATTERN SOLID SLEEVE.
14.	PIPE SPACERS AS REQUIRED MAX OPEN GAP IN PIPE IS 0.25 INCHES.
15.	RESTRAINED JOINT REDUCER(S)
16.	CUT EXISTING PIPE - REMOVE BELL, PLUG AND BLOW OFF.
17.	EXISTING CONC. BLOCKING ON 16" AND LARGER MAINS.
18.	PROPOSED 16" OR LARGER WATER MAIN
19.	PROPERTY LINE OR ROAD R/W.
20.	CORPORATION STOP - INJECTION POINT - CHLORINE OR WATER

NOTES:

A. THIS IS THE ONLY CONNECTION ALLOWED BETWEEN EXISTING WATER SYSTEM AND PROPOSED MAIN UNTIL ACTIVATION AND FINAL CONNECTIONS ARE APPROVED BY CLT WATER.

B. VALVES ON EXISTING WATER SYSTEM TO BE OPERATED BY CLTW EMPLOYEES ONLY.

C. ALL PIPE AND FITTINGS SHALL BE OF RESTRAINED JOINT TYPE AS DETERMINED BY THE CONTRACTOR. (PIPE SHOWN AS FLANGE FOR EASE OF DRAWING ONLY).

D. THIS DRAWING IS A SCHEMATIC FOR INTENT ONLY. PIPING AND CONFIGURATION MAY BE ALTERED BY THE CONTRACTOR, SUBJECT TO CLT WATER APPROVAL.

E. PIPE AND FITTINGS SHALL BE SAME SIZE AS REQUIRED.

F. REFER TO APPROPRIATE STANDARD DETAIL WITH NEW WATER MAIN JUMPER SCHEMATIC FOR MORE INFORMATION ON INSTALLING AN OPERATION OF THE JUMPER.

G. LARGE DIAMETER MAINS MAY REQUIRE MULTIPLE PARALLEL JUMPER/BACKFLOW ASSEMBLIES TO OBTAIN THE REQUIRED MINIMUM FLUSHING VELOCITIES. THE SEALING ENGINEER SHALL RUN HYDRAULIC CALCULATIONS TO DETERMINE THE REQUIRED SIZE AND NUMBER OF ASSEMBLIES REQUIRED FOR FLUSHING VELOCITIES.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

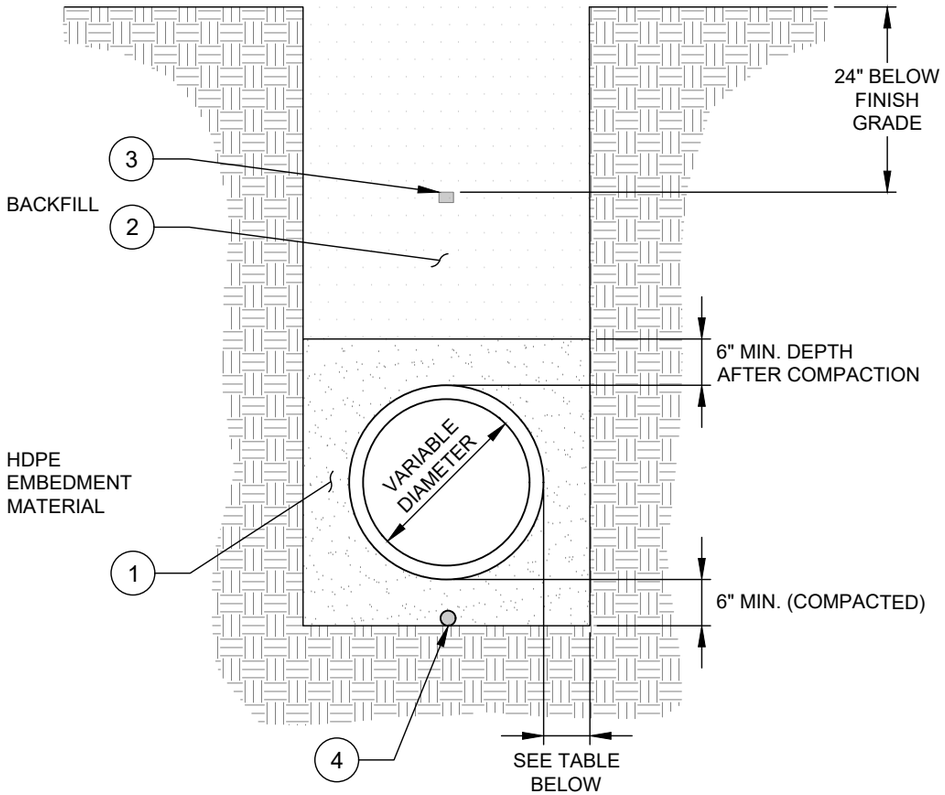
JUMPER CONNECTION DETAIL FOR 16-INCH AND LARGER WATER MAINS

NO SCALE

VERSION 2.0

DATE 01/2025

DETAIL 10.13.3



REQUIRED TRENCH WIDTH		
PIPE SIZE (INCHES)	MINIMUM TRENCH WIDTH (INCHES)	MAXIMUM TRENCH WIDTH (INCHES)
<18	PIPE OD + 12	PIPE OD + 30
18 to 23	PIPE OD + 12	PIPE OD + 36
24 to 32	PIPE OD + 24	PIPE OD + 36

MAXIMUM TRENCH WIDTH NOTES:

A. LARGER TRENCH WIDTH ALLOWED TO ACCOMMODATE BUTT FUSION EQUIPMENT AT FUSION LOCATIONS.

NO. DESCRIPTION:

1. HDPE EMBEDMENT MATERIAL – FINE AGGREGATE WASHED STONE:
   FOR ≤6" PIPE USE #78M
   FOR 8" TO 12" PIPE USE #67
   FOR ≥14" PIPE USE #57

2. BACKFILL - COMPACT BACKFILL PER ASTM D 698 AND AASHTO T-99 AS MODIFIED BY NCDOT TO 95% MAXIMUM DENSITY WITHIN A ROAD RIGHT-OF-WAY. FINAL 12" OF SUBGRADE SHALL BE COMPACTED TO 100%. 85% MAXIMUM DRY DENSITY REQUIRED OUTSIDE ROAD R/W.

3. WARNING TAPE - 6" WIDE WARNING TAPE INSTALLED DIRECTLY ABOVE HDPE EMBEDMENT MATERIAL AND 24" BELOW FINISH GRADE.

4. TRACER WIRE - CONTINUOUS AWG #12 GAUGE SOLID COPPER TRACER WIRE WITH 30 MILS THICK BLUE HDPE INSULATION AT THE BOTTOM OF THE EMBEDMENT LAYER. DO NOT ATTACH TRACER WIRE TO PIPE.

NOTES:

A. WHERE PIPE IS INSTALLED DEEPER THAN 15', INSTALL ADDITIONAL TRACER WIRE AT A DEPTH OF 4' BELOW FINISH GRADE.

B. EMBEDMENT SHOULD BE PLACED IN LIFTS, NOT EXCEEDING 6" IN THICKNESS, AND THEN TAMPED. TAMPING SHOULD BE ACCOMPLISHED WITH A MECHANICAL TAMPER.

C. A MAXIMUM OF 100' OF OPEN TRENCH WILL BE ALLOWED AT ANY TIME, UNLESS APPROVED BY THE ENGINEER.

D. PERFORM CONDUCTIVITY TEST ON THE TRACER WIRE AT FINAL INSPECTION. CONTRACTOR TO TEST ON A DAILY BASIS.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

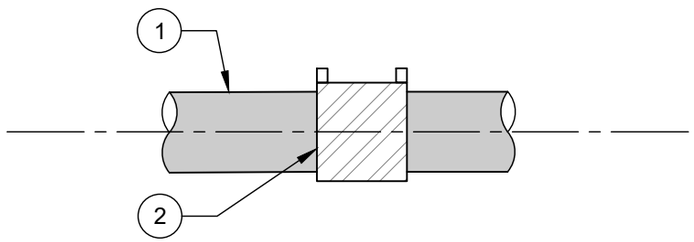
EMBEDMENT AND BACKFILL FOR HDPE PIPE

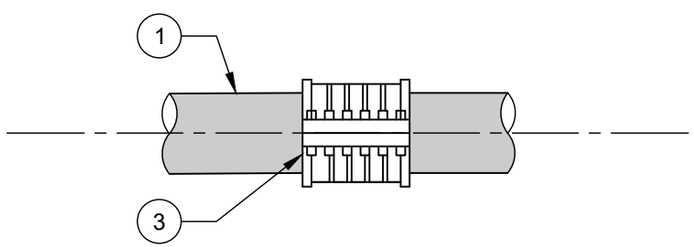
NO SCALE

VERSION
3.0

DATE
01/2026

DETAIL
10.13.4





SMALL PUNCTURE REPAIR

NO.	DESCRIPTION:
1.	EXISTING HDPE WATER MAIN.
2.	WRAP AROUND REPAIR CLAMP.
3.	SOLID RESTRAINED SLEEVE.

NOTES:

A. DETAIL NOT INTENDED FOR USE FOR NEW HDPE INSTALLATIONS.

SMALL PUNCTURE REPAIR NOTES:

a. SMALL PUNCTURE DAMAGE IS DEFINED AS ONE INCH OR SMALLER PUNCTURE IN ONE PIPE WALL.

b. PREFERRED REPAIR METHOD FOR SMALL PUNCTURE IS ELECTROFUSION PATCH. MECHANICAL COUPLING IS ALLOWED WHEN PIPE CAN NOT BE DRIED, UPON APPROVAL OF CLTW INSPECTOR.

c. BEFORE ADDING FITTING, DRILL SMALL HOLE AT EACH END OF DAMAGE TO PREVENT CRACK PROPAGATING.

d. FITTINGS SHALL MEET THE REQUIREMENTS OF AWWA C906.

e. MECHANICAL FITTINGS USED WITH HDPE PIPE SHALL BE SPECIFICALLY DESIGNED FOR USE WITH HDPE PIPE.

f. MINIMUM CLAMP LENGTH IS 12". MINIMUM CLAMP LENGTH IS 5" ON EITHER SIDE OF PUNCTURE, FOR 10" NOMINAL DIAMETER PIPE AND LARGER.

NOTES TO DESIGNER

A. REFER TO PPI TN-34 (INSTALLATION GUIDELINES FOR ELECTROFUSION COUPLINGS 14” AND LARGER).

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

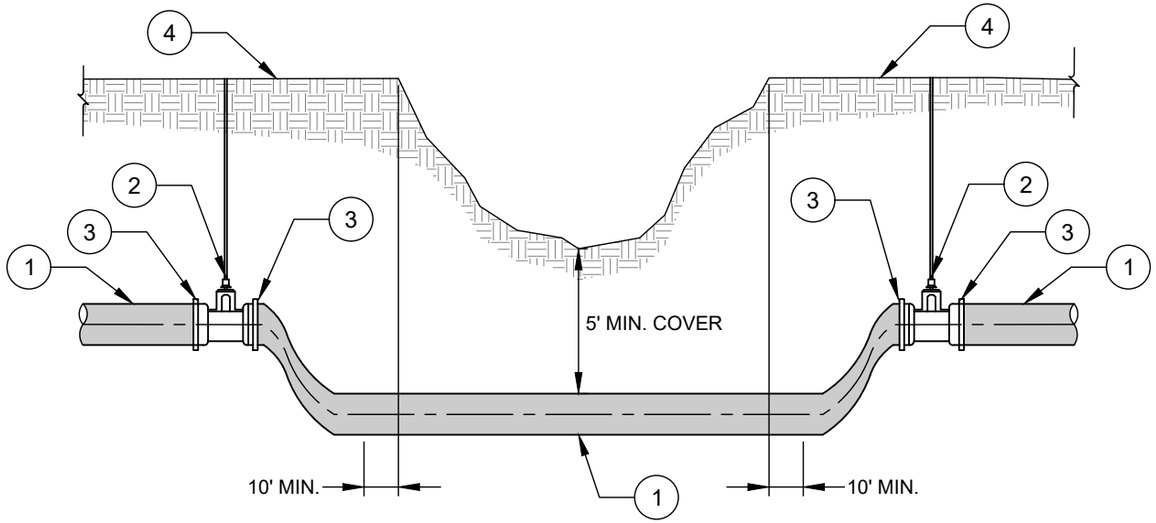
EXISTING HDPE PIPE REPAIR (MAINTENANCE REPAIRS ONLY)

NO SCALE

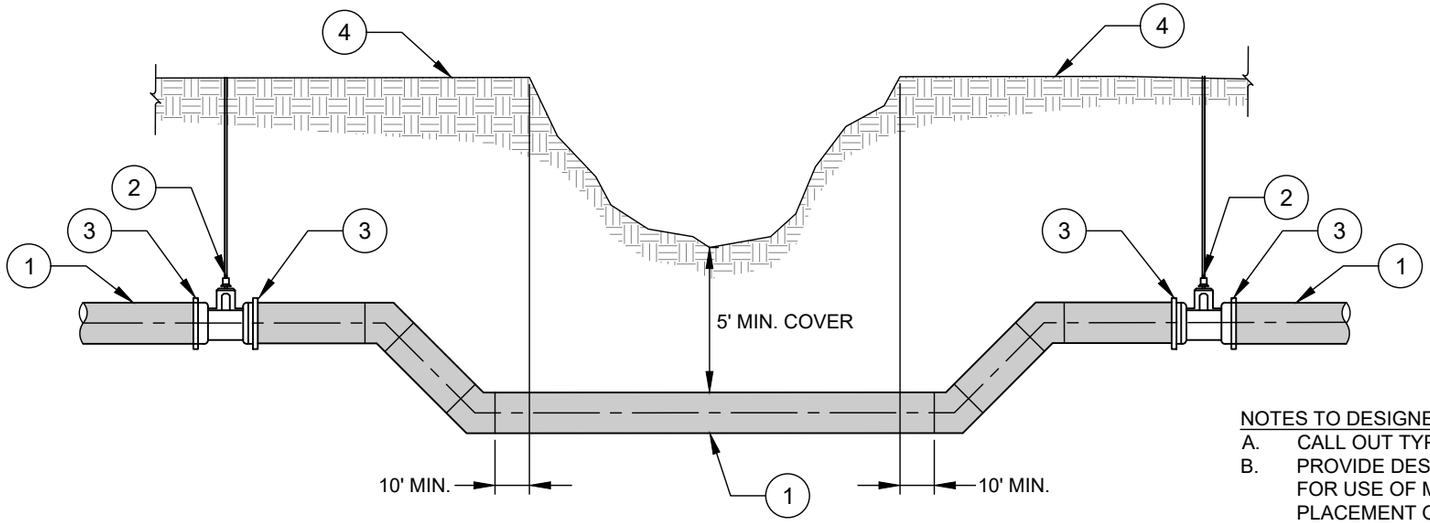
VERSION 1.0

DATE 04/2024

DETAIL 10.13.5



CREEK CROSSING BY DIRECTIONAL DRILL



CREEK CROSSING WITH FITTINGS
OPEN CUT OR CONVENTIONAL BORE

NO.	DESCRIPTION:
1.	HDPE WATER MAIN CARRIER PIPE.
2.	VALVE.
3.	MALE HDPE RESTRAINED JOINT ADAPTER WITH STEEL PIPE STIFFENER.
4.	TOP OF BANK.

NOTES:

A. FITTINGS SHALL MEET THE REQUIREMENTS OF AWWA C906.

B. MECHANICAL FITTINGS USED WITH HDPE PIPE SHALL BE SPECIFICALLY DESIGNED FOR USE WITH HDPE PIPE.

C. STAINLESS STEEL INTERNAL STIFFENERS SHALL BE INSTALLED IN THE END OF THE HDPE PIPE WHEN HDPE PIPE IS INSERTED INTO THE BELL END OF NON-HDPE PIPE, VALVE, FITTING, OR INTO THE HUB OF A BOLTED COUPLING.

D. ALLOWABLE TENSILE LOAD FOR PIPE MAY NOT BE EXCEEDED WHEN PULLING CARRIER PIPE THROUGH HORIZONTAL DIRECTIONAL DRILL (HDD). PROVIDE SEALED CALCULATIONS.

E. LOCATE VALVES IN ACCESSIBLE LOCATION AT TOP OF BANK WITHIN 100 TO 1,000 LINEAR FEET OF TOP OF BANK ON BOTH SIDES OF CENTERLINE OF CREEK.

NOTES TO DESIGNER

A. CALL OUT TYPE OF VALVE ON PLANS.

B. PROVIDE DESIGN CALCULATIONS PER ASTM F1962, STANDARD GUIDE FOR USE OF MAXI-HORIZONTAL DIRECTIONAL DRILLING FOR PLACEMENT OF PE PIPE OR CONDUIT UNDER OBSTACLES, INCLUDING RIVER CROSSINGS. PROVIDE SEALED CALCULATIONS FOR PULLBACK FORCE, TENSILE STRESS, EXTERNAL PRESSURE, BENDING STRESS, THERMAL STRESSES AND STRAINS, AND TORSION STRESS.

C. PROVIDE PE SEALED FLOTATION DESIGN CALCULATIONS COMPLYING WITH THE MINIMUM REQUIREMENTS OF CHAPTER 6 SECTION 3 OF "THE HANDBOOK OF POLYETHYLENE PIPE" REVISION 3 OR LATER BY PPI.

D. VALVES SHOULD BE PLACED IN AN ACCESSIBLE MAINTAINED AREAS.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

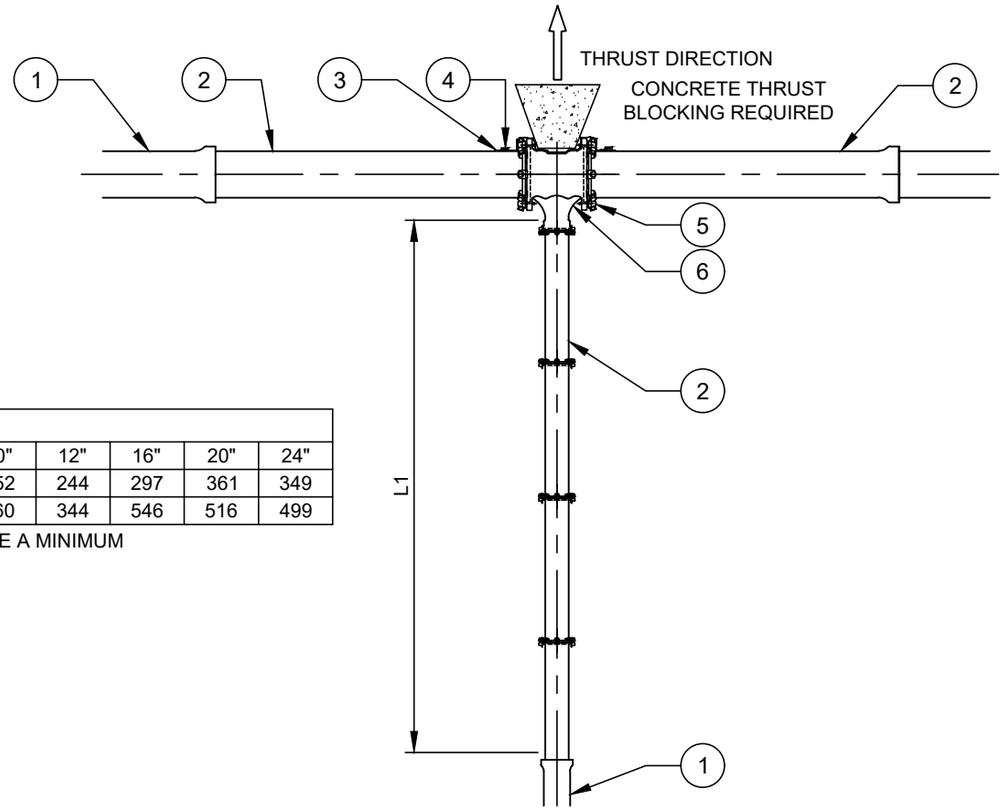
HDPE CREEK CROSSING

NO SCALE

VERSION
1.0

DATE
04/2024

DETAIL
10.13.6



TEE - **L1 (FEET)**							
DIAMETER OF BRANCH (INCHES)	6"	8"	10"	12"	16"	20"	24"
DIP	158	207	252	244	297	361	349
POLYWRAPPED DIP OR PVC	226	296	360	344	546	516	499

FIRST JOINT ON EACH SIDE OF TEE ON RUN SHALL BE A MINIMUM OF 10' FROM THE TEE.

NO.	DESCRIPTION:
1.	SLIP JOINT PIPE.
2.	RESTRAINED JOINT PIPE.
3.	HDPE WRAPPED AROUND FITTING AND WEDGE ACTION RESTRAINT GLAND.
4.	2 EACH x 2" CIRCUMFERENTIAL DUCT TAPE OR HDPE ZIP TIES.
5.	MECHANICAL JOINT DUCTILE IRON COMPACT FITTING.
6.	ALL FLANGE DUCTILE IRON TEE.

DESIGN BASIS:

DIPRA "THRUST RESTRAINT DESIGN FOR DIP"
LAYING CONDITION: TYPE 2
SOIL DESIGNATION: SILT 1
DEPTH OF COVER: 3' MINIMUM (SEE NOTE c.)
DESIGN PRESSURE: 200 PSI
SAFETY FACTOR: 2.0

NOTES:

a. 12" AND SMALLER DIP MAY BE SLIP JOINT PIPE WITH GRIP RESTRAINT GASKETS.
b. 16" AND LARGER DIP SHALL BE FACTORY RESTRAINT JOINT PIPE AND FITTINGS.
c. DEPTH OF COVER FOR 12", 16" AND 20" PIPE IS 4' AND FOR 24" PIPE IS 5'.
d. DESIGN ENGINEER CAN SUBMIT ALTERNATIVE DESIGN BASIS FOR RESTRAINED JOINT LENGTH CALCULATIONS FOR OWNER REVIEW.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

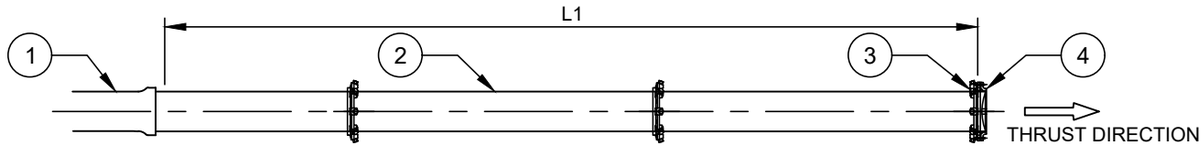
RESTRAINT LENGTH - TEE

NO SCALE

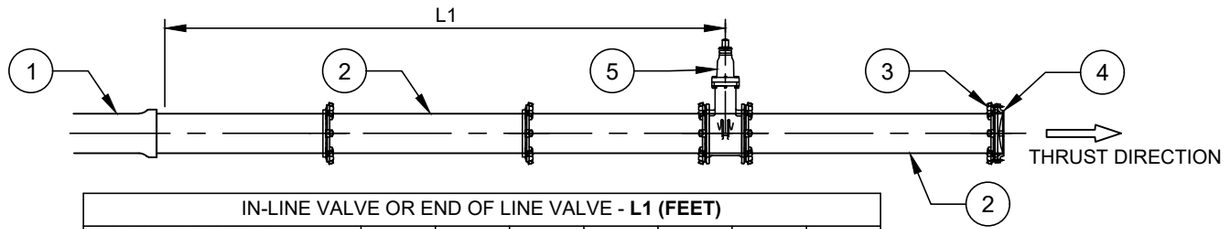
VERSION
2.0

DATE
01/2026

DETAIL
10.14.1



DEAD END, PLUG, OR CAP - **L1 (FEET)**							
DIAMETER (INCHES)	6"	8"	10"	12"	16"	20"	24"
DIP	169	219	264	239	308	373	361
POLYWRAPPED DIP OR PVC	242	312	377	342	440	532	516



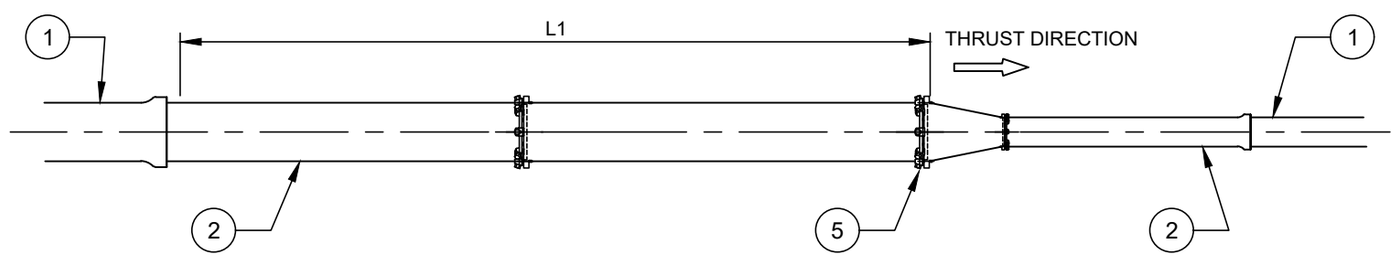
IN-LINE VALVE OR END OF LINE VALVE - **L1 (FEET)**							
DIAMETER (INCHES)	6"	8"	10"	12"	16"	20"	24"
DIP	169	219	264	239	308	373	361
POLYWRAPPED DIP OR PVC	242	312	377	342	440	532	516

FOR IN-LINE VALVE, PROVIDE RJ FOR A DISTANCE OF L1 ON EACH SIDE OF VALVE.

REDUCER - **L1 (FEET)**

	LARGE END DIAMETER	SMALL END DIAMETER						
		6"	8"	10"	12"	16"	20"	24"
DIP	6"							
	8"	92						
	10"	162	88					
	12"	174	127	70				
	16"	259	225	183	131			
	20"	335	307	274	234	131		
	24"		317	294	266	197	108	

	LARGE END DIAMETER	SMALL END DIAMETER						
		6"	8"	10"	12"	16"	20"	24"
POLYWRAPPED DIP OR PVC	6"							
	8"	131						
	10"	231	126					
	12"	249	181	100				
	16"	371	321	261	187			
	20"	478	439	392	334	187		
	24"		452	420	381	281	154	



NO.	DESCRIPTION:
1.	SLIP JOINT PIPE.
2.	RESTRAINED JOINT PIPE.
3.	RESTRAINED JOINT.
4.	RESTRAINED MJ CAP WITH BLOW-OFF.
5.	GATE VALVE (MJ X MJ) RESTRAINED.

DESIGN BASIS:

DIPRA "THRUST RESTRAINT DESIGN FOR DIP"
LAYING CONDITION: TYPE 2
SOIL DESIGNATION: SILT 1
DEPTH OF COVER: 3' MINIMUM (SEE NOTE c)
DESIGN PRESSURE: 200 PSI
SAFETY FACTOR: 2.0

NOTES:

a. 12" AND SMALLER DIP MAY BE SLIP JOINT PIPE WITH GRIP RESTRAINT GASKETS.
b. 16" AND LARGER DIP SHALL BE FACTORY RESTRAINT JOINT PIPE AND FITTINGS.
c. DEPTH OF COVER FOR 12", 16" AND 20" PIPE IS 4' AND FOR 24" PIPE IS 5'.
d. DESIGN ENGINEER CAN SUBMIT ALTERNATIVE DESIGN BASIS FOR RESTRAINED JOINT LENGTH CALCULATIONS FOR OWNER REVIEW.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

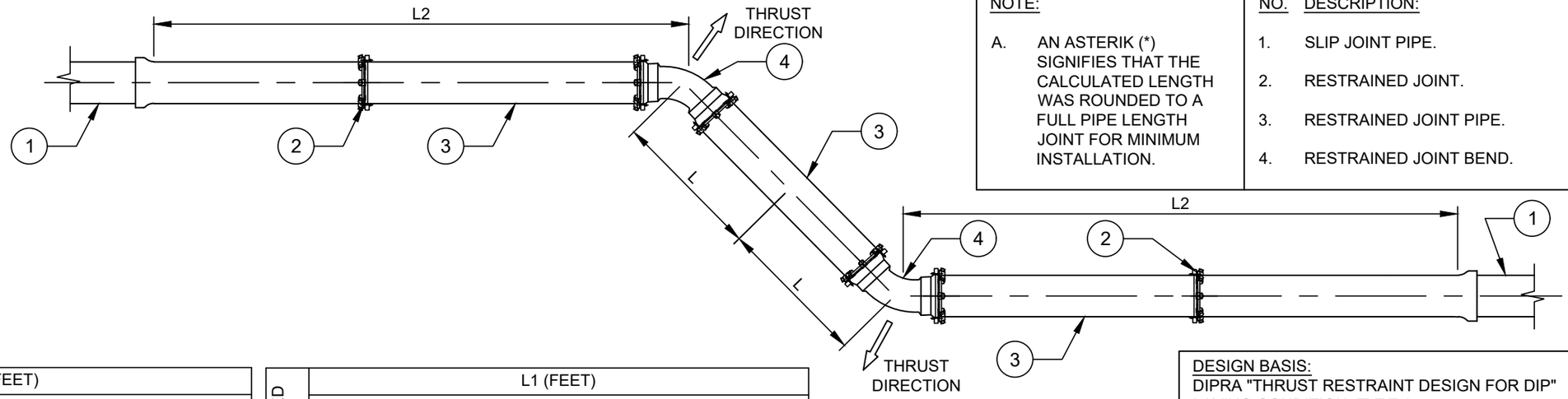
RESTRAINT LENGTH - DEAD END, PLUG, CAP, IN-LINE VALVE, END OF LINE VALVE AND REDUCER

NO SCALE

VERSION 2.0

DATE 01/2026

DETAIL 10.14.2



NOTE:

A. AN ASTERIK (*) SIGNIFIES THAT THE CALCULATED LENGTH WAS ROUNDED TO A FULL PIPE LENGTH JOINT FOR MINIMUM INSTALLATION.

NO.	DESCRIPTION:
1.	SLIP JOINT PIPE.
2.	RESTRAINED JOINT.
3.	RESTRAINED JOINT PIPE.
4.	RESTRAINED JOINT BEND.

HORIZONTAL OFFSET - **L2 (FEET)**

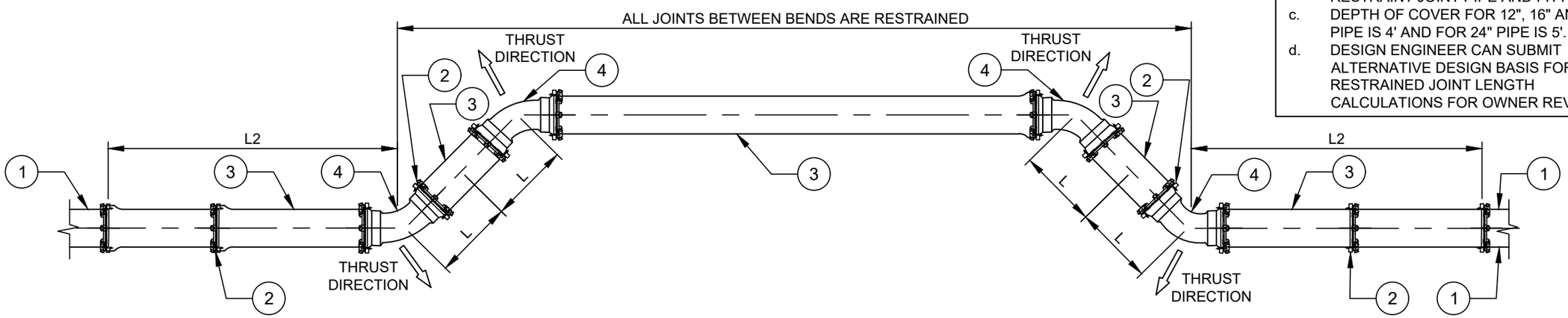
L2 = L1(from table) MINUS L

DIP	L1 (FEET)							
	DIAMETER							
	BEND ANGLE	6"	8"	10"	12"	16"	20"	24"
	45	90	116	140	127	162	195	189
	22.5	54*	56	67	61	78	94	91
	11.25	36*	36*	36*	36*	39	46	45

POLYWRAPPED DIP/PVC	L1 (FEET)							
	DIAMETER							
	BEND ANGLE	6"	8"	10"	12"	16"	20"	24"
	45	112	144	173	156	200	241	233
	22.5	54	69	83	75	96	116	112
	11.25	36*	36*	54*	54*	48	57	55

DESIGN BASIS:
DIPRA "THRUST RESTRAINT DESIGN FOR DIP"
LAYING CONDITION: TYPE 2
SOIL DESIGNATION: SILT 1
DEPTH OF COVER: 3' MINIMUM (SEE NOTE c)
DESIGN PRESSURE: 200 PSI
SAFETY FACTOR: 2.0
NOTES:

a. 12" AND SMALLER DIP MAY BE SLIP JOINT PIPE WITH GRIP RESTRAINT GASKETS.
b. 16" AND LARGER DIP SHALL BE FACTORY RESTRAINT JOINT PIPE AND FITTINGS.
c. DEPTH OF COVER FOR 12", 16" AND 20" PIPE IS 4' AND FOR 24" PIPE IS 5'.
d. DESIGN ENGINEER CAN SUBMIT ALTERNATIVE DESIGN BASIS FOR RESTRAINED JOINT LENGTH CALCULATIONS FOR OWNER REVIEW.



COMBINED HORIZONTAL OFFSET - **L2 (FEET)**

L2 = L1 (FROM TABLE) MINUS L

DIP	L1 (FEET)							
	DIAMETER							
	BEND ANGLE	6"	8"	10"	12"	16"	20"	24"
	45	90	116	140	127	162	195	189
	22.5	54*	56	67	61	78	94	91
	11.25	36*	36*	36*	36*	39	46	45

POLYWRAPPED DIP/PVC	L1 (FEET)							
	DIAMETER							
	BEND ANGLE	6"	8"	10"	12"	16"	20"	24"
	45	112	144	173	156	200	241	233
	22.5	54	69	83	75	96	116	112
	11.25	36*	36*	54*	54*	48	57	55

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

RESTRAINT LENGTH - HORIZONTAL OFFSET AND COMBINED HORIZONTAL OFFSET

NO SCALE

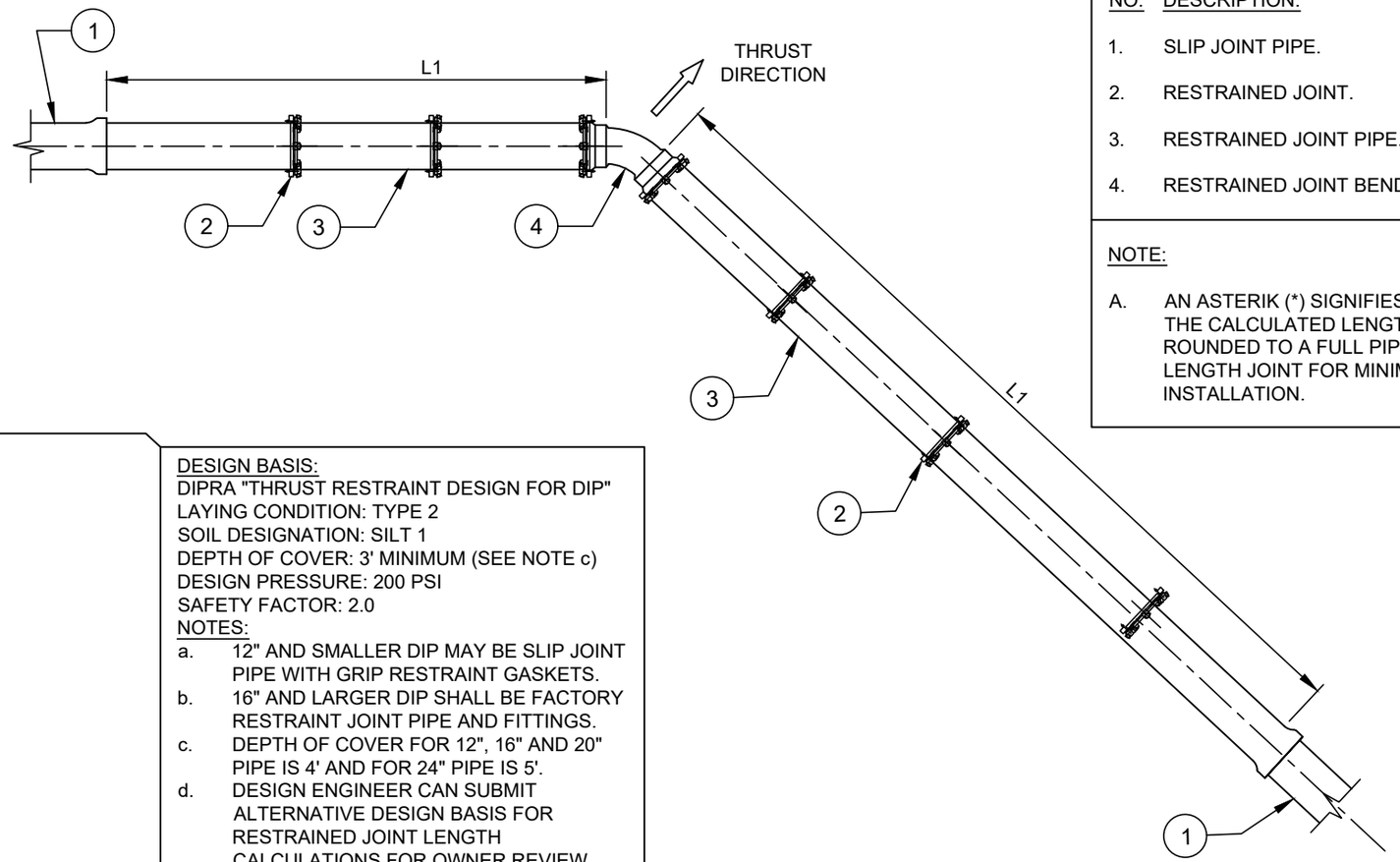
VERSION 2.0

DATE 01/2026

DETAIL 10.14.3

DIP	VERTICAL BEND DOWN (TOP BEND) - **L1 (FEET)**						
	DIAMETER						
BEND ANGLE	6"	8"	10"	12"	16"	20"	24"
45	70	91	109	99	128	154	150
22.5	36*	54*	54*	54*	61	74	72
11.25	18*	36*	36*	36*	36*	54*	36*

POLYWRAPPED DIP/PVC	VERTICAL BEND DOWN (TOP BEND) - **L1 (FEET)**						
	DIAMETER						
BEND ANGLE	6"	8"	10"	12"	16"	20"	24"
45	100	129	156	142	182	221	214
22.5	54*	62	75	68	88	106	103
11.25	36*	36*	54*	36*	54*	54*	54*



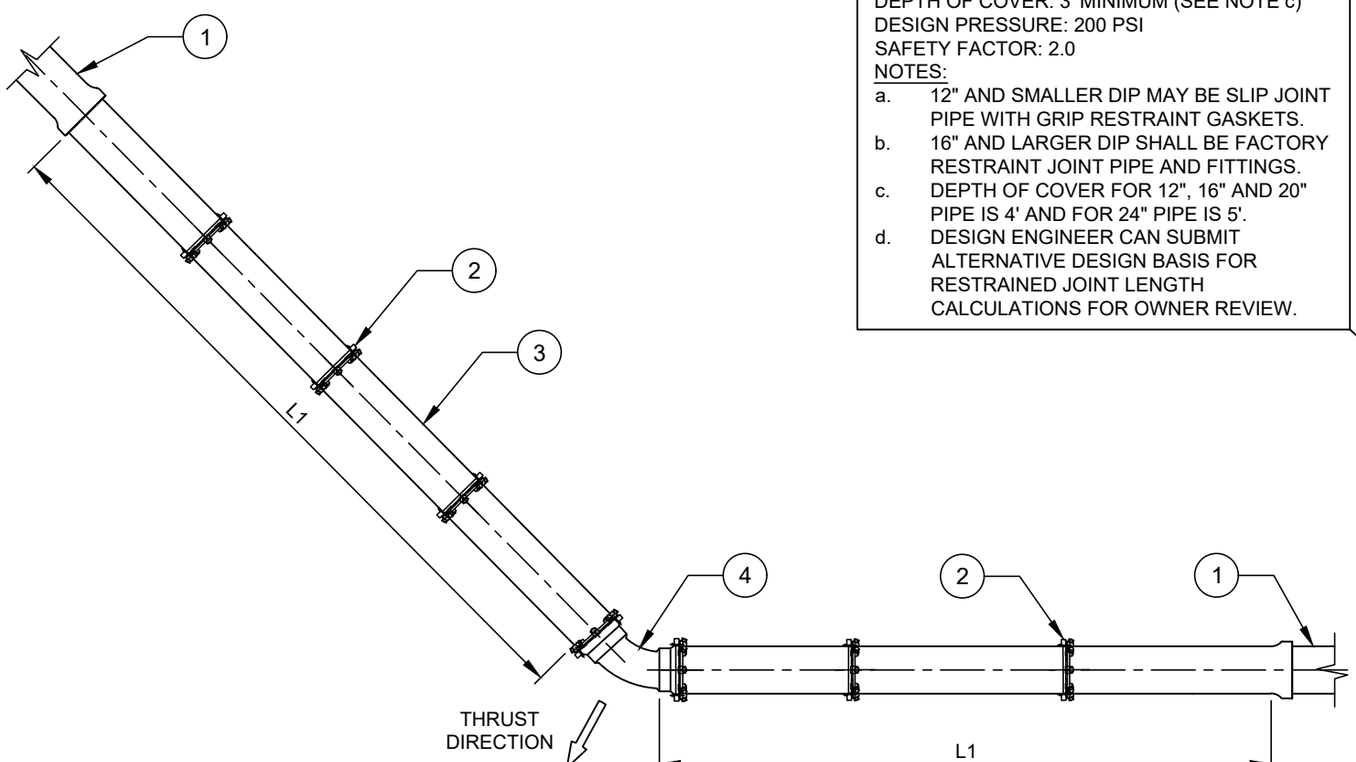
NO.	DESCRIPTION:
1.	SLIP JOINT PIPE.
2.	RESTRAINED JOINT.
3.	RESTRAINED JOINT PIPE.
4.	RESTRAINED JOINT BEND.

NOTE:

A. AN ASTERIK (*) SIGNIFIES THAT THE CALCULATED LENGTH WAS ROUNDED TO A FULL PIPE LENGTH JOINT FOR MINIMUM INSTALLATION.

DESIGN BASIS:
DIPRA "THRUST RESTRAINT DESIGN FOR DIP"
LAYING CONDITION: TYPE 2
SOIL DESIGNATION: SILT 1
DEPTH OF COVER: 3' MINIMUM (SEE NOTE c)
DESIGN PRESSURE: 200 PSI
SAFETY FACTOR: 2.0
NOTES:

a. 12" AND SMALLER DIP MAY BE SLIP JOINT PIPE WITH GRIP RESTRAINT GASKETS.
b. 16" AND LARGER DIP SHALL BE FACTORY RESTRAINT JOINT PIPE AND FITTINGS.
c. DEPTH OF COVER FOR 12", 16" AND 20" PIPE IS 4' AND FOR 24" PIPE IS 5'.
d. DESIGN ENGINEER CAN SUBMIT ALTERNATIVE DESIGN BASIS FOR RESTRAINED JOINT LENGTH CALCULATIONS FOR OWNER REVIEW.



DIP	VERTICAL BEND UP (BOTTOM BEND) - **L1 (FEET)**							
	DIAMETER							
BEND ANGLE	6"	8"	10"	12"	16"	20"	24"
45	54*	58	70	63	81	98	94
22.5	36*	36*	36*	36*	54*	54*	54*
11.25	18*	18*	18*	18*	36*	36*	36*

POLYWRAPPED DIP/PVC	VERTICAL BEND UP (BOTTOM BEND) - **L1 (FEET)**							
	DIAMETER							
BEND ANGLE	6"	8"	10"	12"	16"	20"	24"
45	56	72	86	78	100	120	116
22.5	36*	36*	54*	54*	54*	58	56
11.25	18*	18*	36*	36*	36*	36*	36*

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

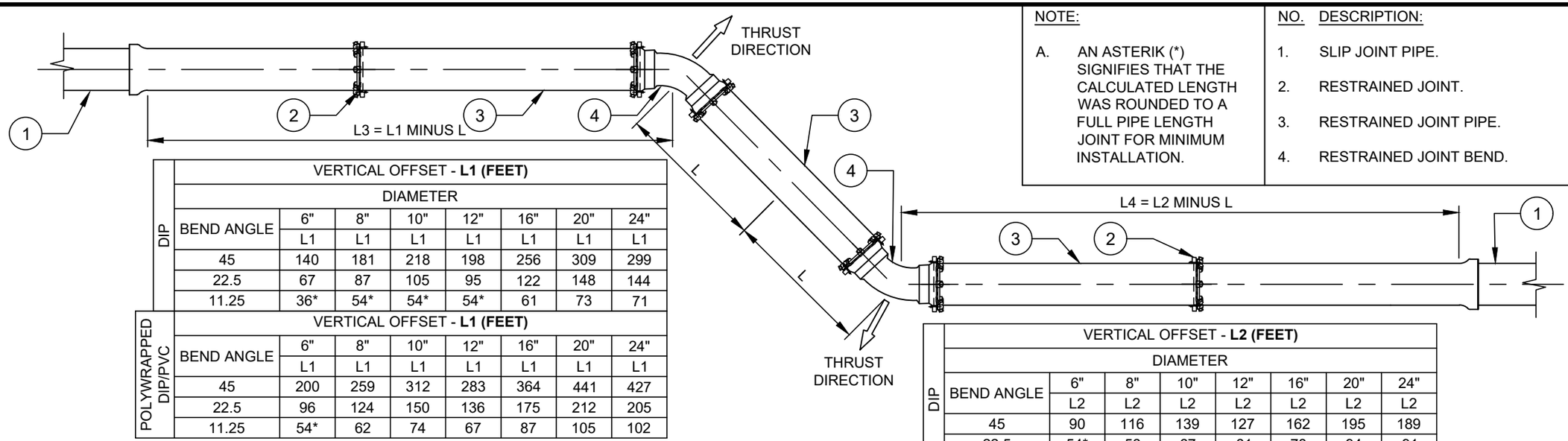
RESTRAINT LENGTH - VERTICAL BEND DOWN AND VERTICAL BEND UP

NO SCALE

VERSION 2.0

DATE 01/2026

DETAIL 10.14.4



NOTE:

A. AN ASTERIK (*) SIGNIFIES THAT THE CALCULATED LENGTH WAS ROUNDED TO A FULL PIPE LENGTH JOINT FOR MINIMUM INSTALLATION.

NO.	DESCRIPTION:
1.	SLIP JOINT PIPE.
2.	RESTRAINED JOINT.
3.	RESTRAINED JOINT PIPE.
4.	RESTRAINED JOINT BEND.

	VERTICAL OFFSET - **L1 (FEET)**						
	DIAMETER						
DIP	BEND ANGLE	6"	8"	10"	12"	16"	20"	24"
		L1	L1	L1	L1	L1	L1	L1
	45	140	181	218	198	256	309	299
	22.5	67	87	105	95	122	148	144
	11.25	36*	54*	54*	54*	61	73	71

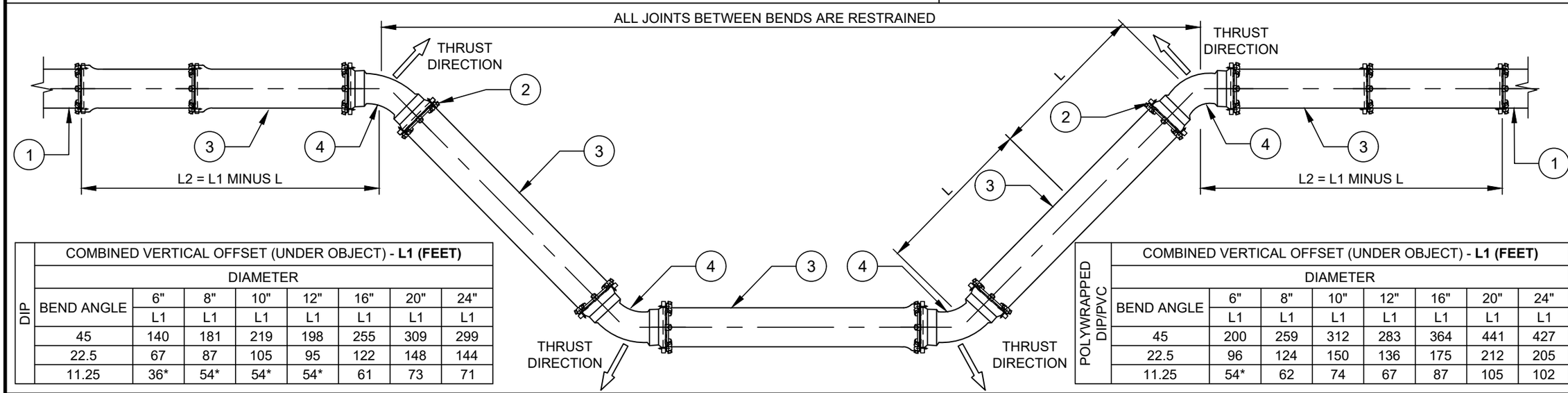
	VERTICAL OFFSET - **L1 (FEET)**						
POLYWRAPPED DIP/PVC	BEND ANGLE	6"	8"	10"	12"	16"	20"	24"
		L1	L1	L1	L1	L1	L1	L1
	45	200	259	312	283	364	441	427
	22.5	96	124	150	136	175	212	205
	11.25	54*	62	74	67	87	105	102

	VERTICAL OFFSET - **L2 (FEET)**						
	DIAMETER						
DIP	BEND ANGLE	6"	8"	10"	12"	16"	20"	24"
		L2	L2	L2	L2	L2	L2	L2
	45	90	116	139	127	162	195	189
	22.5	54*	56	67	61	78	94	91
	11.25	36*	36*	36*	36*	54*	54*	54

	VERTICAL OFFSET - **L2 (FEET)**						
POLYWRAPPED DIP/PVC	BEND ANGLE	6"	8"	10"	12"	16"	20"	24"
		L2	L2	L2	L2	L2	L2	L2
	45	112	144	173	156	200	241	233
	22.5	54*	69	83	75	96	116	112
	11.25	36*	36*	54*	54*	54*	57	55

DESIGN BASIS:
DIPRA "THRUST RESTRAINT DESIGN FOR DIP"
LAYING CONDITION: TYPE 2
SOIL DESIGNATION: SILT 1
DEPTH OF COVER: 3' MINIMUM (SEE NOTE c)
DESIGN PRESSURE: 200 PSI
SAFETY FACTOR: 2.0

NOTES:
a. 12" AND SMALLER DIP MAY BE SLIP JOINT PIPE WITH GRIP RESTRAINT GASKETS.
b. 16" AND LARGER DIP SHALL BE FACTORY RESTRAINT JOINT PIPE AND FITTINGS.
c. DEPTH OF COVER FOR 12" , 16" AND 20" PIPE IS 4' AND FOR 24" PIPE IS 5'.
d. DESIGN ENGINEER CAN SUBMIT ALTERNATIVE DESIGN BASIS FOR RESTRAINED JOINT LENGTH CALCULATIONS FOR OWNER REVIEW.



	COMBINED VERTICAL OFFSET (UNDER OBJECT) - **L1 (FEET)**							
	DIAMETER							
DIP	BEND ANGLE	6"	8"	10"	12"	16"	20"	24"
		L1	L1	L1	L1	L1	L1	L1
	45	140	181	219	198	255	309	299
	22.5	67	87	105	95	122	148	144
	11.25	36*	54*	54*	54*	61	73	71

	COMBINED VERTICAL OFFSET (UNDER OBJECT) - **L1 (FEET)**							
	DIAMETER							
POLYWRAPPED DIP/PVC	BEND ANGLE	6"	8"	10"	12"	16"	20"	24"
		L1	L1	L1	L1	L1	L1	L1
	45	200	259	312	283	364	441	427
	22.5	96	124	150	136	175	212	205
	11.25	54*	62	74	67	87	105	102

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

RESTRAINT LENGTH - VERTICAL OFFSET AND COMBINED VERTICAL OFFSET (UNDER OBJECT)

NO SCALE

VERSION 2.0

DATE 01/2026

DETAIL 10.14.5

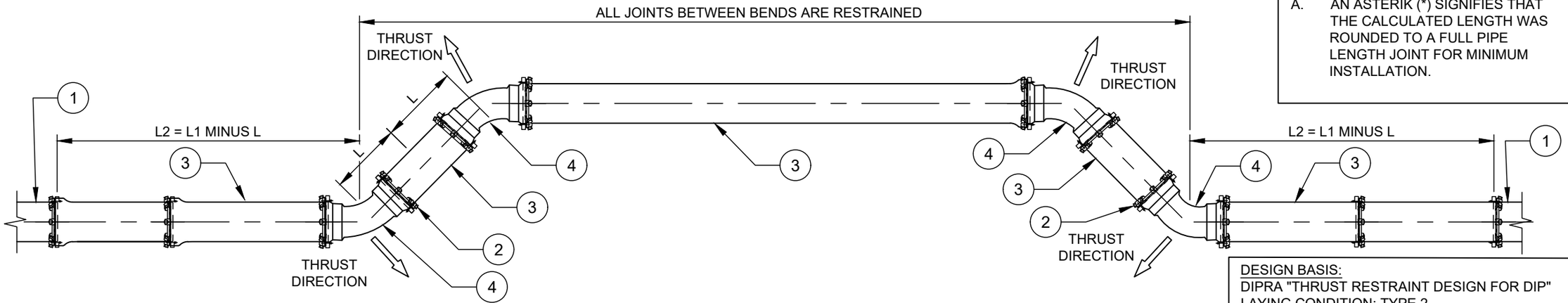
DIP	COMBINED VERTICAL OFFSET (OVER OBJECT) - **L1 (FEET)**							
	DIAMETER							
	BEND ANGLE	6"	8"	10"	12"	16"	20"	24"
		L1	L1	L1	L1	L1	L1	L1
	45	90	116	140	127	162	195	189
	22.5	54*	56	67	61	78	94	91
	11.25	36*	36*	36*	36*	54*	54*	54*

POLYWRAPPED DIP/PVC	COMBINED VERTICAL OFFSET (OVER OBJECT) - **L1 (FEET)**							
	DIAMETER							
	BEND ANGLE	6"	8"	10"	12"	16"	20"	24"
		L1	L1	L1	L1	L1	L1	L1
	45	112	144	173	157	200	241	233
	22.5	54*	69	83	75	96	116	112
	11.25	36*	36*	54*	54*	48	57	55

NO.	DESCRIPTION:
1.	SLIP JOINT PIPE.
2.	RESTRAINED JOINT.
3.	RESTRAINED JOINT PIPE.
4.	RESTRAINED JOINT BEND.

NOTE:

A. AN ASTERIK (*) SIGNIFIES THAT THE CALCULATED LENGTH WAS ROUNDED TO A FULL PIPE LENGTH JOINT FOR MINIMUM INSTALLATION.

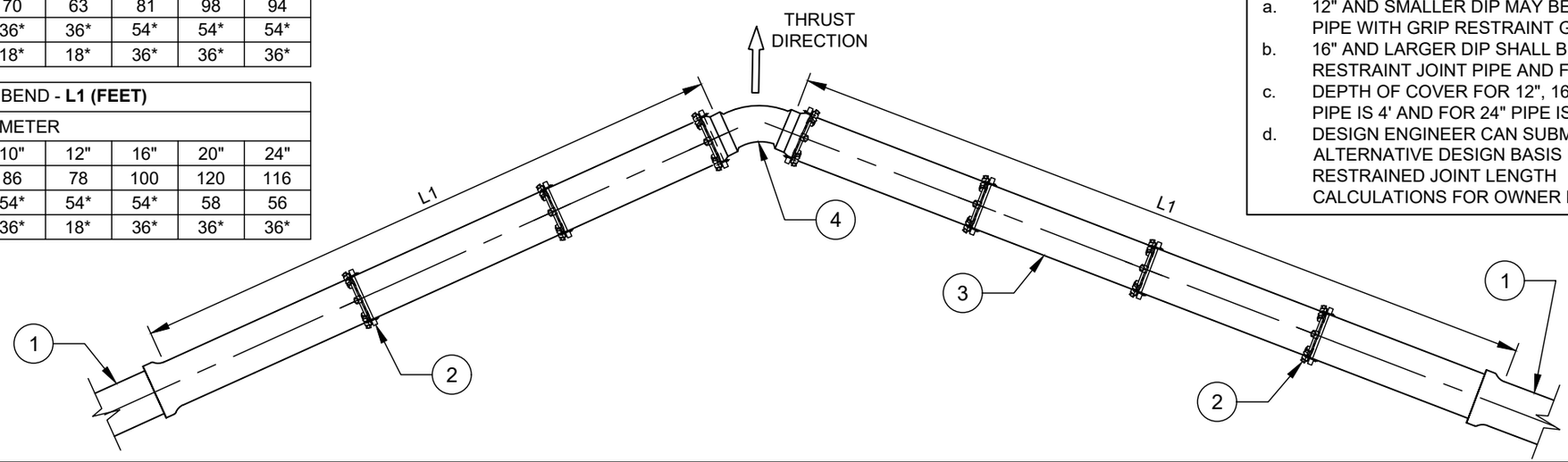


DESIGN BASIS:
DIPRA "THRUST RESTRAINT DESIGN FOR DIP"
LAYING CONDITION: TYPE 2
SOIL DESIGNATION: SILT 1
DEPTH OF COVER: 3' MINIMUM (SEE NOTE c)
DESIGN PRESSURE: 200 PSI
SAFETY FACTOR: 2.0
NOTES:

a. 12" AND SMALLER DIP MAY BE SLIP JOINT PIPE WITH GRIP RESTRAINT GASKETS.
b. 16" AND LARGER DIP SHALL BE FACTORY RESTRAINT JOINT PIPE AND FITTINGS.
c. DEPTH OF COVER FOR 12", 16" AND 20" PIPE IS 4' AND FOR 24" PIPE IS 5'.
d. DESIGN ENGINEER CAN SUBMIT ALTERNATIVE DESIGN BASIS FOR RESTRAINED JOINT LENGTH CALCULATIONS FOR OWNER REVIEW.

DIP	HORIZONTAL BEND - **L1 (FEET)**							
	DIAMETER							
	BEND ANGLE	6"	8"	10"	12"	16"	20"	24"
	45	54*	58	70	63	81	98	94
	22.5	36*	36*	36*	36*	54*	54*	54*
	11.25	18*	18*	18*	18*	36*	36*	36*

POLYWRAPPED DIP/PVC	HORIZONTAL BEND - **L1 (FEET)**							
	DIAMETER							
	BEND ANGLE	6"	8"	10"	12"	16"	20"	24"
	45	56	72	86	78	100	120	116
	22.5	36*	36*	54*	54*	54*	58	56
	11.25	18*	18*	36*	18*	36*	36*	36*



CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

RESTRAINT LENGTH - COMBINED VERTICAL OFFSET (OVER OBJECT) AND HORIZONTAL BEND

NO SCALE

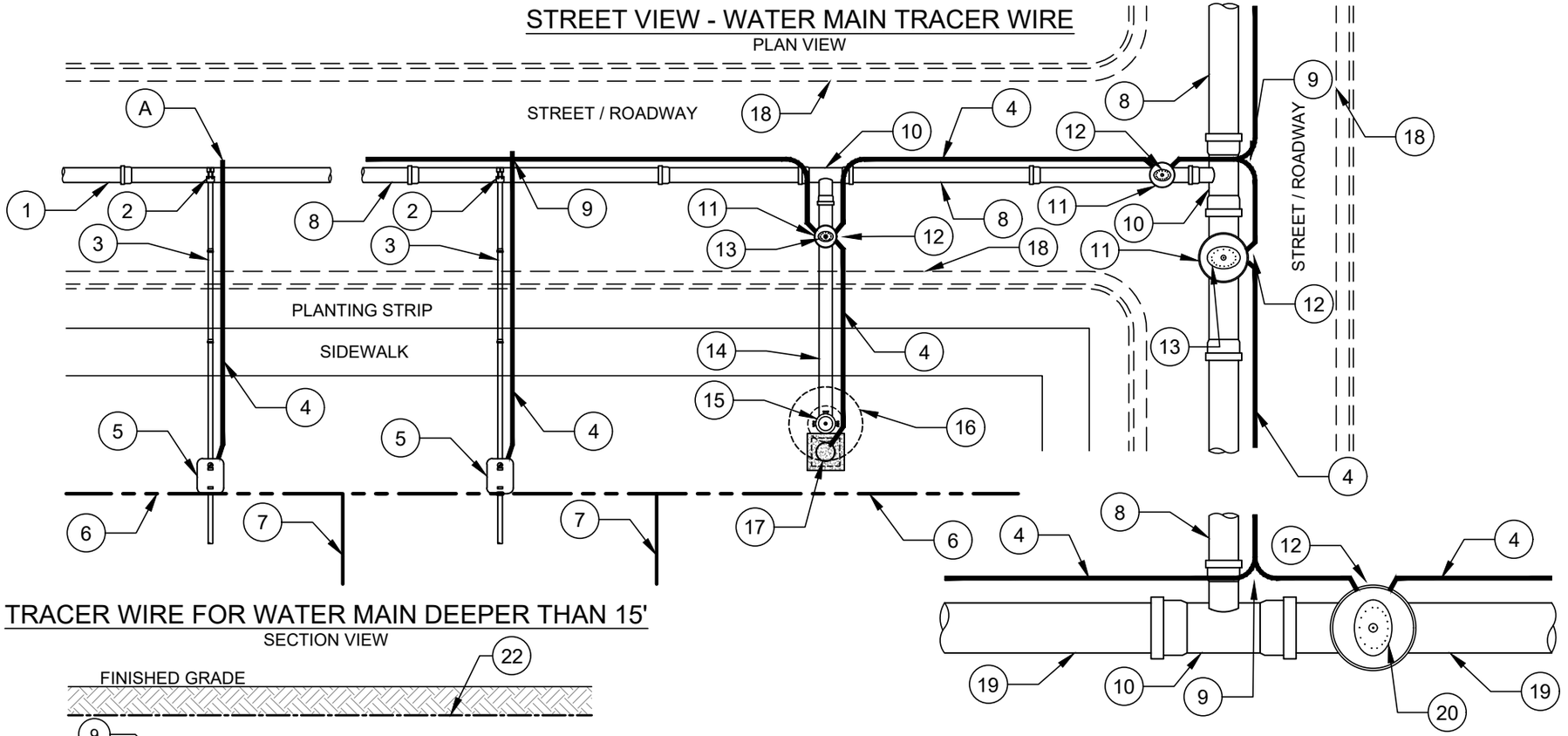
VERSION 2.0

DATE 01/2026

DETAIL 10.14.6

STREET VIEW - WATER MAIN TRACER WIRE

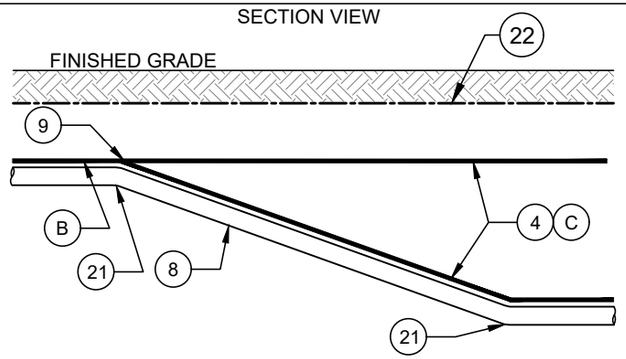
PLAN VIEW



NO.	DESCRIPTION:
1.	EXISTING WATER MAIN LINE WITHOUT TRACER WIRE.
2.	SERVICE SADDLE.
3.	WATER SERVICE LINE.
4.	AWG #12 GAUGE SOLID COPPER TRACER WIRE (TYP.).
5.	METER BOX & LID (SEE CLTW STD. DETAIL).
6.	R/W / EASEMENT LINE.
7.	PROPERTY LINE.
8.	NEW WATER MAIN.
9.	SPLICE (SEE CLTW STD. DETAIL).
10.	TEE.
11.	VALVE BOX ASSEMBLY (SEE CLTW STD. DETAIL).
12.	NO SPLICE.
13.	GATE VALVE.
14.	FIRE HYDRANT BRANCH.
15.	FIRE HYDRANT.
16.	CONCRETE HYDRANT COLLAR. CAST-IN-PLACE. 3' DIAMETER BY 8" THICK. REINFORCE WITH #4 REBARS.
17.	VALVE BOX ASSEMBLY IN SLAB (SEE CLTW STD. DETAIL).
18.	CURB.
19.	WATER TRANSMISSION MAIN LINE.
20.	BUTTERFLY VALVE.
21.	BEND.
22.	6" WIDE WARNING TAPE.

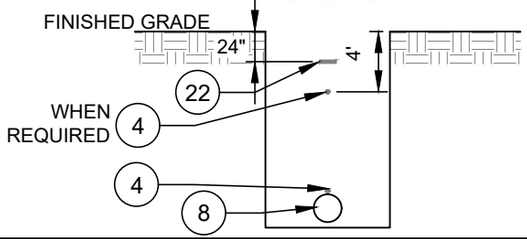
TRACER WIRE FOR WATER MAIN DEEPER THAN 15'

SECTION VIEW



TRENCH DETAIL

PROFILE VIEW



NOTES:

A. FOR NEW SERVICE ON EXISTING MAIN WHERE NO TRACER WIRE IS LOCATED ON WATER MAIN, PLACE TRACER WIRE END AT BOTTOM EDGE OF TRENCH AWAY FROM MAIN AND SERVICE.

B. WATER MAIN LESS THAN 15' DEPTH OF COVER - TRACING WIRE SHALL BE ATTACHED TO PIPE.

C. WATER MAIN GREATER THAN 15' DEPTH OF COVER - TRACER WIRE SHALL BE ATTACHED TO PIPE AND PLACED AT A DEPTH OF 4' BELOW FINISH GRADE.

D. TRACER WIRE SHOWN AWAY FROM PIPE FOR CLARITY. TRACER WIRE SHALL BE INSTALLED IMMEDIATELY ADJACENT TO THE WATER PIPE. TRACER WIRE SHALL BE FASTENED TO THE PIPE WITH ZIP TIES OR DUCT TAPE AT 10' INTERVALS.

E. TRACER WIRE PLACEMENT NEXT TO PIPE FOR PIPE MATERIALS OTHER THAN HDPE. TRACER WIRE PLACEMENT IN RELATION TO HDPE PIPE IS UNDER PIPE IN CASE OF WEATHER.

F. TRACER WIRE SHALL BE SOLID COPPER #12 WITH 30 MILS BLUE HDPE INSULATION.

G. SPLICED CONNECTIONS SHALL BE ALLOWED BETWEEN THE MAIN LINE TRACER WIRE AND THE SERVICE TRACER WIRE.

H. TRACER WIRE SHALL BE PROTECTED FROM DAMAGE DURING THE EXECUTION OF THE WORK. NO BREAKS OR CUTS IN THE TRACER WIRE OR INSULATION SHALL BE PERMITTED.

I. PRIOR TO ACCEPTANCE (POST PUNCH LIST) EACH WIRE SEGMENT SHALL PASS A CONDUCTIVITY TEST, WITNESSED BY THE ENGINEER OR ENGINEER'S REPRESENTATIVE.

J. FOR INSTALLING A NEW SERVICE LINE ON AN EXISTING OR NEW MAIN WITH TRACER WIRE, INCLUDE 2' OF SLACK IN NEW TRACER WIRE AT THE SPLICE. THE METER BOX SHALL SERVE AS THE TEST PORT.

K. MAXIMUM DISTANCE BETWEEN TEST PORTS SHALL BE 750 LINEAR FEET.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

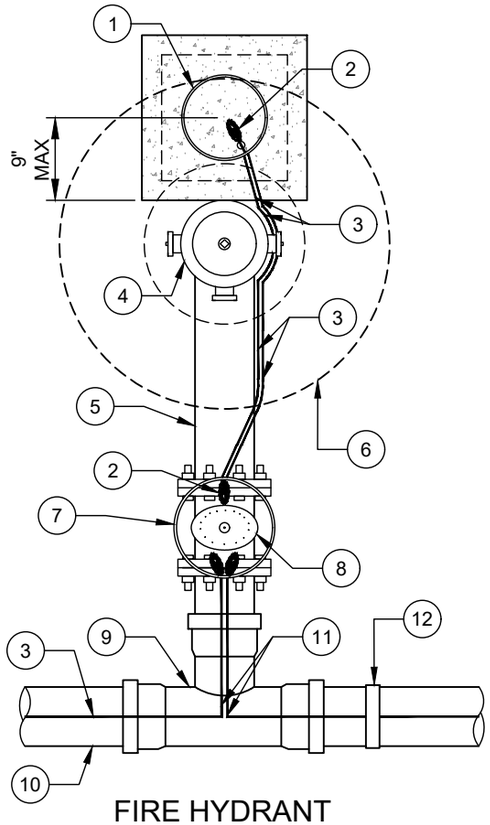
TRACER WIRE - WATER MAIN

NO SCALE

VERSION 3.0

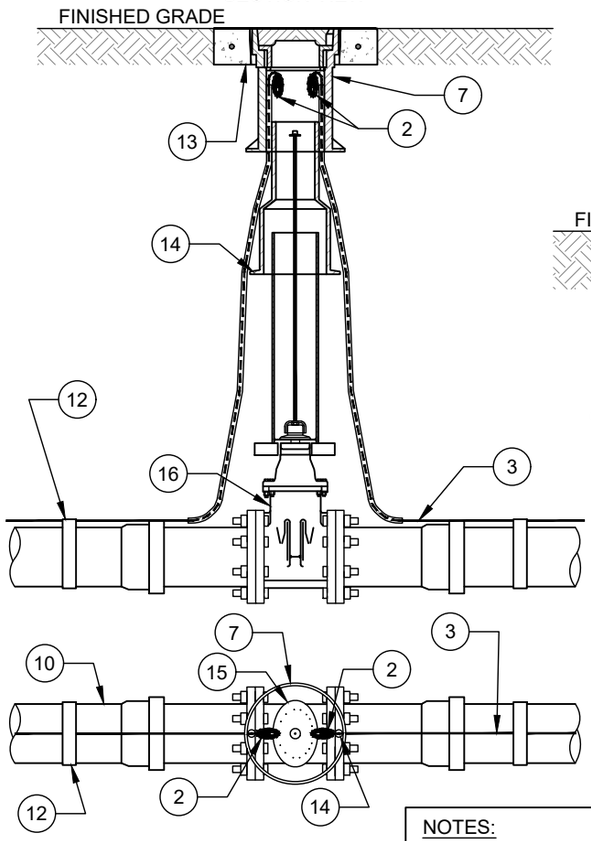
DATE 01/2026

DETAIL 10.15.1

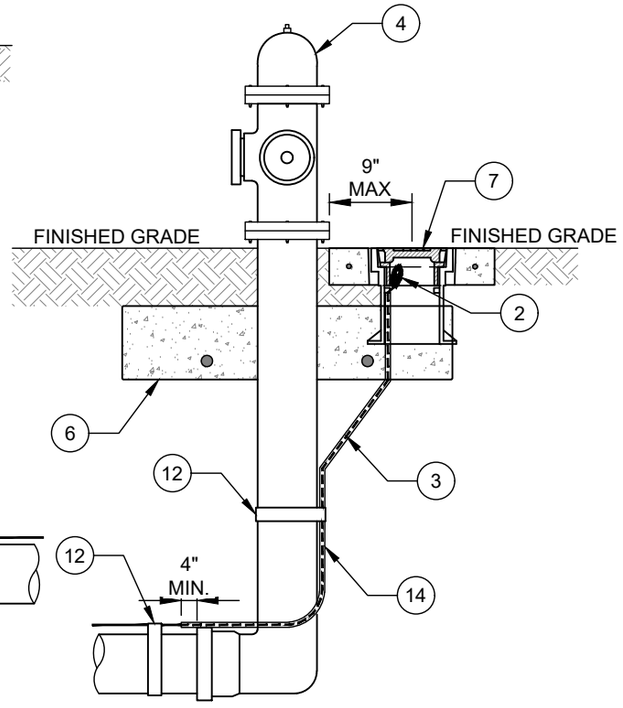


FIRE HYDRANT
PLAN VIEW

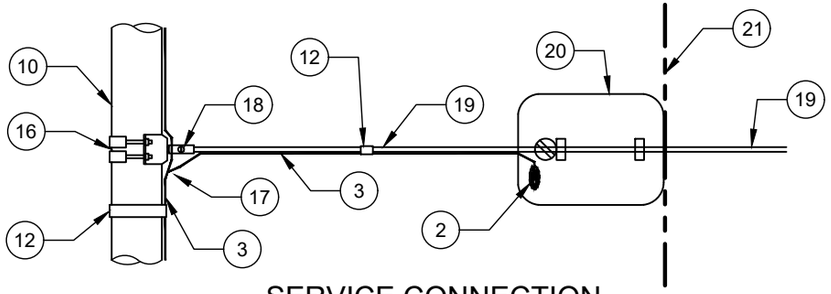
MAIN LINE VALVE
SECTION VIEW



MAIN LINE VALVE
PLAN VIEW



FIRE HYDRANT
SECTION VIEW



SERVICE CONNECTION
PLAN VIEW

NO.	DESCRIPTION:
1.	VALVE BOX ASSEMBLY IN CONCRETE PAD (SEE CLTW STD. DETAIL).
2.	PROVIDE 24" NEATLY COILED WIRE IN BOX.
3.	AWG #12 GAUGE SOLID COPPER TRACER WIRE (TYP.) WITH 30 MILS BLUE HDPE INSULATION.
4.	FIRE HYDRANT.
5.	FIRE HYDRANT BRANCH.
6.	CONCRETE HYDRANT COLLAR. CAST IN PLACE. 3' DIAMETER BY 8" THICK. REINFORCED WITH #4 REBAR.
7.	VALVE BOX ASSEMBLY (SEE CLTW STD. DETAIL).
8.	GATE VALVE.
9.	TEE.
10.	WATER MAIN.
11.	NO SPLICE (RUN TWO WIRES SEPARATELY).
12.	FASTEN TRACER WIRE TO PIPE WITH ZIP TIES OR DUCT TAPE AROUND THE CIRCUMFERENCE OF PIPE AT 10' INTERVALS (TYP.).
13.	CONCRETE PAD (SEE CLTW STD. DETAIL).
14.	ALL VERTICAL WIRE SHALL BE PLACED IN 1/4" OR 3/8" ID CONDUIT SDR 9 PEX TUBING - ASTM F876 (TYP.).
15.	MAIN LINE VALVE.
16.	SERVICE SADDLE.
17.	SPLICE (SEE CLTW STD. DETAIL).
18.	BALL VALVE CORPORATION STOP.
19.	WATER SERVICE.
20.	METER BOX AND LID (SEE CLTW STD. DETAIL).
21.	R/W / PROPERTY LINE.

NOTES:

A. TRACER WIRE SHALL BE AWG #12 GUAGE SOLID COPPER WITH 30 MILS BLUE HDPE INSULATION.

B. THE TRACER WIRE SHALL BE CONTINUOUS TO THE GREATEST EXTENT POSSIBLE. WHERE SPLICES ARE NECESSITATED IN THE WIRE, THE SPLICES SHALL BE SECURLEY BONDED TOGETHER WITH AN APPROVED INDUSTRIAL CONNECTOR TO PROVIDE ELECTRICAL CONTINUITY. CONNECTOR SHALL BE COPPER AND INSULATION SHALL BE REPAIRED AS DETAILED TO SEAL OUT MOISTURE AND CORROSION AND SHALL BE INSTALLED SO AS TO PREVENT ANY UNINSULATED WIRE EXPOSURE. SEE APPROPRIATE STD. DETAIL.

C. SPLICED CONNECTIONS SHALL BE ALLOWED BETWEEN THE MAIN TRACER WIRE AND THE WATER SERVICE TRACER WIRE.

D. TRACER WIRE SHALL BE PROTECTED FROM DAMAGE DURING THE EXECUTION OF THE WORK. NO BREAKS OR CUTS IN THE TRACER WIRE OR INSULATION SHALL BE PERMITTED.

E. PRIOR TO ACCEPTANCE (POST PUNCH LIST) EACH WIRE SEGMENT SHALL PASS A CONDUCTIVITY TEST, WITNESSED BY THE ENGINEER OR ENGINEER'S REPRESENTITIVE.

F. WHERE 2 OR MORE WIRES ENTER A VALVE BOX ASSEMBLY, (PROVIDE 24" OF NEATLY COILED WIRE) AFTER ACCEPTANCE TESTING, CONNECT ENDS OF ALL WIRES WITH WATER PROOF WIRE CONNECTOR NUT AND 3" BARE #12 PIGTAIL.

G. SPLICES IN THE PRIMARY TRACER WIRE ALONG THE WATER MAIN SHALL INCLUDE 2' OF SLACK WIRE ON EACH SIDE OF EACH SPLICE.

H. FOR INSTALLING A NEW SERVICE LINE ON AN EXISTING MAIN WITH TRACER WIRE, ONLY SPLICE TO EXISTING WIRE WITH 2' OF SLACK ON NEW SERVICE LINE.

I. TRACER WIRE PLACEMENT NEXT TO PIPE FOR PIPE MATERIALS OTHER THAN HDPE. TRACER WIRE PLACEMENT IN RELATION TO HDPE PIPE IS UNDER PIPE IN CASE OF WEATHER.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

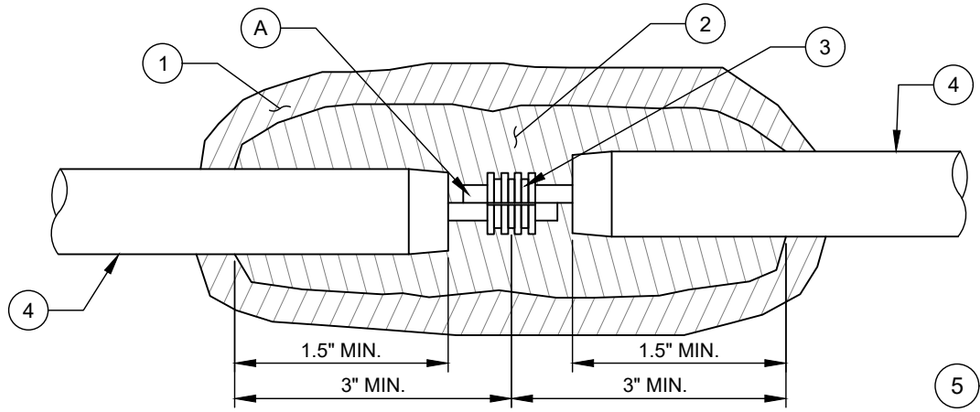
TRACER WIRE - WATER MAIN

NO SCALE

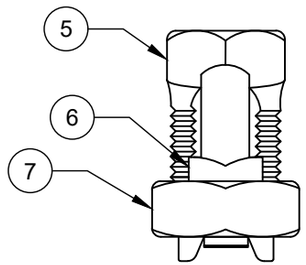
VERSION 1.0

DATE 04/2024

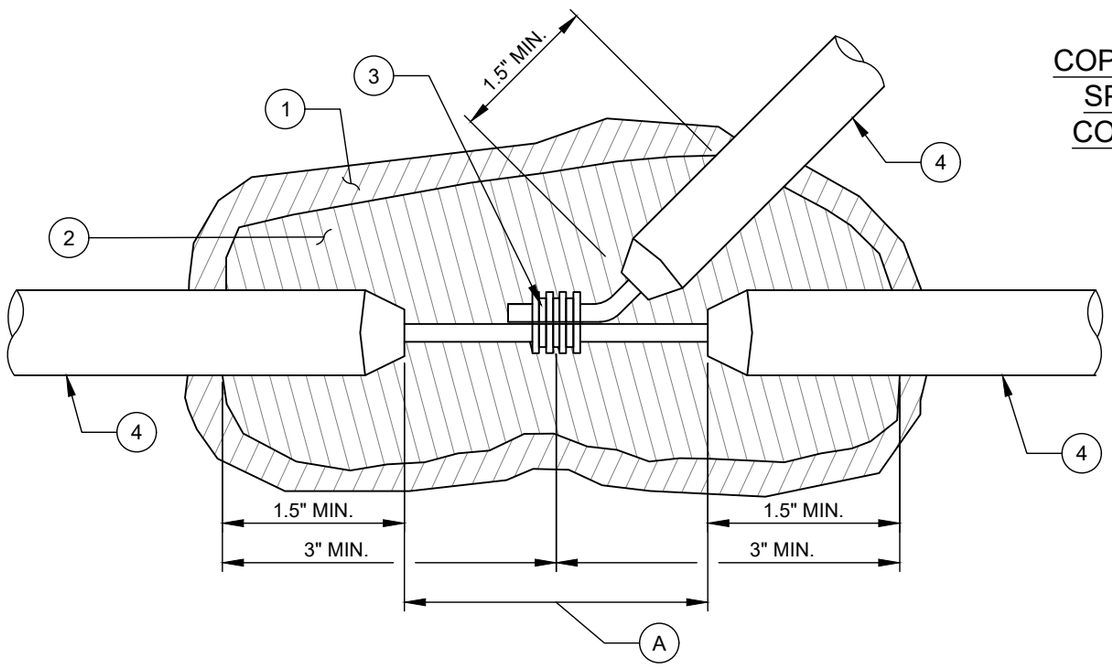
DETAIL 10.15.2



IN-LINE OR REPAIR SPLICE



COPPER ALLOY SPLIT BOLT CONNECTOR



BRANCH IN-LINE SPLICE FOR SERVICE/LATERAL, TEE, CROSS OR AIR RELEASE

NO.	DESCRIPTION:
1.	3-LAYERS OF HALF LAPPED VINYL TAPE.
2.	3-LAYERS OF HALF LAPPED RUBBER TAPE.
3.	COPPER CRIMP CONNECTOR OR COPPER ALLOY SPLIT BOLT CONNECTOR.
4.	SOLID COPPER WITH 30 MILS BLUE HDPE INSULATION (AWG #12 TRACER WIRE).
5.	SPLIT BOLT.
6.	PRESSURE BAR.
7.	HEX NUT.

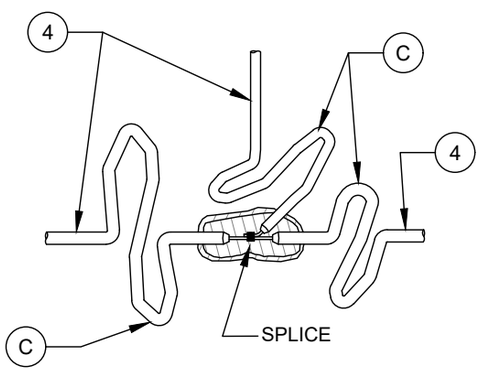
NOTES:

A. REMOVE MAINLINE TRACER WIRE INSULATION MATERIAL TO EXPOSE COPPER CORE WIRE.

B. IN LINE SPLICES SHALL BE LIMITED TO THE GREATEST EXTENT POSSIBLE. TRACER WIRE SHALL BE AS CONTINUOUS AS POSSIBLE WITHOUT SPLICES.

C. SPLICES SHALL INCLUDE 2' OF SLACK WIRE ON EACH SIDE OF EACH SPLICE (SEE DETAIL ON THIS SHEET).

D. TRACER WIRE PLACEMENT NEXT TO PIPE FOR PIPE MATERIALS OTHER THAN HDPE. TRACER WIRE PLACEMENT IN RELATION TO HDPE PIPE IS UNDER PIPE IN CASE OF WEATHER.



SPLICES WITH 2' OF SLACK WIRE

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

TRACER WIRE - WATER MAIN - SPLICE

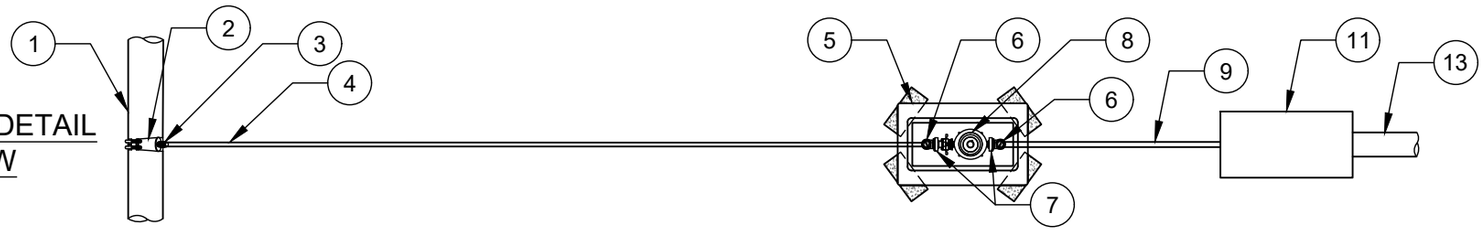
NO SCALE

VERSION 1.0

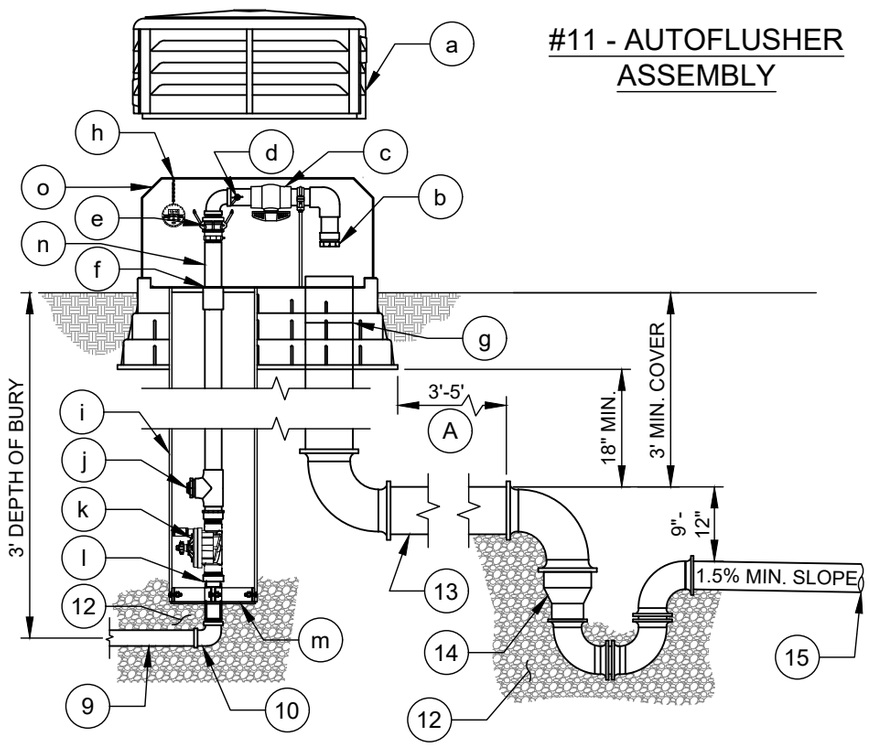
DATE 04/2024

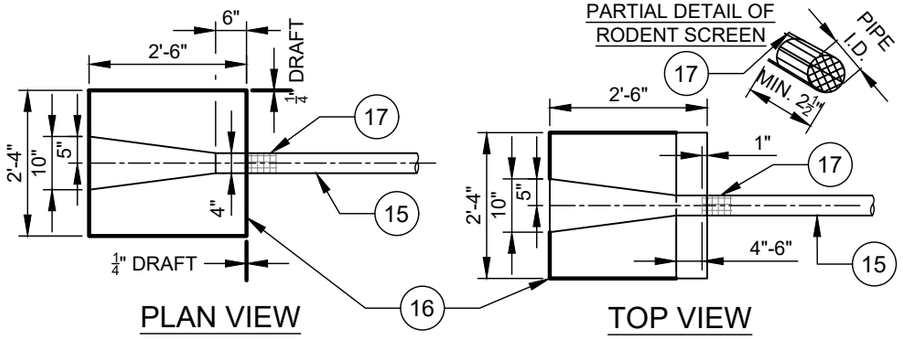
DETAIL 10.15.3

INSTALLATION DETAIL
PLAN VIEW



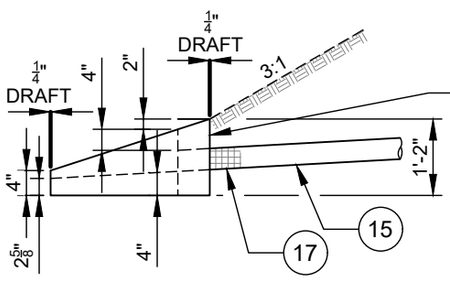
#11 - AUTOFLUSHER ASSEMBLY

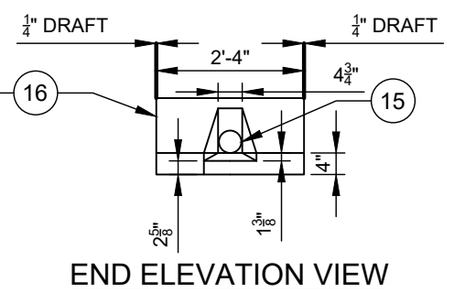




PLAN VIEW

TOP VIEW





ELEVATION VIEW

END ELEVATION VIEW

THE CONCRETE PAD CONSISTS OF 0.137 CUBIC YARDS - 3,600 PSI.

CONCRETE FLAIRED END FOR SHOULDER DRAIN

NOTES:

A. INSTALL TRAP 3'-5' DOWNSTREAM FROM EDGE OF UNIT WITH A 6" SERVICE LINE.
B. FLUSH WATER LINES FREE OF DEBRIS BEFORE INSTALLATION OF AUTO-FLUSHER.
C. DISCHARGE WATER FROM THE AUTO-FLUSHER UNIT MAY BE MANAGED IN ONE OF THREE WAYS:
   1. DISCHARGE INTO AN EXISTING SANITARY SEWER MAIN WITH A 4" SERVICE LINE.
   2. DISCHARGE INTO AN EXISTING STORM WATER MAIN. THIS CONNECTION MUST TAKE INTO ACCOUNT THE DOWNSTREAM IMPACTS OF THE CONNECTION, AND BE APPROVED BY CHARLOTTE OR MECKLENBURG COUNTY STORMWATER SERVICES AND/OR LOCAL MUNICIPAL STORMWATER REQUIREMENTS, IF APPLICABLE.
   3. SURFACE DISCHARGE THROUGH PIPING AND AN OUTLET STRUCTURE, PERMITTING OVERLAND FLOW TO A DITCH OR STREAM. DETAIL FOR THE OUTLET STRUCTURE IS SHOWN ON THIS SHEET.
D. BASED ON ACTUAL METER READINGS, ADJUST ANGLE BALL VALVE TO RESTRICT ACTUAL MAXIMUM FLOW TO 25 GPM.
E. TRACER WIRE INSTALLED PER CLTW TRACER WIRE DETAIL AS APPLICABLE.

NO.	DESCRIPTION:
1.	WATER MAIN.
2.	1" DOUBLE STRAP SERVICE SADDLE.
3.	1" BALL CORPORATION STOP - (CC THREAD X CTS COMPRESSION OUTLET).
4.	1" TYPE K COPPER TUBING OR SDR 9 HDPE (CTS) TUBING, W/ INSERT STIFFENERS.
5.	1" PLASTIC METER BOX W/PLASTIC LID (CONCRETE BOX REQUIRED IN HARDSCAPE) W/ 4 SUPPORT BRICKS.
6.	1" ANGLE BALL VALVE WITH LOCK WINGS - CTS COMPRESSION X YOKE STAR NUT.
7.	1" DUCTILE IRON YOKE BAR.
8.	1" WATER METER ASSEMBLY (BY CLTW) WITH ARM TRANSMITTER.
9.	1" TYPE K COPPER OR SDR 9 HDPE (CTS) TUBING, W/ INSERT STIFFENERS, 36" LAY LENGTH.
10.	1" BRASS 90° BEND - CTS COMPRESSION X FIPT.
11.	1" AUTOFLUSHER UNIT - MODEL 9800A AS MANUFACTURED BY KUPFERLE FOUNDRY COMPANY.
	a. UV RESISTANT LOCKABLE LID.
	b. DIFFUSER/TRAP.
	c. 1" PVC BALL VALVE.
	d. SAMPLING POINT.
	e. 1" STAINLESS STEEL QUICK DISCONNECT.
	f. REMOVABLE ACCESS PLATE.
	g. 6" SEWER PIPE CONNECTION.
	h. CONTROLLER. HANG FROM LID SUPPORT BRACKET.
	i. SDR 35 PVC PIPE.
	j. AUTOMATIC DRAIN.
	k. 1" AUTOMATIC VALVE.
	l. O-RING CONNECTOR.
	m. DEBRIS PLATE.
	n. 1" SCH 80 PVC PIPE.
	o. STEEL LID SUPPORT BRACKET.
12.	CLEAN #57 WASHED STONE.
13.	6" PVC SCH 80 PIPE.
14.	6" X 4" REDUCER - SCH 80 PVC.
15.	4" PVC SCH 80 DISCHARGE PIPING.
16.	PRECAST CONCRETE FLAIRED END SECTION.
17.	RODENT SCREEN. 2" X 2" TO 4" X 4" GALV. HARDWARE CLOTH 0.063 WIRE OR EQUAL INSTALLED 4" TO 6" INSIDE DRAIN PIPE.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

WATER QUALITY AUTOMATIC FLUSHER - 1-INCH AUTOFLUSHER - (MAX. FLOW RATE - 25 GPM)

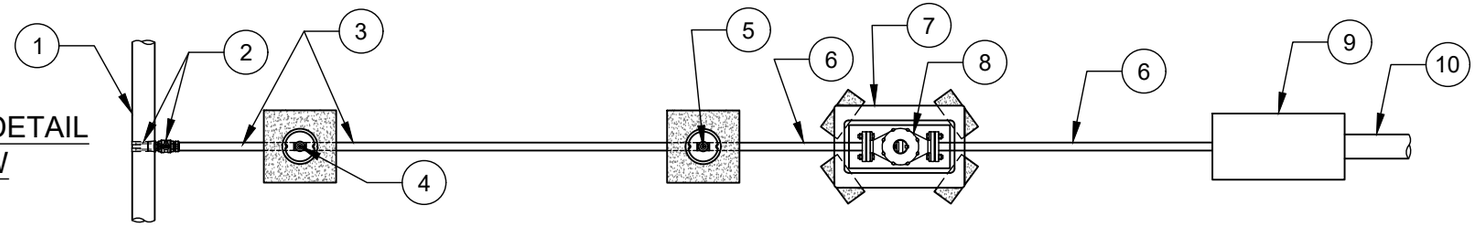
NO SCALE

VERSION 1.0

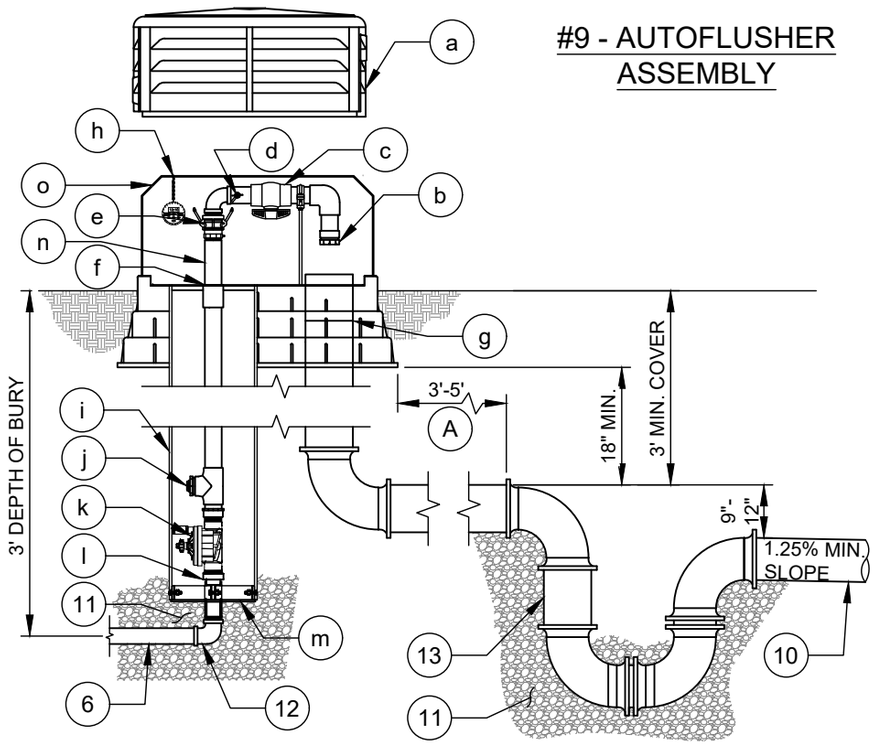
DATE 04/2024

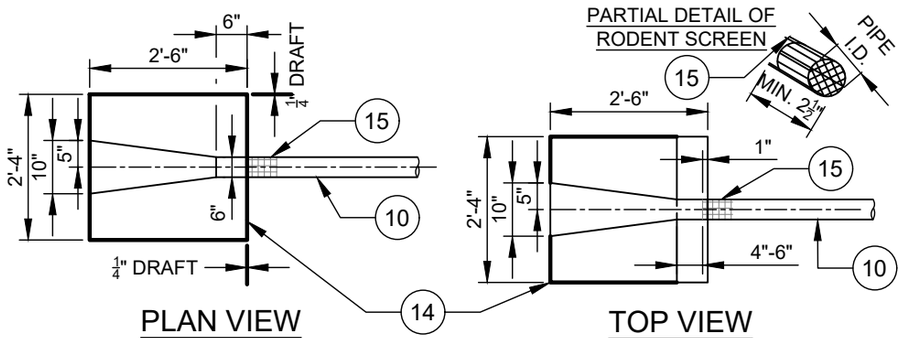
DETAIL 10.16.1

INSTALLATION DETAIL
PLAN VIEW



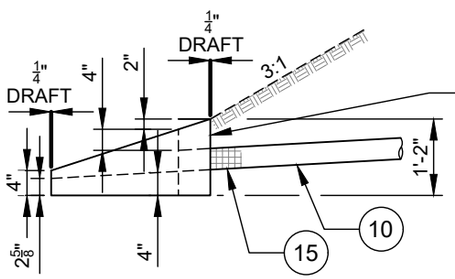
#9 - AUTOFLUSHER ASSEMBLY



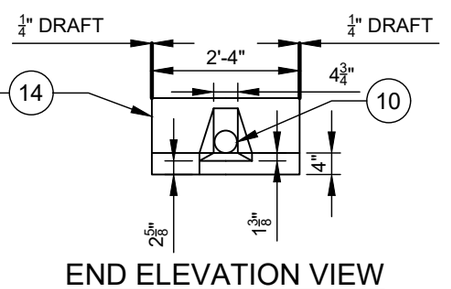


PLAN VIEW

TOP VIEW



ELEVATION VIEW



END ELEVATION VIEW

THE CONCRETE PAD CONSISTS OF 0.137 CUBIC YARDS - 3,600 PSI.

CONCRETE FLAIRED END FOR SHOULDER DRAIN

NOTES:

A. INSTALL TRAP 3'-5' DOWNSTREAM FROM EDGE OF UNIT WITH A 6" SERVICE LINE.
B. FLUSH WATER LINES FREE OF DEBRIS BEFORE INSTALLATION OF AUTO-FLUSHER.
C. DISCHARGE WATER FROM THE AUTO-FLUSHER UNIT MAY BE MANAGED IN ONE OF THREE WAYS:
   1. DISCHARGE INTO AN EXISTING SANITARY SEWER MAIN WITH A 6" SERVICE LINE.
   2. DISCHARGE INTO AN EXISTING STORM WATER MAIN. THIS CONNECTION MUST TAKE INTO ACCOUNT THE DOWNSTREAM IMPACTS OF THE CONNECTION, AND BE APPROVED BY CHARLOTTE OR MECKLENBURG COUNTY STORMWATER SERVICES AND/OR LOCAL MUNICIPAL STORMWATER REQUIREMENTS, IF APPLICABLE.
   3. SURFACE DISCHARGE THROUGH PIPING AND AN OUTLET STRUCTURE, PERMITTING OVERLAND FLOW TO A DITCH OR STREAM. DETAIL FOR THE OUTLET STRUCTURE IS SHOWN ON THIS SHEET.
D. BASED ON ACTUAL METER READINGS, ADJUST GATE VALVE TO RESTRICT ACTUAL MAXIMUM FLOW TO 80 GPM.
E. TRACER WIRE INSTALLED PER CLTW TRACER WIRE DETAIL AS APPLICABLE.

NO.	DESCRIPTION:
1.	WATER MAIN.
2.	2" DOUBLE STRAP SERVICE SADDLE W/CORPORATION STOP - (CC THREAD X CTS COMPRESSION OUTLET).
3.	2" TYPE K COPPER TUBING.
4.	2" GATE VALVE (FIPT X FIPT) W/ BRASS MIPT X CTS COMPRESSION ADAPTOR, EACH END, W/ STD VALVE BOX ASSEMBLY.
5.	2" GATE VALVE (FIPT X FIPT). WHEN REQUIRED BY CLTW, W/ BRASS MIPT X CTS COMPRESSION ADAPTOR-FRONT SIDE, W/ STD VALVE BOX ASSEMBLY.
6.	2" BRASS NIPPLE (MIPT X MIPT) 30" OR 36" LAY LENGTH.
7.	1" PLASTIC METER BOX W/PLASTIC LID (CONCRETE BOX REQUIRED IN HARDSCAPE) WITH 4 SUPPORT BRICKS.
8.	2" WATER METER (2-BOLT METER FLANGE X 2-BOLT METER FLANGE) (W/ BRASS 2-BOLT METER FLANGE X FIPT ADAPTOR, EACH END) (W/ S.S. TYPE 304 BOLTS/NUTS).
9.	2" AUTOFLUSHER UNIT - MODEL 9800 AS MANUFACTURED BY KUPFERLE FOUNDRY COMPANY.
	a. UV RESISTANT LOCKABLE LID.
	b. DIFFUSER/TRAP.
	c. 2" PVC BALL VALVE.
	d. SAMPLING POINT.
	e. 2" STAINLESS STEEL QUICK DISCONNECT.
	f. REMOVABLE ACCESS PLATE.
	g. 6" SEWER PIPE CONNECTION.
	h. CONTROLLER. HANG FROM LID SUPPORT BRACKET.
	i. SDR 35 PVC PIPE.
	j. AUTOMATIC DRAIN.
	k. 2" AUTOMATIC VALVE.
	l. O-RING CONNECTOR.
	m. DEBRIS PLATE.
	n. 2" SCH 80 PVC PIPE.
	o. STEEL LID SUPPORT BRACKET.
10.	6" PVC SCH 80 DISCHARGE PIPING.
11.	CLEAN #57 WASHED STONE.
12.	2" S.S. TYPE 304 OR 316 FIPT X FIPT 90° BEND.
13.	6" PVC SCH 80 PIPE & P TRAP.
14.	PRECAST CONCRETE FLAIRED END SECTION.
15.	RODENT SCREEN. 2" X 2" TO 4" X 4" GALV. HARDWARE CLOTH 0.063 WIRE OR EQUAL INSTALLED 4" TO 6" INSIDE DRAIN PIPE.

NO. ALTERNATE DESCRIPTION:

WHEN USING HDPE (IPS) POLY IN PLACE OF COPPER TUBING, USE THE FOLLOWING PRODUCTS:

2.	2" BALL CORPORATION STOP - (CC THREAD X FIPT OUTLET).
3.	2" SDR 9 (IPS) HDPE PIPE, WITH BUTT FUSED HDPE X S.S. THREADED ADAPTOR, EACH END.
4.	2" GATE VALVE (FIPT X FIPT), W/STD VALVE BOX ASSEMBLY.
5.	2" GATE VALVE (FIPT X FIPT), WHEN REQ'D BY CLTW, W/ STD VALVE BOX ASSEMBLY.
6.	2" SDR 9 (IPS) HDPE PIPE, WITH BUTT FUSED HDPE X S.S. THREADED ADAPTOR, EACH END, 30" OR 36" LAY LENGTH.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER

WATER QUALITY AUTOMATIC FLUSHER - 2-INCH AUTOFLUSHER - (MAX. FLOW RATE - 80 GPM)

NO SCALE

VERSION 1.0

DATE 04/2024

DETAIL 10.16.2

CHAPTER 11
GRAVITY SANITARY SEWERS

CHAPTER 11
GRAVITY SANITARY SEWER DESIGN

1. GENERAL

A. This chapter covers the minimum design criteria to be used for designing sanitary sewer pipelines and appurtenances including those portions of sewer service connections that lie in public rights-of-way and in easements granted to Charlotte Water. All other systems are the responsibility of the respective property owner unless otherwise documented via agreement with Charlotte Water.

B. All engineering plans for sanitary sewers must meet the Charlotte Water design standards as presented, the State standards as indicated in the most recent amended *Administrative Code, Title 15A, Subchapter 2T Waste Not Discharged to Surface Waters* by the North Carolina Department of Environmental Quality (NCDEQ), and the Division of Water Resources' *Minimum Design Criteria*. In general, the Charlotte Water standards should be the primary source for design guidance with the State standards as a supplement. In some cases, the Charlotte Water standard is more stringent than the State standard.

C. All designs must be sealed by a North Carolina professional engineer.

2. HYDRAULIC DESIGN

A. General

1) In general, sewers and associated manholes and structures shall convey the ultimate flow within the area tributary to the sewer including any flow pumped to the sewer basin from adjacent basins.

2) For new sewers servicing previously undeveloped areas, design flows shall be calculated per Item 2(B) of this chapter. For new sewers serving developed areas, design capacity should be determined per the Capacity Assurance Program (CAP).

3) New flow requests shall confirm downstream sewer facilities' capacity through the CAP.

B. Calculating Flows

1) Flow analysis shall include a sewer basin map showing the project's total potential sewered area including any existing upstream sewered or unsewered areas, location of any contributing pumped sewer flow, and downstream connection to an existing sewer.

2) Populations to be served shall be calculated from Future Land Use (FLU) plans for the sewer basin. Population may include residential, commercial, industrial, and institutional categories. Population should be estimated based on developable area.

3) All residential, commercial, industrial, and institutional unit wastewater design flow rates shall be as per 15A NCAC 02T .0114 unless that design flow has been adjusted as granted pursuant to paragraph (f) of that regulation.

4) Peak daily flow shall be proportional to population and calculated using the following equation:

$$PF = \frac{18 + \sqrt{P}}{4 + \sqrt{P}}$$

Where:

PF = peaking factor, minimum of 2.5

P = service population in thousands

Based on the complexity of the proposed project, Charlotte Water may request population projection calculations.

C. Minimum Slope Requirements

Minimum slope for various size sewer pipes is provided in Table 11.1.

Table 11.1: Minimum Slopes for Sanitary Sewers

Sewer Pipe Size (inches)	Minimum Slope (feet per 100 feet)
4	1.50
6	1.25
8	0.60
10	0.35
12	0.28
15	0.19
16	0.18
18	0.15
21	0.13
24	0.10
30	Based on 2.5 fps minimum scour velocity
36	

D. Pipe Sizing

1) Minimum size of a gravity sewer shall be 8 inches.

2) The sewer pipe shall be sized to convey the peak hourly flow with the pipe flowing 90% full.

3) Manning's Equation shall be used to determine pipe size. All sewer pipes shall have a velocity of > 2.5 feet per second (fps) and < 10 fps based on the equation:

$$Q = \frac{1.486AR^{2/3}}{n}S^{1/2}$$

Where:

Q = Capacity, cubic feet per second (cfs)

A = Cross sectional area of pipe, ft^2

R = Hydraulic radius, ft = $\frac{\text{cross sectional area}}{\text{wetted perimeter}}$

n = Manning's roughness coefficient, use n = 0.013

S = Slope, ft/ft

4) Where velocities exceed 10 fps, special provisions shall be required in order to prevent scour and protect against internal erosion and/or impact.

5) The sewer pipe slope and diameters shall be selected in order to minimize sediment accumulation. Flatter slopes shall not be justified or substituted with oversized sewers.

6) Charlotte Water will determine each project's level of required calculation and/or modeling documentation during the CAP application process which will be determined based on amount of flow contribution, location of the project, and sewer network. Calculations may be provided in the form of a spreadsheet summary of each pipe segment for sewer extensions and small development connections, or a calibrated hydraulic model for a large sewer basin connecting to a trunk sewer.

3. SEWERS

A. Location

1) Gravity sewer shall be located within the limits of public road rights-of-way (ROW). Gravity sewer located outside public ROW shall require a dedicated easement and with Charlotte Water approval. Specific horizontal alignment shall be made with consideration to property lines, construction conditions, underground conflicts, and property owner requirements.

2) Sewer lines shall not be located in either public or private alleys.

3) Gravity sewer mains serving drainage basins shall follow the natural drainage pattern of the basin as closely as possible. Specific horizontal alignment shall be made with consideration to property lines, topography, creeks/top of banks, environmental damage, and property owner requirements.

4) Sewer lines between manholes shall be laid in straight lines and at constant grade.

5) Upstream main lines or branch lines shall intersect downstream main lines at a 90-degree angle or greater.

6) Sewer lines shall be installed with warning tape and copper tracer wire as shown in the standard details and referenced in the specifications.

7) Sewer pipe and laterals laid along residential lot lines, extending from the front setback to the rear setback, and between permanent structures shall be epoxy lined ductile iron pipe. Fittings shall be epoxy lined or fusion bonded epoxy lined.

8) The outside edge of sewer easements shall be located a minimum of 10 feet outside the top of streambank. Consideration for sewer pipe within stream and water quality buffers shall be reviewed to meet current regulations. The following buffers are known to exist in Charlotte Water's service area including, but not limited to:

   a. Water Supply Watershed Buffers

   b. Surface Water Improvement and Management (SWIM) Buffers

   c. Post-Construction Buffers

   d. Goose Creek and Six Mile Creek Buffers

9) Where sewer pipe is located near water bodies or wetlands and the sewer trench has the potential to convey and drain the water body, anti-seepage collars shall be installed per the standard detail. Anti-seepage collars shall be placed starting at the downstream pipe boundary of the top of stream bank or wetland and at every 150 feet upstream until the sewer pipe reaches the opposite top of stream bank or exits the wetland boundary. The governing authority may have more stringent requirements.

10) Charlotte Water may set additional requirements for the proposed sewer locations.

B. Steep Slope Allowance

Charlotte Water may, on a case-by-case basis, allow high velocity/steep slopes for 8-inch sewer between 10% (0.10 ft/ft) and 19% (0.19 ft/ft) if all the following requirements are met:

1) High velocity sewer mains shall only be 8-inch in diameter.

2) Slopes greater than 19% are not permitted.

3) The minimum design flow shall be equal to that generated from 20 upstream single-family lots or equal design flow.

4) The maximum design flow depth shall be limited to half of the pipe diameter.

5) If the design velocity is greater than 10 fps, the pipe material and thickness shall be at least AWWA C900 DR 25 PVC pipe or epoxy lined ductile iron pipe. Fittings shall be epoxy lined or fusion bonded epoxy lined.

6) If the design velocity is greater than 15 fps, the pipe shall be epoxy lined ductile iron pipe. Fittings shall be epoxy lined or fusion bonded epoxy lined.

7) Drops are not permitted in the downstream manhole of pipes with slopes greater than 10%.

8) The deflection angle of the discharge in the downstream manhole shall be less than 45 degrees.

4. LATERALS

A. Each dwelling unit or building shall be served by a lateral meeting the requirements.

B. A single lateral may serve a Single-Family or Duplex Dwelling and an Accessory Unit Dwelling if located on the same parcel. These shared laterals are deemed permitted per 15A NCAC 02T.0303.

C. If a parcel contains sublots with separate, individual ownership, each sublot must be served by an individual lateral meeting the requirements below.

D. Each building of a Triplex, Quadraplex, and Multi-Family Dwelling Unit shall be served by a lateral meeting the requirements below.

E. Location

1) Lateral connections onto a new sewer main shall be installed with a tee or into a manhole. Where practical, laterals shall connect to manholes in lieu of tees in roadways.

2) Laterals connecting in manholes shall match larger downsteam pipe crowns.

3) Lateral connections on sewer outfalls greater than 24 inches in diameter shall connect to manholes unless otherwise approved by Charlotte Water.

4) Lateral connections may be installed onto an existing sewer main with a tee saddle if the existing sewer main is a minimum of twice the diameter of the lateral.

5) A doghouse manhole is required when the lateral connection is the same size or one size smaller than sewer main (i.e. not twice diameter).

6) Lateral connections shall be perpendicular to the sewer main.

7) Minimum spacing between sewer laterals and water services shall be 5 feet.

8) Minimum spacing between sewer laterals and parallel storm pipes and/or catch basins shall be 5 feet.

9) Minimum spacing between lateral connections to a sewer main shall be 7 feet and a minimum of 3 feet from pipe joints.

10) Minimum spacing between a lateral connection to a sewer main and a manhole shall be 7 feet.

11) No more than one lateral may be connected to each side of an inline manhole with a minimum angle of 35 degrees between the lateral and sewer main. The minimum angle between the lateral and the downstream pipe shall be 90 degrees.

12) No more than three laterals may be connected to a terminal manhole. No more than two laterals may be connected to a terminal manhole if a future extension upstream is possible. The minimum angle between the lateral and the downstream pipe shall be 90 degrees.

13) Minimum slope on a lateral is 1.5% for 4-inch laterals, 1.25% for 6-inch laterals, and 0.6% for 8-inch laterals.

14) Maximum slope on a lateral is 10% unless approved by Charlotte Water.

15) Laterals are prohibited inside the curb radius point of public or private road intersections unless the lot only has road frontage inside the curb radius point.

16) Laterals shall terminate with a cleanout or manhole located outside the road rights-of-way or sewer easement and no closer than 3 feet from the side property line.

17) All private service lateral easements shall be acquired by the developer/property owner when applicable to confirm land locked customers have established and maintained access to their services. Private service lateral easements are allowed in these situations:

    a. Property is landlocked, i.e. no frontage on a public street,

    b. Property has Charlotte Water sewer service directly available, but the property owner prefers to connect in a different location, i.e. to provide gravity service, or

    c. There is no justification to require Charlotte Water sewer to be extended to the property, i.e. all surrounding property is served.

F. Sizing

1) Laterals shall be a minimum of 4 inches in diameter.

2) Laterals serving a Single-Family or Duplex Dwelling and an Accessory Unit Dwelling shall be a minimum of 8 inches in diameter.

D. Backwater Valves

1) When the building finished floor elevation is located at or below the ground elevation at the sewer main connection, the lateral shall have a private sewer backwater valve located after the property line cleanout, and a cleanout pop off on a private cleanout located between the backwater valve and the building.

5. MANHOLES

A. Location

1) Manholes shall be placed at all horizontal and vertical break points and at the confluence of two or more separate sewer pipes.

2) When located outside of street rights-of-way, roads, sidewalks, driveways, and maintained lawns, manhole rims shall be a minimum of 2 feet above the finished grade.

3) When located within street rights-of-way and in approved landscaped areas and maintained lawns, manhole rims shall be flush with the finished grade.

4) When located in subdivision streets (single family and multi-family developments), manholes shall be located at the crown of the road when possible but at no time closer than 4 feet from the lip of the curb, as measured to the center of the manhole. Sewer pipe shall be no closer than 3 feet from the lip of the curb, as measured to the center of the pipe.

5) When manhole covers are located in roads within 6 feet from the lip of the curb, a solid cover with no vent holes shall be provided.

6) Manhole rims shall be 2 feet above the 100-year flood elevation unless provided with a watertight and locking frame and cover.

7) Manholes shall not be placed within a 100-foot radius of a water supply well.

B. Sizing

Minimum manhole sizing requirements for connected pipe diameter sizes and manhole cover sizes are summarized in Table 11.2 below:

Table 11.2: Minimum Manhole Sizing Requirements

Sewer Pipe Diameter (inches)	Minimum Manhole Diameter (feet)	Manhole Frame Clear Opening Diameter (inches)
8 – 16	4	24
18 – 36	5	30
42 - 54	6	30
54	8	30
60	12	30
$\geq$ 64	12	30

The manhole diameter for a given pipe size may be increased from that shown above for applications where the angle between the influent and effluent pipes precludes proper installation of the pipe connections in the standard size manhole.

C. Spacing

Maximum manhole spacing requirements are summarized in Table 11.3 below:

Table 11.3: Maximum Manhole Spacing Requirements

Sewer Pipe Diameter (inches)	Maximum Manhole Spacing (feet)
8 ≤ 24	500
24 - 42	700
> 42	800

Charlotte Water is the Owner of the connected sewer pipes and has the experience and equipment capability to perform routine cleaning and maintenance at these distances.

D. Venting

1) Manholes shall be vented by use of vented covers or external vent pipe structures.

2) Manhole vents are required at intervals of approximately 1,000 feet.

3) Any manholes subject to flooding or inflow from storm water shall have watertight frames and covers according to the Standard Details for frames and covers.

4) Manholes with external vents shall have locking watertight frames and covers with the vent inlet 2 feet above the 100-year flood elevation or 6 feet above the rim, whichever is greater, and installed on straight wall of manhole, facing downstream. External vents shall be 5-inch diameter, Schedule 40 steel with internal lining and external coating per steel pipe specifications. Vent inlets shall be provided with welded-on external flange ring with flanged stainless-steel bird screen.

5) Offset vents are only allowed in extenuating circumstances as approved by Charlotte Water.

E. Falls and Drops

1) For sewer mains 16 inches in diameter and smaller, a 0.2 foot sloped vertical fall shall be provided through each manhole unless approved by Charlotte Water.

2) For sewer mains 18 inches in diameter and larger, no vertical fall is required through the manholes.

3) Fall through manholes shall be limited as much as possible to prevent turbulent conditions, such as hydraulic drop conditions.

4) At manholes where a smaller diameter pipe connects to a larger diameter pipe, match the crown of the smaller pipe to the crown of the larger pipe.

5) Drops are not allowed unless existing conditions justify their need and with Charlotte Water approval.

   a. When the vertical drop through the manhole is less than 2.5 feet, the un-piped drop shall have a sloped trough across the manhole.

   b. Inside drops shall be used when the vertical drop through the manhole is 2.5 feet or greater. Inside drops shall be constructed of Schedule 40 PVC pipe as shown in the Standard Details. Drop pipe shall be one pipe size larger than the inlet pipe diameter. Inside drop manholes shall be a minimum of 5 feet in diameter and contain no more than two (2) inside drops. Inlet pipes shall have a minimum 5 feet of cover and shall not enter the cone section of the manhole.

   c. The maximum height of an inside drop is 10 feet.

   d. Outside drops must be approved by Charlotte Water on a case-by-case basis. Outside drops shall be constructed of DIP and fittings. An outside drop shall have a minimum of 5 feet of cover and installed as shown in the Standard Details as either an attached or detached/cleanout drop. Attached drop shall be used when located in a road right-of-way and detached/cleanout drops shall be used when located outside of a road right-of-way. Inlet pipes shall not enter the cone section of the manhole.

6. UTILITY SETBACKS AND SEPARATIONS

The minimum clearance requirements for conflicts with utilities and other features, in accordance with NCAC 02T.0305 and governing utility guidelines, is shown in Tables 11.4 and 5. Depth of cover shall be defined from the top of the pipe. Charlotte Water reserves the right to require increased separations.

Table 11.4: Minimum Separations for Sewers per NCAC 02T.0305

Setback Parameter	Separation Requirements*
Storm Sewers and other utilities not listed below (vertical) Where separation cannot be met, DIP or structural bridging to prevent crushing the underlying pipe shall be used.	2 feet
Water Lines Vertical, water over sewer including in a shared, benched trench Horizontal Where a water main crosses over a sewer, one full length of water pipe shall be located so that both joints will be as far from the sewer as possible.	 18 inches 10 feet

Reclaimed Water Lines Vertical, reclaimed over sewer Horizontal, reclaimed over sewer	 18 inches 2 feet
Any private or public water supply source, including any wells, WS-I waters of Class I or Class II impounded reservoirs used as a source of drinking water (stream classifications from Division's NC Surface Water Classifications webpage) For public or private wells where minimum separation cannot be met, piping materials, testing methods and acceptability standards meeting water main standards shall be used. All appurtenances shall be outside the 100' radius. The minimum separation shall however not be less than 25' from a private well or 50' from a public well.	100 feet
Waters classified WS-II, WS-III, WS-IV, B, SA, ORW, HQW, or SB from normal high water or tide elevation, wetlands directly abutting these waters, and wetlands classified as UWL or SWL (stream classifications from Division's NC Surface Water Classifications webpage)	50 feet
Any other stream, lake, impoundment, wetlands classified as WL, waters classified as C, SC, or WS-V, or ground water lowering and surface drainage ditches	10 feet
Any building foundation	10 feet
Any basement	10 feet
Top slope of embankment or cut of 2 feet or more vertical height	10 feet
Drainage systems and interceptor drains	5 feet
Swimming pools	10 feet
Final earth grade (vertical) Where minimum cover cannot be met, DIP shall be used. Where sewers are subject to traffic bearing loads, DIP or other pipe with proper bedding to develop design supporting strength shall be provided.	36 inches
For all other separations, materials, testing methods, and acceptability standards meeting water main standards (15A NCAC 18C) shall be required in any alternative.	

1

Table 11.5: Minimum Separations for Sewers to Other Features	
Stormwater BMP	Sewer easements remain outside 1:1 slope to the BMP easement
Retaining Wall	Sewer to remain a minimum of 5 feet from footings and outside of geogrid area/structural impact of retaining wall

Roadways and Driveways	2 feet from edge of pavement and/or back of curb measured to center of pipe
Gas	3 feet from top of gas main to bottom of sewer
Existing Utilities (water, storm drain, etc.)	1 foot clearance from top of utility to bottom of sewer when sewer crosses over other utility lines, if clearance cannot be met, DIP shall be used from 5 feet outside the utility trench for a minimum length of 20 feet
Ponds/Lakes	Anti-seep collars and DIP shall be used when sewer is 6 feet or greater below the full pond water elevation and within 25 feet as measured from the toe of slope

7. DEPTH AND STRUCTURAL DESIGN

A. A minimum of 4 feet of cover shall be provided for all sewers in off-road easements.

B. A minimum of 5 feet of cover and maximum of 14 feet of cover shall be provided for all sewers in road rights-of-way and other paved areas.

C. A minimum of 4 feet of cover at the curb line or road right of way shall be provided for all laterals.

D. When minimum depths cannot be provided and are approved by Charlotte Water, sewer shall be ductile iron pipe and may require piers or concrete collars to stabilize the pipe.

E. Maximum depths and bedding requirements for each type of allowable pipe material are addressed in the pipe material specifications.

F. Where unstable soil conditions are known to exist, the design shall include special structural elements (pilings, cradles, piers) based on evaluation of actual subsurface explorations and testing.

G. Special structures such as piers, vaults, and pumping stations shall have a foundation design based on evaluation of actual subsurface explorations and testing.

H. Ductile iron pipe and epoxy lining or fusion-bonded epoxy coating may be required at additional locations at Charlotte Water's discretion.

8. STREAM CROSSINGS

Stream crossings shall be minimized, and the following design standards shall be followed:

A. Streambanks shall be protected from erosion at all times and shall comply with all requirements of the jurisdiction having authority.

B. Sewer pipe shall cross stream channels at a near-perpendicular direction.

C. When possible, stream crossings shall be made with the top of pipe casing (or carrier pipe, if no casing) a minimum of 3 feet below the stream bed. Pipe shall be protected from flotation by the use of piers, piles, and/or concrete collars.

D. When necessary, as dictated by depth of cover, stream width, flow conditions, and soil conditions, special anchorage shall be required to prevent flotation and/or washout.

E. Pipe under streambed shall be factory installed restrained joint ductile iron or Charlotte Water approved material.

F. Aerial stream crossings are not recommended and shall only be reviewed by Charlotte Water in extreme circumstances.

G. Designers shall be responsible for compliance with floodplain regulations and any approval(s) required by appropriate jurisdiction having authority.

9. INVERTED SIPHONS

Inverted siphons are not allowed without Charlotte Water approval.

10. CORROSION PROTECTION

A. Where areas of potential release of corrosive hydrogen sulfide gas exists, such as force main discharges and low-pressure sewer discharges, corrosion resilient manholes and structures shall be provided at the discharge structure and a minimum of 100-feet downstream up to a maximum of three downstream manholes at Charlotte Water's direction. This may include protective coatings on exposed concrete surfaces, additives, or polymer concrete structures at Charlotte Water's discretion.

B. When located downstream of force main and low-pressure sewer discharges, ductile iron pipe and fittings shall be lined with epoxy lining a minimum of 100-feet downstream and up to a maximum of three downstream manholes at Charlotte Water's direction.

C. Where ductile iron pipe may be installed in corrosive soils, polyethylene encasement of the ductile iron pipe and fittings is required. Soil testing shall be required to be conducted by an experienced technician as certified by The Association for Materials Protection and Performance (AMPP) to determine if additional protective measures are required.

D. Where pipes are installed near impressed current utilities, such as gas pipelines, high voltage power transmission lines, light rail, street cars, and railroads, a stray current field analysis and soil testing shall be required to be conducted by an experienced technician as certified by The Association for Materials Protection and Performance (AMPP) to determine if additional protective measures are required. External protective measures may include zinc coating, double-wrapped polyethylene encasement, or bonded joints and sacrificial anodes as approved by Charlotte Water. PVC or HDPE pipe is preferred however, at a minimum ductile iron pipe and fittings shall be double wrapped in polyethylene encasement and lined with epoxy lining. Upon approval of controlling agency, C900 PVC carrier pipe inside a casing or open cut HDPE casing pipe may be allowed.

E. Reference Chapter 18 Corrosion Control for specific requirements and details for corrosion control and monitoring systems.

11. DESIGN OF EROSION AND SEDIMENT CONTROL MEASURES

Regardless of size, all sanitary sewer projects shall include measures and/or devices to prevent erosion and to contain sediment within the limits of the right-of-way and/or proposed easements. Design and permitting of erosion and sediment control devices shall be in accordance with Charlotte Land Development Standards including the City of Charlotte Soil Erosion and Sedimentation Control Ordinance for Developer-Donated projects. Charlotte Water designed projects shall meet NCDEQ requirements, as outlined in the North Carolina Erosion and Sediment Control Planning and Design Manual. Projects outside of City limits but within Mecklenburg County or outside of Mecklenburg County shall follow the appropriate county, town, and/or state requirements.

12. BORES AND TUNNELS

A. Sewer crossings of railroads, major city streets, secondary roads, hydrocarbon transmission pipeline easements, and numbered highways must be encased in a steel pipe installed by either auger boring, boring and jacking, hand tunneling lined with prefabricated steel liner plates, or by another approved method by the controlling agency.

B. Minor city streets may be open cut with specific permission of the controlling agency, CDOT, NCDOT, or respective governing agency and if detailed on the construction drawings.

C. The carrier pipe shall be restrained ductile iron pipe, restrained AWWA C900 DR 18 or DR 14 PVC pipe, ASTM F714 HDPE SDR 9 pipe, or other controlling agency approved pipe material.

D. Steel encasement pipe shall be new and manufactured of Grade “B” steel with minimum yield strength of 35,000 psi. Steel pipe shall have machine cut, bevel ends that are perpendicular to the longitudinal axis of the casing or Permalok brand jointed casing pipe. Pipe shall be designed in accordance with AWWA M11.

E. Casing spacers shall be used on all gravity sewer pipes installed within a steel, or HDPE open cut casing pipe or tunnel or solid wall PVC open cut casing. A minimum of 3 casing spacers per joint shall be required. Casing spacers shall be evenly spaced to support the same weight of the carrier pipe and provide the necessary grade of the carrier pipe. Casing spacer manufacturer shall provide the load carrying capacity of each spacer to determine when additional casing spacers are required. Casing spacers shall not allow the carrier pipe to float within the casing pipe.

F. Within NCDOT encroachments, the annular space between the carrier and casing pipe shall be filled if the casing pipe has a diameter of 24 inches or larger. Lightweight cellular concrete grout may be used to fill the annular space to allow future removal if necessary. The Engineer of Record shall certify the casing pipe durability and design life of 100 years in lieu of filling the annular space when approved by NCDOT.

G. Bores and tunnels shall be designed to meet specific encroachment permit requirements, based on the governing agency (CDOT, NCDOT, CSX Corporation, Norfolk Southern Railway, NC Railroad, hydrocarbon transmission pipeline owner, etc.) based on loadings, depths, and minimum separation and clearances. The minimum size and thickness standards for steel casing pipe, carrier pipe, and tunnels for various sewer

pipe sizes shall be in accordance with the governing agencies and meet the minimum requirements in Table 11.6.

H. The minimum thickness provided in Table 11.6 are provided by the controlling agencies. The actual thickness required must be calculated based on site conditions and actual depth of cover.

Table 11.6: Minimum Requirements for Steel Casing Pipe and Tunnels

Carrier Pipe Size (inches)	Casing Pipe Minimum Thickness (inches)			Minimum Tunnel Size (inches)
	Casing Pipe Size (inches)	NCDOT	Railroads	
4	12	0.250	0.250	36
6	12	0.250	0.250	36
8	18	0.250	0.312	48
10	20	0.250	0.344	48
12	24	0.250	0.375	48
16	30	0.312	0.469	48
18	30	0.312	0.469	48
24	36	0.375	0.532	54
30	48	0.500	0.750	60
36	54	0.500	0.781	72
42	60	0.500	0.844	84
48	66	0.625	0.938	90
54	72	0.625	1.000	96

I. When HDPE SDR9 casing pipe is used for open cut casing installations, the minimum casing pipe size shall be as shown in Table 11.7. Bedding shall be Charlotte Water Type IV Granular Stone Bedding.

Table 11.7: Minimum Requirements for HDPE Open Cut Casing Pipe			
Carrier Pipe Size (inches)	Casing Pipe Size (OD, inches)	Casing Pipe Minimum Thickness (inches)	Casing Pipe Average ID (inches)
6	18	2.000	13.760
8	20	2.222	15.289
12	26	2.889	19.875
16	34	3.778	25.991

13. ABANDONMENT AND DISMANTLEMENT

A. Abandonment of existing pipes, structures, appurtenances, and limits of abandonment shall be clearly indicated on the project plans and shall meet the minimum requirements listed below. Abandonment procedures may be more stringent in accordance with the appropriate governing agency's standards.

1) All sewer pipes to be abandoned that are greater than 15 inches shall be filled with excavatable flowable fill or lightweight cellular concrete or removed.

2) Comply with current standards for sewer pipe to be abandoned inside NCDOT rights-of-way.

3) All sewer main pipes with less than 3 feet of cover shall be filled with excavatable flowable fill.

4) All abandoned pipe ends shall be plugged watertight.

5) All abandoned sewer mains shall be removed from active manholes and pipe and manhole walls plugged watertight. The manhole invert shall be rebuilt to conform with the standard details removing the abandoned trough.

6) All manholes shall be demolished to 3 feet below grade, removed from the site, and remaining structure filled with excavatable flowable fill or washed stone. Abandoned mains and laterals shall be plugged watertight at the wall of the abandoned manhole.

7) Abandoned manholes within 50 feet of wetlands shall have mains and laterals disconnected from the manhole, removed a minimum of 2 feet from the manhole, and plugged prior to filling with excavatable flowable fill.

8) Sewer laterals shall be abandoned/dismantled according to the following:

a. Short side sewer lateral – tap outside of pavement, shall be cut at the main/manhole, plugging the main/manhole invert watertight. Lateral shall be cut/plugged watertight at road right-of-way. Dismantled lateral shall be removed from main/manhole to road right-of-way.

b. Long side sewer lateral – tap outside of pavement, shall be cut at the main/manhole, plugging the main/manhole invert watertight. Lateral shall be cut/plugged watertight at road right-of-way. Dismantled lateral shall remain in place below pavement.

c. Sewer lateral – tap inside pavement, shall be cut at the main/manhole, plugging the main/manhole invert watertight. Lateral shall be cut/plugged watertight at road right-of-way. Dismantled lateral shall remain in place below the pavement to the road right-of-way

d. Sewer lateral with outside drop structure at manhole located outside pavement - shall be cut at the manhole, removing outside drop structure and plugging the manhole watertight at both pipe penetrations. Lateral shall be cut/plugged watertight at road right-of-way. Remove pipe from manhole to road right-of-way for short side laterals. Dismantled lateral shall remain in place below the pavement to the road right-of-way for long side laterals.

e. Sewer lateral with outside drop structure at manhole located inside pavement - shall be cut/plugged at the manhole. Lateral shall be cut/plugged watertight at road right-of-way. Invert in manhole and top pipe penetration shall be plugged watertight and the existing tee will be plugged. Dismantled lateral shall remain in place below the pavement to the road right-of-way.

f. Sewer lateral with inside drop structure in manhole located outside pavement - shall be cut at the manhole, removing inside drop structure and plugging the manhole wall at the top pipe penetration watertight. Lateral shall be cut/plugged watertight at road right-of-way. Remove pipe from manhole to road right-of-way for short side laterals. Dismantled lateral shall remain in place below the pavement to the road right-of-way for long side laterals.

g. Sewer lateral with inside drop structure in manhole located inside pavement - shall be cut at the manhole. Lateral shall be cut/plugged watertight at road right-of-way. Inside drop structure shall be removed and the manhole wall at the top pipe penetration shall be plugged watertight. Dismantled lateral shall remain in place below the pavement to the road right-of-way.

h. Sewer laterals inside Charlotte Water easements shall be removed from main to easement limits. Plug lateral watertight at easement limits. Plug lateral watertight at main/manhole per items above.

9) Aerial pipe and piers to be abandoned shall be fully removed from the stream channel to the concrete footings. Pipe shall be removed 3 feet within the stream banks and pipe ends shall be plugged watertight.

10) When a gravity sewer project includes the abandonment of a pump station and/or force main, refer to the Sewer Lift Station chapter for the abandonment requirements.

11) All disturbed areas shall be properly restored per Chapter 23 Restoration.

14. PIPE MATERIALS

A. The pipe material and classification shall be shown on the project plans.

B. For pipe greater than or equal to 24 inches in diameter, pipe material changes may only occur at a manhole.

C. The following pipe materials, displayed in Table 11.8, are approved for various applications.

TABLE 11.8 - Gravity Sewer Materials

Pipe Size (Inches)	Material	Pressure Class / Stiffness	Specifications
Collection Mains			
DIP			
≤ 12	DIP	Min Pressure Class 350	AWWA C151 ASTM A746
16 - 64	DIP	Min Pressure Class 350	AWWA C151 ASTM A746
PVC			
8	Solid Wall PVC	DR 26	ASTM D1784 ASTM D3034
8 – 30	Solid Wall PVC	DR 25	AWWA C900
≥ 30	Closed Profile PVC	ASTM D2412 PS 46, 60 or 75 psi Pipe cell classification 12454 or 12364	ASTM F1803 ASTM D2122 ASTM D2152 ASTM D2412 ASTM D2444
FRPM (Fiberglass Reinforced Polymer Mortar)			
≥ 30	FRPM	ASTM D2412 SN 72 psi	ASTM D3262 AWWA C950 AWWA M45
High strength steel pipe allowed for aerial crossings 40’ max length for 8 & 10-inch diameter pipe 50’ max length for ≥ 12-inch diameter pipe			
Laterals			
4, 6	DIP	Min Pressure Class 350	AWWA C151 ASTM A746
4, 6	Solid Wall PVC	SCH 40, White (used with DR 26 mains)	ASTM D1785 ASTM D2665
4, 6	Solid Wall PVC	DR 18 (used with C900 DR 25 mains)	AWWA C900
PVC white solid wall SCH 40 allowed for cleanouts, standpipes & tailpieces			
PVC gray solid wall SCH 80 allowed for lateral installation in an uncased bore			

END OF SECTION

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CHAPTER 11
GRAVITY SANITARY SEWERS

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PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Ductile-iron, Gravity Sewer Pipe and Fittings
2. PVC Pipe and Fittings
3. Fiberglass Reinforced Polymer Mortar Pipe
4. Aerial Steel Pipe
5. Couplings
6. Service Connections – Tapping Saddles
7. Manholes
8. Parshall Flumes
9. Concrete
10. Miscellaneous Steel
11. Bedding Materials - Stone and Brick/Block
12. Micropiles
13. Anti-Seep Collars
14. Anti-Flotation Collars
15. Anti-Flotation Stone Filled Saddlebags
16. Tracer Wire and Warning Tape

1.2 RELATED DOCUMENTS

A. All other requirements and provisions of the Charlotte Water, Water and Sewer Design and Construction Standards, apply to this section.

B. Reference Charlotte Water Chapter 21 Tunneling & Steel Encasement Specifications for requirements and provisions related to tunneling and encasement.

1.3 DEFINITIONS AND ABBREVIATIONS

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

1.4 SUBMITTALS

A. Product specific submittal requirements may be included in Part 2, Products, under the various products. In addition to product specific submittal requirements, at a minimum, submittals for product approval include, but are not limited to, the following:

1. Product brochures
2. Catalog cut sheets
3. Shop drawings including dimensions and part/material lists

4. Certification of compliance
5. Prior product acceptance test reports
6. Reference contact data
7. Shipping tickets and purchase invoices

B. Provide product data for the following:
1. Ductile-iron, Gravity Sewer Pipe and Fittings
2. PVC Pipe and Fittings
3. Fiberglass Reinforced Polymer Mortar Pipe
4. Aerial Steel Pipe
5. Couplings
6. Service Connections - Tapping Saddles
7. Manholes
8. Parshall Flumes
9. Concrete
10. Miscellaneous Steel
11. Bedding Materials - Stone and Brick/Block
12. Ferrous Castings
13. Micropiles

C. Shop Drawings:
1. A bookmarked and indexed PDF file of shop drawings shall be submitted for review and approval prior to the manufacture, fabrication, and construction.
2. For manholes: At a minimum include plans, elevations, sections, details, steel reinforcement details, structural design sealed by North Carolina Professional Engineer (PE), vent pipe details, manhole connectors, joint sealing information, frames and covers, and buoyancy calculations.
3. For manhole section: The manufacturer shall furnish the Engineer with test results on compression and absorption for one section in every twenty-five (25) sections poured, and certification from cement manufacturer and aggregate supplier certifying chemical content. The Engineer reserves the right to pick random sections for the required testing.
4. For manhole steps: The manufacturer shall submit certification and test results that each step has been tested in accordance with ASTM C-478, plus additional testing requirements of this specification.

D. Product Certificates: Required for all products.

E. PVC Closed Profile Sewer Piping: One sample of each size pipe specified, from each production run (or one per truck load) for the project, shall be tested in accordance with the requirements of ASTM F-1803. The manufacturer shall submit certification and test results that the pipe has been tested in accordance with ASTM F-1803 as applicable and has been found to meet all requirements of this specification. Test samples shall be as selected by the manufacturer or testing laboratory unless otherwise stipulated in the project specific Special Provision Section.

F. Solid Wall PVC Pipe Testing Requirements: The manufacturer shall submit certification and test results that the pipe has been tested in accordance with AWWA C-900 and has been found to meet all requirements. Test samples shall be as selected by the manufacturer or testing laboratory unless stipulated otherwise. 8-inch DR 26 PVC pipe and fittings shall be manufacturer tested in accordance with ASTM D-3034 and the manufacturer shall submit certification and test results indicating that all requirements are met.

G. Reinforced Polymer Mortar Pipe Testing Requirements: Testing Requirements shall be as specified in Section 2.3.B.3 of this specification.

H. Ductile Iron Pipe Testing Requirements: The manufacturer shall perform the standard acceptance tests required by AWWA C-151, Section 5.1.1.2 and shall keep test records on file for inspection by the Engineer. The manufacturer shall furnish an affidavit that the materials used in the making of the pipe meet all provisions of the applicable AWWA and ASTM standards and that the pipe, fittings, accessories, and rubber gaskets meet all applicable provisions of AWWA C-104, C-110, C-111 C-115, C-150, and C-153 respectively.

I. Aerial Steel Pipe Testing Requirements:

1. The pipe shall be manufactured and tested in accordance with ASTM A53. The product markings shall be marked on the inside of the bell or spigot ends and shall be a waterproof marking material. The minimum pipe markings shall include the manufacturer's name or trademark, the production year, piece number per the laying schedule and the pressure rating. Beveled pipe shall be marked with the amount of bevel and the point of maximum pipe length shall be marked on the beveled end. All markings shall be clear and legible.

2. Shop Tests

    a. After the joint configuration is completed and prior to lining with cement mortar, each length of pipe of each diameter and pressure class shall be shop-tested and certified to a pressure of at least 75% of the yield strength of the steel.

    b. The test pressure shall be held for 2 minutes, and the pipe visually inspected to confirm that welds are sound and leak-free.

3. In addition to the tests required in ASTM A53 and A139, weld tests shall be conducted on each 5,000 feet of production welds and at any other times there is a change in the grade of steel, welding procedure, or welding equipment.

4. The Engineer reserves the right to witness any or all acceptance tests. Prior notice of testing schedules will be provided by the manufacturer to the Engineer to accommodate travel or independent third-party witness arrangements.

I. Qualification Data: For qualified testing agency.

J. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:

1. Classification according to ASTM D 2487.

2. Laboratory compaction curve according to ASTM D 698.

K. Pre-excavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finished surfaces that might be misconstrued as damage caused by earth moving operations. For Donated Projects, these requirements apply to existing road rights-of-way only. Submit before earth moving begins.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic pipe, and fittings in direct sunlight. All pipe shall be in brand new factory condition, and no more than one year old from manufacturer date to installation. Pipe manufacturer shall provide letter regarding exposure requirements.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle manholes according to manufacturer's written rigging instructions.

D. The Contractor shall be responsible for the safe storage of materials furnished by or to them, and accepted by them and intended for the work, until they have been incorporated in the completed project. Handling and storage of all project materials are to be in compliance with the manufacturer's recommendations for handling and storage. The interior of all pipe, manholes and other accessories shall be kept free from dirt and foreign materials at all times.

E. Transportation of Materials and Equipment: The Contractor and their Suppliers are directed to contact the North Carolina Department of Transportation to verify axle load limits on State maintained roads (and bridges) which would be used for hauling of equipment and materials for this project. The Contractor and their Suppliers shall do all that is necessary to satisfy the Department of Transportation requirements and shall be responsible for any damage to said roads which may be attributed to this project. All materials required to construct this project shall be furnished by the Contractor and shall be delivered and distributed at the site by the Contractor or their material supplier.

F. Loading and Unloading Materials: Ductile iron pipe and cast-iron accessories shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Pipe and precast manholes shall be unloaded with hoists and/or as recommended by the respective manufacturers. Under no circumstances shall such materials be dropped. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground.

G. Responsibility for Materials on Site: In distributing the material at the site of the work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench. Each piece shall be redundantly chocked at each end to prevent movement or rolling. Pedestrian or vehicular traffic shall not be unduly inconvenienced in placing of material along the streets or right-of-way, as applicable.

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

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

H. Material and Equipment Storage Sites: Unless otherwise shown on the plans, the Contractor shall be responsible for locating and providing storage areas for construction

materials and equipment. Unless prior written consent from the owner of the proposed storage area is received by Charlotte Water, the Contractor shall be required to store all equipment and materials within the limits of the project site, or the limits of the sanitary sewer right-of-way and temporary construction easement provided. The materials and equipment storage shall comply with all local and state ordinances throughout the construction period. Material and equipment may only be stored within road right-of-way if approved by the controlling agency. Bulk storage of stacked materials shall not be permitted in or along road rights-of-way.

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

1.6 FIELD CONDITIONS

A. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to Charlotte Water requirements indicated:

1. Notify Engineer and Owner no fewer than three (3) days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without Owner's permission.

PART 2 - PRODUCTS

2.1 PIPE, GENERAL

A. All materials furnished in accordance with these specifications shall be new and unused, unless otherwise specified in the project Special Provisions. Unless superseded or modified by a Special Provision, all materials, apparatus, supplies, methods of manufacture, or construction shall conform to the specification for same contained in this Section. National material standards (ASTM, ANSI, etc.) referred to herein shall be considered to be the latest revisions only.

2.2 DUCTILE-IRON, GRAVITY SEWER PIPE AND FITTINGS

A. Pipe: At a minimum, all Ductile iron pipe shall conform to the requirements of AWWA Standard C-151 and ASTM A-746. Unless otherwise shown on the construction plans, all ductile iron pipe shall be furnished with push-on joints or restrained joints in accordance with AWWA C-111, and cement mortar lining.

1. Pipe (12-inch diameter and smaller): AWWA C151/A21.51, ASTM A-746, minimum pressure class 350, with cement mortar lining of standard or double thickness in accordance with AWWA C104.
2. Pipe (16-inch to 64-inch diameter): AWWA C151/A21.51, ASTM A-746, minimum pressure class 250, with cement mortar lining of standard or double thickness in accordance with AWWA C104.
3. The pipe class selection for all diameters shall be based on the installation conditions and existing or proposed depth of cover. Special thickness class pipe up to and

including thickness class 56 shall be required when specified, based on installation conditions and depth of cover.

4. The pipe shall contain all product markings required by ASTM A-746 and AWWA C-151. The minimum pipe markings shall include the weight, class or nominal thickness, casting date. The manufacturer's mark, the country where cast, the production year, and the letters "DI" or "DUCTILE" shall be cast or metal stamped on the pipe, and on pipe sizes 14-inch and larger shall not be less than ½-inch in height. All markings shall be clear and legible, and all cast or metal-stamped marks shall be on or near the bell.

5. Manufacturers:

   a. DIP shall be as furnished by American Cast Iron Pipe, McWane Cast Iron Pipe or US Pipe Company.

B. Fittings

1. Standard Fittings: AWWA C110/A21.10, ductile with cement mortar lining of standard or double thickness in accordance with AWWA C104.

2. Compact Fittings: AWWA C153/A21.53, with cement mortar lining of standard or double thickness in accordance with AWWA C104.

3. The fittings shall contain all product markings required by AWWA C-110 or C-153 as applicable. The minimum markings on each fitting shall include the identity of the AWWA standard, the pressure rating, nominal diameters, manufacturer's identification, the county where cast, the letters "DI" or "DUCTILE", and the angle of all bends. The markings shall be distinctly cast raised or in relief on the outside of the fitting body.

4. Ductile iron fittings may be mechanical joint, slip joint, or restrained joint.

5. Manufacturers:

   a. DI fittings 24-inch and smaller in diameter shall be manufactured within the North American Continent or imported by an approved importer/manufacturer. DI fittings shall be as furnished by American Cast Iron Pipe, McWane Cast Iron Pipe, Star Pipe Products, Sigma Corporation, SIP Industries, Tyler Pipe, or US Pipe Company only.

   b. DI fittings 30-inch and larger in diameter shall be manufactured within the North American Continent by an approved manufacturer. DI fittings shall be as furnished by American Cast Iron Pipe, McWane Cast Iron Pipe, Tyler Pipe/Union or US Pipe Company only.

C. Gaskets: AWWA C111/A21.11, Styrene Butadiene Rubber (SBR), of shape matching pipe and fittings. Nitrile (NBR) rubber (acrylonitrile butadiene) gaskets shall be furnished when specified or shown on the construction plans and when sewer mains are located near contaminated soils or gasoline storage facilities. EPDM gaskets shall be furnished when specified or shown on the construction plans.

D. When specified or shown on the approved constructions plans, ductile iron pipe and fittings shall be epoxy lined (Induron Protecto 401, Tnemec Perma-Shield PL Series 431, Permite Permox CTF or approved equal), or shall have fusion-bonded epoxy lined/coating in accordance with AWWA C116. The interior of the pipe shall receive 40 mils nominal dry film thickness, or as indicated by the coating manufacturer.

E. The Engineer reserves the right to witness any or all acceptance tests. Prior notice of testing schedules will be provided by the manufacturer to the Engineer to accommodate travel or independent third-party witness arrangements.

F. Corrosion Protection: When indicated on the plans, corrosion protection equipment and installation shall be in accordance Charlotte Water standard specifications for Corrosion Control as indicated in Chapter 18.

2.3 PVC PIPE AND FITTINGS

A. PVC Closed Profile Sewer Piping:

1. Pipe: Sewer pipe 30-inch and larger may be Closed Profile PVC sewer pipe manufactured in accordance with ASTM F1803 and tested in accordance with ASTM D2122, ASTM D2152, ASTM D2412, and ASTM D2444 with a minimum pipe stiffness of 46 psi in accordance with ASTM D2412. Required pipe stiffness shall be based on loading and bedding conditions. Pipe stiffness may be 46, 60 or 75 psi. Pipe cell classification 12454 or 12364. All seams on the completed pipe shall be heat welded (thermally fused). Glued seams shall not be allowed.

2. Pipe joining shall be push-on elastomeric joints only and joints shall be manufactured in accordance with ASTM Specification D-3212. The pipe shall be furnished with integral bells and with gaskets that are permanently installed at the factory.

3. Fittings: Fittings shall be in accordance with ASTM D-3212, and/or D-3034 as applicable, with stiffness and wall thickness equal to or greater than the pipe. Adapters shall be provided to join different materials.

4. Gaskets: ASTM F 477, elastomeric seals. The lubricant used for assembly shall be as recommended by the manufacturer and shall have no detrimental effect on either the pipe or the rubber gasket.

5. The pipe shall contain all product markings required by ASTM F-1803. The minimum pipe markings shall include manufacturer's name, nominal pipe size, PVC cell classification 12454 or 12364, wall stiffness number "PS 46 PVC Sewer Pipe", and ASTM designation - ASTM F-1803.

6. Color Requirements: PVC Solid Wall Sewer Pipe and Fittings for sanitary sewer shall be green or white in color.

7. Manufacturers:

   a. PVC Closed Profile Sewer Pipe shall be manufactured within the North American Continent and shall be furnished by the following or pre-approved equal:

   b. Trenchless Resources Global Holdings (Vylon Pipe) – F1803

B. PVC Solid Wall Sewer Piping

1. Uses: Unless otherwise indicated on the Project Plans, Sewer pipe 8 inches through 30 inches in diameter may be Solid Wall DR 25 PVC sewer pipe manufactured in accordance with AWWA C900. PVC Solid Wall PVC pipe used for lateral piping on C900 PVC sewer pipelines shall be manufactured in accordance with AWWA C900.

2. Pipe: Sewer pipe 8 inches through 30 inches in diameter may be Solid Wall PVC sewer pipe manufactured in accordance with AWWA C900. The pipe shall be furnished with integral bells and with gaskets that are permanently installed at the factory. The pipe shall be furnished in nominal lengths of 13, 20 or 22 feet. Shorter lengths shall be accepted to allow for the proper placement of fittings. PVC sewer pipe shall be green in color.

    a. 6-inch and smaller PVC pipe shall be Dimension Ratio (DR) 18.

    b. 8-inch and larger PVC pipe shall be Dimension Ratio (DR) 25.

3. All PVC Sewer Pipe shall be shipped, stored, and strung at the project in such a manner as to be protected from total accumulated exposure to sunlight and possible ultraviolet radiation for no more than one year from the manufacturer date.

4. Fittings: 12-inch and smaller fittings shall comply with or exceed AWWA C907. Fittings shall be gasketed joint of one piece and injection molded of PVC compound with a cell class 12454 per ASTM D1784. Fittings shall be pressure rated at 235 psi and shall have a Dimension Ratio (DR) of 18.

5. The fittings shall contain all product markings required by AWWA C-907 as applicable. The minimum markings on each fitting shall include the identity of the AWWA standard, the pressure rating, nominal diameter and deflection angle is applicable, manufacturer's identification, and maximum allowable joint deflection for each gasket joint. The markings shall remain legible during normal handling, storage and installation.

6. 14-inch and larger fittings shall be molded one-piece fittings as specified above or shall be fabricated from AWWA C-900 pressure rated pipe and shall have a Dimension Ratio (DR) of 18. Fabricated fittings shall be submitted for approval. They shall be manufactured to meet the requirements of the same specifications and shall have the same diameter and thickness as standard fittings, but their laying lengths and types of ends (bell or spigot x bell) shall be determined by their position in the pipelines and by the particular piping to which they connect.

7. Gaskets: ASTM F 477, elastomeric seals. Gasket lubricant shall be as recommended by the pipe manufacturer.

8. Color Requirements: PVC Solid Wall Sewer Pipe and Fittings for sanitary sewer shall be green or white in color.

9. Manufacturers:

    a. PVC AWWA C-900 pipe shall be manufactured within the North American Continent and shall be furnished by the following or pre-approved equal:

        1) North American Pipe Corporation, NAPCO

        2) JM Eagle

        3) Diamond Plastics

        4) National Pipe

        5) Sanderson Pipe

        6) Jetstream (by Pipelife)

    b. PVC fittings shall be manufactured within the North American Continent and shall be furnished by the following or pre-approved equal:

1) North American Pipe Corporation, NAPCO
2) IPEX
3) HARCO (Harrington Corporation)
4) Multi Fittings Corporation
5) GPK Products, Inc.

10. PVC Solid Wall Sewer Pipe for Cleanouts, Standpipes, and Tailpieces.

a. White solid wall schedule 40 pipe for cleanouts, standpipes, and tailpieces shall be in accordance with ASTM D-2665, NSF 14, and D-1785. Fittings shall be socket type in accordance with ASTM D-2466. PVC material shall be PVC1120, PVC1220 or PVC2120. Joining shall be through solvent cement in accordance with ASTM D-2564.

b. Gray solid wall schedule 80 pipe is allowed for lateral installation in an uncased bore.

c. The pipe shall contain all product markings required by ASTM D-1785, or ASTM D-2665. The minimum pipe markings shall include manufacturer's name or trademark, ASTM designation "ASTM D-1785 or D-2665", nominal pipe size, type of plastic material such as "PVC1120"pipe", Schedule 40 or Schedule 80, and production code including year, month, day, shift, plant and extruder. Markings shall be at intervals of not more than 5 feet.

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

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

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

g. Color Requirements: PVC Solid Wall Sewer Pipe and Fittings for cleanouts, standpipes, and tailpieces shall be white in color for Schedule 40 and gray for Schedule 80.

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

i. Manufacturers:

1) North American Pipe Corporation, NAPCO
2) JM Eagle
3) National Pipe
4) Sanderson Pipe
5) Jetstream (by Pipelife)

C. PVC Solid Wall Sewer Piping: DR 26

1. Uses: Sewer pipe 8 inches in diameter may be Solid Wall DR 26 PVC sewer pipe manufactured in accordance with ASTM D3034 and ASTM D1784. Solid Wall PVC pipe used for lateral piping on DR 26 mains shall also be allowed to be Sch 40 PVC and shall be manufactured in accordance with ASTM D1785.

2. Pipe:

   a. Sewer main pipe 8 inches in diameter shall be Solid Wall PVC sewer pipe manufactured in accordance with ASTM D3034. The pipe shall be furnished with integral bells and with gaskets that are permanently installed at the factory. The pipe shall be furnished in nominal lengths of 14 or 20 feet. Shorter lengths shall be accepted to allow for the proper placement of fittings.

      1) 8-inch PVC pipe shall be Standard Dimension Ratio (DR) 26

      2) Fittings shall be manufactured in accordance with ASTM D3034 and ASTM F1336. They shall be injection molded from virgin PVC compound of cell classification 12454 to meet ASTM D1784.

      3) Gaskets shall be manufactured in accordance with ASTM F477. Gasket lubricant shall be as recommended by the pipe manufacturer.

      4) Joints shall be in accordance with ASTM D3212.

      5) Color Requirements: PVC Solid Wall Sewer Pipe and Fittings for sanitary sewer shall be green or white in color.

      6) DR 26 PVC pipe and fittings shall be manufactured within the North American Continent. An officer of the manufacturing company shall certify that all the pipe and fittings were manufactured in North America.

      7) Pipe Manufacturers:

         a) North American Pipe Corporation (NAPCO) / Westlake

         b) JM Eagle

         c) Diamond Plastics

         d) National Pipe

         e) Sanderson Pipe

         f) Jetstream (by Pipelife)

         g) Or, pre-approved equal

      8) Fitting Manufacturers:

         a) North American Pipe Corporation (NAPCO) / Westlake

         b) IPEX

         c) HARCO (Harrington Corporation)

         d) Multi Fittings Corporation

         e) GPK Products, Inc.

         f) Or, pre-approved equal

b. Lateral pipe 4-inches and 6-inches shall be Solid Wall PVC pipe manufactured in accordance with ASTM D1785 and ASTM D2665. Fittings shall be socket type in accordance with ASTM D2466. PVC material shall be PVC1120, PVC1220 or PVC2120. Joining shall be through solvent cement in accordance with ASTM D2564. The pipe shall be furnished in nominal lengths of 10 or 20 feet. Shorter lengths will be accepted to allow for the proper placement of fittings.

1) The pipe shall contain all product markings required by ASTM D-1785, or ASTM D-2665. The minimum pipe markings shall include manufacturer's name or trademark, ASTM designation "ASTM D-1785 or D-2665", nominal pipe size, type of plastic material such as "PVC1120" pipe, Schedule 40, and production code including year, month, day, shift, plant and extruder. Markings shall be at intervals of not more than 5 feet.

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

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

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

5) Color Requirements: PVC Solid Wall Sewer Pipe and Fittings for cleanouts, standpipes, and tailpieces shall be white in color for Schedule 40.

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

7) Manufacturers:

a) North American Pipe Corporation, NAPCO

b) JM Eagle

c) National Pipe

d) Sanderson Pipe

e) Jetstream (by Pipelife)

3. All PVC Sewer Pipe shall be shipped, stored, and strung at the project in such a manner as to be protected from total accumulated exposure to sunlight and possible ultraviolet radiation for no more than one year from the manufacturer date.

2.4 FIBERGLASS REINFORCED POLYMER MORTAR PIPE

A. Uses: Unless indicated otherwise on the project plans, sewer pipe 30 inches and larger in diameter may be Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) reinforced polymer mortar (FRPM) pipe.

B. Performance / Design Criteria

1. Pipe

a. The pipe shall be manufactured by the casting process to produce a dense, nonporous, corrosion-resistant, consistent composite structure. The pipe shall be manufactured and tested in accordance with ASTM D-3262, AWWA C950 and AWWA M-45. Joints shall be filament wound sleeve type couplings with an elastomeric membrane seal. Joints shall perform in accordance with the requirements of ASTM D-4161.

b. Design pipe for service loads that include:

1) External groundwater and earth loads

2) Jacking/pushing loads

a) The allowable jacking/pushing capacity shall not exceed 40% of the ultimate compressive strength, or the maximum allowable compressive strength recommended by the manufacturer, whichever is less.

3) Traffic loads

4) Practical considerations for handling, shipping and other construction operations

c. Design is to be conducted under the supervision of a Professional Engineer licensed in the State of North Carolina, who shall seal and sign the design.

d. Pipe shall be supplied in nominal lengths of 20, 30 or 40 feet. Actual laying length shall be nominal +1 or -4 inches. At least 90% of the total footage of each size and class of pipe, excluding special order lengths, shall be furnished in nominal length sections.

e. Minimum pipe stiffness when tested shall be in accordance with ASTM D2412. The minimum pipe stiffness shall not be less than SN 72 psi unless otherwise shown on the drawings and recommended by the manufacturer given consideration of the field condition, applicable loading, depth, trench width, water table and 100-year flood plain elevation. The pipe stiffness for each segment shall also be approved by the Charlotte Water.

f. Accommodate vertical alignment changes required because of existing utility or other conflicts by an appropriate change in pipe design depth.

g. In no case shall pipe be installed deeper than its design allows.

2. Dimensional Tolerances

a. Outside diameter

1) Pipe shall be outside diameter (OD) controlled pipe size and shall not vary in tolerance more than +0.08-inch or -0.06-inch, per ASTM D3262

b. Wall thickness

1) Provide minimum single point thickness no less than 98% of stated design thickness.

c. End Squareness

1) Provide pipe ends square to pipe axis with maximum tolerance of 1/4 inch or 0.5% of the nominal diameter.

d. Fittings

1) Provide tolerance of angle of elbow and angle between main and leg of tee to ±2 degrees.

2) Provide tolerance of laying length of fitting to ±2 inches.

3. Inspection and Testing During Fabrication

a. The Contractor, during the fabrication of the pipe, shall retain at his expense the services of a testing laboratory to make all tests of materials to be incorporated into the pipe and maintain control of the acceptance of these materials for fabrication of the pipe.

b. At a minimum, actual test results shall be required as follows:

1) Load bearing tests: Provide test results for the first joint manufactured of each size and class, and at least one joint per hundred joints thereafter.

2) Material tests: Provide material test results per the ASTM and AWWA Standards.

c. Each piece of pipe shall bear the approval stamp of the testing laboratory. The selection of the testing laboratory shall be subject to the approval of Charlotte Water and its work subject to the Engineer's review.

1) Load bearing tests: Provide test results for the first joint manufactured of each size and class, and at least one joint per hundred joints thereafter.

2) Material tests: Provide material test results per the ASTM and AWWA Standards.

d. Charlotte Water or other designated representative shall be entitled to inspect pipes or witness the pipe manufacturing. Such inspection shall not relieve the manufacturer of the responsibilities to provide products that comply with the applicable standards and these Specifications.

e. Should Charlotte Water request to see specific pipes during any phase of the manufacturing process, the manufacturer shall provide Charlotte Water with adequate advance notice of when and where the production of those pipes will take place.

f. Should Charlotte Water elect not to inspect the manufacturing, testing, or finished pipes, it in no way implies approval of products or tests.

g. An inspection of the pipe after delivery to the project shall be made by a representative of Charlotte Water. Pipe with visible defects which are indicative of poor structural condition or poor workmanship shall be rejected and replaced without cost to Charlotte Water. Visible defects shall include cracks of any type, honeycombs, delamination, or any other defects of poor

workmanship. Any pipe rejected shall not be returned under any condition to the project.

C. Materials

1. Resin Systems

a. Only use polyester resin system with proven history of performance in this particular application. The historical data shall have been acquired from a composite material of similar construction and composition as the proposed product. The internal liner resin shall be suitable for service as sewer pipe and shall be highly resistant to exposure to sulfuric acid as produced by biological activity from hydrogen sulfide gases.

2. Glass Reinforcements

a. Use reinforcing glass fibers of highest quality commercial grade E-glass filaments with binder and sizing compatible with impregnated resins to manufacture components.

3. Fillers

a. Silica sand or other suitable materials may be used.

b. Use 98% silica with maximum moisture contest of 0.2%.

4. Additives

a. Resin additives, such as curing agents, pigments, dyes, fillers, thixotropic agents, etc., when used, shall neither detrimentally affect the performance of the product nor impair visual inspection of the finished products.

5. Internal liner resin

a. Suitable for service as sewer pipe

b. Highly resistant to exposure to sulfuric acid

c. Produced by biological activity from hydrogen sulfide gases

d. Meet or exceed requirements of ASTM D3681

6. Gaskets

a. Supply from approved gasket manufacturer in accordance with ASTM F477 and suitable for service intended.

b. Affix gaskets to pipe by means of suitable adhesive or install in a manner so as to prevent gasket from rolling out of pre-cut groove in pipe or sleeve coupling.

c. Provide the following gaskets in potentially contaminated areas.

1) Petroleum (diesel, gasoline) – Nitrile

2) Other contaminants – Manufacturer recommendation

7. Couplings

a. Field connected pipe shall connect with fiberglass sleeve couplings that utilize elastomeric sealing gaskets as sole means to maintain joint water tightness.

8. Joints

   a. All pipes so joined shall be made from the same class and type of raw material made by the same raw material supplier.

   b. Joints shall meet requirements of ASTM D4161.

   c. Unless otherwise specified, the pipe shall be field connected with fiberglass sleeve couplings or bell-spigot joints that utilize elastomeric sealing gaskets as the sole means to maintain joint water tightness.

   d. Joints at tie-ins, when needed, may utilize fiberglass, gasket-sealed closure couplings.

9. Pipe markings shall meet the minimum requirements of ASTM D3236. Minimum pipe markings shall be as follows:

   a. Manufacturer

   b. Manufacturer Number (identifies factory, location, date manufactured, shift and sequence)

   c. Nominal diameter

   d. Beam load

   e. Laying length

   f. ASTM designation

10. Connections

   a. Unless approved by Charlotte Water, material changes shall only occur at manholes.

   b. Flanges, elbows, reducers, tees, laterals and other fittings shall be capable of withstanding all operating conditions when installed. They may be contact molded or manufactured from mitered sections of pipe joined by glass-fiber-reinforced overlays. Properly protected standard ductile iron, fusion-bonded epoxy-lined iron and stainless-steel fittings may also be used.

   c. Closures may be accomplished using a special closure kit, fiberglass gasket-sealed closure couplings, flush fiberglass bell-spigot joints, or other method approved by the Engineer. Location of closures shall be subject to the approval of the Engineer.

D. Manufacturing and Construction

1. Manufacture pipe by the centrifugal casting or filament wound process to result in a dense, nonporous, corrosion-resistant, consistent composite structure. The interior surface of the pipes exposed to sewer flow shall be manufactured using a resin with a 50% elongation (minimum) when tested in accordance with ASTM D638, or a glass reinforced resin liner system. The interior surface shall provide crack resistance and abrasion resistance. The exterior surface of the pipes shall be comprised of a sand and resin layer, or a glass reinforced resin layer which provides UV protection to the exterior. Pipes shall be Type 1, Liner 1 or 2, Grade 1 or 3 per ASTM D3262.

E. Color Requirements: FRPM Pipe and Fittings for sanitary sewer shall be green or white in color if available.

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

G. Storage and Handling: Pipe shall be handled only from the outside of the pipe using woven slings. No forks, chains, straps, hooks, etc. shall be placed inside the pipe for lifting, positioning, or laying.

H. Manufacturers

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

2. Fiberglass reinforced polymer mortar (FRPM) pipe and fittings shall be manufactured within the North American Continent. An officer of the manufacturing company shall certify that all FRPM pipe and fittings were manufactured in North America. Pipe shall be furnished by the following manufacturers or pre-approved equal:

a. Hobas Pipe USA, Inc.

2.5 AERIAL STEEL PIPE

A. Steel Pipe (Aerial Crossings, 40-foot maximum length for 8-inch and 10-inch diameter pipe and 50-foot maximum length for 12-inch and larger diameter pipe):

1. High Strength Steel Pipe shall be seamless, straight seam, or spiral weld, manufactured in accordance with ASTM A-53 for Welded and Seamless Steel Pipe (8-inch to 24-inch inclusive) and/or ASTM A-139 for Welded Straight-Seam Steel Pipe (8-inch to 92-inch inclusive).

2. All steel shall be Grade "B" only, with minimum yield strength of 35,000 psi. Thickness shall be 0.250-inch unless otherwise specified or shown on the plans.

3. The pipe shall be produced in a single continuous length. Welding of two or more individual pieces together end to end shall not be permitted.

4. All steel pipes shall receive shop applied linings on the inside of pipe barrel as follows:

a. Minimum 15 mils dry film thickness of Tnemec Perma-Shield PL Series 431, or approved equal, or shall have fusion-bonded epoxy coating in accordance with AWWA C213).

b. Surface preparation and application shall be as recommended by Tnemec or approved equal manufacturer. Applicator shall be a Tnemec, or approved equal manufacturer, approved certified applicator.

c. Lined pipe shall be handled only from the outside of the pipe using woven slings. No forks, chains, straps, hooks, etc. shall be placed inside the pipe for lifting, positioning, or laying.

5. The outside of steel pipe shall receive one or more shop applied coats to the complete exterior surface of the pipe barrel, conforming to the following:

a. Minimum 20 mils dry film thickness of Tnemec Perma-Shield PL Series 431 or approved equal or shall have fusion-bonded epoxy coating in accordance with AWWA C213. Exterior coating shall be black, or as approved by the Engineer. Submit 6-inch square sample paint chip for review and approval.

b. Surface preparation and application shall be as recommended by Tnemec or approved equal manufacturer. Applicator shall be a Tnemec, or approved equal manufacturer, approved certified applicator.

c. Coated pipe shall be handled only from the outside of the pipe using woven slings. No forks, chains, straps, hooks, etc. shall be placed inside the pipe for lifting, positioning, or laying.

d. Damage to exterior coatings shall be repaired with the same coating used by the manufacturer and applied as recommended by the manufacturer.

6. Pipe ends shall have tolerances within the limits required for approved couplings. Pipe shall also be furnished with plain right-angle ends with all burrs removed from the ends.

7. Pipe transition couplings shall be AWWA C-110 or AWWA C-153 ductile iron long pattern solid sleeves. For transition from steel pipe to ductile iron pipe, use a standard MJ gland pack with oversize transition gasket on the steel pipe, and a wedge action joint restraint gland on the ductile iron pipe end.

8. Pipe couplings for steel pipe to steel pipe segments shall be AWWA C110 or C153 ductile iron long pattern solid sleeves. A standard MJ gland pack with oversize transition gasket shall be used on each end connection to the steel pipe.

9. Couplings and glands shall receive field applied protective coatings as specified for steel pipe.

10. Manufacturers

a. Steel pipe and fittings shall be manufactured within the North American Continent. An officer of the manufacturing company shall certify that all steel pipe and fittings were manufactured in North America. Pipe shall be furnished by the following manufacturers or pre-approved equal:

1) American

2) U.S. Steel Tubular Products

3) American Piping Products

B. Aerial crossings shall utilize pipe crossing pedestrian fan guards as shown on the Standard Details.

1. Coatings: All guard components shall receive one or more shop applied coats to the complete exterior surface as detailed above for exterior pipe coatings.

2.6 COUPLINGS (FOR REPAIRS TO EXISTING PIPING ONLY)

A. Flexible Transition Couplings used to join various types of pipes (VCP, PVC etc.) to ductile iron pipe, shall be elastomeric PVC or natural rubber sleeve couplings with external stainless steel compression bands and external stainless steel shear rings. Bushings of like material may be used inside the coupling to accommodate pipes of differing outside diameters. The coupling shall provide a watertight connection at a minimum test pressure

of 4.3 psi. Couplings shall conform to the requirements of ASTM C-1173 and as modified below. The minimum coupling length and shear band requirements shall be:

1. Diameter 6-inch through 12-inch: Minimum Coupling Length is 6-inch. Shear Band Required
2. Diameter 15-inch through 24-inch: Minimum Coupling Length is 10-inch. Shear Band Required
3. Diameter 30-inch through 72-inch: Minimum Coupling Length is 12.5-inch. Shear Band Not Required

B. External shear bands shall be ASTM A-167/A-240 series 300 stainless steel, minimum thickness of 0.012-inches, and shall cover the coupling from compression band to compression band. Exterior compression bands clamps, bolts and nuts shall be ASTM A-167/A-240 series 300 stainless steel. Clamps shall be nut and bolt, or T-Bolt design. Couplings 30-inch and larger without the shear bands shall require two (2) compression bands at each end of the coupling, and a minimum 3/8-inch-thick coupling with multiple sealing ribs.

C. Couplings 24-inch and smaller shall be Mission Rubber Company Flex-Seal Adjustable Repair Couplings (ARC), Fernco Strong Back RC Series Repair Coupling, or approved equal. Couplings 30-inch and larger shall be Mission Rubber Company Flex-Seal Couplings, Fernco Large Diameter Coupling, or approved equal.

D. Transition Adaptors: Transitions adaptors for 12-inch diameter and smaller pipe may be PVC or DIP as specified below:

1. PVC Transition adaptors may be used for 12-inch and smaller pipe. PVC Transition Couplings used to join PVC sewer OD pipe to ductile iron OD pipe, shall be PE sewer spigot x DIOD gasket bell or PE DIOD spigot x sewer gasket bell. Adaptors shall be one piece PVC and conform to the requirements of ASTM D-3034 with a minimum wall thickness equal to or greater than the adjacent sewer pipe. Transition adaptors shall be as manufactured by HARCO or approved equal.
2. Ductile Iron Transition adaptors may be used for 12-inch and smaller pipe. Ductile Iron Transition Couplings used to join PVC sewer OD pipe to ductile iron OD pipe, shall be PE sewer spigot x DIOD gasket bell or PE DIOD spigot x sewer gasket bell. Adaptors shall be one-piece Ductile Iron and conform to the requirements of ASTM D-A-536 grades 65-45-12 or 80-55-06 iron, with a minimum wall thickness equal to or greater than AWWA C-153 pressure class 350 fittings. Adaptor shall be fusion bond epoxy coated inside and out according to AWWA C-116.

E. Ductile Iron Restrained Joint Couplings: Long pattern ductile iron restrained joint couplings may be used when necessary to conform to non-standard existing pipe outside diameters. Gasket sizing shall be as required to conform to the existing pipe outside diameters. Ductile iron couplings may only be used when long pattern solid sleeves will not accept the OD size pipe diameter. Ductile iron couplings shall be designed for a minimum of 350 psi working pressure and shall be fusion bonded epoxy coated inside and out with a minimum thickness of 12 mils. Bolts, nuts, washers, etc. shall be type 304 or 316 stainless steel. Threads shall be coated with an anti-seize compound.

1. The following ductile iron restrained joint couplings are approved in sizes 1.5-inch through 16-inch diameters:
    a. ROMAC Industries – Standard Alpha Coupling, Alpha XL and Alpha Transition Coupling – 4-inch through 16-inch.

2. Shop drawings shall be required from the manufacturer for 16-inch and larger ductile iron couplings.

2.7 SERVICE CONNECTIONS – TEES AND TAPPING SADDLES

A. New Main Service Connections – Tees and Vertical Bends: All lateral connections to new sewer mains shall be installed using tees and a vertical bend only for connection to new pipe or shall connect to a manhole. Tapping saddles are not allowed for connections to new mains.

B. Ductile Iron Fittings: All fittings shall be cast from the standard grade 70-50-05 ductile iron with conformance values of 70,000 psi minimum tensile strength, 50,000 psi minimum yield strength and 5% minimum elongation.

1. 3-inch through 24-inch diameter: minimum Pressure Class 350, cast from ductile iron, in accordance with AWWA C-110 for full body fittings or AWWA C-153 for compact fittings.

2. 30-inch through 48-inch diameter: minimum Pressure Class 250, cast from ductile iron, in accordance with AWWA C-110 for full body fittings or AWWA C-153 for compact fittings.

3. 54-inch through 64-inch diameter: minimum Pressure Class 150, cast from ductile iron, in accordance with AWWA C-110 for full body fittings or AWWA C-153 for compact fittings.

4. All cast fittings shall have a cement mortar lining of standard or double thickness in accordance with AWWA C-104, or fusion bonded epoxy lining and coating of minimum thickness in accordance with AWWA C-116. Ceramic epoxy lining or approved equal shall be required on fittings when specified on a project specific basis.

5. The fittings shall contain all product markings required by AWWA C-110 or C-153 as applicable. The minimum markings on each fitting shall include the identity of the AWWA standard, the pressure rating, nominal diameters, manufacturer's identification, the county where cast, the letters "DI" or "DUCTILE", and the angle of all bends. The markings shall be distinctly cast raised or in relief on the outside of the fitting body.

6. Ductile iron fittings with straight through runs, such as tees, shall have an interior diameter that will allow the standard mandrel diameter to pass through the fitting.

7. Manufacturers:

   a. All fittings, including gaskets, glands, and bolts, shall be furnished by one fittings manufacturer.

   b. 24-inch and smaller fittings shall be manufactured within the North American Continent or imported by an approved manufacturer:

      1) American Cast Iron Pipe Co

      2) U.S. Pipe Co

      3) McWane Cast Iron Pipe

      4) Tyler/Union Foundry

      5) Star Pipe Corporation

6) Sigma Corporation.

7) SIP Industries

c. 30-inch and larger fittings shall be manufactured within the North American Continent by an approved manufacturer:

1) American Cast Iron Pipe Co

2) U.S. Pipe Co

3) Griffin Pipe Company

4) McWane Cast Iron Pipe

5) Tyler/Union Foundry

C. PVC Tees in New PVC Sewer Mains: Sewer connections to new PVC sewer mains shall be made with PVC tees.

1. Sewer connections shall be constructed 90° to main (angled connections not permitted) and shall typically be perpendicular to roadway. All connections shall be made substantially as shown on the Standard Details.
2. Connections to the new sewer main shall be made with the appropriate size tees to accommodate the connection and shall be made of C900 DR18 PVC or with DR 26 PVC.

D. Existing Main Service Connections – Tapping Saddles: Sewer tapping saddles for lateral connections, to existing mains, for use on solid or smooth wall pipe shall be ABS Plastic, PVC, Elastomeric PVC, or approved equivalent.

1. Tapping saddles connected to VCP, smooth wall PVC, concrete or ductile iron pipe shall use a fast-setting two-part exothermic epoxy sealant that can be used in wet or dry conditions. The tapping saddle shall protrude into the hole, but no part shall protrude into the waterway of the mainline pipe. The saddle shall be of a design that will accommodate AWWA C900 or Ductile Iron lateral pipe with outlet fitting of compression, mechanical or sealing type. The outlet fitting shall not be solvent weld.

a. Manufacturers:

1) Fast Fit Sewer Tap Saddle as manufactured by PREDCO (Plumbing Research Engineering and Development Company) or approved equal.

2. Tapping Saddles on 8-inch through 16-inch Ductile Iron Mains: When ductile iron laterals are to be connected to existing ductile iron or cast-iron sewer mains, the tap on the existing main shall be as follows:

a. Saddles for gravity sewer applications shall have a base that consists of Class 30 Cast Iron conforming to ASTM A-48 and dip-coated in water-based bituminous tar at minimum. Base casting shall have an alignment flange which protrudes into the tapped hole to assure perfect alignment. Adapter accepting DIP shall be made of ductile iron and comply with ASTM A536, Grade 65-45-12 or 80-55-06. Bell depths shall meet the minimum socket depth requirements of ASTM F1336. Adapter gasket grooves shall be machined, and gaskets shall be of SBR rubber and comply with ASTM F477. Saddle strap shall be made from 24-gauge 304 Stainless Steel with a width of 2.5 inches to support the saddle. Saddle strap pins shall be at least 0.75-

inch diameter and made from 304 Stainless Steel. T-bolts shall be at least 0.375-inch type 304 Stainless Steel. Nuts and Washers shall be at least 18-8 Stainless Steel. Gasketed O-ring shall meet or exceed ASTM C-361-77 Tubular Polyisoprene. Saddles shall be SEALTITE Type “F” multi-range Tee sewer saddle with alignment flange as manufactured by The General Engineering Company, Frederick, MD, or Romac Style "CB" sewer saddle - CB-4.80 or CB-6.90 or approved equal.

3. Tapping Saddles on 24-inch and Larger Mains: Service connections to 24-inch and larger mains shall be connected to manholes only. If Charlotte Water approves a direct 4-inch or 6-inch connection to the existing pipe, the connection shall consist of a tapping sleeve and vertical ductile iron bend. The tapping sleeve shall comply with the tapping sleeve specifications in the Water Main Specifications but may be a mechanical joint outlet in lieu of a flange outlet. Provide submittal package for review.

4. Sewer Tapping saddles on ductile iron pipe within a 100-foot radius of a well shall be as specified for water main tapping sleeves. A tapping valve is not required. In lieu of the tapping saddle, a ductile iron tee may be installed or cut in. All pipes including lateral pipe and cleanouts within the 100-foot radius of the well shall be ductile iron as specified.

2.8 MANHOLES

A. Standard Precast Concrete Manholes:

1. All precast manhole sections, and manufacturers shall meet the minimum requirements established by NCDOT for precast manholes in addition to the following Charlotte Water requirements and standard details. All sewer manholes shall be constructed of precast concrete sections only in conformance with the following specifications and Charlotte Water Standard Detail Drawings. Special cast in place manhole structures shall be as shown on the plans and shall comply with the various other applicable sections in these specifications.

2. Manholes shall be furnished with pre-cast bottom slabs and flexible watertight boots for 16-inch and smaller pipe. The boots shall be cast in as integral parts of the base or installed in cored or formed openings with stainless steel compression bands and shall conform to ASTM C-923. Manholes for 18-inch and larger pipe may be furnished with precast bottom slabs and flexible boots or flexible seals. Flexible connectors shall conform to ASTM C-923.

   a. Flexible boot and seal manufacturers:

      1) PSX: Direct Drive as manufactured by Press-Seal Corporation

      2) Tylox MIB Series Connectors as manufactured by Hamilton Kent

      3) G3 or QUIK-LOK Boot Connectors as manufactured by A-LOK Products, Inc.

      4) Kor-N-Seal - 106/406, 206 and 706 series - as manufactured by Trelleborg.

      5) Manhole boots used in manholes greater than 30 feet deep shall require submittal approval by Charlotte Water.

b. Manhole diameters may be controlled by the boot or seal diameters. A minimum of 6 inches of manhole wall shall be provided between cored or cast pipe openings for pipe connections, or as may be required by the boot/seal manufacturer, whichever is greater.

3. Manholes to be placed over existing pipelines shall be furnished with straddle/doghouse openings in the precast manhole bottom section allowing the manhole to be set over existing pipes in accordance with the Standard Details.

4. Sections: All precast reinforced concrete manholes shall conform to Charlotte Water Standard Detail drawings and to ASTM C-478. The following minimum standards shall also apply:

a. Wall thickness shall be 1/12th of the inside diameter with a minimum thickness of five (5) inches. Top of cone sections shall have a minimum wall thickness of seven (7) inches.

b. Base sections shall be cast monolithically and shall NOT have a cold joint between the walls and the base slab.

c. Cone sections shall normally be eccentric with the inside face of one side vertical and flush with the inside face of the barrel section. 4-foot diameter eccentric cones shall have a minimum vertical height, as measured from the top of the cone to the bottom of the bell, of 32 inches. Eccentric cones with a minimum vertical height of 40-inches shall be required for 5' diameter manholes. The sloped wall of the cone section shall be the full required cone height. Cone sections taller than the required cone height may include a vertical wall skirt below the required cone height. Concentric cones with a vertical height of 20-inches may be used on manholes less than five (5) feet deep (4-ft diameter manhole only).

d. Transition slabs may be placed a minimum of six (6) feet above the invert shelf for six (6) feet and larger diameter manholes where the slab will be buried. Flat top slabs directly below the frame and cover may be used for six (6) feet and larger diameter manholes, unless the manhole is located within pavement or maintained lawns. Flat top slabs require a minimum of six (6) feet above the invert shelf.

e. Joints between sections shall be manufactured in accordance with ASTM C-990. Joints shall be sealed with two rings of butyl rubber sealants conforming to ASTM C-990. A primer adhesive shall be used when recommended by the sealant manufacturer.

f. Butyl rubber joint sealants shall meet or exceed the requirements of ASTM C-990 including the 10 psi hydrostatic test requirement.

1) Butyl rubber joint sealant manufacturers:

a) Butyl-Tite by MultiSeal

b) Butyl-Loc by A-Lok Products, Inc.

c) Crete Stik and EZ-Stik Sealant by Press Seal Gasket Corporation,

d) CS102 or CS202 by ConSeal Concrete Sealants, Inc.

e) HK Kent Seal No.2 by Hamilton Kent, Inc.

f) Or, approved equal

g. All exterior joints (including base and riser sections) shall be sealed with one 6-inch wide (minimum) exterior butyl rubber joint sealant membrane centered on the joint. The tape shall be capable of sealing manhole joints against groundwater and sand infiltration. Exterior Joint Wrap sealant with rubber or plastic backing shall meet or exceed the requirements of ASTM C-877 Type III and C-990. Joint wrap shall be a minimum of 6 inches wide and not less than 1.5 times the joint depth. The butyl component of the joint wrap shall be a minimum of 0.030 inches (3 mils) thick. The rubber or plastic backing material shall be a minimum of 0.040 inches (4 mils) thick. The installation of the joint sealant membrane shall be in conformance with the recommendations of the manufacturer. A primer/adhesive shall be used when recommended by the sealant manufacturer.

1) Exterior joint wrap manufacturers:

a) EZ-Wrap by Press-Seal Gasket Corporation

b) CS-212 by ConSeal Concrete Sealants, Inc.

c) Butyl-Tite Wrap by MultiSeal

d) Bidco Wrap by NPC Corporation

e) Or, approved equal

h. All markings required by ASTM C-478 shall be clearly stamped on interior and exterior of each section. The minimum markings on each section shall include manufacturer's name or trademark, date of manufacture, and specification and product designation. Each manhole section installed in existing or future NCDOT right-of-way shall contain all approval markings required by and/or furnished by NCDOT.

i. Aggregate shall conform to requirements of ASTM C-33. Flat or elongated aggregate or smooth round stones shall NOT be acceptable.

j. The hydraulic cement used shall be Portland cement meeting requirements of ASTM C-150 Type II or Portland-limestone cement meeting ASTM C-595 Type IL(MS). Type II shall have a maximum tricalcium aluminate (content 8%).

k. Manhole base sections, riser sections, transition slabs, flat top slabs, and cone sections shall be designed for H-20 loadings, and a minimum manhole height of 40 feet. Earth loading shall be 120 pounds per cubic foot. Flat top slabs shall be designed for a minimum of 3 feet of earth loading.

l. The manufacturer shall furnish the Engineer with test results on compression and absorption for one section in every twenty-five (25) sections poured, and certification from cement manufacturer and aggregate supplier certifying chemical content. The Engineer reserves the right to pick random sections for the required testing. Manufacturer's with NCDOT approved labs may self-perform the required daily tests. At least one set of tests each month shall be performed by an independent testing facility. Manufacturer's without NCDOT approved labs shall use an independent

testing facility for daily tests. All test results shall be submitted to Charlotte Water.

m. Precast products shall not be shipped from the manufacturer until it has reached a minimum of 4000 psi compressive strength, and no less than 7 days after casting, whichever is greater.

5. Steps

a. Manhole steps shall be furnished in accordance with the Standard Details, ASTM C-478 and current OSHA regulations. In addition to the testing requirements of ASTM C-478 each step installed in pre-cast manholes shall be tested to resist a 1000 lb. pullout. The manhole manufacturer shall furnish test report results for step test with each shipment showing manhole location, date of test, and results. Each step installed in the field shall be tested as specified above. All step test results shall be submitted to Charlotte Water.

b. Plastic of manhole steps shall meet the requirements of ASTM D-4101. Steel reinforcing bar shall be Grade 60 deformed ½-inch diameter rebar conforming to the requirements of ASTM A-615.

c. Manhole step manufacturers:

1) MA Industries, Inc.

2) BOWCO Industries, Inc.

3) American Step Company, Inc.

4) Or, approved equal

6. Liner: Where indicated on the plans or elsewhere in these specifications, precast concrete manholes shall be furnished with a cementitious liner in accordance with these specifications for resistance to corrosive sewers.

7. Manholes shall be manufactured by manhole manufacturer's which have been approved by NCDOT and Charlotte Water to provide precast manhole product. New firms requesting approval to supply product to Charlotte Water projects, shall provide approval letters from NCDOT for each product line, prior to requesting approval from Charlotte Water.

8. Required submittals for product approval shall include, but are not limited to, product brochures, catalog cuts or shop drawings including dimensions and part/material list, design calculations, concrete mix design, cement certification, aggregate analysis, certification of compliance, prior product acceptance test reports, and reference contact data. Sample products shall be inspected by Charlotte Water at the manufacturing plant and/or at the site of a previously installed product. Manhole shop drawings and design calculations shall be signed and sealed by a North Carolina Professional Engineer.

9. Required daily and monthly test reports/results shall be submitted to the Charlotte Water Materials and Methods Committee Chair. Failure to provide required test results shall result in removal of the manufacturer from the approved manufacturer's list. Test results for projects advertised and bid directly by Charlotte Water shall be sent directly to the attention of the Charlotte Water Project Manager.

10. The following precast concrete manhole manufacturers are approved to supply manhole products for inclusion into the Charlotte Water system as indicated by manhole diameter:

MANUFACTURER	MANHOLE DIAMETERS APPROVED				
	4-FT	5-FT	6-FT	8-FT	10-FT
Tindall Corp.	X	X	X	X	X
CP&P Denver – Formerly Dellinger Precast	X	X	X	X	
CP&P Concord – Formerly Precast Supply Co.	X	X	X	X	
Performance Precast, Inc.	X	X			

11. This list was current at the time of publication. Be aware that these manufacturers produce some products that conform to these specifications and also produce some products that do not conform to the specifications. Project approval shall be based on shop drawing review and approval. Approved manufacturers and approved product sizes are subject to change, based on compliance with the specifications, quality control, acceptance test reporting and NCDOT approval.

B. Polymer Concrete Manholes:

1. General: All precast manhole sections, and manufacturers shall meet the minimum requirements established by NCDOT for precast manholes in addition to the following Charlotte Water requirements and standard details. All sewer manholes shall be constructed of precast concrete sections only in conformance with the following specifications and Charlotte Water Standard Detail Drawings. Special cast in place manhole structures shall be as shown on the plans and shall comply with the various other applicable sections in these specifications.

   a. The polymer concrete manhole shall be as manufactured by Armorock, US Composite Pipe Inc.; or pre-approved equal.

   b. Reference to a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.

   c. Like items of materials/equipment shall be the end products of one manufacturer in order to provide standardization for appearance, operation, maintenance, spare parts and manufacturer's service.

   d. Provide engineered non-penetrating lifting devices in each precast section for proper handling.

   e. Cement for base slabs and anti-flotation slabs/collars shall conform to ASTM C150, Type II cement or equal.

   f. Mark date of manufacture, name and trademark of manufacturer on inside and outside of each precast section.

   g. Brick masonry shall not be utilized for any part of the polymer concrete manhole.

2. Polymer Concrete Structure Sections

a. Precast concrete base sections, riser sections, transition top sections, flat slab tops and grade rings shall conform to ASTM C478 and meet the following requirements:

1) Structures shall be designed for all live and dead loads in accordance with ASTM C890 including a live load equal to AASHTO H-20 truck loading applied at finished grade with a minimum manhole height of 40 vertical feet.

2) Base, riser and top sections shall have bell and spigot/ship-lap design so that, on assembly, the manhole base, riser, and top section make a continuous uniform manhole.

3) Top section shall be eccentric cone where cover over pipe exceeds 4 feet. Top section shall be a flat slab where cover over top of pipe is 4 feet or less. Top section shall meet the general requirements of the concrete manhole specifications above and the standard details, unless otherwise approved by Charlotte Water.

3. Design

a. Structure walls, transition slabs, tops, and base slab shall be designed according to the requirements of ASTM C478 and C890. FRP (fiber-reinforced polymer) reinforced products shall be designed according to ACI 440.1R.

b. Design loading requirements:

1) AASHTO M-306 H-20/HS-20 design live loading loads as referred to in AASHTO M-305, applied to manhole cover or structure top slab and transmitted down to transition and base slabs.

2) Manhole design loading requirements shall be for a minimum vertical height of 40 feet.

3) Unit weight of soil of 120 pcf located above portions of structure, including base slab projections.

4) Lateral soil pressure based on saturated soil conditions producing an at rest equivalent fluid pressure of 100 psf.

5) Internal liquid pressure based on unit weight of 63 pcf.

6) Dead load of manhole sections fully supported by transition and base slabs.

c. Structure wall thickness shall be designed to resist hydrostatic pressures with a minimum factor of safety of 2.0 for full depth conditions from grade to invert. The manufacturer shall assume the design groundwater level is at finished grade. Wall thickness shall be a minimum of 3 inches for 48-inch and 60-inch diameter manholes and 4 inches for 72-inch, 84 -inch, and 96-inch manholes.

d. Structure shall be designed with sufficient bottom anchorage and side friction to resist buoyancy with a minimum factor of safety of 2.0. Field cast floatation collars are acceptable. The manufacturer shall assume the design groundwater level is at finished grade and the structure is empty.

e. For manholes with a minimum vertical height of 40 feet, the minimum clear distance between pipe openings shall be 6 inches or half the diameter of the smaller opening, whichever is greater.

f. For manholes with a minimum vertical height of 40 feet, the minimum clear distance between an opening and a joint shall be 6 inches.

g. Structure shall have a monolithic base slab unless otherwise approved. Monolithic base sections shall have vertical reinforcing extend into the base slab section.

h. Structures shall be designed with the reinforcement carrying all of the tensile stress. The tensile property of the polymer concrete shall not be used in the design calculations.

4. Polymer Concrete

a. Resin:

1) The resin shall be polyester, or vinyl ester resin systems designed for use with this particular application.

2) The resin content shall be a minimum of 7% by weight.

3) The resin shall have a minimum deflection temperature of 158 F when tested at 264 psi following test method in accordance with ASTM D648.

4) The resin selection shall be suitable for application in the corrosive conditions in a wastewater manhole.

b. Filler: All aggregate, sand and quartz powder shall meet the requirements of ASTM C33.

c. Additives: Resin additives such as curing agents, pigments, dyes, fillers and thixotropic agents, when used, shall not be detrimental to the manhole.

d. Polymer concrete compressive strength shall be a minimum of 9000 psi per ASTM C497.

e. No Portland cement shall be permitted in the polymer concrete mix and all aggregates shall have a minimum acid insoluble content of 95%.

5. Reinforcement

a. Deformed Steel Reinforcing Bars: ASTM A615, Grade 60 deformed bars.

b. Deformed Fiberglass Reinforced Polymer Bars (FRP): ACI 440.1R-06, “Guide for Design & Construction of Structural Concrete Reinforced with FRP Bars”.

c. Reinforcing shall be in accordance with ASTM C478. If FRP reinforcement is used, reinforcement shall be placed according to ASTM C478 for barrel sections and slabs. Required ASTM C478 steel area shall be converted to equivalent FRP design per ACI 440.1R. Hoop reinforcement shall only be permitted per ASTM C478.

d. Steel Welded Wire Reinforcement: ASTM A497.

6. Joints

a. Structure components shall be connected with an elastomeric joint sealant as the sole means to maintain joint water tightness and both the sealant material and the manhole joint shall meet the requirements of ASTM C990.

b. Structure shall utilize spigot and bell type joints incorporating either a confined O-ring or single step profile joint.

c. Joints shall be sealed with two rings of butyl rubber sealants conforming to ASTM C-990. A primer adhesive shall be used when recommended by the sealant manufacturer.

d. All exterior joints (including base and riser sections) shall be sealed with one 6-inch wide (minimum) exterior butyl rubber joint sealant membrane centered on the joint.

7. Pipe Connections

a. Provide resilient connectors conforming to the requirements of ASTM C923. Certification from connector manufacturer shall be provided if requested. Resilient connectors shall be installed directly to the monolithic structure wall or cast in during the initial pour. Cold joint pipe stub grouting shall not be allowed to facilitate connectors unless specifically indicated on the plans. Use the following materials for metallic mechanical devices as defined in ASTM C923:

1) External clamps: Type 304 Stainless steel

2) Internal, expandable clamps: Type 304 stainless steel, 11-gauge minimum.

b. All connectors are to be watertight.

c. Where penetrations of prefabricated polymer concrete structures are required for piping, conduit, or ducts, such penetrations shall be through precast openings. All openings shall be smooth and free of surface irregularities and with exposed steel reinforcing. A separate opening shall be provided for each pipe or conduit entering the structure.

8. Vent Pipe

a. Vent pipes shall be constructed of steel or stainless steel pipe as shown on the Standard Details.

9. Ladders for Polymer Concrete Manholes

a. Access to polymer concrete manholes shall be via a field installed polypropylene vault ladder.

b. Polypropylene shall conform to ASTM D-4101.

c. Ladder shall meet all ASTM C-497 load requirements as well as OSHA 1910.26 and 1910.27 specifications.

d. Ladders shall meet a minimum of 1,500 lbs. pull out force.

e. Ladder rails shall be aluminum reinforced copolymer polypropylene 1.75-inch x 1.75-inch diameter.

f. Ladder rungs shall be steel reinforced copolymer polypropylene 1-5/8-inch x 1.25-inch diameter with molded finger grips 12 inches c.c.

10. Manholes shall be manufactured by manufacturers approved by NCDOT and Charlotte Water to provide manhole product. New firms requesting approval to supply product to Charlotte Water projects, shall provide approval letters from NCDOT for each product line, prior to requesting approval from Charlotte Water. Manhole shop drawings and design calculations shall be signed and sealed by a North Carolina Professional Engineer.

11. Required submittals for product approval include, but are not limited to, product brochure, catalog cuts or shop drawings including dimensions and part/material list, design calculations, polymer concrete mix design, polymer certification, aggregate analysis, certification of compliance, prior product acceptance test reports, and reference contact data. Sample products shall be inspected by Charlotte Water at the manufacturing plant and/or at the site of previously installed product.

12. Required daily and monthly test reports/results shall be submitted to the Charlotte Water Materials and Methods Committee Chair. Failure to provide required test results shall result in removal of the manufacturer from the approved manufacturers list. Test results for projects advertised and bid directly by Charlotte Water, shall be sent directly to the attention of the Charlotte Water Project Manager.

C. Manhole Frames and Covers:

1. Cast Iron Castings

a. Frames, Covers, And Grates: All manhole frames and covers shall conform to ASTM A-48, Class 35 and shall be manufactured in domestic foundries as allowable. Dimensions and minimum weight shall conform to the Charlotte Water Standard Details.

b. Manhole frames and covers shall be furnished with the common contact surfaces between frame and cover machined. Frames and covers shall be U.S. Foundry & Manufacturing Corp, EJ Group, Inc., or pre-approved equal.

c. Where watertight frames and covers are specified, the watertight seal between frame and cover shall be accomplished by means of a rubber gasket and a camlock bolt down locking system. Watertight frames and covers shall be U.S. Foundry & Manufacturing Corp, EJ Group, Inc., or pre-approved equal.

d. Smart Covers and Frames

1) The smart cover system shall include an e-box, distance sensing module, power source, antenna, and 316 stainless steel mounting hardware.

2) The e-box shall have a tilt detection angle of 10° ±3° and have external connectors for the antenna, power source, and sensor.

3) The distance sensing module shall be a dual sensor capable of sensing via both ultrasonic and pressure. The distance sensing module shall be free hanging and have a total dynamic range of 40 feet.

a) The standard system timing shall obtain a level measurement once every 5 minutes and record the level data once every 10 minutes.

4) The power source shall be a 3.6 VDC power pack and have a standard operating lifetime of two years.

5) The smart cover system shall communicate two-way (transmit and receive) with a low-earth-orbit satellite with global coverage. The communications system shall operate on a radio frequency from 1616 to 1626.5 MHz with a typical latency ranging from 10 seconds to 10 minutes. The antenna shall be traffic compatible and weatherproof.

a) The system shall have a data transmission reporting interval of 1 hour and a status reporting interval of 14 hours.

6) The smart cover system shall be capable of operating in temperatures from 14°F to 140 °F and humidity from 0% to 100% RH.

7) The smart cover system shall have an application programming interface designed to provide programmatic access to data with location list, location summary, historical data, alarm list, alert list, token refresh, and latest data capabilities.

8) Manufacturers

a) SmartCover

b) SUEZ in North America

c) X-Logic

d) Accuflo

2. Composites - Frames and Covers

a. Clear openings, general dimensions, markings, accessories, etc., and installation shall conform to the Charlotte Water Standard Details for castings.

b. From fiber reinforced polymer following AASHTO M306.

c. Composite manhole covers shall meet the AASHTO H20 loading requirements.

d. Frame shall be set with four (4) quarter turn locks and water-resistant secondary O-ring gaskets.

e. All lock components shall be manufactured using a 300-grade stainless steel.

f. Manufacturers

1) EJCO

2) Trumbull Manufacturing, Inc

3) Enviro Design Products

g. Shop drawing submittal packages are required for review and preapproval by the Charlotte Water materials and methods committee.

D. Grade Rings: Grade rings may be concrete, rubber, or expanded polypropylene (EPP) adjustment grade rings with flat or with taper for slope adjustment. All brick and mortar used to adjust frames shall be in accordance with materials defined in Part 2, Products, of these technical specifications.

1. Concrete Grade Rings: All concrete grade rings shall conform to ASTM C478 and AASHTO M 199 with the exception that concrete grade rings shall have two rings of rebar near inner and outer face and with a minimum width of 7 inches. Concrete grade ring manufacturers shall be as defined in Part 2.7.A.10, Products (approved concrete manhole manufacturers), or pre-approved equal. Minimum grade ring height shall be 2 inches and maximum grade ring height shall be 8 inches. Steel reinforcements shall be a minimum of 0.07 sq. inches per vertical foot but not less than 0.024 sq. inches in any one grade ring. Any cracks shall result in rejection of the grade ring.

2. Rubber Grade Rings: All rubber grade rings shall conform to ASTM D3574-05 Test A, ASTM D2240-05, ASTM D412-06, and ASTM D573-04 and have a minimum width of 6 inches. Rubber grade rings shall be EJ Group, Inc. Infra-Riser, American Highway Products Flex-ORing, or pre-approved equal. Height of flat rings shall be from 0.50 inches to 3.0 inches in 0.50-inch increments. Taper/angle ring heights shall be a minimum of 0.50 inches and a maximum height of 3.0 inches. The maximum height of rubber rings on a manhole shall be 8 inches. Any additional height shall be made up with concrete grade rings.

3. Expanded Polypropylene (EPP) Grade Rings: All EPP grade rings shall conform to ASTM D4819-13 and AASHTO M 306 and have a minimum width of 6 inches. EPP grade rings shall be Cretex Pro-Ring, ARPRO, or pre-approved equal. Height of flat rings shall be from 0.75 inches to 4.0 inches in 0.50-inch increments. Taper/angle ring heights shall be a minimum of 0.75 inches and a maximum height of 1.75 inches. The maximum height of EPP rings on a manhole shall be 8 inches, any additional height shall be made up with concrete grade rings.

4. Ring Adhesives:

   a. For Rubber Grade Rings: Adhesive between rings shall be a butyl rubber sealant conforming to ASTM C-990 and AASHTO M-198.

   b. For Expanded Polypropylene (EPP) Grade Rings: Adhesive shall be as recommended by EPP ring manufacturer. For Cretex Pro-Ring, adhesive shall be M-1 or Rapid Set Flexible Construction Adhesive type only.

2.9 PARSHALL FLUMES

A. Configuration

1. Size: As indicated on the construction drawings.

2. The manhole height shall be as measured from:

   a. Dome top manholes:

      1) Inlet invert to surface grade plus 12 inches

B. Construction

1. One-piece construction with integral inlet and outlet end connections.

C. Materials

1. Fiberglass reinforced plastic, complying with ASTM D 3753, latest edition.

2. Factory-assembled, ready for installation except for field-installed equipment.

3. The exterior surface shall be relatively smooth with no sharp projections. The surface shall be free of blisters larger than 1/2 inch in diameter, delamination and fiber show.

4. The interior surfaces shall be resin rich and unpigmented to allow for visual inspection of the manhole laminate. There shall be no exposed fibers. Additionally, the interior surface shall be smooth for improved corrosion resistance and reduced sludge build-up. The surface shall be free of crazing, delamination, blisters larger than 1/2 inch in diameter, and wrinkles of 1/8 inch or greater in depth.

5. Minimum 1/2-inch wall thickness.

6. Integral fiberglass ladder bolted and glassed to the manhole wall with 1-1/2-inch diameter pultruded fiberglass rungs with a photoluminescent high visibility non-slip top surface and reinforced with threaded T-304 5/16-inch diameter stainless steel rods and solid 1-1/4-inch diameter pultruded fiberglass spacers.

7. Inlet and outlet end connections molded to the flume and laminated to the manhole barrel. The end connections shall be provided with:

    a. PVC or fiberglass pipe stubs with flexible rubber boots and stainless-steel bands.

8. A 3/4-inch-thick expanded polystyrene bead board shall be supplied to place under the manhole on the concrete slab.

9. A 4-inch wide FRP integral mounting flange shall be molded to the base of the manhole barrel for anchoring to the manhole to the concrete slab.

10. An OSHA approved “Confined Space Entry” sign shall be applied to the interior surface of the manhole above the first ladder rung (H-20 type) or on the underside of the manhole top (dome top and aluminum hatch types).

11. One (1) 2-inch NPT coupling to facilitate the installation of sample or bubble tubing, electrical power, or other cabling into the manhole. Run sample lines and electrical lines in separate conduits or crosstalk may occur across unshielded electrical lines.

12. The resins used shall be unsaturated, supplier certified, isophthalic polyester resins. Mixing lots of resin from different manufacturers or “odd-lotting” of resins shall not be permitted. Quality assurance records on the resin shall be maintained.

13. The manhole interior shall be provided with a resin rich, corrosion resistant interior surface. The interior surface shall be unpigmented to allow for visual inspection for voids, inclusions, and defects as well as for verification that “odd-lotting” has not occurred.

14. 15 mil isophthalic U.V. resistant gel coat on all exterior surfaces.

15. Reinforcing materials shall be high performance commercial grade with a coupling agent that will provide a suitable bond between the glass reinforcement and the resin.

16. The manhole laminate shall consist of multiple layers of glass matting and resin. The surface exposed to the sewer / chemical environment shall be resin rich and shall have no exposed fibers.

17. The flume laminate shall be a minimum of 3/16 inch thick with a 15 mil isophthalic U.V. resistant gel coat, with those portions of the flume extending outside the

manhole sufficiently thickened and reinforced as necessary to withstand the forces of the intended application.

D. Materials Properties

1. Manhole Barrel and Reducer:

a. Flexural strength (ASTM D790):

1) 15,400 psi (reducer - hoop).

2) 17,200 psi (reducer - axial).

3) 22,500 psi (reducer - hoop).

4) 14,300 psi (reducer - axial).

b. Compressive Strength (ASTM D695):

1) 18,900 psi (barrel).

c. Barrel Stiffness (ASTM D2412):

1)	Manhole Length: 3-6 ft	psi:	0.72
2)	Manhole Length: 7-12 ft	psi:	1.26
3)	Manhole Length: 13-20 ft	psi:	2.01
4)	Manhole Length: 21-25 ft	psi:	3.02
5)	Manhole Length: 26-35 ft	psi:	5.24

2. Flume:

a.	Tensile strength (ASTM D 638):	14,000 psi.
b.	Flexural strength (ASTM D 790):	27,000 psi.
c.	Flexural modulus (ASTM D 790):	1,000,000 psi.
d.	Barcol hardness (ASTM D 2583):	50.

E. Top Style

1. Dome Top:

a. A fully opening dome top cover rated for 1,000 lb. static top load with a solid FRP hinge block, neoprene gasket for sealing, and stainless-steel hardware (consisting of a piano hinge, lockable hasp, and cover support bar with locking pin on a retaining chain).

F. Flume And Measurement Options

1. Molded-in, high visibility staff gauge, graduated in 0.1-foot and 0.01-foot increments.

2. Ultrasonic mounting bracket, vertically adjustable, over-channel, 304 stainless-steel.

G. Manufacturers

1. The product shall be manufactured by TRACOM, Inc.; 6575-A Industrial Way, Alpharetta, Georgia 30004; Toll-Free Voice (877) 435-8637, Toll-Free Fax (866) 435-8637, www.tracomfrp.com. or approved equal.

2. Requests for substitution shall be made in writing and received by the Engineer's office a minimum of ten (10) business days before bid opening.

3. Substitutions: Manufacturers not pre-approved shall not be allowed.

4. Fiberglass tanks modified for flume installation shall not be allowed.

5. Warranty: Manholes shall be warranted to be free of defects in workmanship and materials for a period of (2) two years from shipment.

2.10 CONCRETE

A. Portland Cement: All concrete shall conform to the Standard Specifications for READY MIXED CONCRETE, ASTM C-94. An air-entraining admixture, conforming to ASTM C-260, shall be added to either Type II or Type III Portland Cement. Fly Ash conforming to ASTM C-618 for Class F Fly Ash may be added to the concrete mix but shall not be considered as replacement for more than 25% of the cement therein (strengths shall not be less than hereinafter required). Type IL Portland-limestone cement, meeting ASTM C-595, shall be allowed in lieu of Type II Portland-cement.

1. Types III and IIIA Portland Cement shall only be used for manhole inverts, concrete encasement, concrete blocking, and/or as directed by the Engineer and shall conform to ASTM C-150.

2. Types II and IIA Portland Cement shall be used in precast manholes, cast in place structures, reinforced concrete piers and concrete as directed by the Engineer, and shall conform to ASTM C-150 except that Tricalcium Aluminate content shall not exceed 8%. Portland-limestone cement Type IL(MS), conforming to ASTM C-595, shall be allowed in lieu of Types II and IIA.

B. Aggregates: All aggregates used for concreting shall conform to ASTM C-33 and shall be checked daily for any variances in moisture content. Said variances shall be corrected and/or taken into consideration for each batch.

1. Coarse Aggregates: Shall be uniformly and evenly graded for each application in accordance with A.C.I. Standard 318. Unless otherwise approved, aggregate shall be sound, crushed, angular granitic stone. Flat or elongated aggregate or smooth round stones shall not be acceptable.

2. Fine Aggregates: Shall consist of natural sand, manufactured sand or a combination thereof. Fine aggregates shall conform to the sieve gradation as specified in Table 1 of ASTM C-33.

C. Mix Design: Concrete shall be watertight, resistant to freeze-thaw cycles and moderate sulfate attack, abrasion resistant, workable, and/or finishable. These qualities may be met through the use of admixtures (if and only if approved in the mix design as hereinafter specified) conforming to the appropriate ASTM with the exception of the use of calcium chloride, which shall be limited to no more than 1% by cement weight - thoroughly mixed to insure uniform distribution within the mix. If the concrete is used with reinforcing steel, no calcium chloride shall be allowed. The Contractor shall assume responsibility for concrete mixture. When required by the Engineer, and prior to beginning construction, the Contractor, at their expense, shall obtain from an approved commercial testing laboratory a design for a suitable concrete mix and submit same with their list of materials and material suppliers for approval. The concrete shall be proportioned to meet the following requirements: (Note: This mix does not apply "in total" to precast manholes).

1. Compressive Strength: Minimum 3,600 psi
2. Water-Cement Ratio By Weight: Maximum 0.50
3. Slump: Minimum 3 inches, Maximum 5 inches
4. Superplasticizer Slump: 6 inches – 8 inches
5. Air Content (Entrained and Entrapped): Minimum 4%, Maximum 6%
6. Coarse Aggregate:0.75-inch – 1.5-inch (as required by the application)

D. Superplasticizer: When superplasticizers are specified or allowed provide in accordance with ASTM C494, Types F & G, with a slump in excess of 7.5 inches.

E. Curing Compound: All concrete curing compounds shall conform to the standard specifications for LIQUID MEMBRANE - FORMING COMPOUNDS FOR CURING CONCRETE, ASTM C-309, Type 2. Curing compounds shall be applied if forms are stripped when concrete is to remain exposed to atmosphere.

F. Grouts: All grouts shall be of a non-shrink nature (as may be achieved through additives or proportioning) and depending upon application range from plastic to flowable cement water paste. Testing as specified above for concrete may be required for acceptance of grouts to include frequent checks for consistency by a time-of-flow measurement. Expansion grouts shall be either MasterFlow 648 epoxy grout by BASF, or 1428HP Grout by W.R. Meadows, or approved equal. Grouts shall be mixed (if applicable) and placed in accordance with the manufacturer's current recommendations for each specific application. Expansion grouts shall be used only as directed by the Engineer. Acceptable range of testing requirements:

1. Compressive Strength: 10,500 psi to 12,500 psi.
2. Bond Strength: 1,350 psi to 1,700 psi.
3. Percent Expansion: + 0.025% to + 0.75%

G. Mortar: Mortar used in sanitary sewer manholes shall be hydraulic cement mortar in accordance with ASTM C-398. Mortar used in sewer manholes shall be Type M mortar in accordance with ASTM C-270.

H. Flowable/Excavatable Fill (CLSM): Contractor shall furnish and place flowable fill i.e. controlled low strength material (CLSM) backfill where shown in the drawings.

1. Cement: All cement used shall be Type II Portland cement which shall conform to the requirements of ASTM C150.
2. Fly Ash: ASTM C618, Class F.
3. Aggregates: Fine aggregate shall conform to the grading and quality requirements of ASTM C33. Coarse aggregate shall conform to the grading and quality requirements of ASTM C33 for size No. 476, No. 57, or No. 67.
4. Water: The batch mixing water and mixer washout water shall conform to the requirements of ASTM C94.
5. Flowable Fill Properties:
    a. CLSM shall have a maximum fifty-six (56) day compressive strength of one hundred (100) psi when molded and cured as in conformance with ASTM D4832.

b. CLSM shall have a minimum cement content of fifty (50) pounds per cubic yard. The water-cementitious materials ratio of the mix shall not exceed three and one-half to one (3.5:1).

c. CLSM shall be air entrained to a total air content of approximately 5%.

d. The minimum slump shall be 6 inches and the maximum slump shall be 8 inches when tested in accordance with ASTM D6103.

e. Fine aggregate shall be between 50% and 60% by volume of the total aggregates in the CLSM mix.

f. The consistency of the CLSM slurry shall be such that the material flows easily into all openings between the pipe and the lower portion of the trench. When trenches are on a steep slope, a stiffer mix of slurry may be required to prevent CLSM from flowing down the trench. When a stiffer mix is used, vibration shall be performed to ensure that the CLSM slurry completely fills all spaces between the pipe and the lower portion of the trench.

I. Lightweight Cellular Concrete Fill – For Use In Annular Spaces Inside Casing Pipe and Tunnel Pipes. See Chapter 21 “Tunneling and Encasement” of the Charlotte Water Standards.

2.11 MISCELLANEOUS STEEL

A. General: This section contains general product specifications for miscellaneous steel components. See project drawings for project specific requirements, and/or Charlotte Water’s Standard Details.

B. Steel Pier Material:

1. All steel pier material shall be hot dipped galvanized and coated in accordance with these specifications.

2. Steel piles, cross braces, cradles, etc., shall consist of structural steel shapes of the section required on the Plans and Details. The steel shall conform to Specifications For Steel For Bridges And Buildings, ASTM A-36.

3. All bolts and nuts shall conform to ASTM A-325 for 7/8-inch and to ASTM A-490 for 1-inch and larger.

4. The Contractor shall handle and store steel members above ground on platforms, skids, or other supports. Members shall be free of dirt, grease, and other foreign material and protected against corrosion.

5. Welding Electrodes shall conform to the following:

a. Shielded Metal-Arc: AWS A5.1 or AWS 5.5, E70XX

b. Submerged-Arc: AWS A5.17, F70X-EXXX

c. Gas Metal-Arc: AWS A5.18, E70S-X or E70U-1

d. Flux Cored-Arc: AWS A5.20, E70T-X (except 2 and 3)

C. Steel Vent Pipe

1. Steel Vent Pipe: Unless otherwise specified, steel vents shall be Schedule 40 5-inch diameter steel pipe, consisting of Grade "B" steel as specified in ASTM A-139, with ANSI Class 150 flange end outlet.

2. All steel shall be Grade "B" only, with a minimum yield strength of 35,000 psi
3. Pipe design shall be in accordance with AWWA M11 considering the following:
    a. Internal pressure
    b. External pressure
    c. Special physical loading
    d. Practical requirements
    e. Minimum wall thickness of 0.25 inch
4. The steel pipe shall have an inside lining - minimum 20 mils dry film thickness of Tnemec Perma-Shield PL Series 431, or approved equal, or shall have fusion-bonded epoxy coating in accordance with AWWA C213. Surface preparation and supplication shall be as recommended by Tnemec or approved equal manufacturer. Lining applicator shall be a Tnemec approved certified applicator or approved equal manufacturer's approved certified applicator.
5. Outside surface of the pipe exterior coating shall be fusion-bonded epoxy coating in accordance with AWWA C213 as per Tnemec or approved equal. Surface preparation and application shall be as recommended by Tnemec or approved equal. The coating applicator shall be a Tnemec or approved equal certified applicator.
    a. Exterior coating shall be forest green or olive green, as approved by the Engineer.
6. Vent pipe shall be equipped with a screen to guard from insects, debris, and animals as indicated on the Standard Details. Screen shall be sized to fit and installed securely inside the hub or coupling of the vent pipe. Screen shall be constructed of 0.009-inch thick 316 stainless steel 18 x 18 mesh with 0.047 inch openings.

D. Stainless Steel Vent Pipe – This section for future development
    1. Stainless Steel Vent Pipe: Vent pipe may be stainless steel subject to approval. No interior coating is required with stainless steel.

E. Anchors
    1. Including uses for, but not limited to, the following:
        a. Hardware for vertical manhole frame and cover adjustments
    2. Anchors: All frame anchors, bolts and washers shall conform to the requirements of ASTM A-36 with a minimum yield strength of 36,000 psi All anchor components shall be hot dipped galvanized as specified below. Including uses for, but not limited to, the following:
        a. Manhole frame and cover anchorage.

F. Stainless Steel Straps and Anchors
    1. Including uses for, but not limited to, the following:
        a. Piping for inside and outside drops for manholes
        b. Reinforced concrete piers

c. Service lateral connections to CIPP

d. Precast manhole vents

2. Straps for concrete piers, manhole vent pipes, inside drops, and outside drops: Stainless Steel ASTM A240 Type 304 or Type 304L.

3. For stainless steel anchors, bolts, and washers (hardware): Stainless Steel ASTM A240 Type 316 or Type 316L.

4. Epoxy Adhesive Anchorage: Adhesive anchors shall consist of a two-component structural epoxy injection gel meeting the requirements of ASTM C881, stainless steel screen tubes of hollow base materials. Minimum adhesive anchor embedment shall be 4 inches (5 inches minimum for frame and cover) unless otherwise indicated. Provide epoxy adhesive anchors by Hilti Corporation HIT-HY 200, ITW Red Head A7+ Quick-Dure Adhesive, Powers Fasteners Pure 150-Pro Epoxy, or pre-approved equal.

   a. Cartridge Injection Adhesive Anchors

      1) Threaded steel rod inserts or reinforcing dowels, complete with nuts, washers, polymer or hybrid mortar adhesive injection system, and manufacturer's installation instructions. Type and size as indicated on the Standard Details.

      2) Interior and Exterior Use: As indicated on the drawings, provide stainless steel anchors. Stainless steel anchors shall be AISI Type 316 stainless steel provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. All nuts shall conform to ASTM F594 unless otherwise specified.

      3) When indicated on the project drawings, or specified by the Standard Details, deformed reinforcing dowels shall be A615 Grade 60.

   b. Capsule Anchors

      1) Threaded steel rod inserts and deformed reinforcing dowels with 45-degree chisel point, complete with nuts, washers, glass or foil capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, and manufacturer's installation instructions. Type and size as indicated on the Standard Details.

      2) Interior and Exterior Use: As indicated on the Drawings, provide chisel-pointed stainless-steel anchors. Stainless steel anchors shall be AISI Type 304, or Type 316 stainless steel provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. All nuts shall conform to ASTM F594 unless otherwise specified.

      3) Deformed reinforcing dowels shall be A615 Grade 60, with 45-degree chisel-points at embedded end.

5. Anti-seize/anti galling lubricant: For use on all bolt and nut threads as recommended by manufacturer for each application. Anti-seize/anti-galling lubricant shall be MRO Solutions LLC Solution 1000; Permatex Anti-Seize

Lubricant, Finish Line Anti-seize Assembly Lube, USS Ultra Tef-Gel, Loctite Heavy Duty Anti-Seize, Loctite LB 771 by Henkel or pre-approved equal. Manufacturers to provide products specifically for use with SS when required.

G. Galvanizing

1. Where project specific requirements, Standard Details, or these specifications require galvanization, provide galvanization according to the following:

   a. Galvanization shall be performed in accordance with ASTM A-153. All exposed surfaces, including anchors, bolts, nuts, washers, etc. shall be fully bituminously coated in accordance with AASHTO M-190. Anchor bolts (non- head) shall conform to ASTM A-36 with tension test to be made (as required) on the bolt body or on the bar stock used for making the anchor bolts. Unless otherwise specified all other fasteners shall conform to ASTM A-307 for carbon steel externally and internally threaded standard fasteners Grade A or B. For use within manholes, the entire strap shall be 304 grade Stainless Steel (not galvanized) and all anchors and/or bolts, washers, and nuts shall be 316 grade Stainless Steel (not galvanized).

   b. Repair damage to galvanized coatings using ASTM A780/A780M zinc rich paint for galvanizing damaged by handling, transporting, cutting, welding, or bolting. Do not heat surfaces to which repair paint has been applied.

   c. Surfaces to be repaired shall be clean, dry and free of oil, grease, pre-existing paint, corrosion and rust. Surface to be repaired shall be blast-cleaned to SSPC-SP 10 (near white). Where circumstances do not allow blast or power tool cleaning to be used, then hand tools may be used. Cleaning shall meet SSPC-SP 2, the removal of loose rust, mil scale or paint to the degree specified, by hand chipping, scrapping, sanding and wire-brushing. Surface preparation shall extend into the undamaged galvanized coating.

   d. Instead of repairing by painting with organic zinc repair paint, other methods of repairing galvanized surfaces that are abraded or damaged are allowed provided the proposed method is acceptable to the Engineer.

H. Steel Reinforcing For Concrete:

1. Bars: All reinforcement bars shall conform to the Standard Specifications for billet-steel bars for concrete reinforcement, ASTM A-615, or low alloy steel deformed and plain bars for concrete reinforcement, ASTM A-706. All bars shall be deformed and of structural Grade 60.

2. Wire: All reinforcement wire fabric shall conform to the Standard Specifications for welded steel wire fabric for concrete reinforcement, ASTM A-185 and steel wire, plain, for concrete reinforcement, ASTM A-82. Minimum yield strength shall be 65,000 psi and minimum tensile strength shall be 75,000 psi.

I. Helical Piles: This work shall consist of constructing helical piles as shown on the Standard Details in accordance with these Specifications.

1. The helical piles/anchors shall have a central shaft that is cold formed welded and seamless carbon steel structural round tubing with a minimum yield strength of 65 ksi and meeting the dimensional and workmanship requirements of ASTM A500.

2. Helix Plates:

a. Shall conform to ASTM A-36 and have minimum yield strength (Fy) of 50 ksi.

b. Shall have a minimum thickness of 3 /8 inches.

3. All other flat plate steel shall conform to ASTM A-36 unless noted otherwise on the plans.

4. All coupling connection thru bolts shall be 3/4-inch diameter and conform to SAE J429 Grade 8 or equivalent. (minimum yield strength (Fy) = 130 ksi and minimum tensile strength (Fu) = 150 ksi)

5. All piling sections and brackets shall be hot dipped galvanized, in compliance with ICC-ES acceptance criteria AC228 for corrosion resistance.

6. All helical pile components shall be selected to provide a minimum factor of safety against ultimate mechanical failure of two (2).

7. Helical piles shall be designed by a North Carolina licensed Professional Engineer in accordance with the current International Building Code (IBC) adopted by the local jurisdiction.

8. The helical pile shall be recognized by the International Code Council (ICC) and the manufacturer shall hold a current ICC-ES issued ESR report showing compliance with AC358 and the current International Building Code (IBC).

2.12 BEDDING MATERIALS - STONE AND BRICK/BLOCK

A. Granular Bedding Material: All bedding material shall be angular, clean washed crushed stone graded in accordance with Size #57, Size #67, or Size #78M in ASTM D-448 for "Standard Sizes of Coarse Aggregate" (NCDOT Standard size #57, #67 and #78). Bedding material shall be used only as instructed in the Specifications and/or as specifically directed by the Engineer.

B. Stone Stabilization Material: All stone stabilization material shall be angular, clean washed crushed stone graded in accordance with standard sizes #467 in ASTM D- 448, (NCDOT Standard size #467M). Stabilization material shall be used only as instructed in the specifications and/or as specifically directed by the Engineer. In conditions unsuitable for use of #467 stone, larger material conforming to NCDOT Class A, B, 1, and 2 stone and ASTM D-448 standard size #357 stone may be used as directed by the Engineer and shall meet the following class and size distribution.

Required Stone Sizes, Inches			
Class	Minimum	Midrange	Maximum
A	2	4	6
B	5	8	12
1	5	10	17
2	9	14	23

No more than 5% of the material furnished can be less than the minimum size specified and no more than 10% of the material can exceed the maximum size specified.

Weight Percent Passing Each Sieve				
Size No.	Nominal Size Square Openings	2 ½ Inches	2 Inches	1 Inch
#357	2 inches to No. 4	100	95 to 100	35 to 70

C. Foundation Material: Foundation materials shall consist of field stone or rough unhewn quarry stone. The stone shall be sound, tough, dense, resistant to the action of air and water, and suitable in all other respects for the purpose intended. All stone shall meet the approval of the Engineer. While no specific gradation is required, there should be equal distribution of the various sizes of the stone within the require size range. The size of an individual stone shall be determined by measuring its long dimension. No more than 5% of the material can be less than the minimum size specified and no more than 10% can exceed the maximum size specified. Foundation material shall be used only as instructed in the specifications and/or as specifically directed by the Engineer.

REQUIRED STONE SIZES - INCHES			
NCDOT CLASS	MINIMUM	MIDRANGE	MAXIMUM
A	2	4	6
B	5	8	12
1	5	10	17
2	9	14	23

D. Clay Brick: All brick used to construct manhole inverts or adjust frames shall be made from clay or shale, shall be solid only and shall be of standard building size. All brick shall meet or exceed the compressive strength and water absorption properties specified in ASTM C-32 for Grade MS brick or in ASTM C-216 and ASTM C-62 for Grade SW brick.

E. Concrete Brick/Block: All concrete brick/block used to make vertical manhole adjustments shall be solid, of standard building size and meet the requirements of ASTM C55 for Grade S-II. Concrete brick/block shall conform to NCDOT requirements and shall be red tinted per NCDOT requirements. Concrete brick/block may be used in vertical manhole height adjustments as shown on the Standard Details, or when approved by the Engineer, and shall NOT be used in invert work.

2.13 MICROPILES

A. Micropiles: This work shall consist of constructing micropiles as shown on the Standard Details in accordance with these Specifications.

1. Admixtures for Grout: Admixtures shall conform to the requirements of ASTM C494/AASHTO M194. Admixtures that control bleed, improve flowability, reduce water content, and retard set may be used in the grout, subject to the review and acceptance of Charlotte Water. Admixtures shall be compatible with the grout and mixed in accordance with the manufacture's recommendations. Expansive admixtures shall only be added to the grout used for filling sealed encapsulations and anchorage covers. Accelerators are not permitted. Admixtures containing chlorides are not permitted.

2. Cement: All cement shall be Portland cement conforming to ASTM C 150/AASHTO M85, Types II, III or V.

3. Centralizers and Spacers: Centralizers and spacers shall be fabricated from schedule 40 PVC pipe or tube, steel, or material non-detrimental to the reinforcing steel. Wood shall not be used. Centralizers and spacers shall be securely attached to the reinforcement; sized to position the reinforcement within ½ inch of plan location from center of pile; sized to allow grout tremie pipe insertion to the bottom of the drillhole; and sized to allow grout to freely flow up the drillhole and casing and between adjacent reinforcing bars.

4. Encapsulation: Encapsulation (double corrosion protection) shall be shop fabricated using high-density, corrugated polyethylene tubing conforming to the requirements of ASTM D3350/AASHTO M252 with a nominal wall thickness of 1/32 inches. The inside annulus between the reinforcing bars and the encapsulating tube shall be a minimum of ¼ inch and be fully grouted with non-shrink grout conforming to this section.

5. Epoxy Coating: The minimum thickness of coating applied electrostatically to the reinforcing steel shall be 0.01 inches. Epoxy coating shall be in accordance with ASTM A775 or ASTM A 934. Bend test requirements are waived. Bearing plates and nuts encased in the pile concrete footing need not be epoxy coated. TS-67.0 – 1.

6. Fine Aggregate: If sand – cement grout is used, sand shall conform to ASTM C 144/AASHTO M45.

7. Grout: Neat cement or sand/cement mixture with a minimum 3-day compressive strength of 2000 psi and a 28-day compressive strength of 4000 psi per AASHTO T106/ASTM C109.

8. Grout Protection: Provide a minimum 1-inch grout cover over bare or epoxy coated bars (excluding bar couplers).

9. Permanent Casing Pipe: Permanent steel casing/pipe shall have the diameter and at least minimum wall thickness as determined by the Engineer. The permanent steel casing/pipe shall meet the Tensile Requirements of ASTM A252, Grade 3, except the yield strength shall be a minimum of 50 ksi to 80 ksi.

10. Plates and Shapes: Structural steel plates and shapes for pile top attachments shall conform to ASTM A 36/AASHTO M31, Grade 420 or Grade 520 or ASTM A722/AASHTO M275, Grade 1035.

2.14 ANTI-SEEP COLLARS

Anti-seep collar shall be placed at the downstream (utility line gradient) wetland boundary and every 150 feet up until the gradient exits the wetland.

A. Concrete

1. Anti-seep collar shall be placed at the downstream (utility line gradient) wetland boundary and every 150 feet up until the gradient exits the wetland. Concrete anti-seep collar may be constructed with class B concrete meeting the following specifications:

   a. Minimum cement content, sacks per cubic yard with rounded coarse aggregate = 5.0

   b. Minimum cement content, sacks per cubic yard with angular coarse aggregate = 5.5

   c. Maximum water-cement ratio gallons per sack 6.8

   d. Slump range = 2 inches to 4 inches

   e. Minimum strength - 28-day psi 3,600

B. Compacted Clay (Bentonite)

1. Compacted clay (bentonite) shall be tested by an independent soils lab to verify its suitability and shall have a specific infiltration of 1 x 10^{-5} cm/sec or less. The clay source material shall be laboratory tested/verified prior to approval by the Engineer. Testing shall be performed by a material testing laboratory and certified by a geotechnical Professional Engineer or Professional Geologist. Placement of clay anti-seep collars shall be as shown on the construction plans and/or where directed by the Engineer. The clay anti-seep collars shall conform to the Standard Detail. Clay shall be compacted to a minimum of 98% of maximum dry density. Compaction test shall be required on each anti-seep collar.

2.15 ANTI-FLOTATION COLLARS

A. Contractor to provide submittals that include the following information:

1. Provide PE stamped anti-flotation calculations by an Engineer registered in the State of North Carolina.

2. Provide maximum spacing between consecutive anti-flotation collars.

3. Collars shall comply with the Standard Detail requirements.

2.16 ANTI-FLOATATION STONE FILLED SADDLEBAGS

A. Stone Filled Saddlebags: Where shown on the plans, engineered geotextile fabric with weights may be used in lieu of anti-flotation collars. Contractor to provide submittals that include the following information:

1. Provide PE stamped anti-floatation calculations by an Engineer registered in the State of North Carolina.

2. Provide UV treated geotextile fabric material that is non-biodegradable and resistant to acidic soils.

3. Grams per square meter (GSM), tensile and puncture strength for the engineered geotextile fabric material.

4. Provide filled weight and gradation of stone used to weigh down pipe.

5. Provide maximum spacing between consecutive saddlebags.

6. Bags may be filled with washed stone or sand, as recommended by the manufacturer.

7. Provide a submittal package for review and approval.

2.17 TRACER WIRE AND WARNING TAPE

A. Sewer Detectable Warning Tape:

1. Shall be 6 inches wide, with 5-mil thickness, green with black lettering tape located directly above the pipe and 24 inches below finished grade.

2. Warning tape shall be brightly colored non-biodegradable plastic ribbon. The words “Warning Buried Sewer Line Below” shall be printed continuously along the length of the ribbon in large letters.

3. Approved Products:

   a. Brady Underground Utility Marking Tape

   b. Terra Tape

   c. Seton Detectable Underground Warning Tape

   d. Pre-Approved equal by Charlotte Water

B. All main line sewer pipe and lateral pipe shall be installed with copper tracer/locator wire, regardless of pipe material.

C. Tracer/Locator Wire System: The tracer wire shall be a single conductor AWG No. 12 (gauge) solid copper wire with HDPE insulation. The insulation shall be green and shall be 30 mils thick for open cut installation or 45 mils thick for Horizontal Directional Drill (HDD) installation. HDD installations shall require two (2) conductors. The copper conductor wire shall conform to the requirements of ASTM B-3. Tracer wire shall be furnished in coiled rolls of 500 feet or greater length. Tracer wire shall be secured to the pipe every 10 feet using an HDPE zip tie or Duct Tape. A 24-inch pigtail shall be provided in each manhole, vault, valve box, cleanout, or any structure exposed to daylight.

1. The wire may be of domestic manufacture or import.

2. The product markings shall be at intervals of not more than 5 feet. The minimum product markings shall include the production record code, conductor average wire gauge (“AWG No. 12”), manufacturer’s name or trademark, and the insulation rating. All markings shall be clear and legible.

D. Wire Splice System: Tracer wire shall be continuous to the greatest extent possible. When wire splices are required, they shall conform to the Standard Details and shall be made with a butt splice, and three (3) layers of vinyl and rubber tapes. The butt splice shall be made with copper alloy split connector or copper crimp connector.

1. The splice system may be of domestic manufacture or import and shall be preapproved by Charlotte Water.

2. The product packaging shall indicate approved conductor type and size, the manufacturer’s name, product name or number, and that the product is designed for direct bury and submersible installations. All markings shall be clear and legible.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION, GENERAL

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

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

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

D. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

E. When installing pipe under streets or other obstructions that cannot be disturbed, use dry bore with encasement, auger without encasement, dry punch/mole, pipe-jacking process, or microtunneling, as shown on the plans or as approved by the Engineer.

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

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

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

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

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

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

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

7. Type VI – Flowable Fill Embedment: 6 inches below pipe, up to the spring line with excavatable flowable fill, for use adjacent to lakes and ponds, when the pipe is more than 6 feet below full pond, or when excavation occurs within 45-degree line sloping out and down from toe of a foundation slab. Depending upon soil and groundwater conditions, wider trenches may be required to create a stable condition in poor soils that cannot brace the flowable fill. Type VI flowable fill embedment shall be used as directed by the Engineer.

8. Stone Stabilization: When the bottom of the trench is not sufficiently stable to prevent vertical or lateral displacement of the pipe after installation with Type III bedding, stone stabilization shall be required to develop a non-yielding foundation for the bedding and pipe. When such conditions are encountered, the trench shall be excavated to a depth as great as 2.5 feet below the pipe bell, or as determined by the Engineer, and #367 or #467 crushed stone, ballast stone or rip rap shall be placed to an elevation 6 inches below the bottom of the pipe. The pipe shall then

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

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

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

3.2 PIPING INSTALLATION, GRAVITY-FLOW, NON-PRESSURE PIPE

A. Installation Depth Limitations: The following are limitations and bedding requirements for supportive strength and shall be adhered to at all times. Granular material embedment may still be required for lesser depths of cover should groundwater, bedrock, and/or soil conditions warrant its use, as determined by the Engineer.

B. Trench width:

1. The minimum trench width shall be defined as the minimum trench width necessary to accommodate compaction equipment necessary to achieve required compaction. Trench widths shall be maintained constant as measured at the top of the pipe.

2. Maximum trench width general requirements:

a. Pipe Size Diameter 4-inch to 16-inch: Maximum Trench Width equals nominal pipe size diameter plus 30 inches.

b. Pipe Size Diameter 18-inch to 30-inch: Maximum Trench Width equals nominal pipe size diameter plus 36 inches.

c. Pipe Size Diameter larger than 30-inch: Maximum Trench Width equals nominal pipe size diameter plus 42 inches.

d. Deviations to listed trench widths must be approved by the Engineer. Deviation from the maximum trench width shall necessitate an increase in the stone bedding around the pipe and/or a change in the type or class of pipe being installed at the Contractor's expense.

C. Ductile Iron Pipe: Installation of Ductile Iron Pipe shall be installed subject to the bedding limitations specified below, based on a deflection limit of 3% for cement lining. Greater

depths of cover may be achieved by using a higher-pressure classification and/or using pipe with a flexible lining.

MAXIMUM DEPTH OF COVER - DIP				
Pipe Size (Inches)	Pressure Class	BEDDING		
		Type I (feet)	Type II (feet)	Type III (feet)
8	350	20	34	50
10	350	15	28	45
12	350	15	28	44
14	250	15	23	36
16	250	15	24	34
18	250	14	22	31
20	250	14	22	30
24	250	15	20	29
30	250	15	19	27
36	250	14	18	25
42	250	14	17	25
48	250	13	17	24
54	250		16	24
60	250		16	24
64	250		16	24

Table Note: Type II Bedding is minimum requirement allowed. Type I Bedding is allowed for installation of DIP 4-inch and 6-inch diameter laterals.

D. Poly Vinyl Chloride (PVC) Pipe: PVC pipe shall be installed with a minimum of 3.0 feet of cover and a maximum of 20 feet of cover. When the cover is less than 3.0 feet or more than 20 feet, Ductile Iron Pipe shall be used subject to the specified limits. PVC pipe shall be installed in accordance with ASTM D-2321 (and/or ASTM D-2774) with the following limitations:

1. All PVC pipe shall be installed using Type III Granular Embedment or greater. Type I and Type IA Bedding is allowed for installation of PVC 4-inch and 6-inch diameter laterals. Minimum and maximum trench widths shall be as follows:

Pipe Size (inches)	Minimum Trench Width (inches)	Maximum Trench Width (inches)
4	20	40
6	22	42
8	24	44
12	28	48
16	32	52
18	34	54
20	36	56
24	42	60
30	50	66
36	57	78
42	65	84
48	72	90
54	80	96
60	87	102

a. Deviations to listed trench widths must be approved by the Engineer.

b. The bedding shall extend from the pipe to the trench wall, or 2.5 pipe diameters (OD) on each side of the pipe, whichever is less.

E. Fiberglass Reinforced Polymer Mortar Pipe (FRPMP): FRPMP shall be installed according to AWWA M45 and ASTM D3262 with the following limitations:

1. Trench Width

a. The minimum trench width shall provide sufficient working room at the sides of the pipe to permit accurate placement and adequate compaction of the pipe zone backfill material. Minimum trench widths are given in the table below:

Nominal Diameter (in.)	Minimum Trench Width (in.)
18 to 20	Diameter + 12
24 to 33	Diameter + 18
36 to 48	Diameter + 24
51 to 72	Diameter + 36
78 to 126	Diameter + 48

b. There is no maximum limit on trench width, however, it is required that the pipe zone backfill materials be placed and compacted as specified for the

full width of the trench or a distance of 2.5 diameters on each side of the pipe, whichever is less.

2. Supported Trench

a. When a permanent or temporary trench shoring is used, minimum trench width shall be as per above. When using movable trench supports, care should be exercised not to disturb the pipe location, jointing or its embedment. Removal of any trench protection below the top of the pipe and within 2.5 pipe diameters is not recommended after the pipe embedment has been compacted unless all voids created by sheeting removal are filled with properly compacted embedment material and any loose soils at pipe zone elevation are properly compacted prior to loading the pipe with overburden. When possible, use movable trench supports on a shelf above the pipe with the pipe installed in a narrow, vertical wall sub ditch.

3. Preparation of Trench Bottom

a. The trench bottom should be constructed to provide a firm, stable and uniform support for the full length of the pipe. Bell holes should be provided at each joint to permit proper joint assembly and alignment. Any part of the trench bottom excavated below grade should be backfilled to grade and should be compacted as required to provide firm pipe support. When an unstable subgrade condition is encountered which will provide inadequate pipe support, additional trench depth should be excavated and refilled with suitable foundation material. In severe conditions special foundations may be required such as wood pile or sheeting capped by a concrete mat, wood sheeting with keyed-in plank foundation, or foundation material processed with cement or chemical stabilizers. A cushion of acceptable bedding material should always be provided between any special foundation and the pipe. Large rocks and debris should be removed to provide six inches of soil cushion below the pipe and accessories.

4. Standard Embedment Conditions

a. FRPM shall be installed in accordance with Type V Granular Material Embedment as stated above in “Pipe Bedding”.

5. Type V Pipe Zone (Embedment) Backfill Materials

Bedding and pipe zone (embedment) backfill materials shall be as specified in this Chapter under Section 2 for “Granular Bedding Material”. Certain projects may warrant additional geotechnical information which may determine alternate bedding conditions. Such projects should be addressed with specific consultation between the Engineer and Charlotte Water during project design.

a. Maximum grain size should typically not exceed 1 to 1.5 times the pipe wall thickness or 1.5 inches whichever is smaller.

b. Well graded materials that will minimize voids in the embedment materials should be used in cases where migration of fines in the trench wall material into the embedment can be anticipated. Alternatively, separate the open graded material from the non-cohesive soil with a filter fabric to prevent migration of the smaller grained soil into the open graded material. Such migration is undesirable since it would reduce the soil density near the pipe zone and thereby lessen the pipe support.

c. Embedment materials should contain no debris, foreign or frozen materials.

6. Bedding

a. A firm, uniform bed should be prepared to fully support the pipe along its entire length. Bedding material should be as specified by the standard embedment condition.

b. Initially place and compact bedding to achieve 2/3 of the total bed thickness. Loosely place the remaining bedding material to achieve a uniform soft cushion in which to seat the pipe invert (bottom).

c. After joining pipes, assure that all bell holes are filled with the appropriate embedment materials and compacted as specified.

d. Note: Do not use blocking to adjust pipe grade.

7. Haunching

a. A very important factor affecting pipe performance and deflection is the haunching material and its density. Material should be placed and consolidated under the pipe while avoiding both vertical and lateral displacement of the pipe from proper grade and alignment.

8. Backfilling

a. Pipe zone (embedment) material shall be as specified by the standard embedment condition.

b. Place and compact the embedment material in lifts to achieve the depths and densities specified by the standard embedment condition. Little or no tamping of the initial backfill directly over the top of the pipe should be done to avoid disturbing the embedded pipe.

c. Remaining backfill may be the native trench material provided clumps and boulders larger than 3 to 4 inches in size are not used until 12 inches of pipe cover has been achieved.

9. Pipe Deflection

a. Pipe initial vertical cross-section deflection measured within the first 24 hours after completion of all backfilling and removal of dewatering systems, if used, shall not exceed 2.75% of the original pipe diameter.

b. Pipe deflection after 30 days should not exceed parameters displayed in table under Section 3.12.G for FRPMP deflection standards. Maximum long-term pipe deflection is 5% of the original pipe diameter. Maximum long-term deflection for pipes with vinyl ester resin liner is 4%.

c. For very high stiffness pipes (approx. SN 120 and above), the maximum long-term deflection may be reduced, and the 24 hour and 30-day deflection limits also decreased proportionally with Engineer's approval.

F. Grade and Line for Pipe: As a minimum, centerline hubs shall be set and offset stakes set at each manhole, and if required at 100-foot intervals between manholes. Cut sheets shall show the vertical distance from the offset stakes to the inlet and outlet pipe invert at each manhole and to the pipe invert at each offset stake. For 30-inch diameter and larger pipe, each joint shall be checked with a grade rod and automatic self-leveling laser level.

Laser alignment beams shall be used to set line and grade. The Contractor shall provide adequate and accurate equipment for the Engineer to check their line and grade at each cut stake (lock levels shall not be considered adequate). The grade shall be checked at each manhole and at benchmarks every 500 feet.

For pipe larger than 30 inches in diameter, laser alignment beams shall generally be used to set line and grade. Each joint shall also be checked with an automatic self-leveling level and grade rod and recorded as survey notes in a survey field book. The field book shall be reviewed by the Engineer periodically during construction and shall be provided to the Engineer at the end of construction.

The Contractor shall keep close check of their laser for variations in line and grade. No variations between manholes shall be corrected without relaying that portion of line which has deviated from line or grade unless otherwise approved by the Engineer.

G. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place watertight plug-in end of incomplete piping at end of day and when work stops during the day/shift.

Construction Staking (Excluding Developer Donated Projects): Contractor is responsible for staking gravity sewer manholes, easements, rights-of-ways, limits of disturbance, tree protection fence line, wetland boundaries, buffers, Project Control Points and other horizontal control reference points and benchmarks for the work shown on the Drawings. Charlotte Water will provide a drawing and/or staking plan files in electronic format to Contractor. Contractor shall confirm all drawing dimensions, elevations and establish elevations, lines, and levels from reference points, utilizing recognized engineering survey practices. During construction, Contractor shall provide competent helpers for checking elevations, lines, and levels deemed necessary by Charlotte Water. Contractor shall establish horizontal and vertical control benchmarks and reference points on the site located in prominent and protected places as agreed upon by Contractor and Charlotte Water. Construction Staking shall be approved by a Professional Land Surveyor registered in the State of North Carolina.

1. Prior to construction, the Engineer will provide the following construction layout for each pipeline project:
    a. Centerline of each proposed manhole, structure, pier and/or centerline of proposed end of main shall be established and offset referenced.
    b. Begin and end point of proposed mainline dry bore with steel encasement or tunnel shall be established and offset referenced centerline.
2. Permanent or temporary benchmarks shall be established by Contractor at or near:
    a. Connection to existing main
    b. Each proposed manhole
    c. Proposed end of main
    d. Proposed piers
    e. Mainline bore with encasement or tunnel
3. The Contractor is responsible for protecting these control points until construction is complete. All other construction layout and surveying, which may be required for construction, shall be provided by the Contractor. The Contractor is responsible

for determining the amount of additional construction layout and surveying that may be required to complete construction.

3.3 LATERAL INSTALLATION

A. 4-inch laterals may connect to new mains at manholes, with cored holes with compression rubber boots, or at tees in new mains. 4-inch laterals may connect to existing mains at manholes with cored holes with compression rubber boots or at cored taps with tapping saddles in existing mains.

B. 6-inch lateral connections may connect to new mains at manholes with cored holes and compression rubber boots or at tees in the new main. 6-inch lateral connections to existing mains may connect at manholes with cored holes with compression rubber boots or at tees installed in existing 8-inch and 10-inch mains. 6-inch laterals may connect to existing 12 inch and larger mains with a cored tap with tapping saddles into the existing main or may connect at manholes with cored holes and compression rubber boots.

C. 4-inch and 6-inch Laterals: 4-inch and 6-inch diameter laterals shall be connected to the main with tees as previously specified if the lateral is installed during the construction of the main. 4-inch and 6-inch diameter laterals shall be connected to existing mains with saddles placed in holes cored by an approved coring machine, or hole saw, as applicable. Saddles and tees shall be as previously specified and as shown on the Standard Details. When approved by the Engineer, tees may be cut into the existing main in lieu of tapping.

D. 4-inch and 6-inch sewer laterals shall extend from the main to the property line or right-of-way line using a 22.5 or 45-degree vertical bend at the tee or saddle and pipe as previously specified and as shown in the Standard Details. The lateral shall be laid with a minimum slope of 1.5% (3/16 inches per foot) for 4-inch laterals and 1.25% (1/8 inches per foot) for 6-inch laterals. All tees, saddles and bends shall be completely encased in #57 washed stone. An "S" shall be cut in the curb at the location where lateral crosses under curb.

E. A schedule 40 PVC pipe cleanout shall be installed on 4-inch and 6-inch diameter laterals, immediately outside the right-of-way, on the applicant’s property as detailed in the Standard Details. The cleanout shall consist of a DR 18 PVC wye and 1/8 bend, vertical Schedule 40 PVC standpipe, and schedule 40 PVC tailpiece. Vertical standpipe shall end with a removable airtight plug. Tailpiece shall end with a solvent weld PVC plug.

F. If the cleanout is installed in paved areas, driveways, or concrete, the top section shall be cast iron with a cast iron lid.

G. Pools shall require maximum 4-inch diameter sewer laterals.

H. Laterals shall not be installed within the curb radius point, unless the lot only fronts the road right-of-way inside the radius points or otherwise approved by Charlotte Water.

I. Cleanouts for 4-inch diameter laterals in maintained yards shall be flush with finished grade, with a sewer valve box assembly. Cleanouts in un-maintained yards or yards still under construction shall extend vertically to 1 foot above finish grade, or flush with a valve box assembly, as directed by the Engineer. The lateral shall terminate with a 3-foot-long tailpiece, immediately behind the cleanout. A treated lumber post (4-inch x 4-inch) shall be placed behind the plug and extend vertically to one-foot above finish grade, if required by the Engineer.

J. Single family home private pressurized sewer lines may discharge into cleanouts. Commercial private pressurized sewer lines shall discharge into private manholes, located outside of the road right-of-way or outside the Charlotte Water sewer easement, regardless of the size of the lateral.

K. In subdivisions constructed without curb, the Contractor shall paint an “S” on the edge of pavement at the location where the lateral crosses under the edge of pavement. Markings shall be made using green paint.

L. All laterals except those serving lots adjacent to inline manholes or upstream from dead-end manholes in cul-de-sacs shall be connected to the sewer main. Laterals connected to the main shall be installed 90 degrees to the main. Angled laterals are prohibited unless connected to a manhole. Laterals connected to manholes shall be laid on a line from the center of the lot to the center of the manhole and shall extend not more than 6 inches inside the manhole wall. Terminal manholes located in cul-de-sacs shall have a maximum of three (3) laterals. Any in line manhole shall have a maximum of two (2) laterals, with each lateral entering the manhole from an opposing side to the other lateral. The lateral elevation entering the manhole shall match crown to crown with the main entering the manhole and a trough shall be formed for the lateral invert. Laterals that are connected to outfall lines shall enter the manhole at the shelf, matching crown to crown with the outfall pipe, and an invert shall be cut into and/or formed in a sweeping motion to carry the lateral flow to the downstream invert.

M. The laterals shall be installed with a minimum of 4 feet of cover at the easement line/road rights-of-way and curb line, unless otherwise approved by Charlotte Water. The depth of the lateral at the easement line shall not be greater than what is required to serve the lot/building. The Contractor shall not backfill any portion of the lateral connection to the main, cleanout or bends, until the installation is approved by a Charlotte Water Inspector.

N. Spacing Requirements shall be as follows:

1. Minimum spacing between tees/taps along the sewer line shall be 7.0 feet, and a minimum of 3.0 feet from pipe joints.

2. Minimum spacing from outside face of manhole and tees/tap shall be 7.0 feet.

3. Minimum spacing from water service shall be 5 feet or distance equal to depth of sewer lateral, whichever is greater.

4. Minimum spacing from parallel storm pipe shall be 5 feet or distance equal to depth of sewer lateral, whichever is greater.

5. Minimum spacing from catch basins shall be 5 feet or distance equal to depth of sewer lateral, whichever is greater.

6. Minimum spacing from property lines shall be 3 feet or distance equal to depth of sewer lateral, whichever is greater.

O. Measurements: The Inspector, assisted by the Contractor, will measure the distance to the tee or tap from the downstream manhole to obtain the information required for the "As-Built" records.

P. 8-Inch and Larger Laterals: 8-inch and larger diameter laterals shall connect to manholes with the lateral crown level with the crown of the main line pipe, or with inside or outside drops, in accordance with Specifications and Standard Details for mainline construction. When the lateral is the same diameter as the main line pipe, a drop of 0.2 feet shall be provided in the manhole between the invert of the lateral and the invert of the main line

pipe. The lateral shall be laid with a minimum slope of 0.60%, and no more than a maximum of 10%, or as approved by the Engineer.

Q. 8-inch and larger laterals shall extend from the main to the easement line or road right-of-way line. The lateral shall terminate immediately outside the right-of-way and shall be plugged with a removable airtight cap or plug. A treated lumber post (4-inch x 4-inch) shall be placed behind the plug and extend vertically to 1 foot above finish grade.

R. 8-inch and larger laterals serving more than one structure are considered public mains and shall be permitted/tested accordingly.

S. Cleanouts are not permitted on 8-inch or larger pipes.

T. For developer installed services, the lateral shall terminate immediately outside the right-of-way or easement, in a private manhole.

U. Due to air testing requirements, a temporary solvent weld plug may be required on the cleanout. Due to the gasketed wye and bend, the vertical standpipe may require counterweights (such as sandbags) during required air testing. Temporary solvent weld plugs, if used, shall be removed after testing, and the permanent screw in plug assembly installed.

V. All laterals, standpipe and fittings in the air test section shall be properly capped or plugged and carefully braced against the internal pressure to prevent air leakage by slippage and blowouts.

W. Sewer tapping saddles on DIP within a 100-foot radius of a well shall be as specified for water main tapping sleeves. A tapping valve is not required. In lieu of the tapping saddle, a ductile iron tee may be installed or cut in. All pipes including lateral pipe and cleanouts within the 100-foot radius of the well shall be ductile iron as specified.

3.4 MANHOLE INSTALLATION

A. General: Install manholes complete with appurtenances and accessories indicated. Manhole vents, frames and covers shall be installed immediately following installation of manholes for safety and flooding reasons. Manholes shall be clean and free of any and all debris.

B. All manholes outside street rights-of-way or landscaped areas shall be constructed to a height of 2 feet above the adjacent ground unless otherwise indicated on the plans or by the special provisions. Manholes within street rights-of-way or landscaped areas shall have finished rim elevations flush with the pavement or adjacent finished grade. After final inspection is complete and all deficiencies have been corrected, the Contractor shall lock all cam-lock style frames and covers in the closed or locked position.

1. Precast Reinforced Concrete Structures: All precast manhole sections shall conform to these Specifications and Standard Details. Precast manholes shall be treated similar to pipe for installation. That is, if groundwater and/or soil conditions require stabilization for pipe installation comparable measures shall be required for precast manhole installation. Under no circumstances shall a precast base section be placed on unstable soil as solely determined by a Geotech Engineer and/or the Engineer. Jointing of precast sections shall be done in accordance with the manufactures recommendation, with special attention called to the amount of force used. Joints shall be made watertight by two (2) rings of butyl rubber joint sealant placed in the joint prior to joint assembly. Sealant shall be sized as recommended by the manhole manufacturer. After the joint is assembled, an exterior joint wrap

shall be applied to the exterior of the completed joint, as indicated in the standard Detail. After completion of manhole construction, the manhole shall be subjected to a vacuum as specified for manhole vacuum testing for approximately 10 minutes to seat the manhole joints and compress the butyl rubber joint sealant. The time required to seat the joint may be temperature dependent and shall be complete when the joint sealant has fully filled the joint annular space, as determined by visual inspection. All backfill around structures shall be thoroughly tamped in layers as specified for placing backfill. Regardless of the type of manhole construction used, the Contractor shall do that which is necessary to stabilize the soil intended to support the structure. A stable condition shall only be so adjudged by the Engineer or their authorized representative. Any cost incurred by the Contractor in stabilizing the area to support a manhole shall be considered incidental to the manhole construction.

2. Outside Drops: When design considerations dictate a large elevation change across a manhole, outside drop manholes may be used at the discretion of the Engineer on a case-by-case basis, constructed in accordance with the Standard Details. Depending on the particular fittings used, elevation differences of 2.0 to 2.5 feet are required to accommodate an outside drop. When there is not sufficient elevation difference to permit construction of an outside drop, the grade of the influent pipe shall be lowered such that the vertical separation of the influent and effluent pipes is 0.2 feet, as measured at the center of the manhole when the grades of both pipes are projected to that point. Outside drops shall not enter the cone section of precast manholes or be within 4 inches of a manhole joint assembly, as measured from the edge of the core.

3. Inside Drops: When connecting a proposed sewer main to an existing 5-foot diameter or larger manhole at an elevation significantly higher than the existing invert elevation, the connection may be made with an inside drop constructed in conformance with the Standard Details. Inside drops shall be used only where shown on the plans or specifically approved by the Engineer. Inside drops shall not enter the manhole in the cone section or be within 4 inches of a manhole joint assembly. Inside drops are not allowed on 4 feet diameter manholes. Inside drops shall have downspout piping one pipe diameter larger than an inlet pipe diameter, as shown on the Standard Details. Un-piped drops are prohibited.

4. Installation Of Frames and Covers: The frame shall be installed on the manhole with anchor bolts on all manholes. 7.5-inch-tall frames shall be used for manholes located in the road right-of-way and manholes located outside of the road right-of-way. These frames shall have holes in the support flange to permit installation on the cone with anchor bolts. Holes shall be equally spaced in the flange. Complete anchor bolt assemblies shall be zinc plated steel and shall consist of an epoxy adhesive anchor, a threaded stud, a double size washer, a standard washer, and two nuts. Use of “red head” mechanical anchoring assemblies are prohibited. Anchors shall be installed in field drilled holes in the cone, and/or adjustment grade rings. Minimum diameter of the threaded stud shall be 1/2 inch. The Contractor shall seal the frame to the manhole by installing two (2) rings of butyl rubber joint sealant to form a gasket between frame and manhole. The butyl rubber joint sealant shall have a 1-inch cross section and shall make two full circles when placed on the cone section and shall be compressed by the frame with the anchor bolts. Cement mortar grouting of the frame shall be required as shown on the Standard Details. Brick may not be used to adjust rim elevations of above

grade manholes. Manholes that are installed flush with pavement or grade shall have frames attached to the manhole with anchor bolts. Precast concrete, recycled rubber or expanded polypropylene (EPP) adjustment grade rings may be used to adjust the finished rim elevation of such manholes. Anchor bolts shall extend through grade rings into the cone section, per the Standard Details. Recycled rubber and Expanded polypropylene (EPP) grade rings shall be installed according to the manufacturer's recommendations. This adjustment using expanded polypropylene or recycled rubber grade rings may not exceed 8 inches in height (total). The maximum adjustment height from top of precast concrete cone section to top of frame shall not exceed 21 inches in height.

5. Manhole Step Testing: The Contractor shall furnish a hydraulic driven system consisting of cylinder, connecting hose and above ground pump with gauge to test manhole steps to exceed 1000 lbs. of resistance of pullout. All field installed steps shall be tested. In lieu of field-testing steps installed at the plant, certified shop test reports by the manufacturer showing that each step passed the required 1000 lb. pullout shall be accepted. The test report certificates shall be furnished to the Inspector prior to field installation of the manhole. Unless the Contractor can furnish the manufacturer's certification on step tests, the Contractor shall be required to test 10% of the plant installed steps. An additional 10% shall be tested for each failure. Failed steps shall be re-installed and re-tested until passing results are approved by the Engineer.

6. Steel or Stainless Steel Vent Pipes: Vent pipes shall be installed in accordance with the Standard Details. Shop drawings of strap on vents, mounting straps, and anchor bolts shall be subject to approval of the Engineer. Material shall be as specified Part 2, Products. Vent pipes shall be grouted watertight into the precast concrete manhole cone section or may be connected using a rubber manhole/pipe boot connector.

7. Polymer Concrete Manholes

   a. Verify that lines and grades are correct.

   b. Structures shall be constructed to the dimensions shown on the drawings and as specified herein. Protect all work against flooding and floatation.

   c. Place the structure section plumb and level, trim to correct elevations.

   d. Place the structure base on a bed of minimum 6-inch-thick base of #57 stone with suitable bearing capacity as approved by Geotechnical Engineer. Set manhole and base grade so that a maximum grade adjustment of 12 inches is required to bring the manhole frame and cover to final grade.

   e. Install approved resilient connectors at each pipe entering and exiting manholes in accordance with the manufacturer's instructions. Test all connections for water tightness before backfilling.

   f. Construct invert channels to provide smooth flow transition waterway with no disruption of flow at pipe-manhole connections. Conform to the following criteria:

      1) Slope of invert bench: 1 inch per foot minimum, 1.5 inches per foot maximum.

      2) Depth of bench to invert shall be at least equal to the largest pipe diameter.

3) Inverts slope through manhole: 0.20-foot drop across manhole with smooth transition of invert through manhole, or as shown on the approved construction plans.

g. Polymer bench and channel are to be constructed with all resin aggregate material. No alternative fill material is allowed.

h. Ladders for Polymer Concrete Manholes

1) Access to polymer concrete manholes should be via a field installed polypropylene vault ladder.

2) Ladder shall be fastened to the floor and wall with 0.5-inch x 3.75-inch Type 316 stainless steel anchors. Fastener brackets shall be installed on the wall at 4 foot intervals from the top of manhole.

a) Drill pilot hole using a hammer drill with a 3/8-inch diamond-tipped stop drill bit with 1-11/16-inch embedment shoulder to avoid drilling through wall.

b) Clear the resulting hole free of dust using compressed air or a vacuum/blower.

c) Fill cleared hole with anchoring adhesive.

d) Install anchor bolt in hole immediately after apply applying the anchoring adhesive.

e) Allow time for curing per manufacturer's recommendation.

f) Set ladder and tighten bolts.

C. Form continuous polymer concrete channels and benches between inlets and outlet.

3.5 PARSHALL FLUMES

A. Install products in accordance with Engineer's instructions, plans, blueprints, etc., local codes, and in a manner consistent with the installation instruction and recommendation of the manufacturer.

B. Ensure that the product is installed plumb and true, free of twist or warp, within the tolerances specified by the manufacturer and as indicated in the contract documents.

C. Nylon or fabric slings should be used in conjunction with a spreader bar to lift or move the manhole.

D. Excavate an area large enough to contain the manhole and the concrete pad while allowing for sufficient space to allow for a safe work environment.

E. Follow all OSHA requirements for open trench construction.

F. Pour a pad of sufficient width and length to support all of the manhole, the flume, and the connecting piping. The thickness of the pad shall be a minimum of 6 inches thick and shall be sized to ensure that proper loading is observed, and that the manhole shall not float. The surface of the pad should be level to within 1/8 inch.

G. Clean the concrete slab of all sharp objects and debris before laying the foam pad provided with the manhole.

H. If PVC boots are provided, install them on the manhole pipe stubs before lowering the manhole into the opening.

I. Lower the manhole onto the pad.

J. Drill holes in the base mounting flange, foam, and concrete pad to accept the stainless-steel anchor bolts (supplied by others unless indicated in 2.2.E).

K. Check to ensure that the flume is level from side to side and from front to back, adjust the pad and anchor bolts, shimming if necessary.

L. Connect and secure piping.

M. Grout the areas between the flume and the concrete pad outside of the manhole.

N. Backfill with specified bedding material, 1/4 to 3/4 inch in diameter, using uniform lifts of no more than 12 inches.

3.6 PIERS

A. Pier locations as shown on the Plans shall be considered a guide only, with final determination made at the time of construction by the Engineer. Pier spacing center to center, shall be as shown on the Plans, but all pier locations may be adjusted by the Engineer due to field conditions.

Piers shall be placed parallel to the flow of the creek unless otherwise directed by the Engineer.

1. Steel Pile Piers: The work covered by this section consists of furnishing and driving piles, as indicated on the plans, the Standard Details, and as approved by the Engineer, in conformity with the specifications and to the bearing and penetration required.

   a. Installation: General - The pilings shall be driven to obtain a bearing capacity of 20 tons based on the following formula (the Engineering News Record Pile Driving Equation) and to a minimum depth of 10 feet in undisturbed earth below the bottom of the creek channel or existing ground when not adjacent to the creek.

      ENR Formula: $S = (2E/R) – C$

      S = penetration per blow (inches)

      R = specified bearing capacity (pounds)

      E = energy per blow (ft-lbs.)

      C = 1.0 for drop hammer; 0.1 for air, or diesel hammer

      See Standard Details for approved H-pile types and sizes.

   b. Piles Lengths: Full length piles shall be used where practicable and not more than two (2) pieces (1 splice) of steel pile shall be permitted in making up one full length pile unless approved by the Engineer. Splices, where necessary and approved by the Engineer, shall be made as to maintain the true alignment and position of the pile sections. Both pieces of a spliced pile shall be the same shape.

      Splices should develop not less than 100% of the bending strength of the pile and not less than 100% of the axial load strength of the pile. All welded splices shall be of full butt weld type. Back-up plates welded to the flanges and web of the steel piles are not required. All welding of structural steel

in the shop or in the field shall meet the requirements of the AWS Code and be done by qualified welders. Certification of welders and welds will be required by the Engineer in accordance with the AWS Code.

c. Driving: Steel piles shall be driven with a diesel, drop, or air hammer with a rated energy of not less than 15,000 ft. lbs., fixed leads and a ram weight of 1 to 1.5 times the pile weight. In case the required penetration is not obtained by the use of a hammer complying with the above minimum requirements, the Contractor shall provide a heavier hammer, at their own expense. The piles shall be driven on a batter of 15 degrees to the vertical or as shown on the plans and shall not be out of position at the top of the pile by more than 3 inches in any direction after driving.

d. Cross Bracing: Cross bracing shall be required only when the undisturbed ground level is below the intersection of the cross bracing.

e. Testing And Inspection: Charlotte Water will provide inspection and will determine bearing capacity of the driven piles. Piles may only be driven while under observation of the Charlotte Water Inspector. The Contractor shall schedule all pipe driving with the inspector. The Contractor shall submit certification of rated hammer energy acceptable to the Engineer. A calibrated, certified scale shall be made available upon request by the Inspector.

The Inspector will be present during all pile driving operations and the Contractor shall provide them evidence that the average penetration for the last 10 blows is less than the S calculated by use of the above formula.

Test piles furnished and driven by the Contractor for their use in determining the lengths of piles to be furnished may be so located that they may be cut off and become a part of the completed structure, provided that such test piles conform to the specifications and are approved by the Engineer.

Test piles shall be driven with equipment of the same type and capacity as that used for driving piles for the structure.

Test piles which are not to be incorporated in the completed structure shall be removed to at least 2 feet below the surface of the ground or the stream bed, and the remaining hole backfilled with earth or other suitable material.

The Contractor shall give written notice a minimum of 72 hours before beginning construction on the steel piles in order to coordinate this work with Charlotte Water inspection staff.

Bolt holes shall be drilled with high-speed drill bits. Acetylene torch bolt holes are prohibited. End cuts shall be ground straight and true, with burrs removed.

f. Repair damage to galvanized coatings using ASTM A780/A780M zinc rich paint for galvanizing damaged by handling, transporting, cutting, welding, or bolting. Do not heat surfaces to which repair paint has been applied.

g. Surfaces to be repaired shall be clean, dry and free of oil, grease, pre-existing paint, corrosion and rust. Surface to be repaired shall be blast-cleaned to SSPC-SP 10 (near white). Where circumstances do not allow

blast or power tool cleaning to be used, then hand tools may be used. Cleaning shall meet SSPC-SP 2, the removal of loose rust, mil scale or paint to the degree specified, by hand chipping, scrapping, sanding and wire-brushing. Surface preparation shall extend into the undamaged galvanized coating.

h. Instead of repairing by painting with organic zinc repair paint, other methods of repairing galvanized surfaces that are abraded or damaged are allowed provided the proposed method is acceptable to the Engineer of Record.

2. Concrete Piers: If the required penetration for a pile is not obtained, as determined solely by the Engineer, the Contractor may be directed to construct a reinforced concrete pier. The Contractor shall not attempt to drive a second pile at a pier location at which the first pile did not achieve the required penetration unless the Engineer has determined that the first pile will be used.

A pile which will not be incorporated in the completed structure shall be removed or cut off so that the top of the pile is below the concrete footing.

3. Helical Piers: Consisting of helical steel piers with one (or more) helically shaped steel plate attached to a central steel shaft. Piers are extended by adding shaft extensions.

a. Installers specializing in performing the work of this section shall have documented credentials or certification from the pier manufacturer.

b. Provide electric or hydraulic powered, rotary type installation torque units with forward and reverse capability which are capable of positioning the pier at the designed angle.

c. The minimum installation equipment rating shall equal or exceed the maximum torque rating of the specified helical pier.

d. Securely connect the installation equipment to the pier during installation.

e. Monitor torque applied by the installing units during the entire installation and record values achieved on each pier.

f. Provide a torque monitoring device as part of the installing unit or as a separate inline device.

g. Make calibration torque monitoring data available for the Engineer of Record, Inspector, and Charlotte Water.

h. Position helical pier as indicated in drawings. Establish proper angular alignment at the start of installation.

i. Provide extension material to obtain indicated depth. Couple the helical pier and extension sections with bolts in accordance with International Conference of Building Officials (ICBO) report ER-5110.

j. Remove encountered obstructions or relocate the helical pier and adjacent helical piers as required. Notify Engineer of Record of pier relocation requirement prior to helical pier placement.

k. Installation:

1) Connect the lead section to the torque motor using the drive tool and drive pins. Position and align the lead section at the location and to the inclination shown on the drawings and crowd the pilot point into the soil. Advance the lead section and continue to add extension sections to achieve the termination criteria. Connect extensions using bolts shown on drawings. Bolts shall be "snug-tight" per the ASIC. "the snug-tightened condition is the tightness that is attained with a few impacts of an impact wrench or the full effort of an ironworker using an ordinary spud wrench to bring the connected plies into firm contact". Bolts do not require a specific torque. Do not over-torque bolts. All sections shall be advanced into the soil in a smooth, continuous manner at a rate of rotation between 10 and 30 revolutions per minute. Constant axial force (crowd) shall be applied while rotating the helical piles/anchors into the ground. The crowd applied shall be sufficient to ensure that the helical pile/anchor advances into the ground a distance equal to at least 80% of the blade pitch per revolution during normal advancement. The torsional strength rating of the helical pile/anchor shall not be exceeded during installation.

2) Helical piles/anchors shall be advanced until both of the following criteria are satisfied:

   a) Final installation torque is achieved. Final installation torque is as determined by the Engineer, Manufacturer, or pile schedule.

   b) Minimum depth is obtained. The minimum depth shall be as shown on the plans, that which corresponds to the planned bearing stratum, or the depth at which the final installation torque is measured, whichever is greater.

3) If maximum torque has been reached or augering occurs prior to achieving the minimum depth, contractor shall have the following options:

   a) Reverse the direction of torque, back-out the helical pile/anchor a distance of 1 to 2 feet and attempt to reinstall by decreasing crowd and augering through the obstruction.

   b) Terminate the installation at the depth obtained subject to the review and acceptance of the Engineer.

   c) Remove the helical pile/anchor and install a new one with fewer and/or smaller diameter helical bearing plates. The new helical configuration shall be subject to review and acceptance of the Engineer.

   d) Remove the helical pile/anchor and pre-drill a pilot hole in the same location and reinstall the anchor/pile. Pilot hole diameter shall match the diameter of the helical pile shaft.

   e) If the obstruction is shallow, remove the helical pile/anchor and remove the obstruction by surface excavation. Backfill and compact the resulting excavation and reinstall the pile/anchor.

   f) Remove the helical pile/anchor and sever the uppermost helical bearing plate from the lead section if more than one helical

bearing plate is in use or reshape the helical bearing plates by cutting with a band saw. Reinstall the pile/anchor.

4) If the final installation torque is not achieved at the contract length, the Contractor shall have the following options:

a) Until the maximum depth is achieved, if any, install the helical pile/anchor deeper using additional extension sections.

b) Remove the helical pile/anchor and install a new one with additional and/or larger diameter helical bearing plates.

c) Decrease the rated load capacity of the helical pile/anchor and install additional helical piles/anchors. The rated capacity and additional unit location shall be subject to the review and acceptance of the engineer.

5) If the minimum depth has been obtained but the final installation torque is not achieved due to augering on an obstruction under maximum crowd (refusal):

a) Record "refusal" on installation logs in place of final torque.

b) Submit installation logs to the Engineer of record for review and approval.

6) The pile/anchor may be deemed acceptable if one of the following conditions are met:

a) The boring logs indicate suitable bearing stratum at the approximate depth of refusal.

b) Pile capacity is verified by dynamic or static load test. Otherwise, the pile shall be downgraded based on last credible torque reading obtained prior to refusal and additional piles/anchors shall be installed.

4. Micropiles: The micropile Contractor shall select the drilling method, the grouting procedure, and the grouting pressure used for the installation of the micropiles. The micropile Contractor shall also determine the micropile casing size, final drillhole diameter and bond length, and central reinforcement steel sizing necessary to develop the specified load capacities and load testing requirements. The micropile Contractor is also responsible for estimating the grout take. There shall be no extra payment for grout overruns.

a. Drilling: The drilling equipment and methods shall be suitable for drilling through the conditions to be encountered, without causing damage to any overlying or adjacent structures or services. The drill hole shall be open along its full length to at least the design minimum drill hole diameter prior to placing grout and reinforcement. When micropile construction will occur in close proximity to settlement sensitive structures vibratory pile driving hammers shall not be used or used at the sole discretion of the micropile Contractor. Temporary casing or other approved method of pile drill hole support shall be required in caving or unstable ground to permit the pile shaft to be formed to the minimum design drill hole diameter. The Contractor’s proposed method(s) to provide drill hole support and to prevent detrimental ground movements shall be reviewed by the Engineer. Detrimental ground

movement is defined as movement which requires remedial repair measures. Use of drilling fluid containing bentonite is not allowed.

b. Ground Heave or Subsidence: During construction, the Contractor shall observe the conditions in the vicinity of the micropile construction site on a daily basis for signs of ground heave or subsidence. Immediately notify the Engineer if signs of movements are observed. Contractor shall immediately suspend or modify drilling or grouting operations if ground heave or subsidence is observed, if the micropile structure is adversely affected, or if adjacent structures are damaged from the drilling or grouting. If the Engineer determines that the movements require corrective action, the Contractor shall take corrective actions necessary to stop the movement or perform repairs. When due to the Contractor's methods or operations or failure to follow the specified/approved construction sequence, as determined by the Engineer, the costs of providing corrective actions shall be borne by the Contractor.

c. Pipe Casing and Reinforcing Bars Placement and Splicing: Reinforcement may be placed either prior to grouting or placed into the grout – filled drill hole before temporary casing (if used) is withdrawn. Reinforcement surface shall be free of deleterious substances such as soil, mud, grease or oil that might contaminate the grout or coat the reinforcement and impair bond. Pile cages and reinforcement groups, if used, shall be sufficiently robust to withstand the installation and grouting process and the withdrawal of the drill casings without damage or disturbance. The Contractor shall check pile top elevations and adjust all installed micropiles to the planned elevations. Centralizers and spacers (if used) shall be provided at 3 feet centers maximum spacing. The upper and lower most centralizer shall be located a maximum of 5 feet from the top and bottom of the micropile. Centralizers and spacers shall permit the free flow of grout without misalignment of the reinforcing bar(s) and permanent casing. The central reinforcement bars with centralizers shall be lowered into the stabilized drill hole and set. The reinforcing steel shall be inserted into the drill hole to the desired depth without difficulty. Partially inserted reinforcing bars shall not be driven or forced into the hole. Contractor shall redrill and reinsert reinforcing steel when necessary to facilitate insertion. Lengths of casing and reinforcing bars to be spliced shall be secured in proper alignment and in a manner to avoid eccentricity or angle between the axes of the two lengths to be spliced. Threaded pipe casing joints shall be located at least two casing diameters (OD) from a splice in any reinforcing bar. When multiple bars are used, bar splices shall be staggered at least 1 foot.

d. Grouting: Micropiles shall be primary grouted the same day the load transfer bond length is drilled. The Contractor shall use a stable neat cement grout or a sand cement grout with a minimum 28-day unconfined compressive strength of 4,000 psi. Admixtures, if used, shall be mixed in accordance with manufacturer's recommendations. The grouting equipment used shall produce a grout that is free of lumps and undispersed cement. The Contractor shall have means and methods of measuring the grout quantity and pumping pressure during the grouting operations. The grout pump shall be equipped with a pressure gauge to monitor grout pressures. A second pressure gauge shall be placed at the point of injection into the pile top. The

pressure gauges shall be capable of measuring pressures of at least 150 psi or twice the actual grout pressures used, whichever is greater. The grout shall be kept in agitation prior to mixing. Grout shall be placed within one hour of mixing. The grouting equipment shall be sized to enable each pile to be grouted in one continuous operation. The grout shall be injected from the lowest point of the drill hole and injection shall continue until uncontaminated grout flows from the top of the pile. The grout may be pumped through grout tubes, casing, hollow-stem augers, or drill rods. Temporary casing, if used, shall be extracted in stages ensuring that, after each length of casing is removed the grout level is brought back up to the ground level before the next length is removed. The tremie pipe or casing shall always extend below the level of the existing grout in the drill hole. The grout pressures and grout take shall be controlled to prevent excessive heave or fracturing of rock or soil formations. Upon completion of grouting, the grout tube may remain in the hole but shall be filled with grout. Grout within the micropiles shall be allowed to attain the required design strength prior to being loaded. If the Contractor elects to use a post-grouting system, working drawings and details shall be submitted to the Engineer of Record for review.

e. Grout Testing: Grout within the micropile verification and proof test piles shall attain the minimum required 3-day compressive strength of 2000 psi prior to load testing. Previous test results for the proposed grout mix completed within one year of the start of work may be submitted for initial verification of the required compressive strengths for installation of pre-production verification test piles and initial production piles. During production, micropile grout shall be tested by the Contractor for compressive strength in accordance with AASHTO T106/ASTM C109 from each grout plant each day of operation or per every 10 piles, whichever occurs more frequently. The compressive strength shall be the average of the three (3) specimens tested. Grout consistency as measured by grout density shall be determined by the Contractor per ASTM C 188/AASHTO T 133 or API RP-13B-1 at a frequency of at least one test per pile, conducted just prior to start of pile grouting. The Baroid Mud Balance used in accordance with API RP-13B-1 is an approved device for determining the grout density of neat cement grout. Grout samples shall be taken directly from the grout plant. Provide grout cube compressive strength and grout density test results to the Engineer of Record within 24 hours of testing.

f. Micropile Installation Records: Contractor shall prepare and submit to the Engineer full-length installation records for each micropile installed. The records shall be submitted within one work shift after that pile installation is completed. The data shall be recorded on the micropile installation log. A separate log shall be provided for each micropile.

g. Pile Load Tests: inspection by the Contractor and Owner's Engineer is needed to assure that each individual micropile is well constructed and to justify load testing only a small number, e.g., 5%, of the total number of production piles installed. Perform verification and proof testing of piles at the locations specified designated by the Engineer. Perform compression load testing in accord with ASTM D1143, tension load testing in accord with ASTM D3689, and lateral load testing in accord with ASTM D3966, except as modified herein.

3.7 CONCRETE PLACEMENT

A. Ready mix concrete shall not be accepted without the inspector receiving the plant dispatch ticket.

B. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by the Engineer.

D. Before test sampling and placing concrete, water may be added at project site, subject to limitations of ACI 301. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

E. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete shall be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.

2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.

3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

F. Forms: Forms may be made of wood, plywood, metal, or any other material approved by the Engineer. Forms shall be mortar tight, of material strong enough to resist noticeable deflection or bulging between supports, and the interior dimensions of the forms shall be such that the finished concrete shall be of the form and dimensions shown on the plans. The design of the forms shall take into account the effect of vibration of concrete as it is placed and also the rate of speed at which the forms shall be filled. Forms shall be coated with a lubricant as approved by the Engineer. Mechanical vibrators, of an approved type, and continuous spading and/or rodding of concrete shall be used to produce proper contact of concrete with forms and reinforcing steel in piers and with forms and pipe in monolithic inverts insuring a compact, dense and impervious artificial stone of uniform texture.

G. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When forecast high and low temperature is expected to fall below 40 deg F for three successive days. Maximum temperature in concrete after placement shall not exceed 160 Deg F (70 Deg C). Maximum temperature difference between center and surface of placement shall not exceed 35 Deg F (19 Deg C).

2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

4. Do not place concrete until the foundation, the adequacy of the forms, the placing of reinforcement and other embedded items have been inspected and approved.

5. Place concrete in daylight unless an approved lighting system is provided.

6. Remove all debris from the interior of forms in preparation for placing concrete. Moisten earth or base course surfaces on which concrete is to be placed immediately before placing concrete. Do not place concrete on excessively wet or frozen surfaces.

7. Place concrete in its final position in the forms within the time stipulated in Sub article 1000-3(E) of NCDOT'S 2024 Standard Specifications for Roads and Structures. Table 1000-2. – Elapsed time shall be measured as the time between adding the mixing water to the mix and placing the concrete. Maximum time in between placing the batches at the work site shall not exceed 20 minutes.

ELAPSED TIME FOR PLACING CONCRETE

Air or Concrete Temperature, whichever is higher.	Maximum Elapsed Time	
	No Retarding Admixture Used	Retarding Admixture Used
90°F or above	30 minutes	1 hr. 15 minutes
80°F through 89°F	45 minutes	1 hr. 30 minutes
79°F or below[A]	60 minutes	1 hr. 45 minutes
70°F through 79°F[B]	60 minutes	1 hr. 45 minutes
69°F or below[B]	1 hr. 30 min	2 hr. 15 minutes

8. Place concrete to avoid segregation of the materials and the displacement of the reinforcement. Thoroughly work the concrete during placement. Bring mortar against the forms to produce a smooth finish, substantially free from water and air pockets or honeycombs.

9. Do not place concrete when the air temperature, measured at the location of the concrete operation in the shade away from artificial heat, is below 35°F unless permission is otherwise granted by the Engineer. When such permission is granted, uniformly heat the aggregates and water to a temperature no higher than 150°F. Place the heated concrete at a temperature of at least 55°F and no more than 80°F.

10. All concrete shall be protected from freezing by the Contractor during the initial 7 days of curing. The Contractor shall submit an anti-freezing plan for review. Frozen concrete shall be removed and replaced at the Contractor's expense.

H. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water

equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

I. Finishing: Provide the type of finish required by the contract directly applicable to the work being constructed

1. Ordinary Surface Finish: Remove all form ties or metal spacers to a depth of at least 1 inch below the surface of the concrete and clean and fill the resulting holes or depressions with grout. Metal devices with exposed cross-sectional area not exceeding approximately 0.05 square inches on surfaces permanently in contact with earth fill may be broken off flush with the surface of the concrete.

Remove all fins caused by form joints and other projections. Remove stains and discoloration. Clean all pockets and fill with grout as directed. Thoroughly soak the surface of all concrete with water before the application of a grout repair.

Use grout consisting of one part cement and two parts sand. Use cement from the same source as originally incorporated in work. Cure the grout for at least 3 days. After the grout has thoroughly hardened, rub the patch with a carborundum stone as required to match the texture and color of the adjacent concrete.

On surfaces that are to be backfilled or surfaces that are enclosed, the removal of form marks, fins and pockets; the rubbing of grouted areas to uniform color; and the removal of stains and discoloration shall not be required.

2. Sidewalk Finish: Strike off fresh concrete and compact until a layer of mortar is brought to the surface. Finish the surface to grade and cross section with a float, trowel smooth and finish with a broom.

3. Rubbed Finish: After the ordinary surface finish has been completed, thoroughly wet and rub the entire surface. Use a coarse carborundum stone or other equally good abrasive to bring the surface to a smooth texture and remove all form marks. Carefully stroke the surface with a clean brush to finish the paste formed by rubbing. Alternatively, spread the paste uniformly over the surface and allow it to take a reset. Finish by floating with a canvas, carpet-faced or cork float or rub down with dry burlap.

4. Float Finish: Finish the surface with a rough carpet float or other suitable device leaving the surface even but distinctly sandy or pebbled in texture.

J. Curing: Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than 7 days with the following materials:

a. Water.

b. Continuous water-fog spray.

c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch overlap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides

and ends overlapping at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than 7 days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.

b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.

c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies shall not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.

a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

K. Flowable Fill

1. Use straps, soil anchors or other approved means of restraint to ensure correct alignment when flowable fill is used as backfill for pipe or where flotation or misalignment may occur.

2. Protect flowable fill from freezing for a period of 36 hours after placement or until the fill is backfilled.

3. Place flowable fill to the designated fill line without vibration or other means of compaction.

4. Flowable fill may be placed during freezing conditions, provided measures are taken to prevent damage to the concrete until sufficient strength has been attained. Care should be taken to avoid freezing before initial set. Concrete shall not be placed during heavy or prolonged precipitation.

5. Take all necessary precautions to prevent any damages caused by the hydraulic pressure of the fill during placement prior to hardening. Provide the means to confine the material within the designated space.

L. Testing: The following tests will be performed by a Testing Laboratory selected by Charlotte Water to ensure the concrete quality. The costs for performing the tests will be paid by for by Charlotte Water when the test results are in conformity with the specifications below. However, those which show no conformity, or a failure will be paid for by the Contractor. It shall be the responsibility of the Contractor to properly inform the Testing Laboratory as to when the concrete will be placed into the forms. For developer projects, the testing laboratory shall be approved by the Engineer and shall be a subconsultant to the Developer's Consulting Engineer. All cost of testing shall be paid by the Developer.

1. Compressive strength in accordance with ASTM C-31 and ASTM C-39. Test cylinders which are formed in the field shall be left in the field until compression testing (7-day, 14-day, 28-day) is completed thereby more closely approximately the curing conditions of the field placed concrete.
2. Slump Test in accordance with ASTM C-143.
3. Air Content Test in accordance with either ASTM C-173 or ASTM C-231.
4. A strength test shall be the average of the strengths of at least two (2) 6-inch x 12-inch cylinders or at least three (3) 4-inch x 8-inch cylinders made from the same sample of concrete and tested at 28 days or at test age designated for f'c.
5. Cellular concrete unit weight testing shall be in accordance with ASTM C496, ASTM C796 and ASTM C869.
6. The testing agency performing acceptance testing shall comply with ASTM C1077.
7. Samples for preparing strength test specimens of each concrete mixture placed each day shall be taken in accordance with (a) through (c):
    a. At least once a day.
    b. At least once for each 150 CY of concrete.
    c. At least once for each 5,000 SF of surface area for slabs or walls.
8. Engineer shall be consulted if exemption from testing is requested.

3.8 CONNECTIONS TO EXISTING SEWERS

A. Tie-ins to existing activated sewer lines will be allowed when proper precautions are taken to protect the existing main. Tie-ins to existing unactivated sewer lines not installed under the same contract shall not be allowed without written approval from all parties involved (Charlotte Water, contractors, contract holders, etc.). The Contractor shall be required to install watertight masonry plugs in the proposed pipeline at the existing manhole and watertight masonry plugs or approved mechanical plugs at the first proposed manhole until all construction and testing is complete. If the proposed sewer does not begin at an existing manhole, a straddle type manhole as shown on the Standard Details shall be constructed over (and around) the undisturbed existing pipeline and the proposed pipeline plugged as specified. The existing pipeline shall not be cut out and the new invert formed until all testing has been successfully completed.

1. Pre-Cast Manhole Tie-In: Any connection with 18-inch and smaller pipe at an existing precast manhole shall require the Contractor to core the necessary opening through the manhole wall. Connections to existing manholes with 20-inch and larger pipe may be cored or sawed as approved by the Engineer. Jackhammer or sledgehammer break-in to the manhole is not permitted. The connection shall be completed with the installation of a watertight manhole/pipe rubber compression boot in the cored hole. The connection shall be completed with a monolithic concrete invert/shelf/exterior collar in the sawed hole.
2. Brick/Block Manhole Tie-In: Connections to existing brick/block manholes may be cored or sawed for all pipe diameters. Depending on the condition of the existing manhole, Charlotte Water may require replacement of the manhole. The connection shall be completed with a monolithic concrete invert/shelf/exterior collar in the sawed or cored hole.

3. Manholes Within Floodplain: Contractor shall make provisions to prevent flooding of manholes located within a floodplain when the frame, cover or riser sections are removed during tie-in or bypass pumping. The contractor shall submit a written method/process to the Engineer for review and approval prior to scheduling any work which endangers the existing sewer system.

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

5. Scheduling: When the flow of an existing sewer must be interrupted and/or bypassed, the Contractor shall, before beginning any construction, submit a work schedule which shall minimize the interruption and/or bypassing of wastewater flow during construction. This schedule shall be approved by the appropriate controlling agencies and Engineer and may require night, holiday, and/or weekend work.

3.9 BYPASS PUMPING

A. Bypass Pumping: If pumping is required, an identical standby pump shall be on site in the event of failure of the primary pump. The standby pump shall include its own bypass piping system or shall be connected to the primary bypass piping system, so the standby pump can immediately be placed into service when needed. All pumps shall be sound attenuated to 68 dBA at 23 feet. The bypass pumping system shall be continuously monitored by the Contractor at all times bypass pumping is occurring. This includes 24-hour monitoring when no work is being performed. If at any time during construction, effluent from the existing sewer is not fully contained by the bypass system, gravity service shall be restored by a temporary tie to the new construction and work shall be suspended until the problem is resolved to the satisfaction of the Engineer. All bypass pumping and piping operations shall be installed a minimum of 2 feet above the 100-year flood elevation.

B. Plugging or blocking of sewage flows shall incorporate a primary and secondary plugging device for 15-inch up to 24-inch diameter pipe. When plugging or blocking is no longer needed for performance and acceptance or work, it is to be removed in a manner that permits the sewage flow to slowly return to normal without surge, to prevent surcharging or causing other major disturbances downstream.

C. The Contractor shall tie-off and/or anchor temporary plugs used in the bypassing of flow such that plugs are not able to proceed into downstream piping.

D. During any bypass pumping operations, signage and emergency contact information shall be clearly visible at the bypass pumping operations site.

E. Sustained bypass pumping operations (operations exceeding 24 hours) shall require installation of an auto-dialer, even if the operation is continuously monitored by a person.

F. Contractor shall provide a temporary cast iron or steel cover over the bypass pumping suction manhole and discharge manhole to safeguard the manholes, to prevent inflow and to minimize odors. At the discharge manhole, the Contractor shall route the discharge piping down into the manhole and shall install 90-degree bends on the end of the piping to direct the flow out of the discharge manhole and heading downstream. The piping arrangement shall be such that the flow is not vertically directed. This piping arrangement will help to direct the flow and minimize turbulence (and odors) in the discharge manhole.

G. The Contractor shall be required to submit, for approval by the Engineer, a detailed plan of the method the Contractor proposes to maintain the existing flow during construction. The plan shall include a provision for handling the existing peak flow by pumping or bypassing by gravity. At a minimum, the following items shall be included with the submittal:

1. Number of pumps, pump manufacturer data, and pump curves. A backup pump(s) shall be provided such that the peak bypass flow can be maintained with the largest pump out of service.

2. The primary and standby pumps shall be piped so no changes in piping are required to switch between pumps. Automated controls are required to switch between the primary and standby pump(s).

3. Provisions for manned 24-hour monitoring, as long as bypass pump is in operation.

4. Site plan showing location of bypass pumping operations, suction manholes, discharge manholes, bypass piping layout/alignment and access. The layout shall include the profile, including 100-year flood elevation, the pump elevations, manhole rim elevations, invert elevations, bypass piping profile – on grade or trenched installation.

5. Expected duration of bypass pumping operations.

6. Location and number of proposed tie-off and/or anchors used to prevent movement or blowouts for plugs.

H. Upon approval of the plan, and prior to initiating bypass pumping operations, the Contractor shall be required to verify his method of handling sewer flows during construction by pumping at peak flows for four (4) hours for each pump. Testing shall include verification of automated controls, automated switch to standby pump and auto-dialer operations. This test must be witnessed by Charlotte Water.

I. The Contractor shall be required to perform bypass pumping operations during dry weather, unless otherwise authorized by Charlotte Water.

J. If a failure of bypass pumping operations occurs, the Contractor shall be responsible for any fines levied as a result of effluent reaching creeks and waterways.

K. Flow from all connecting sewers shall be accommodated. Bypass piping for connecting sewers 8-inch to 12-inch may utilize lay flat hose. Bypass piping for connecting sewers 15-inch to 24-inch shall utilize hard piping and shall have primary and standby sound-attenuated diesel auto-priming pumps. If connecting to the main bypass discharge line, the connection shall have an isolating gate valve.

3.10 DISMANTLEMENT AND ABANDONED SANITARY SEWER SYSTEMS

A. The following requirements shall apply for proposed abandonment of existing facilities unless otherwise shown on the plans or approved by the Engineer. All areas disturbed by abandonment shall be restored.

1. Abandonment Of Existing Manholes: Manholes which are to be abandoned shall first have both influent and effluent lines plugged inside the manhole with watertight masonry plugs. The manhole invert shall have a minimum 2-inch diameter hole drilled through the base to permanently drain the manhole structure. The manhole shall then be filled with non-compressible material (#67 stone or as approved), to a point 3 feet below the finish grade. The remainder of the manhole shall be broken down and removed. Then the excavation shall be filled to finish grade with suitable soil compacted in place. When an existing manhole to be abandoned is located within 50-feet of a wetland, piping shall be completely disconnected from the manhole by cutting the pipe outside the manhole and then plugging the abandoned main and the manhole wall with watertight masonry plugs.

2. Abandonment Of Existing Manholes (Within 50 feet of Wetlands): When an existing manhole to be abandoned is located within 50 feet of a wetland, piping shall be completely disconnected from the manhole by cutting the pipe outside the manhole and then plugging the abandoned main and the manhole wall with watertight masonry plugs. The manhole invert shall have a minimum 2-inch diameter hole drilled through the base to permanently drain the manhole structure. The manhole shall then be filled with non-compressible material (#67 stone or as approved), to a point 3 feet below the finish grade. The remainder of the manhole shall be broken down and removed. Then the excavation shall be filled to finish grade with suitable soil compacted in place.

3. Abandonment Of Mains At Manholes Which Remain In Service: Abandoned mains at active manholes shall be completely removed from the manhole, including the manhole/pipe connector boot. The hole in the manhole shall then be plugged with a watertight masonry plug. When the abandoned pipe connects to the manhole without a rubber boot, the abandoned pipe shall be completely disconnected from the manhole by cutting the pipe outside the manhole and then plugging the abandoned main and the manhole wall with watertight masonry plugs. The invert shall then be rebuilt to conform with the Standard Details.

4. Abandonment Of Exposed Pipe: Exposed sections of abandoned mains shall be removed to a point not less than 5 feet into the adjacent banks. The remaining ends of the pipe shall be plugged with watertight masonry. Concrete piers or collars in the creek channel shall be removed completely. Concrete piers or collars not located in the creek channel shall be removed to a point 3 feet below the finished grade. Steel piers shall be cut off 3 feet below finish grade.

5. Abandonment of Sanitary Sewer Services: Dismantlement of sewer services may include but shall not be limited to capping or plugging lateral at main, manhole, and/or at right-of-way. Sewer laterals shall be dismantled according to the following scenarios:

   a. Short side sewer lateral – tap **outside** of pavement, shall be cut at the main/manhole, plugging the main/manhole invert watertight and rebuilding the invert. Lateral shall be cut/plugged watertight at road right-of-way. Dismantled lateral shall be removed from main/manhole to road right-of-way.

b. Long side sewer lateral – tap **outside** of pavement, shall be cut at the main/manhole, plugging the main/manhole invert watertight and rebuilding the invert. Lateral shall be cut/plugged watertight at road right-of-way. Dismantled lateral shall remain in place below pavement.

c. Sewer lateral – tap **inside** pavement, shall be cut and plugged watertight at the edge of pavement or back of curb. If the lateral connects to a manhole inside the pavement, the lateral pipe shall be plugged watertight from inside the manhole. The invert shall be rebuilt per the Standard Details. Lateral shall be cut/plugged watertight at road right-of-way. Dismantled lateral shall remain in place below the pavement to the road right-of-way.

d. Sewer lateral with outside drop structure at manhole located outside pavement - shall be cut at the manhole, removing outside drop structure and plugging the manhole watertight at both pipe penetrations. The lateral invert shall be rebuilt per the Standard Detail. Lateral shall be cut/plugged watertight at road right-of-way. Remove pipe from manhole to road right-of-way for short side laterals. Dismantled lateral shall remain in place below the pavement to the road right-of-way for long side laterals.

e. Sewer lateral with outside drop structure at manhole located inside pavement - shall be plugged watertight from inside the manhole. The lateral invert shall be rebuilt per the Standard Detail. Lateral shall be cut/plugged watertight at road right-of-way. Invert in manhole and top pipe penetration shall be plugged watertight and the existing tee shall be plugged. Dismantled lateral shall remain in place below the pavement to the road right-of-way.

f. Sewer lateral with inside drop structure in manhole located outside pavement - shall be cut at the manhole, removing inside drop structure and plugging the manhole wall at the top pipe penetration watertight. Lateral shall be cut/plugged watertight at road right-of-way. Remove pipe from manhole to road right-of-way for short side laterals. Dismantled lateral shall remain in place below the pavement to the road right-of-way for long side laterals.

g. Sewer lateral with inside drop structure in manhole located inside pavement - shall be plugged watertight from inside the manhole after removing the inside drop structure. The lateral invert shall be rebuilt per the Standard Detail. Lateral shall be cut/plugged watertight at road right-of-way. Inside drop structure shall be removed and the manhole wall at the top pipe penetration shall be plugged watertight. Dismantled lateral shall remain in place below the pavement to the road right-of-way.

h. Sewer laterals inside Charlotte Water easements – shall be removed from main to easement limits. Plug lateral watertight at easement limits. Plug lateral watertight at main/manhole per bullets above.

i. Inverts shall be reworked to remove abandoned trough when applicable. No open ends of pipe shall be left unplugged, including the private side of the service lateral past the cleanout, if applicable. All pipe cuts shall be plugged watertight.

j. Sanitary sewer services to be dismantled may require CCTV work to be performed in the sewer main in order to locate laterals for dismantlement. In an event that the CCTV camera gets stuck or obstructions in the main

prevent the camera from progressing, the CCTV camera shall be retracted, and the existing sewer line shall need to be cleaned with the appropriate equipment to remove all obstacles for the CCTV.

k. The Engineer may require that sections of the existing sewer main be replaced if the CCTV work performed under this contract deems necessary. The scope of pipe replacement shall be determined based off the existing pipe and the Engineer's discretion.

l. Cleanouts located inside road rights-of-way shall be removed 3 feet below grade and plugged watertight. Cleanouts located outside road rights-of-way or Charlotte Water easements shall not require any additional dismantlement.

m. In the event that active shoring is required, the minimum size trench box necessary to perform the dismantlement shall be utilized.

6. Abandonment Of Existing Pump Stations: Pumps, motors, controls, generator, etc., shall be salvaged and transported by the Contractor to Charlotte Water facilities as directed. All influent and effluent pipes shall be plugged with watertight masonry. The pump chamber and wet well (if abandoned) shall be filled with noncompressible material (#67 stone or as approved), to a point 3 feet below the finish grade. The base of the pump chamber and wet well shall have a minimum 2-inch diameter hole drilled through the base to prevent accumulation of water within the abandoned structures and permanently drain the structures. The remainder of the structure shall be broken down and removed. Then the excavation shall be filled to finished grade with suitable soil compacted in place. All above ground structures associated with the pump station, including fencing and the access road shall be removed and the area restored. Water service shall be abandoned as required in the water chapter, and any wells on site shall be abandoned and plugged as required by state code. Overflow containment basin berms shall be removed, and the fill material shall be used to partially fill the basin and flatten slopes. Access road shall be removed, and all disturbed areas shall be restored.

7. Abandonment within NCDOT Rights-of-Way: utility pipes larger than 24 inches to be abandoned via removing completely or filling with cellular grout or flowable fill to at least 90% full in accordance with NCDOT Standard Specifications for Roads and Structures Section 1530 Abandon or Remove Utilities 1530-3 (A).

3.11 TRACER WIRE, PIPE MARKING, AND IDENTIFICATION

A. The installation of tracer wire is required on all underground pipe, including both sewer and sewer laterals. All sewer pipe, regardless of size or pipe material, shall be installed with a tracer wire.

B. Tracer Wire System: A single conductor AWG No. 12 (12-guage) solid copper wire with 30 mils green HDPE insulation shall be laid on top of the pipe to aid in locating the pipe for maintenance purposes. The wire shall extend along the entire length of the new pipe installed. The copper conductor wire shall conform to ASTM B-3.

1. The wire shall be secured to the pipe with zip ties or duct tape (2 inches in width) at every pipe crown and at the midpoint of each pipe joint, or at a maximum, every 10 feet. The wire shall be a single continuous conductor from manhole to manhole.

2. When joining two sections of tracer wire a weatherproof, copper alloy crimp connector or split bolt wire shall be used to connect each end, according to the Standard Details. The primary wire shall be a single continuous wire from manhole to manhole. The primary wire along the main shall not be cut to complete a splice for a service lateral. The insulation on the primary wire shall be removed to allow the lateral service tracer wire splice. The splice shall be made watertight with application of multiple overlap layers of rubber tape and finished with multiple overlap layers of vinyl tape, as required in the Standard Details. Splices shall be isolated from direct tension on the wires in accordance with the Standard Details.

3. All vertical tracer wires shall be installed in PVC conduits per the Standard Details.

4. A 24-inch pigtail shall be provided in each manhole, vault, valve box, cleanout, or any structure exposed to daylight, per the Standard Details.

C. Tracer Wire for Horizontal Directional Drilling: Install all facilities such that their location can be readily determined by electronic designation after installation. Attach a minimum of two (2) separate and continuous conductive tracking (tone wire) materials, either externally, internally or integral with the product. The ends of the tone wire shall be stubbed up through a 1-inch diameter SCH 80 PVC pipe which shall be installed in the concrete valve pad adjacent to the isolation valve box on both sides of the directional drill, or in its own concrete flush mounted underground locator box. Tracer wires shall be solid No. 12 AWG copper coated steel wire with 45 mils green HDPE insulation. Conductors shall be located on opposite sides when installed externally. Conductor ends shall be stubbed out through the PVC conduit at the isolation valve box at the terminus of the drill.

D. Tracer Wire Testing

1. Contractor shall perform post installation testing of the tracer wire system to confirm conductivity from manhole to manhole and sewer laterals on a daily basis during construction. Immediately prior to, or during the final inspection, the Contractor shall perform post installation testing of the tracer wire system to confirm conductivity from manhole to manhole and sewer laterals. Test tracer wire for continuity, in presence of Engineer during the final inspection or when approved by the Engineer.

2. Notify Engineer in writing 5 working days in advance to schedule testing.

3. Tracer wire installation shall allow for proper access for connection of line tracing equipment and allow for proper locating of wire without loss or deterioration of low frequency signal.

4. If test for continuity is negative, repair or replace as necessary to achieve continuity. The repair or replacement of any defective or improperly installed systems shall be the responsibility of the Contractor. Any and all repairs or replacement of defective or improperly installed tracer wire systems shall be performed by the Contractor and at no cost to Charlotte Water. Method of repairs or replacement shall be subject to the approval of the Engineer.

5. Approved Testing Equipment:

   a. Fluke Networks PRO3000 Tone Generator and Probe Kit

   b. Pre-Approved Equal

E. Sewer Warning Tape: 6-inch wide green with black lettering warning tape shall be installed above the top of all mainline sewer pipe and sewer laterals 24 inches below finished grade. Tape shall be laid in continuous lengths. Any breaks or tears shall be repaired before proceeding with backfilling operations.

3.12 GRAVITY SEWER AND MANHOLE TESTING

A. Sewer Lines and Manholes: The Contractor shall provide proper ventilation of sewer lines and manholes during any test or inspection procedure. The Contractor shall be responsible for providing all equipment and personnel necessary to comply with OSHA confined spaces regulations.

B. The Contractor shall PRETEST the gravity sewer system as indicated below prior to requesting official tests. The Contractor shall advise the Engineer of any problem areas. Repairs shall be made with the knowledge and approval of the Engineer. Methods of repairs shall be subject to approval of the Engineer. Infiltration into manholes and pipe shall be corrected prior to required testing of manholes and pipe. Once all required pre-testing has been successfully completed, the Contractor shall schedule the official test with the Engineer. All official tests shall be conducted under the direct inspection, review and approval of the Engineer. All testing procedures shall be verified and witnessed by the Engineer.

C. The following quality control tests are required prior to acceptance and activation of gravity sewer systems:

1. For Pipe:
    a. Infiltration and Internal Inspection,
    b. Deflection,
    c. Low Pressure Air Test (Manhole to Manhole), or,
    d. Low Pressure Air - Pipe Joint Test,
    e. Hydrostatic Test (Manhole to Manhole), when within 100 feet of a well, or when specified,
    f. Internal Visual Inspection (Joint by Joint), when specified,
    g. Internal CCTV Inspection (MH to MH and Laterals).
2. For Manholes and Wet wells:
    a. Infiltration Inspection
    b. Internal Inspection
    c. Vacuum Test
    d. Exfiltration (Water) Test
    e. Zero Leakage Hydrostatic Test
3. Tracer Wire Conductivity Test

D. ALL TESTING SHALL BE COMPLETED IN THE FINAL 30 DAYS PRIOR TO ACTIVATION OR ACCEPTANCE BY Charlotte Water, EXCEPT PIPE JOINT TESTING PERFORMED AT THE TIME OF INSTALLATION.

E. Gravity Sewer Pipe Leakage Testing: No sooner than 10 days following completion of backfill, the Contractor along with the project inspector shall be required to determine the level of the groundwater table. The groundwater table elevation shall be noted on the plans relative to the top of the pipe. The sewer line shall be inspected and tested for infiltration. Regardless of the groundwater table elevation, all gravity sewer mains shall be low-pressure air tested – manhole to manhole, or individual joint test by low pressure air or low-pressure water. Each test shall be performed as follows:

1. Infiltration: Each manhole and section of pipe shall be visually inspected. The allowable leakage shall be 0.0 gallons. Weir measurements will not be necessary. Any visible point of infiltration or leak, or any flow of water in the pipe invert shall constitute failure of the test. Any failed section of pipe or manhole shall be repaired or removed and replaced in a manner approved by the Engineer. Upon completion of remedial actions, the testing procedures shall restart from the beginning. The process shall continue until each pipe section and manhole has passed the official test.

2. Low Pressure Air Test (Manhole to Manhole)

   a. The low pressure air test may be dangerous to personnel if, through lack of understanding or carelessness, a line is over pressurized, or plugs are installed improperly. It is extremely important that the various plugs be installed so as to prevent the sudden expulsion of a poorly installed or partially inflated plug.

   b. Tests shall be performed in accordance with ASTM F-1417 (Plastic Gravity Sewer Pipe – PVC), regardless of pipe material, and as modified below. Low pressure air tests shall be performed on sewer lines 24 inches in diameter and smaller. The test method shall be the Time-Pressure Drop Method as indicated in the standards and as modified below. Test pressure will be measured by gauges furnished by Charlotte Water and installed by the Contractor above ground at the manhole opposite the air supply. The Contractor shall furnish all other test equipment required including connecting hoses at the Charlotte Water supplied gauge.

   c. Required Test Time:

      1) Determine the Main Test Time (T_M), Lateral Test Time (T_L), Total Test Time (T_T), Minimum Test Time (T_m) and the Required Test Time (T_R):

      2) $T_M = T1 \times L$, where:

         a) T_M = Main Test Time, Seconds,

         b) T1 = Constant as indicated in table below, based on Main Diameter,

         c) L = Length of Main, feet.

      3) $T_L = T2 \times n$, where:

         a) T_L = Lateral Test Time, Seconds,

         b) T2 = Constant as indicated in table below, based on lateral Diameter,

         c) n = Number of laterals included in the test section, each.

      4) $T_T = T_M + T_L$, where:

a) T_T = Total Test Time, Seconds,

5) T_m = T3, where:

a) T_m = Minimum Test Time, Minutes and Seconds,

b) T3 = Constant as indicated in the table below.

6) $T_R = T_T$ or T_m , compare T_T and T_m , and use whichever is greater, where

a) T_R = Required Test Time, to be used in the Low-Pressure Air Test.

Pipe Diameter, D - inches	1.0 psi Test T1 – Main Test Time – Seconds	1.0 psi Test T2 – Lateral Test Time - Seconds	1.0 psi Test T3 - Minimum Test Time - Minutes: Seconds
4	n/a	12.0	n/a
6	n/a	26.0	n/a
8	1.520	n/a	7:34
10	2.374	n/a	9:26
12	3.418	n/a	11:20
15	5.342	n/a	14:10
16	6.038	n/a	15:10
18	7.692	n/a	17:00
20	9.418	n/a	19:00
21	10.470	n/a	19:50
24	13.674	n/a	22:40

7) When approved by the Engineer, 15-inch diameter and larger mains may be tested by the 0.5 psi Time-Pressure Drop Method in lieu of the 1.0 psi Time-Pressure Drop Method. The 0.5 psi Test may only be used when the Contractor requests the 0.5 psi Test, and the Required Test Time (T_R), as determined above, is greater than 30 minutes. When the 0.5 psi Test has been approved by the Engineer, the Required Test Time (T_R) shall be determined based on the equations above and the table below:

Pipe Diameter, D - inches	0.5 psi Test T1 – Main Test Time – Seconds	0.5 psi Test T2 – Lateral Test Time - Seconds	0.5 psi Test T3 - Minimum Test Time - Minutes: Seconds
4	n/a	6.0	n/a
6	n/a	13.0	n/a
8	n/a	n/a	n/a
10	n/a	n/a	n/a
12	n/a	n/a	n/a
15	2.671	n/a	7:05
16	3.019	n/a	7:35
18	3.846	n/a	8:30
20	4.709	n/a	9:30
21	5.235	n/a	9:55
24	6.837	n/a	11:20

d. Required Test Pressure:

1) The Contractor along shall be required to determine the level of the groundwater table. The groundwater table elevation shall be noted on the plans relative to the top of the pipe at the upstream end of each section of pipe.

2) Since water produces a pressure of 0.43 psi for every foot of depth, the required air test pressure shall be increased to offset the depth of groundwater over the sewer main. If the groundwater level is 2 feet or more above the top of the pipe at the upstream end, or if the air pressure required for the test is greater than 9 psi, the air test method shall not be used until the groundwater level is lowered by pumping or dewatering.

3) The minimum required starting test pressure shall be 3.5 psi. When groundwater is present, the required starting test pressure shall be increased as indicated below. The maximum required starting test pressure shall be 9.0 psi.

4) Determine the Require Starting Pressure (P_T) and the Stabilization Pressure (P_S):

5) $P_W = (E_W – E_I) \times 0.43$, where

   a) P_W = Pressure increases due to groundwater table elevation, psi,

   b) E_W = Elevation of water table, feet,

   c) E_I = Elevation of pipe invert at downstream manhole, feet.

6) $P_T = P_M + P_W$, but less than 9.0 psi, where:

   a) P_T = Required Starting Test Pressure, psi,

   b) P_M = Minimum Required Starting Test Pressure = 3.5 psi,

   c) P_W = Pressure increases due to groundwater table elevation, psi.

7) $P_S = P_T + 0.50$, where:

a) P_S = Stabilization Pressure, psi

e. Low Pressure Air Test Procedure

1) Observe the Following Safety Precautions:

a) No personnel shall be allowed in the manholes during testing because of the safety hazards.

b) Plugs and cleanouts shall be securely installed and braced in such a way as to prevent blowouts.

c) When mains are to be tested, the plugs and cleanouts shall be braced as an added safety factor.

d) Do not over pressurize the lines. It is also imperative that the pressure in the pipe be relieved completely before any plug is loosened for removal.

e) Pressurizing equipment shall include a 9-psi pressure relief valve or regulator to prevent over pressurization and possible damage to the main.

f) Personnel shall NOT be allowed in the manholes or within 10 feet of the manholes during pressurization, testing, or depressurization.

2) Preparation of the Sewer Main and Test Procedure:

a) Clean the section of sewer main to be tested by flushing or other means prior to conducting the low pressure air test. This cleaning serves to eliminate debris and produce the most consistent results.

b) Isolate the section of sewer main to be tested by inflatable plugs, mechanical test plugs or other suitable test plugs.

c) Plug or cap the ends of all branches, laterals, cleanouts, tees, and stubs to be included in the test to prevent air leakage. All plugs and caps shall be securely braced to prevent blow out. The plug at each manhole shall have an inlet tap, or other provision for connecting a hose.

d) Connect the air hose to the inlet tap and portable air control source. The air equipment shall consist of necessary valves and pressure gauges to control an oil-free air source and the rate at which air flows into the test section to enable monitoring of the air pressure within the test section.

e) Connect the air hose to the inlet tap at the manhole opposite the portable air control source. The 15 psi gauge shall be furnished by the Engineer and connected to the hose. The gauge shall be positioned a minimum of 10 feet away from the manhole.

f) Add air slowly to the test section until the pressure inside the pipe reaches the stabilization pressure (P_S), equal to the required test pressure (P_T) plus 0.5 psi.

g) After the stabilization pressure is obtained, regulate the air supply so that the pressure is maintained within 0.5 psi of the stabilization pressure for at least 2 minutes. The stabilization period will vary, depending on air/ground temperature conditions. The air temperature should stabilize in equilibrium with the temperature of the pipe walls. The pressure will normally drop slightly until equilibrium is obtained; however, the pressure shall be maintained within 0.5 psi of the stabilization pressure.

h) When the pressure has remained stable for 2 minutes, disconnect the air supply and slowly decrease the pressure to the required test pressure ($P_{T)}$ before starting the test.

i) Record the starting test pressure and the starting time and begin the timed test.

j) Monitor the pressure gauge to determine the rate of air/pressure drop by the time-pressure drop method.

k) Monitor the pressure gauge and the clock until the end of the required test time (T_R) period.

l) Record the ending test pressure and the ending time.

m) For the 1 psi Time-Pressure Drop Test, the section of main shall pass the test if the pressure drop is less than 1 psi at the end of the required test (T_R) period. The section of main shall fail the test if the pressure drop is greater than 1 psi at the end of the required test time (T_R) period.

n) For the 0.5 psi Time-Pressure Drop Test, the section of main shall pass the test if the pressure drop is less than 0.5 psi at the end of the required test (T_R) period. The section of main shall fail the test if the pressure drop is greater than 0.5 psi at the end of the required test time (T_R) period.

o) Upon completion of the test, open the bleeder valve and allow all air to escape. Plugs shall not be removed until all air pressure in the test section has been reduced to atmospheric pressure.

p) If the main fails the test, segmented testing may be utilized solely to find the location of leaks. Once leaks are located and repaired, retest the completed pipe installation to requirements of this test method.

f. Any failed section of pipe shall be repaired or removed and replaced in a manner approved by the Engineer at no cost to Charlotte Water. Repairs shall be made with the knowledge and approval of the Engineer. Upon completion of remedial actions, the testing procedures shall restart from the beginning. The process shall continue until each pipe section has passed the official test.

g. Sewer lines larger than 24 inches in diameter shall be tested for infiltration as specified above. Each joint shall be individually tested by low pressure air or water as specified below. Each joint shall also be visually inspected by a Charlotte Water representative as specified below.

3. Low Pressure Air – Pipe Joint Test (Individual Joint Test)

a. Sewer mains 30 inches and larger shall be tested by the Low-Pressure Air - Pipe Joint Test. The use of compressed air is dangerous if a sewer line is not prepared properly, and proper procedures are not followed. It is imperative that all pressures be relieved completely before the test apparatus is loosened for removal. Pressurizing lines for both ends element sealing tubes shall be separate from the lines for pressurizing the void volume created by the joint test apparatus. The pressures required to seal the end element tubes shall be as specified by the apparatus manufacturer and are greater than the pressure required to test the joint. The line for pressurizing the void volume shall include a 6-psi pressure relief valve to reduce hazards and avoid over-pressurization.

b. Tests shall be performed in accordance with ASTM C 1103 (Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines), regardless of pipe material, and as modified below. Test pressure will be measured by gauges furnished by Charlotte Water and installed by the Contractor a safe distance away from the test joint, the testing equipment and the air supply. The Contractor shall furnish all other test equipment required including connecting hoses at the Charlotte Water supplied gauge.

c. The Contractor shall test joints of installed sewer pipe, regardless of pipe material, with air to demonstrate the integrity of the joint. Joints shall be tested after backfilling, and without any groundwater effect. Assuming the backfilling operations have covered approximately one-half the last joint of pipe installed, the joint to be tested will be the third joint from the open bell of the last joint installed. After each joint has been installed and before the joint test, all joints shall be tested with a feeler gauge supplied by the pipe manufacturer to determine if the joint gasket has been properly seated.

d. Joint testing apparatus, including an air compressor and hose, shall be furnished by the Contractor and shall be as manufactured by Cherne Industries Incorporated, or approved equal. The joint tester end element sealing tubes when inflated shall create an airtight seal over the joint of the pipe. Inflate end element sealing tubes with air in accordance with the equipment manufacturer's instructions.

e. The center cavity between the end elements shall be pressurized with air to 3.5 psi. Pumps, dewatering equipment or wellpoint systems shall be used to maintain the groundwater elevation a minimum of 6 inches below the bottom of the pipe.

f. If the pressure in the cavity holds or drops less than 1 psi in 5 seconds, the pipe joint shall be found to be acceptable. If the pressure drop is greater 1 psi in 5 seconds, the joint is defective and shall be disassembled and remade or repaired and retested.

g. Testing of pipe joints shall be performed immediately after installing and backfilling the next pipe section. The test operator shall keep a log of all tests showing the following:

1) Joint number from specific numbered manholes.

2) Date and time.

3) Name of test operator.

4) Sealing pressure used.

5) Joint test pressure used.

6) Number of seconds joint held pressure to 1 psig drop.

7) Whether joint passed or failed.

8) Action taken if failure occurred, including retesting.

9) Contractor shall schedule and notify the inspector prior to testing each joint.

h. The Contractor shall use the form provided by the Engineer to log all test data.

i. The Contractor shall submit his plan for joint testing to the Engineer for review at least 10 days before starting installation of pipe. Any damage to the pipe from testing shall be repaired by the Contractor.

j. Low Pressure Air-Joint Test Procedure:

1) Observe the Following Safety Precautions:

a) The use of compressed air is dangerous if a sewer line is not prepared properly, and proper procedures are not followed.

b) It is imperative that all pressures be relieved completely before the test apparatus is loosened for removal.

c) Pressurizing lines for both ends element sealing tubes shall be separate from the lines for pressurizing the void volume created by the joint test apparatus. The pressures required to seal the end element tubes shall be as specified by the apparatus manufacturer and are greater than the pressure required to test the joint. The line for pressurizing the void volume shall include a 6-psi pressure relief valve to reduce hazards and avoid over-pressurization.

2) Preparation of the Pipe Joint and Test Procedure:

a) Clean the joint and interior joint surfaces to eliminate debris prior to wetting and testing.

b) Attach the Charlotte Water furnished gauge and locate a safe distance away from the test joint, test equipment, and compressed air supplies.

c) Verify the groundwater conditions surrounding the sewer line to be tested are below the pipe.

d) Review proper operation, safety, and maintenance procedures as provided by the manufacturer of the joint test apparatus.

e) Move the joint test apparatus into the sewer line to the joint to be tested and position it over the joint. Make sure the end element

sealing tubes straddle both sides of the joint and the hoses are attached.

f) Inflate end element sealing tubes with air in accordance with equipment and manufacturer's instructions.

g) An air or water reservoir shall be included in the joint test system. By maintaining a constant supply of air in a reservoir, continuous pumping of air or water is not required, and any variances in test equipment and joint space shall be negated. The reservoir shall have a minimum volume of 2.5 cubic feet.

h) Pressurize the void volume with air to 3.5 psi. Allow the air pressure and temperature to stabilize for approximately 15 seconds before shutting off the air supply and start of test timing.

i) If the joint being tested holds pressure, or drops less than 1 psi in 5 Seconds, the joint is acceptable.

j) If the joint being tested drops more than 1 psi in 5 seconds, the joint fails, it shall be retested. If the retest fails, the pipe joint shall be removed and replaced in a manner approved by the Engineer.

k) After the joint test is completed, slowly exhaust void volume of air, then slowly exhaust end element tubes prior to removal of apparatus.

l) A passing test by the Low Pressure Air - Joint test method shall not preclude rejection of the work if groundwater infiltration subsequently occurs at the joint. The required standard is zero leakage at the joint.

k. Any failed pipe joint shall be removed and replaced in a manner approved by the Engineer. Repairs shall be made with the knowledge and approval of the Engineer. Upon completion of remedial actions, the testing procedures shall restart from the beginning. The process shall continue until each pipe section has passed the official test.

4. <u>Hydrostatic Test (Manhole to Manhole)</u>

a. When specified, or when any of the pipe is located within 100 feet of a public or private well, the pipe section shall be tested manhole to manhole according to the Hydrostatic Test requirements indicated below. The test section shall consist of one upstream manhole and the downstream section of pipe. Vents connected to the manhole shall be included in and tested as part of the manhole. Laterals connected to the manhole shall be included in and tested as part of the manhole. Laterals connected to the pipe shall be included in and tested as part of the pipe. The Hydrostatic Test shall be in addition to the Low-Pressure Air Test or the Low-Pressure Air – Pipe Joint Test specified above. The low-pressure air test methods shall be used as an indicator test to determine if there is a leak in the pipe before the Hydrostatic Test is performed.

b. Installation Requirements:

1) Two rows of Butyl Sealant shall be used at all joints (manhole, grade rings, and frame), as specified.

2) All manhole frame and covers located within 100 feet radius of a public or private well shall be solid watertight covers with gasket and camlocks, as specified.

3) Exterior joint wrap sealant shall be used on all manhole joints, as specified.

4) The manhole included in the test section shall be vacuum tested for 10 minutes to seat the joints on assembly prior to or after backfilling around manhole, as specified.

5) The inside of any concrete grade rings shall be coated with hydraulic cement grout to make the grade ring watertight.

6) Construct and/or verify that all sanitary sewer mainline pipe and service laterals within 100 feet of a public or private well are constructed with ductile iron pipe only.

7) Construct and/or verify that the ends of each service laterals and cleanouts are properly plugged and restrained (no concrete blocking) to prevent leakage during the test and prevent a plug from blowing out due to hydrostatic pressure.

c. Testing Procedure:

1) Prior to performing hydrostatic test, confirm that no customers/property owners have connected their private plumbing to the service lateral connection.

2) Verify the pipe plugs to be used are rated at a higher-pressure rating than expected during the test, due to the height of water in the manhole.

3) The Test Section shall consist of one upstream manhole and one downstream pipe segment.

4) Install a pipe plug in the flowline pipe inlet at the downstream manhole and brace the plug to prevent movement.

5) Install a pipe plug in the flowline pipe inlet at the upstream manhole and brace the plug to prevent movement. This includes the upstream manhole in the test segment.

6) Lateral service connections at manholes shall not be plugged. All lateral service connections to the pipe segment and connected to the manhole shall be included in the test.

7) Slowly fill the pipe segment and the upstream manhole until the water level in the upstream manhole is within 1.5 inches of the top of the cast iron frame. Release any trapped air in lateral cleanouts. Refill and note the water level in the frame and allow the test section to saturate for a minimum of 24 hours.

8) After the 24-hour saturation period, observe and note water level in the upstream manhole.

9) If no drop in water level has occurred during this initial 24-hour period, return after two (2) additional hours and observe and note water level.

If no drop in water level has occurred after this 2-hour period, the test shall be considered successful.

10) If after 2 hours there has been a drop in the water level, the amount of drop shall be noted. Refill the manhole to the initial water level to within 1.5 inches of the top of the cast iron frame. Note the water level.

11) The above sequence of fill and monitor shall continue until the water level in the manhole has been maintained at the starting water elevation for two (2) consecutive hours. When the water level remains unchanged (no drop in elevation) for a 2-hour period, the test shall be considered successful.

12) If after the fourth hour it is determined that the water level cannot be maintained without dropping, the test shall be terminated and considered failed.

13) Necessary repairs and/or improvements shall be made to the pipe or manhole. Repairs shall be made with the knowledge of, and in a manner approved by the Engineer.

14) Upon completion of remedial actions, the system shall be retested from the beginning, as indicated above.

15) If during the previous 4 hours, the water level drop has been at a diminishing rate, the contractor may choose to continue the fill and monitor sequence until the water level has been maintained at the same level for two (2) consecutive hours.

d. The Contractor may choose to test the pipe and the manhole separately as independent tests. When testing the manhole, laterals connected to the manhole shall be included in and tested with the manhole. The manhole shall be tested according to the test procedure above, except the pipe plugs shall be installed in the upstream and downstream mainline pipes to isolate the test manhole.

e. When testing the mainline pipe segment between two manholes, laterals connected to the pipe shall be included in and tested with the pipe. The pipe segment shall be isolated by plugging the pipe where it enters the upstream and downstream manholes. The lateral cleanout nearest the upstream manhole shall be extended to the elevation of the upstream manhole's rim elevation. The pipe segment shall be tested according to the test procedure above, except the cleanout shall be used to fill the pipe with water, and water level measurements shall be made at the cleanout.

f. When a lateral cleanout is not located in the test section, or near the upstream manhole, the plug at the upstream manhole shall include a pass-through tap. A 2-inch diameter standpipe shall be connected to the tap in the plug. The standpipe shall extend to within 1.5 inches of the top of the cast iron frame. The pipe segment shall be tested according to the Test Procedure above, except the standpipe shall be used to fill the main with water, and water level measurements shall be made at the standpipe.

g. Any failed section of pipe or manhole shall be repaired or removed and replaced in a manner approved by the Engineer. Repairs shall be made with the knowledge and approval of the Engineer. Upon completion of remedial

actions, the testing procedures shall restart from the beginning. The process shall continue until each test section has passed the official test.

F. Manhole Leakage Testing: All manholes shall be subjected to a visual infiltration inspection as specified. All newly constructed manhole leakage testing shall take place before the application of any lining or coating systems. All manholes installed on the project shall be tested by either the exfiltration method or vacuum air method, as described herein. At the direction of the Engineer, all manholes which may have the potential to surcharge in the event of a lift station failure or backup shall be tested by the exfiltration method. Manholes shall be tested by plugging the mainline inlet and outlet pipes with airtight plugs and using one of the following procedures: All newly constructed straddle manholes on existing pipe shall be tested prior to cutting out and removing the existing pipe inside the manhole. Laterals connected to the manhole shall be included in and tested as part of the manhole. Vents connected to the manhole shall be included in and tested as part of the manhole. The Vacuum Air Test procedure shall be used to seat the manhole sections, compress the butyl rubber joint sealant, and verify that the manhole should not infiltrate or leak groundwater into the manhole. The Exfiltration Test shall be used to verify that the manhole is watertight and should not leak sanitary sewer into the groundwater. Charlotte Water testing has confirmed that both tests are required to reasonably confirm that a manhole will not infiltrate or exfiltrate. Therefore, each manhole shall be tested by both methods.

1. Infiltration: Each manhole shall be visually inspected. The allowable leakage shall be 0.0 gallons per day. Weir measurements will not be necessary. Any visible point of infiltration or leak, or any flow of water in the manhole invert shall constitute failure of the test. Any failed manhole shall be repaired or removed and replaced in a manner approved by the Engineer. Repairs shall be made with the knowledge of and the approval of the Engineer. Upon completion of remedial actions, the infiltration inspection procedures shall restart from the beginning. Each manhole shall pass the official test.

   A passing test during the infiltration inspection shall not preclude rejection of the work if groundwater infiltration subsequently occurs at the manhole. The required standard is zero leakage at the manhole until the end of the warranty period.

2. Exfiltration

   a. All newly constructed manholes shall be subjected to an exfiltration test as specified below. Manholes located within 100 feet of a public or private well are exempt from the Exfiltration Test but shall pass the Hydrostatic Test (Manhole to Manhole) specified herein, or the Hydrostatic Test (Manhole), specified herein. Vents connected to the manhole shall be included in and tested as part of the manhole. Laterals connected to the manhole shall be included in and tested as part of the manhole. All manholes installed on the project are to be tested. Projects that include lift station rehabilitation or replacement shall have exfiltration testing performed on any existing manhole directly upstream of the lift station wet well. Manholes that fail the test shall be repaired as specified and retested until they pass.

   b. Summary of Practice

      1) Fill the manhole to within 1.5 inches of the top of the cast iron frame with water and allow the level to equalize due to saturation.

2) Refill the manhole and mark the level to begin the test. The test shall last at least 2 hours and allowable leakage shall be 3 gallons per hour.

c. Installation Considerations

1) The manhole vacuum test shall be completed prior to this test procedure.

2) All manholes located outside 100 feet radius of a public or private well shall be tested to this standard, as specified.

3) Construct and/or verify that the ends of each service lateral and cleanout are properly plugged and restrained (no concrete blocking) to prevent leakage during the test and prevent a plug from blowing out due to hydrostatic pressure.

d. Testing Procedures

1) Prior to performing exfiltration test, confirm that no customers/property owners have connected their private plumbing to the service lateral connection.

2) Verify the pipe plugs to be used are rated for higher pressures than expected during the test, due to the height of water in the manhole.

3) Install a pipe plug in the mainline pipes on the upstream and downstream sides of the manhole and brace the plugs to prevent movement.

4) Lateral service connections at manhole shall not be plugged. All lateral services connected to the manhole shall be included in the test.

5) Vent pipes connected to the manhole shall not be plugged. Vent pipes connected to the manhole shall be included in the test.

6) Fill the manhole until the water level in the manhole is within 1.5 inches of the top of the cast iron frame. Release any trapped air in lateral cleanouts. Refill and note the water level in the frame and allow the test section to saturate for a minimum of 24 hours.

7) After the 24-hour saturation period, observe and note water level in the manhole.

8) If no drop in water level has occurred during this initial 24-hour period, return after two (2) additional hours and observe and note water level. If the water level drop is less than 3 gallons per hour, after this two-hour period, the test will be considered successful.

9) If after 2 hours there has been a drop greater than 3 gallons per hour in the water level, the amount of drop shall be noted. Refill the manhole to the initial water level, within 1.5 inches of the top of the cast iron frame. Note the water level.

10) The above sequence of fill and monitor shall continue until the water level drop in the manhole is less than 3 gallons per hour for two consecutive hours. When the water level drop diminishes to less than 3 gallons per hour for a 2-hour period, the test will be considered successful.

11) If after the fourth hour it is determined that the water level drop is not within allowable limits, the test will be terminated and considered failed.

12) Necessary repairs and/or improvements shall be made to the manhole. Repairs shall be made with the knowledge of, and in a manner approved by the Engineer.

13) Upon completion of remedial actions, the manhole shall be retested from the beginning, as indicated above.

14) If during the previous four hours, the water level drop has been at a diminishing rate, the contractor may choose to continue the fill and monitor sequence until the water level drop is within the allowable leakage for two (2) consecutive hours.

e. Any failed manhole shall be repaired or removed and replaced in a manner approved by the Engineer. Repairs shall be made with the knowledge and approval of the Engineer. Upon completion of remedial actions, the testing procedures shall restart from the beginning. The process shall continue until each manhole has passed the official test.

3. Vacuum Test – (Negative Air Pressure)

a. Manhole vacuum testing shall be performed in accordance with ASTM C-1244, and as modified below. The steel test plate head shall be placed on the top surface of the manhole frame. Test heads that seat inside the frame/grade ring/manhole cone section are prohibited. All manholes installed on the project shall be tested. Manholes that fail the test shall be repaired as specified or as approved by the Engineer and retested until they pass. Repairs shall be made with the knowledge and approval of the Engineer.

b. The minimum test time shall be as determined in the table below, based on manhole diameter and manhole depth. Actual manhole depth shall be rounded up to the next 2-foot increment. When flat slab transitions are used to reduce the upper portion of a large diameter manhole to a smaller diameter manhole, the Test Time for the manhole shall be determined by:

1) $T_T = T_D + T_d$, where:

a) T_T = Minimum Total Test required for the manhole, seconds,

b) T_D = Test Time as indicated in table below, based on the manhole diameter below the transition slab and the manhole height below the manhole slab, seconds.

c) T_d = Test Time as indicated in table below, based on the manhole diameter above the transition slab and the manhole height above the manhole slab, seconds.

Minimum Test Times for Various Manhole Diameters							
Manhole Depth, Feet	Manhole Diameter, Feet						
	4	5	6	7	8	10	12
	Test Time, Seconds						
4	10	13	16	19	22	28	34
6	15	19	24	29	33	42	52
8	20	26	32	38	44	57	69
10	25	32	40	48	55	71	86
12	30	39	48	57	66	85	103
14	35	45	56	67	77	99	121
16	40	52	64	76	88	113	138
18	45	58	72	86	100	127	155
20	50	65	80	95	111	141	172
22	55	71	88	105	122	156	189
24	60	78	96	114	133	170	207
26	65	84	104	124	144	184	224
28	70	91	112	133	155	198	241
30	75	97	120	143	166	212	258
32	80	104	128	152	177	226	276
34	85	110	136	162	188	240	293
36	90	117	144	171	199	254	310
38	95	123	152	181	210	269	327
40	100	130	160	191	221	283	345
42	105	136	168	200	232	297	362
46	114	149	184	219	254	325	396
48	119	156	192	229	265	339	413
50	124	162	200	238	276	353	431

c. Summary of Practice

1) A vacuum shall be drawn, and the vacuum drop over a specified time period is used to determine the acceptability of the manhole.

d. Preparation of the Manhole

1) Verify the manhole has been subjected to the vacuum time required to seat the manhole joints, as specified.

2) If any manhole section includes lifting holes, they shall be plugged watertight with non-shrink grout.

3) All mainline pipes entering the manhole shall be temporarily plugged watertight/airtight, taking care to securely brace the pipes and plugs to prevent them from being drawn into the manhole.

4) Service lateral pipes entering the manhole shall not be plugged. The service lateral pipe shall be included in the test. Verify lateral and cleanout are properly plugged watertight/airtight, taking care to securely brace the pipes and plugs to prevent them from being drawn into the manhole/pipe.

5) Vent pipes entering the manhole shall be temporarily plugged watertight/airtight at the vent snout above the 100-year flood elevation. Care shall be taken to securely brace the plug to prevent it from being drawn into the vent.

e. Vacuum Test Procedure

1) The plate test head shall be placed at the top of the manhole frame in accordance with the manufacturer's recommendations. The test head shall compress against the top edge of the cast iron frame such that all joints (manhole, grade rings, frame, pipe and laterals) in the manhole are subjected to the test vacuum. Test heads that seat inside the frame/grade ring/manhole cone section are prohibited from use.

2) A vacuum of 10 inches Hg (mercury) [or 5.0 psi negative air pressure] shall be drawn on the manhole, the valve on the vacuum line of the test head closed, and the vacuum pump shut off. The time shall be measured for the vacuum to drop to 9 inches Hg (mercury) [or 4.5 psi negative air pressure].

3) The manhole is acceptable if the time needed for the vacuum reading to drop from 10 inches Hg to 9 inches Hg [or from 5.0 psi negative air pressure to 4.5 psi negative air pressure] meets or exceeds the minimum test time indicated in the table and or equation above.

4) If the manhole fails the initial test, the manhole shall be repaired by an approved method and with the knowledge of the Engineer.

5) Upon completion of remedial actions, the manhole shall be retested until a satisfactory test is obtained.

6) A passing test by the vacuum test procedure shall not preclude rejection of the work if groundwater infiltration subsequently occurs at the manhole. The required standard is zero leakage at the manhole until the end of the warranty period.

7) Any failed manhole shall be repaired or removed and replaced in a manner approved by the Engineer. Repairs shall be made with the knowledge and approval of the Engineer. Upon completion of remedial actions, the testing procedures shall restart from the beginning. The process shall continue until each manhole has passed the official test.

4. Hydrostatic Test (Manhole)

a. When specified, or when the manhole is located within 100 feet of a public or private well, the manhole shall be tested according to the Hydrostatic Test requirements indicated below, unless included in a Hydrostatic Test (Manhole to Manhole) as indicated above. Laterals connected to the manhole shall be included in and tested as part of the manhole. The Hydrostatic Test shall be in addition to the Vacuum Test (Negative Air Pressure) specified above. The vacuum test method shall be used as an indicator test to determine if there is a leak in the manhole before this Hydrostatic Test is performed.

b. Installation Considerations

1) Two rows of butyl sealant shall be used at all joints (manhole, grade rings, and frame), as specified.

2) All manhole frame and covers located within 100 feet radius of a public or private well shall be solid watertight covers with gasket and camlocks, as specified.

3) Exterior joint wrap sealant shall be used on all manhole joints, as specified.

4) The manhole shall be vacuum tested for 10 minutes to seat the joints on assembly prior to or after backfilling around manhole, as specified.

5) The inside of any concrete grade rings shall be coated with hydraulic cement grout to make the grade ring watertight. Rubber and Expanded Polypropylene (EPP) grade rings may be used in place of concrete grade rings.

6) Construct and/or verify that all sanitary sewer mainline pipe and service laterals connected to the manhole, and within 100 feet of a public or private well, are constructed with ductile iron pipe only.

7) Construct and/or verify that the ends of each service laterals and cleanouts are properly plugged and restrained (no concrete blocking) to prevent leakage during the test and prevent a plug from blowing out due to hydrostatic pressure.

c. Testing Procedure

1) Prior to performing hydrostatic test, confirm that no customers/property owners have connected their private plumbing to the service lateral connection.

2) Verify the pipe plugs to be used are rated at a higher-pressure rating than expected during the test, due to the height of water in the manhole.

3) The test section shall consist of one manhole and any lateral connected to the manhole.

4) Install pipe plugs in the flowline pipe inlet and outlet and brace the plugs to prevent movement.

5) Lateral service connections at manhole shall not be plugged. All lateral services connected to the manhole shall be included in the test.

6) Fill the manhole until the water level in the manhole is within 1.5 inches of the top of the cast iron frame. Release any trapped air in lateral cleanouts. Refill and note the water level in the frame and allow the test section to saturate for a minimum of 24 hours.

7) After the 24-hour saturation period, observe and note water level in the upstream manhole.

8) If no drop in water level has occurred during this initial 24-hour period, return after two (2) additional hours and observe and note water level. If no drop in water level has occurred after this 2-hour period, the test will be considered successful.

9) If after 2 hours there has been a drop in the water level, the amount of drop shall be noted. Refill the manhole to the initial water level, within 1.5 inches of the top of the cast iron frame. Note the water level.

10) The above sequence of fill and monitor shall continue until the water level in the manhole has been maintained at the starting water elevation for two (2) consecutive hours. When the water level remains unchanged (no drop in elevation) for a 2-hour period, the test will be considered successful.

11) If after the fourth hour it is determined that the water level cannot be maintained without dropping, the test shall be terminated and considered failed.

12) Necessary repairs and/or improvements shall be made to the manhole. Repairs shall be made with the knowledge of, and in a manner approved by the Engineer.

13) Upon completion of remedial actions, the manhole shall be retested from the beginning, as indicated above.

14) If during the previous four hours the water level drop has been at a diminishing rate, the contractor may choose to continue the fill and monitor sequence until the water level has been maintained at the same level for two (2) consecutive hours.

15) Any failed manhole shall be repaired or removed and replaced in a manner approved by the Engineer. Repairs shall be made with the knowledge and approval of the Engineer. Upon completion of remedial actions, the testing procedures shall restart from the beginning. The process shall continue until each manhole has passed the official test.

G. Deflection Testing of Pipe

1. Not less than 30 days following completion of backfill, the pipe (48-inch and smaller in diameter) shall be tested for deflection with a go/no-go mandrel. Pipe 54-inch and larger in diameter shall be tested for deflection by measuring the inside diameter at four (4) points in the cross-section of each section of pipe during the internal visual inspections. The four (4) point measurements shall be made using a rig or mandrel that allows measurements vertically and horizontally in the cross-section. Regardless of this time restriction, under no circumstances shall the deflection testing be scheduled until all backfill materials have been compacted, and soil density requirements have been met and accepted by the Engineer.

DEFLECTION STANDARDS FOR PIPE				
Pipe Material	Type of Pipe	Testing Standard		Lifetime Standard
		Mandrel and Proving Ring Dimension	Maximum Allowable Deflection	Maximum Deflection
PVC	Flexible	95.0%	5.0%	7.5%
DIP w/ cement lining	Flexible	97.0%	3.0%	3.0%
DIP w/ epoxy lining	Flexible	98.0%	5.0%	5.0%
FRPMP	Flexible	97.25%	2.75%	4.0%

2. The size of each mandrel and proving ring shall be as indicted in the tables below based on type of pipe.

PIPE DIMENSIONS, INCHES PIPE TYPE - SOLID WALL PVC DR 26 STANDARD ASTM D-3034					
Nominal Diameter	OD per Standard	Min. Wall Thickness	ID per Standard	Mandrel and Proving Ring (95% of Standard ID)	Allowable Deflection (5% of Standard ID)
8	8.400	0.323	7.754	7.521	0.233

PIPE DIMENSIONS, INCHES PIPE TYPE - SOLID WALL PVC DR 25 STANDARD – AWWA C900					
Nominal Diameter	OD per Standard	Min. Wall Thickness	ID per Standard	Mandrel and Proving Ring (95% of Standard ID)	Allowable Deflection (5% of Standard ID)
8	9.05	0.362	8.28	7.866	0.414
10	11.1	0.444	10.16	9.652	0.508
12	13.2	0.528	12.08	11.476	0.604
14	15.3	0.612	14	13.300	0.700
16	17.4	0.696	15.92	15.124	0.796
18	19.5	0.78	17.85	16.958	0.893
20	21.6	0.864	19.77	18.782	0.989
24	25.8	1.032	23.61	22.430	1.181
30	32	1.28	29.4	27.930	1.470

PIPE DIMENSIONS, INCHES PIPE TYPE - CLOSED PROFILE PVC PR 46 PSI STANDARD - ASTM F1803					
Nominal Diameter	OD per Standard	Min. Wall Thickness	ID per Standard	Mandrel and Proving Ring (95% of Standard ID)	Allowable Deflection (5% of Standard ID)
30	31.606	1.098	29.41	27.940	1.471
36	38.036	1.3205	35.395	33.625	1.770
42	44.2	1.4125	41.375	39.306	2.069
48	50.57	1.605	47.36	44.992	2.368
54	57.1	1.875	53.35	50.683	2.668
60	63.932	2.296	59.34	56.373	2.967

**Any stiffness rating other than PR 46 shall require an updated chart for required sizing from Engineer for approval.

PIPE DIMENSIONS, INCHES PIPE TYPE - SOLID WALL FRPM SN 72** STANDARD - ASTM D3262			
Nominal Diameter	ID per Standard	Mandrel and Proving Ring (97.25% of Standard ID)	Allowable Deflection (2.75% of Standard ID)
30	30	29.175	0.825
36	36	35.01	0.99
42	42	40.845	1.155
48	48	46.68	1.32
54	54	52.515	1.485
60	60	58.35	1.65
66	66	64.185	1.815
72	72	70.02	1.98
78	78	75.855	2.145
84	84	81.69	2.31
90	90	87.525	2.475
96	96	93.36	2.64
102	102	99.195	2.805
108	108	105.03	2.97
114	114	110.865	3.135
120	120	116.7	3.3
132	132	128.37	3.63
144	144	140.04	3.96

**Any stiffness rating other than SN 72 shall require an updated chart for required sizing from Engineer for approval.

PIPE DIMENSIONS, INCHES PIPE TYPE – DIP – EPOXY LINED** PC 350 STANDARD - AWWA C 151						
Nominal Diameter	OD per Standard	Epoxy Lining Thickness***	Min. Wall Thickness	ID per Standard	Mandrel and Proving Ring (95% of Standard ID)	Allowable Deflection (5% of Standard ID)
8	9.05	0.040	0.25	8.47	8.216	0.254
10	11.1	0.040	0.26	10.5	10.185	0.315
12	13.2	0.040	0.28	12.56	12.183	0.377

PIPE DIMENSIONS, INCHES PIPE TYPE – DIP – EPOXY LINED** PC 250* STANDARD - AWWA C 151						
Nominal Diameter	OD per Standard	Epoxy Lining Thickness***	Min. Wall Thickness	ID per Standard	Mandrel and Proving Ring (97% of Standard ID)	Allowable Deflection (3% of Standard ID)
16	17.4	0.040	0.3	16.72	16.218	0.502
18	19.5	0.040	0.31	18.80	18.236	0.564
20	21.6	0.040	0.33	20.86	20.234	0.626
24	25.8	0.040	0.37	24.98	24.231	0.749
30	32	0.040	0.42	31.08	30.148	0.932
36	38.3	0.040	0.47	37.28	36.162	1.118
42	44.5	0.040	0.52	43.38	42.079	1.301
48	50.8	0.040	0.58	49.56	48.073	1.487
54	57.56	0.040	0.65	56.18	54.495	1.685
60	61.61	0.040	0.68	60.17	58.365	1.805
64	65.67	0.040	0.72	64.15	62.226	1.925

* Pressure Classes other than 250 shall require an updated chart for required sizing from Engineer for approval.

** Mandrels used inside epoxy lined pipe shall have plastic skid plates or shall have polyethylene rails.

*** Epoxy lining thickness of 0.040-inch based of 40 mils thickness.

PIPE DIMENSIONS, INCHES PIPE TYPE – DIP – CEMENT LINED PC 350 STANDARD - AWWA C 151						
Nominal Diameter	OD per Standard	Double Cement Lining Thickness	Min. Wall Thickness	ID per Standard	Mandrel and Proving Ring (97% of Standard ID)	Allowable Deflection (3% of Standard ID)
8	9.05	0.125	0.25	8.30	8.051	0.249
10	11.1	0.125	0.26	10.33	10.020	0.310
12	13.2	0.125	0.28	12.39	12.018	0.372
PIPE DIMENSIONS, INCHES PIPE TYPE - DIP PC 250* STANDARD - AWWA C 151						
Nominal Diameter	OD per Standard	Cement Lining Thickness	Min. Wall Thickness	ID per Standard	Mandrel and Proving Ring (97% of Standard ID)	Allowable Deflection (3% of Standard ID)
16	17.4	0.09375	0.3	16.61	16.114	0.498
18	19.5	0.09375	0.31	18.69	18.130	0.561
20	21.6	0.09375	0.33	20.75	20.130	0.623
24	25.8	0.09375	0.37	24.87	24.126	0.746
30	32	0.125	0.42	30.91	29.983	0.927
36	38.3	0.125	0.47	37.11	35.997	1.113
42	44.5	0.125	0.52	43.21	41.914	1.296
48	50.8	0.125	0.58	49.39	47.908	1.482
54	57.56	0.125	0.65	56.01	54.330	1.680
60	61.61	0.125	0.68	60	58.200	1.800
64	65.67	0.125	0.72	63.98	62.061	1.919

* Pressure Classes other than 250 shall require an updated chart for required sizing from Engineer for approval.

3. For all pipe sizes, the mandrel shall be sized based on a percentage of the published Inside Diameter of the type of pipe (material) used, according to the appropriate ASTM and AWWA Standards. Allowances for manufacturing and production tolerances or ovality of pipe shall not be counted as part of the calculation for determining the mandrel and proving ring diameters.

4. The Contractor shall furnish aluminum or steel mandrels for each size and type of pipe used on each project. The mandrels shall meet the diameter requirements

indicated for testing deflection for each size and type of pipe and shall not be adjustable. The mandrel shall consist of an unequal number of rails, with a minimum of nine (9) rails. Rail length shall be at least equal to the nominal pipe diameter. Charlotte Water will provide the applicable proving rings. Bare steel or aluminum mandrels shall not be pulled through epoxy lined ductile iron pipe. The steel or aluminum mandrel shall be equipped with polyethylene or other plastic skid plates with recessed attachment hardware to prevent damage to the epoxy lining. Shop drawings of mandrels proposed for use in epoxy lined pipe shall be subject to approval by the Engineer. Larger diameter mandrels shall require increasing number of rails and are subject to approval of the Engineer. Maximum spacing between rails shall be 4.0 inches on larger diameter mandrels. Rail length in contact with the pipe wall shall be at least equal to the nominal pipe diameter and not greater than 1.75 times the nominal pipe diameter. Rails shall be the specified diameter for the full rail length. Rails with reduced mid-section diameters shall not be approved.

5. Prior to each use, the Contractor shall demonstrate to the Project Inspector that the mandrel tightly fills the proving ring along the full length of the mandrel. The trailing edge of the mandrel shall be the full diameter of the proving ring. The maximum gap between the proving ring and any individual rail shall be less than 1/32-inch. The Contractor shall retain ownership of mandrels at the end of the contract.

6. The mandrel shall be pulled through each section of pipe from manhole to manhole. The mandrel must slide freely through the pipe and service tees with only a nominal hand force applied. No mechanical/pneumatic/hydraulic device shall be used in pulling the mandrel. Any pipe which refuses the mandrel shall be removed and replaced or re-rounded and the bedding shall be properly constructed as specified to prevent excessive deflection. Repairs shall be with the knowledge of and approval of the Engineer. Refusal of the mandrel shall be defined as any location where the mandrel will not freely slide through the pipe. Such sections shall be retested for deflection after completion of backfill. Repairs shall be made with the knowledge and approval of the Engineer. Upon completion of remedial actions, the testing procedures shall restart from the beginning.

7. Pipe segments that include aerial crossings that are steel pipe do not require mandrel testing of the aerial steel pipe. Appropriately sized mandrels may be pulled from each manhole to the beginning point of the steel pipe. Pipe segments that include aerial crossings that are all ductile iron pipe shall be mandrel tested from manhole to manhole with the appropriately sized mandrel.

8. Any section of the pipe not passing the mandrel test shall be uncovered. The pipe shall be checked for damage, and the bedding material replaced and re-compacted, as approved by the Engineer. Re-rounding of the pipe by mechanical means, without uncovering the pipe shall typically not be approved. If re-rounding is approved by the Engineer, any device used for re-rounding shall be subject to approval by the Engineer. The contractor shall schedule all testing and retesting with the Engineer. All testing procedures shall be verified and witnessed by the Engineer.

3.13 TELEVISION INSPECTION OF SEWER MAINS AND LATERALS

A. The Contractor shall perform closed circuit television (CCTV) inspection of newly installed gravity sanitary sewer and laterals for all newly installed gravity sewer mains and laterals.

B. CCTV Inspections shall not take place until the last 30 days prior to activation or acceptance by Charlotte Water.

C. CCTV Inspections shall not take place until the last 30 days of the warranty period for the newly installed gravity sanitary sewer and laterals.

D. The television inspection of all new sewer mains and laterals shall be performed after all other required testing (low pressure air test, soil density testing, manhole testing, etc.) and inspections have been completed. Under no circumstances shall internal inspections be performed until the backfill has been completed and the compaction results have been approved by the Engineer.

E. The Contractor shall use the appropriate equipment to thoroughly clean all debris from each sewer segment. The equipment used for the cleaning operations shall be specifically designed for cleaning sewers. When pipe segments include epoxy lined ductile iron pipe or steel pipe, the cleaning equipment shall be designed specifically for use inside epoxy lined pipe. Equipment submittals shall be provided for review and approval. The required equipment shall be high velocity water jet cleaning equipment with various attachments. When pipe segments include epoxy lined pipe, the cleaning pressure and velocity shall be limited as required by the coating manufacturer to prevent damage to the epoxy lining. All solids shall be removed at the downstream manhole of the section being cleaned. Passing material from one sewer segment to another shall not be permitted. Cleaning operations shall begin at the most upstream sewers and proceed downstream. The solids shall be removed from the site and properly disposed by the Contractor. The cleaning operation is not part of the closed-circuit television inspection procedure. Water for cleaning operations shall be obtained as described in Charlotte Water's Fire Hydrant Program for Temporary Service.

F. After the sewers are completely cleaned, the sewers shall be inspected via closed circuit television (CCTV). A minimum of 25 gallons of potable water shall be inducted into the uppermost manhole, 1 to 2 hours prior to the CCTV work. The water is intended to assist the Engineer in evaluation of the sewer main. The purposes of the CCTV inspections are to verify that the sewers have been thoroughly cleaned, to document the condition of the new sewers, locations of service connections, to locate sewer defects prior to acceptance by the Engineer, and to confirm that the new main was properly installed. The camera equipment used for the CCTV inspections shall be self-powered tractor assemblies 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. The camera shall be a full color, pan-and-tilt camera. The complete video system (camera, lens, lighting, cables, monitors, and recorders) shall be capable of providing picture quality and definition acceptable the Engineer. The video system shall record directly to a digital computer file format.

G. All field inspections shall be performed using ITPipes™ software. ITPipes™ software shall be installed in the field equipment that is performing the television inspections and used for the live field inspections. If ITPipes™ software with the specific Charlotte Water template is not in the field equipment, the work shall immediately cease until it is installed in the field equipment to be used during the inspection process.

H. The Contractor shall use the Charlotte Water ITPipes™ software template. This template contains all correct data entry fields, all observation inputs and required parameters, template settings for overlay control and setup, and other settings. The Contractor shall obtain the template prior to performing any CCTV inspections. Inspections performed without using the Charlotte Water template shall be rejected, and the Contractor shall have to re-perform the inspections at no cost to the City.

I. WMV recording with embedded meta-data is required. Each submittal to the Engineer shall include the ITPipes™ software database file within the approved structure along with the WMV video files. The Contractor shall make all adjustments necessary to adhere to the required format specified herein, including performing the work using the required software at no additional cost to the City. After the first submittal, the Engineer shall notify the Contractor of any required changes in the data and file format, and the Contractor shall make such modifications at no additional cost.

J. The digital recording shall include both audio and video information that accurately reproduces the original picture and sound of the video inspection. The video portion of the digital recording shall be free of electrical interference and shall produce a clear and stable image. The audio portion shall be sufficiently free of background and electrical noise as to produce an oral report that is clear and discernible.

K. Video Overlay

1. The video shall include overlay/text display with an initial display screen and with a continuous running screen.

2. Each inspection start shall include overlay display of section details including at a minimum:

    a. City name

    b. Project name

    c. Contractor name

    d. Street name (if applicable)

    e. Date/time of inspection

    f. CLTW MH Start #/MH End #

    g. Pipe material

    h. Pipe size

    i. Direction of video

    j. Weather or Flow Level

    k. Pipe Identifier Number (GM Number)

3. The continuous running screen shall include a constant display of the street name, CLTW MH start #/MH End #, date and distance shall appear on screen.

4. The CCTV inspector shall move or remove overlay display accordingly, so it does not interfere with the inspection review of particular observations/defects as the inspection is occurring.

5. As an observation/defect is noted by the inspector, a text display shall appear with the text describing the observation/defect. Text shall display for 4-5 seconds.

6. Distance shall appear continuously in the lower right corner of the video image as the camera is traveling down the line.

7. It is imperative that distance is accurate. The CCTV inspector shall calibrate/test footage at the beginning of each day, as incorrect footage shall result in the invalidation of inspection and a requirement to perform again at no cost to Charlotte Water.

L. Video Format

1. Completed work shall consist of WMV video files captured live off the inspection camera.

2. Each pipe inspection's observations shall be related to a time point within the video.

3. Each pipe inspection WMV file shall have a related text file, with an identical name but different extension on the file. This file shall contain the distances of each observation and the related time point for that observation.

4. During the inspection, the video file recording shall pause as the operator selects the observation/defect notation, eliminating "on hold" video.

5. The video file resolution shall be 640 x 480 dpi.

6. The audio shall be included within the WMV and not as a separate file.

M. Video Media

1. The database file and the corresponding video files shall be submitted to the Engineer on flash drives or portable external hard drives. One copy of the printed logs (in color) that correspond to the inspections shall be submitted to the Engineer. The Engineer will return the hard drive to the Contractor after the inspections have been reviewed.

2. Each submittal to the Engineer shall include a transmittal letter, listing the file names and all sewer segments and video files included on the hard drive.

N. Customized Data Fields: Charlotte Water has developed customized data fields for its viewing software. The Contractor shall be required to use these data fields, without any modifications, to enter project information for each inspection. These data fields are available for download from Charlotte Water. Observations for each inspection shall include:

1. Observation distance (part of the Charlotte Water catalog)

2. Observation defect/description (part of the Charlotte Water catalog)

3. Counter time observation occurs within digital video (part of the Charlotte Water catalog)

4. Severity rating for each observation/defect (part of the Charlotte Water)

5. Infiltration rating (part of the Charlotte Water catalog)

O. The camera shall be moved through the line in either direction at a uniform rate, but not greater than 30 feet per minute. The camera shall follow closely behind the mandrel. Following distance shall be acceptable to the Engineer and shall allow the Engineer to observe the trailing edge of the mandrel to determine the amount of pipe deflection. Following distance shall also allow the Engineer to observe other conditions of the pipe,

including joints, defects, connections and ponding water. The camera shall be stopped at any defect and service connections and shall be panned, tilted and rotated to fully view the defects and connections. Particular attention should be paid to service connections and changes in pipe materials. All such inspections shall be documented.

P. The inspections shall be completed from manhole to manhole without the need for reverse setups unless approved otherwise by the Engineer. If, during the work, the CCTV inspection is blocked by debris, or a defect which must be repaired, the Contractor shall remove the blockage or repair the defect as authorized by the Engineer. The segment of sewer main shall then be cleaned and inspected by CCTV. No additional payment will be made for the initial CCTV inspections that were blocked by debris or required repairs.

Q. The accuracy of the measurements cannot be stressed too strongly. Daily calibration of measuring devices shall be performed. Accurate and continuous footage readings shall be superimposed on the recording for the sections inspected. The date of inspection and manhole designation for each manhole on the section of line inspected shall also be shown.

R. Upon completion of the cleaning and television inspection work, the Contractor shall submit one copy of the final television inspection video and inspection logs to the Engineer. The video and inspection logs shall be clearly labeled as to their contents. The final inspection shall mean that the sewer has been completely cleaned (no debris or defects), and the inspection has been completed from manhole to manhole. If point repairs or main replacements are performed after the inspections are submitted, it shall be the Contractor's responsibility to complete an additional cleaning and CCTV inspection at no additional cost to Charlotte Water.

S. Prior to cleaning the sewer mains, the sewer laterals shall be cleaned from the cleanout at the property line, or easement line, or road right-of-way line to the connection point at the main. A minimum of 2 gallons of potable water shall be induced into each cleanout prior to the CCTV inspection of the sewer lateral. Sewer laterals shall be inspected by CCTV from the cleanout to the connection point at the main, as specified for mainline sewer mains. The camera equipment used for the CCTV inspections of sewer laterals shall be one specifically designed and constructed for sewer lateral inspections. Lighting for the camera shall be suitable to allow a clear picture for the entire periphery of the pipe. The camera shall be a push type color camera with a minimum of 150 feet of cable. The picture quality and definition shall be to the satisfaction of the Engineer, and the camera does not require pan and tilt capabilities. The video system shall record directly to a digital computer file format, as indicated above. Upon completion of the lateral inspection work, the Contractor shall submit one copy of the final television inspection video and inspection logs to the Engineer. The video and inspection logs shall be clearly labeled as to their contents. The sewer lateral inspection and acceptance shall be completed prior to the CCTV inspection of the adjacent sewer main segment.

T. All costs associated with providing the digital television inspections as specified including performing the inspections using ITPipes™ software and Charlotte Water's template shall be included in the various bid items – no separate or additional payment shall be made.

U. All costs associated with cleaning and CCTV inspections on Developer projects shall be provided by the Developer and at no cost to Charlotte Water.

3.14 REPAIRS

A. All repairs of any type shall be with the prior knowledge and approval of the Engineer. All repair methods shall be subject to review and approval of the Engineer. Chemical grouting or internal or external wiping of joints with cement grout are specifically not approved as methods for repairing leaks on new pipelines, regardless of pipe material. All leaks shall be repaired by identifying and exposing the defective section of pipe and completing repairs as follows:

1. FRPM or Ductile Iron Pipe: Defective or damaged pipe including leaking joints shall be removed and replaced with sound new pipe. The pipe shall be re-connected with approved couplings as specified in this document. Repairs shall be limited to one pipe repair for every 100 feet not to exceed three (3) pipe repairs between manholes. Deficiencies in excess of these limitations shall be corrected by relaying the section of pipe manhole to manhole.

   Poly Vinyl Chloride Pipe (PVC): Defective or damaged pipe including leaking joints shall be removed and replaced with sound new pipe. The pipe shall be re-connected with approved couplings as specified in this document. Pipe that is sound and otherwise acceptable, but will not pass the deflection test, shall be exposed and the bedding materials removed and replaced. Repairs shall be limited to one pipe repair for every 100 feet not to exceed three (3) pipe repairs between manholes. Deficiencies in excess of these limitations shall be corrected by relaying the section of pipe manhole to manhole.

   Re-rounding of the pipe by mechanical means, without uncovering the pipe shall typically not be approved. If re-rounding is approved by the Engineer, any device used for re-rounding shall be subject to approval by the Engineer. Re-rounding shall not be permitted within 4 feet of a pipe joint. Over-deflection of the pipe near the joint shall be corrected by excavation only.

2. PCCP: Defective or damaged pipe including leaking joints shall be removed and replaced with sound new pipe. Pipe reconnections shall be made, and joint leaks repaired, using reinforced concrete collars or repair sleeves pre-approved by the Engineer.

   Chemical grouting or internal or external wiping of joints with cement grout are specifically not approved as methods for repairing leaks on new pipelines, regardless of the pipe material.

   Repairs shall be limited to one pipe repair for every 100 feet not to exceed three (3) pipe repairs between manholes. Deficiencies in excess of these limitations shall be corrected by relaying the section of pipe manhole to manhole.

3. Aerial Steel Pipe: Defective or damaged pipe including leaking joints shall be removed and replaced with sound new pipe.

4. Laterals: Defective or damaged laterals including leaking joints, cracked pipe or fittings, shall be removed and replaced with sound new pipe. Pipe reconnections shall be made, and joint leaks repaired, using repair couplings pre-approved by the Engineer.

   Repairs shall not to exceed two (2) pipe repairs between the main and the cleanout. Deficiencies in excess of these limitations shall be corrected by relaying the lateral from the main to the cleanout.

5. Manholes: Any damage to the interior wall of the manhole resulting from penetration of the lift holes shall be repaired with non-shrink cement grout. Defective or damaged manhole sections or joints shall be removed and replaced with sound new manhole sections. Leaks through manhole joints or walls or around pipe collars, may be repaired from inside the manhole with non-shrink cement grout. If the size of the leak, or the external water pressure, prevents such repairs, the manhole shall be excavated and repaired from outside. Leaks around boots or gaskets used to join pipe to manholes shall be repaired by external concrete collars, removed and replaced with sound new manhole connectors, or as approved by the Engineer.

6. Manhole Liner: Any damage to the manhole liner shall be repaired per specifications in Chapter 16.3 Manhole Rehabilitation as well as the liner Manufacturer's instructions, standards and/or recommendations.

7. Wet Wells: Any damage to the interior wall of the precast wet well resulting from penetration of the lift holes shall be repaired with non-shrink expansion cement grout. Defective or damaged precast wet well sections or joints shall be removed and replaced with sound new precast sections.

   Leaks through wet well joints or walls or around pipe collars, shall be removed and replaced with sound new precast sections, due to the critical nature of the wet well application. Repairs to prevent leaking shall not be approved.

   Leaks around boots or gaskets used to join the pipe to the precast wet well shall be removed and replaced with sound new manhole connectors. Repairs to prevent leaking shall not be approved.

8. Tracer Wire: Any damage to the tracer wire shall be repaired by removing and replacing the damaged wire and splicing the new wire per the Wire Splice System per the Standard Details, and as specified herein describing splicing and/or joining sections of tracer wire.

3.15 FINAL INSPECTION

A. A final inspection shall be held for each project once construction and complete restoration has been completed. The Contractor SHALL ATTEND the final inspection. During the final inspection, all structures shall be opened and inspected. All other features of the project, either constructed or reconstructed, shall also be inspected. The official tracer wire test shall be conducted during the Final Inspection process, unless otherwise approved by the Engineer. The Contractor shall be responsible for providing equipment and labor, as may be necessary, to conduct the final inspection and to provide a safe worksite. Deficiencies, if any, shall be noted for correction by the Contractor. The Contractor shall schedule the work with the Inspector. Any and all corrective actions necessary to correct a deficiency noted at the final inspection shall be completed prior to final acceptance of the work and project.

3.16 WARRANTY PERIOD

A. A one-year warranty period is required. The project warranty period shall be established from the date all deficiencies (if any) have been corrected, following the final inspection, and will extend for one year, unless extended as indicated below.

B. Should deficiencies develop during the warranty period, the Engineer shall determine the severity of the deficiency and advise the Contractor of its priority rating. The priority ratings shall be defined as Emergency, Major, Minor, or Routine. The Engineer reserves

the sole right to determine the priority rating of a deficiency and to raise or lower the rating as needed. The Contractor shall respond to these deficiencies according to the following schedule:

1. Emergency: Once notified, the Contractor shall report to the project site within a maximum of 2 hours and shall mobilize and take all actions necessary to make the site safe. The Contractor and the Engineer will agree on a course of required actions and timeline for completing those actions. All work necessary to correct the Emergency deficiency shall be completed as quickly as possible.

2. Major: Once notified, the Contractor shall mobilize to the project site within a maximum of 2 business days. The Contractor shall schedule the work with the Inspector. All work necessary to correct the Major deficiency shall be completed within a maximum of 5 business days of mobilization, or according to timeline approved by the Engineer.

3. Minor: Once notified, the Contractor shall mobilize to the project site within a maximum of 10 business days. The Contractor shall schedule the work with the Inspector. All work necessary to correct the Minor deficiency shall be completed within a maximum of 5 business days of mobilization, or according to timeline approved by the Engineer.

4. Routine: Once notified, the Contractor shall mobilize to the project site within a maximum of 25 business days. The Contractor shall schedule the work with the Inspector. All work necessary to correct the Routine deficiency shall be completed within a maximum of 5 business days of mobilization, or according to timeline approved by the Engineer.

C. A warranty inspection will be scheduled for the project during the final month of the project warranty period. The Contractor SHALL ATTEND the warranty inspection. During the warranty inspection, all structures shall be opened and inspected. All other features of the project, either constructed or reconstructed, shall also be inspected. The Contractor shall be responsible for providing equipment and labor, as may be necessary, to conduct the warranty inspection and to provide a safe worksite. Any deficiencies, if any, shall be noted for correction by the Contractor. The Contractor shall schedule the work with the Inspector. The Engineer reserves the sole right to determine the priority rating of each deficiency noted at the warranty inspection. Any and all corrective actions necessary to correct a deficiency noted at the warranty inspection shall be completed within a maximum of 30 days following the warranty inspection.

D. Deficiencies noted and corrected during the warranty period shall extend the project warranty period. The contractor shall warrant and guarantee the corrected work for one year from the date the deficiency is corrected. A warranty inspection will be conducted within the final month of the extended warranty period. The extended warranty inspection will be conducted as described above for a warranty inspection for the specific items that required warranty repairs during the warranty period.

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GRAVITY SANITARY SEWER DETAILS
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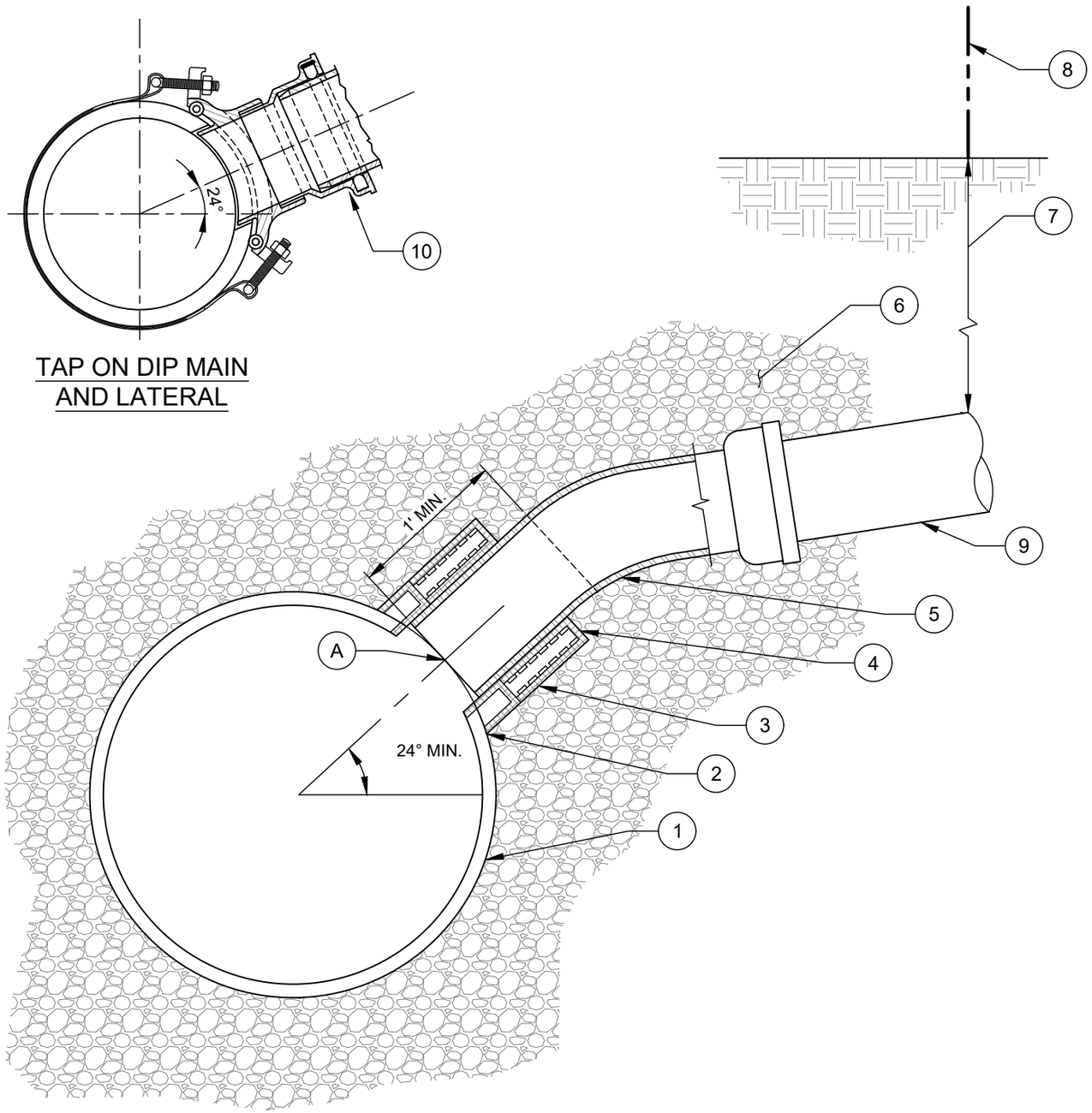


TAP ON DIP MAIN
AND LATERAL

NO.	DESCRIPTION:
1.	EXISTING SEWER MAIN - VCP, PVC, DIP, FRP, OR CONCRETE, ETC.
2.	EPOXY SEALANT AS RECOMMENDED BY TAP SADDLE MANUFACTURER.
3.	SEWER TAP SADDLE AS MANUFACTURED BY PREDCO OR OTHER MANUFACTURERS AS LISTED IN SPECIFICATIONS.
4.	COMPRESSION JOINT SEALER.
5.	22-1/2° BEND (SPIGOT X SLIP JOINT BELL) (C900 DR18 PVC).
6.	#57 STONE BEDDING.
7.	MINIMUM DEPTH OF COVER AT PROPERTY LINE SHALL BE 4'. UNLESS GREATER DEPTH IS REQUIRED TO SERVE THE BUILDING. MINIMUM DEPTH AT SIDE DITCH SHALL BE 2.5'.
8.	PROPERTY LINE, ROAD R/W OR CLTW EASEMENT LINE.
9.	MIN. SLOPE SHALL BE 1.5% FOR 4" PIPE AND 1.25% FOR 6" PIPE.
10.	FOR 4" AND 6" DUCTILE IRON LATERAL, USE A SEALTITE TYPE F TEE SEWER SADDLE AS MANUFACTURED BY THE GENERAL ENGINEERING COMPANY, FREDERICK, MD TO FIT 6.275" TO 17.40" O.D. MAINS.

NOTES:

A. THE OPENING IN PIPE SHALL BE CUT WITH A TAP MACHINE OR HOLE SAW. TAPPING BIT SHALL BE DESIGNED FOR THE PIPE MATERIAL BEING CUT AND ALSO INCLUDE PILOT BIT AND SHELL CUTTER.

B. THE TAP SHALL BE MADE IN THE UPPER HALF OF THE PIPE AT 24° (MIN.) FROM THE HORIZONTAL.

C. TAP SIZE SHALL MATCH LATERAL SIZE. MAXIMUM SIZE TAP SHALL BE 4" OR 6" ONLY. 6" TAPS SHALL BE USED ON 10" AND LARGER MAINS ONLY.

D. TAPPING SADDLE & BEND TO BE FULLY ENCASED WITH #57 CRUSHED STONE.

E. C900 DR18 PVC LATERAL PIPE REQUIRE TYPE 3 GRANULAR BEDDING IF GROUND WATER, ROCK, OR UNSTABLE SOIL IS PRESENT.

F. MIN. CLEARANCE TO PIPE JOINT ON MAIN SHALL BE 1'.

G. THE LATERAL SHALL BE INSTALLED PERPENDICULAR TO THE MAIN.

H. IF THE LATERAL HAS LESS THAN 3' OF COVER, THE LATERAL MUST BE DIP.

I. MIN. DISTANCE BETWEEN SERVICE TAPS SHALL BE 7' CENTER TO CENTER.

J. TRACER WIRE INSTALLED PER CLTW TRACER WIRE DETAIL AS APPLICABLE.

K. MIN. DISTANCE FROM SERVICE TAP TO MANHOLE SHALL BE 7'.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
GRAVITY SEWER

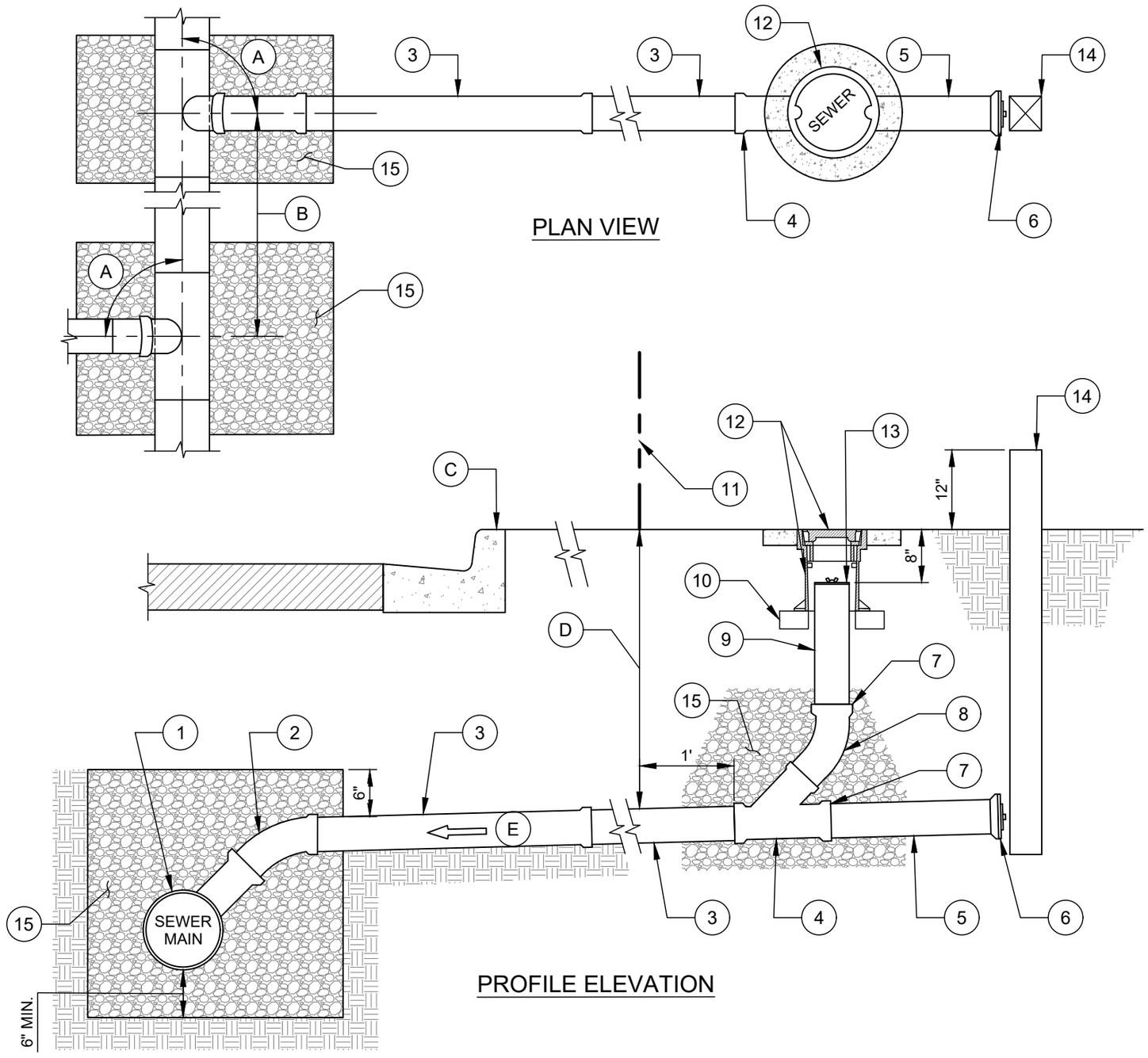
4" AND 6" LATERAL SADDLE TAPS ON EXISTING SEWER MAIN

NO SCALE

VERSION
1.0

DATE
04/2024

DETAIL
11.1.1



NO. DESCRIPTION:

1. RUN x 4" OR 6" ALL BELL TEE (C900 DR18 PVC OR DIP).
2. 22 1/2° OR 45° BEND - SPIGOT X BELL - (C900 DR18 PVC OR DIP).
3. C900 DR18 PVC/PIPE OR DIP.
4. 4" X 4" X 4" OR 6" X 6" X 6" 45° ALL BELL WYE (C900 DR18 PVC).
5. 4" OR 6" PVC PIPE TAILPIECE (SCH 40 PVC - LL + 36" MIN.).
6. TEST-KAP OR END-CAP TEST CAP BY CHERNE INDUSTRIES OR APPROVED EQUAL. SCH 40 GLUE ON CAP.
7. IPS (SCH 40) TRANSITION GASKET.
8. 4" OR 6" SXB 45° BEND (C900 DR18 PVC).
9. 4" OR 6" SCH 40 PVC VERTICAL STANDPIPE.
10. 2 STANDARD CONCRETE BRICKS.
11. PROPERTY LINE, ROAD R/W OR CLTW EASEMENT LINE.
12. SEWER VALVE BOX TOP SECTION, SEWER COVER, AND CONCRETE PAD. PAINT COVER WITH 2 COATS EPOXY ENAMEL-GREEN. FOR 6" CLEANOUTS, VALVE BOX TO BE REPLACED WITH US FOUNDRY MODEL 7610 COVER, EJ CORP #1570Z, OR APPROVED EQUAL.
13. GRIPPER (END OF PIPE- TYPE) PLUG SHALL BE SCH 40 FIPT ADAPTER WITH SCREW CAP.
14. 4" X 4" PRESSURE TREATED LUMBER POST.
15. #57 STONE EMBEDMENT.

NOTES:

A. SEWER CONNECTION SHALL BE CONSTRUCTED 90° TO MAIN (ANGLED CONNECTIONS NOT PERMITTED) AND SHALL TYPICALLY BE PERPENDICULAR TO ROADWAY.

B. MINIMUM SPACING BETWEEN CONNECTIONS SHALL BE 7'.

C. CUT LETTER "S" IN CURB WHERE PIPE CROSSING UNDER CURB AND PAINT WITH GREEN PAINT. IF NO CURB, PAINT LETTER "S" IN PAVEMENT.

D. MINIMUM DEPTH OF COVER AT PROPERTY LINE SHALL BE 4'. UNLESS GREATER DEPTH IS REQUIRED TO SERVE THE BUILDING. MINIMUM DEPTH AT SIDE DITCH SHALL BE 2.5'.

E. MINIMUM SLOPE SHALL BE 1.5% FOR 4" PIPE AND 1.25% FOR 6" PIPE.

F. ALL FITTINGS 12" AND SMALLER SHALL BE MOLDED FITTINGS. FITTINGS LARGER THAN 12" MAY BE MOLDED OR FABRICATED PVC.

G. TYPE 3 GRANULAR BEDDING REQUIRED IF GROUNDWATER, ROCK, OR UNSTABLE SOIL IS ENCOUNTERED.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
GRAVITY SEWER

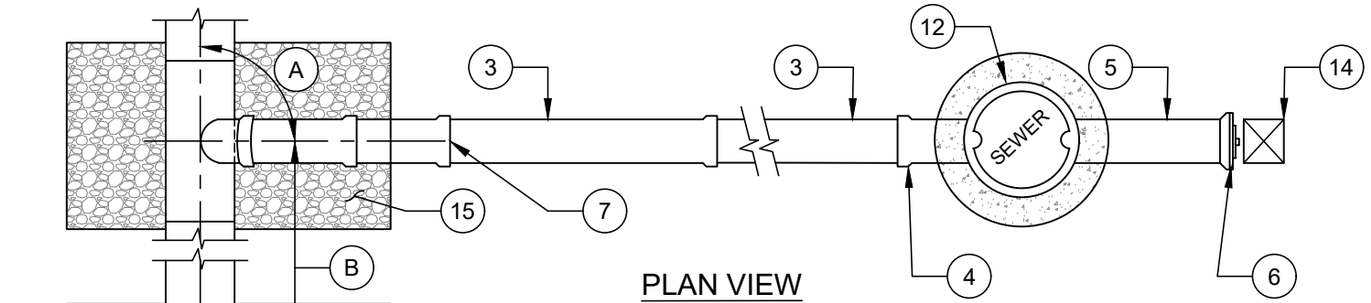
4" AND 6" SERVICE LATERAL TEE ON NEW 8" AND LARGER DR 25 PVC SEWER MAIN

NO SCALE

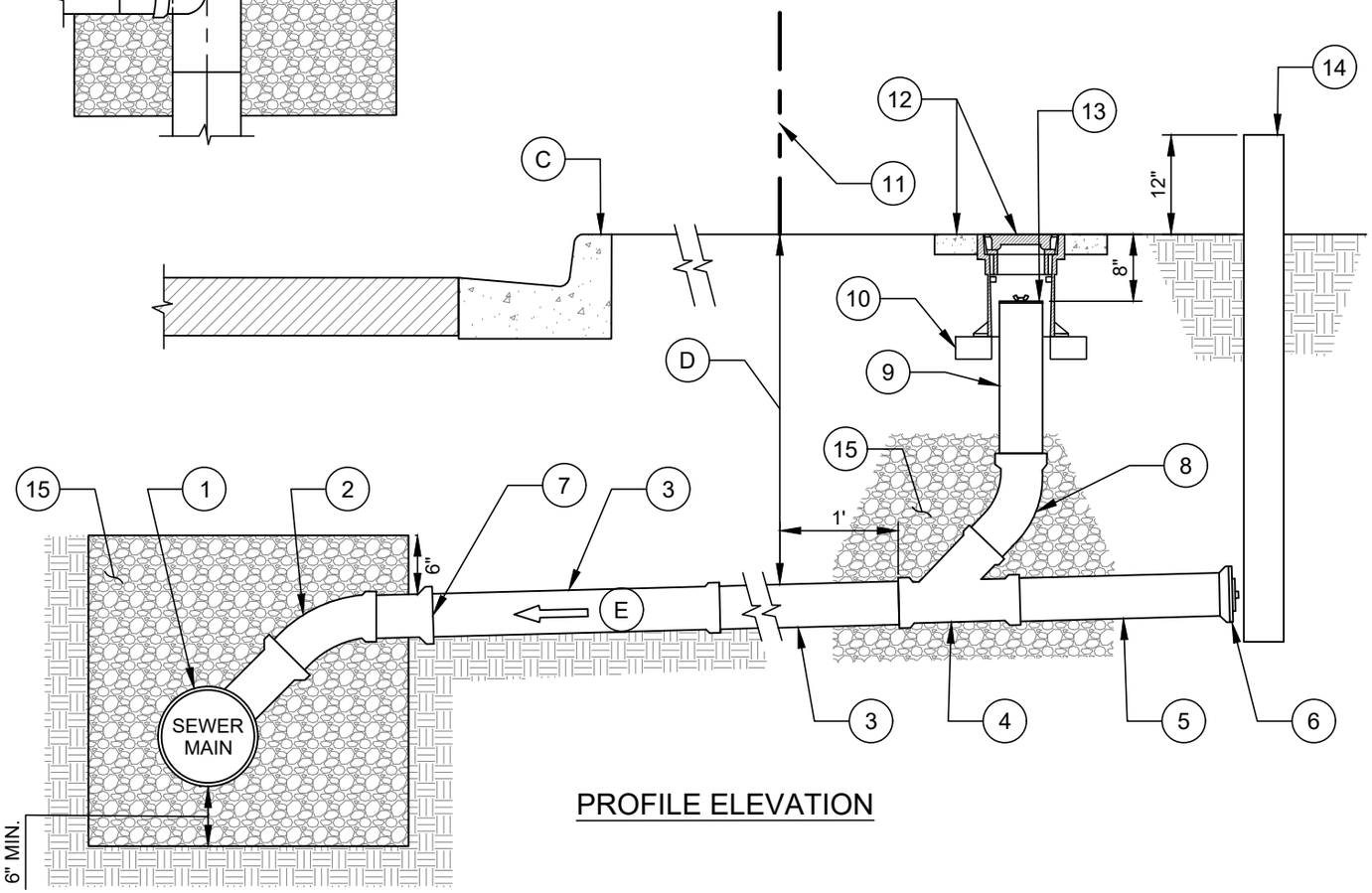
VERSION
1.0

DATE
04/2024

DETAIL
11.1.2



PLAN VIEW



PROFILE ELEVATION

NO.	DESCRIPTION:
1.	8" RUN x 4" OR 6" ALL BELL TEE (SDR 26 PVC OR DIP).
2.	22 1/2° OR 45° BEND - SPIGOT X BELL - (SDR 26 PVC OR DIP).
3.	SOLID WALL SCH 40 PVC/PIPE OR DIP.
4.	4" X 4" X 4" OR 6" X 6" X 6" 45° ALL BELL WYE (SCH 40 PVC). SEE NOTE H.
5.	4" OR 6" PVC PIPE TAILPIECE (SCH 40 PVC - LL + 36" MIN.).
6.	TEST-KAP OR END-CAP TEST CAP BY CHERNE INDUSTRIES OR APPROVED EQUAL. SCH 40 GLUE ON CAP.
7.	HARCO TRANSITION ADAPTER - SEWER PIPE SPIGOT X IPS GASKET.
8.	4" OR 6" SXB 45° BEND (SCH 40 PVC). SEE NOTE H.
9.	4" OR 6" SCH 40 PVC VERTICAL STANDPIPE.
10.	2 STANDARD CONCRETE BRICKS.
11.	PROPERTY LINE, ROAD R/W OR CLTW EASEMENT LINE.
12.	SEWER VALVE BOX TOP SECTION, SEWER COVER, AND CONCRETE PAD. PAINT COVER WITH 2 COATS EPOXY ENAMEL-GREEN. FOR 6" CLEANOUTS, VALVE BOX TO BE REPLACED WITH US FOUNDRY MODEL 7610 COVER, EJ CORP #1570Z, OR APPROVED EQUAL.
13.	GRIPPER (END OF PIPE- TYPE) PLUG SHALL BE SCH 40 FIPT ADAPTER WITH SCREW CAP.
14.	4" X 4" PRESSURE TREATED LUMBER POST.
15.	#57 STONE EMBEDMENT.

NOTES:

A. SEWER CONNECTION SHALL BE CONSTRUCTED 90° TO MAIN (ANGLED CONNECTIONS NOT PERMITTED) AND SHALL TYPICALLY BE PERPENDICULAR TO ROADWAY.

B. MINIMUM SPACING BETWEEN CONNECTIONS SHALL BE 7'.

C. CUT LETTER "S" IN CURB WHERE PIPE CROSSING UNDER CURB AND PAINT WITH GREEN PAINT. IF NO CURB, PAINT LETTER "S" IN PAVEMENT.

D. MINIMUM DEPTH OF COVER AT PROPERTY LINE SHALL BE 4'. UNLESS GREATER DEPTH IS REQUIRED TO SERVE THE BUILDING. MINIMUM DEPTH AT SIDE DITCH SHALL BE 2.5'.

E. MINIMUM SLOPE SHALL BE 1.5% FOR 4" PIPE AND 1.25% FOR 6" PIPE.

F. ALL FITTINGS SHALL BE MOLDED FITTINGS.

G. TYPE 3 GRANULAR BEDDING REQUIRED IF GROUNDWATER, ROCK, OR UNSTABLE SOIL IS ENCOUNTERED.

H. ALTERNATE - COMBINE ITEMS 4 AND 8 USING 4" X 4" X 4" OR 6" X 6" X 6" ALL BELL COMBINATION WYE BEND (SCH 40 PVC).

I. THIS STANDARD DETAIL IS FOR USE ON DEVELOPER INSTALLED GRAVITY SEWER PROJECTS ONLY.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
GRAVITY SEWER

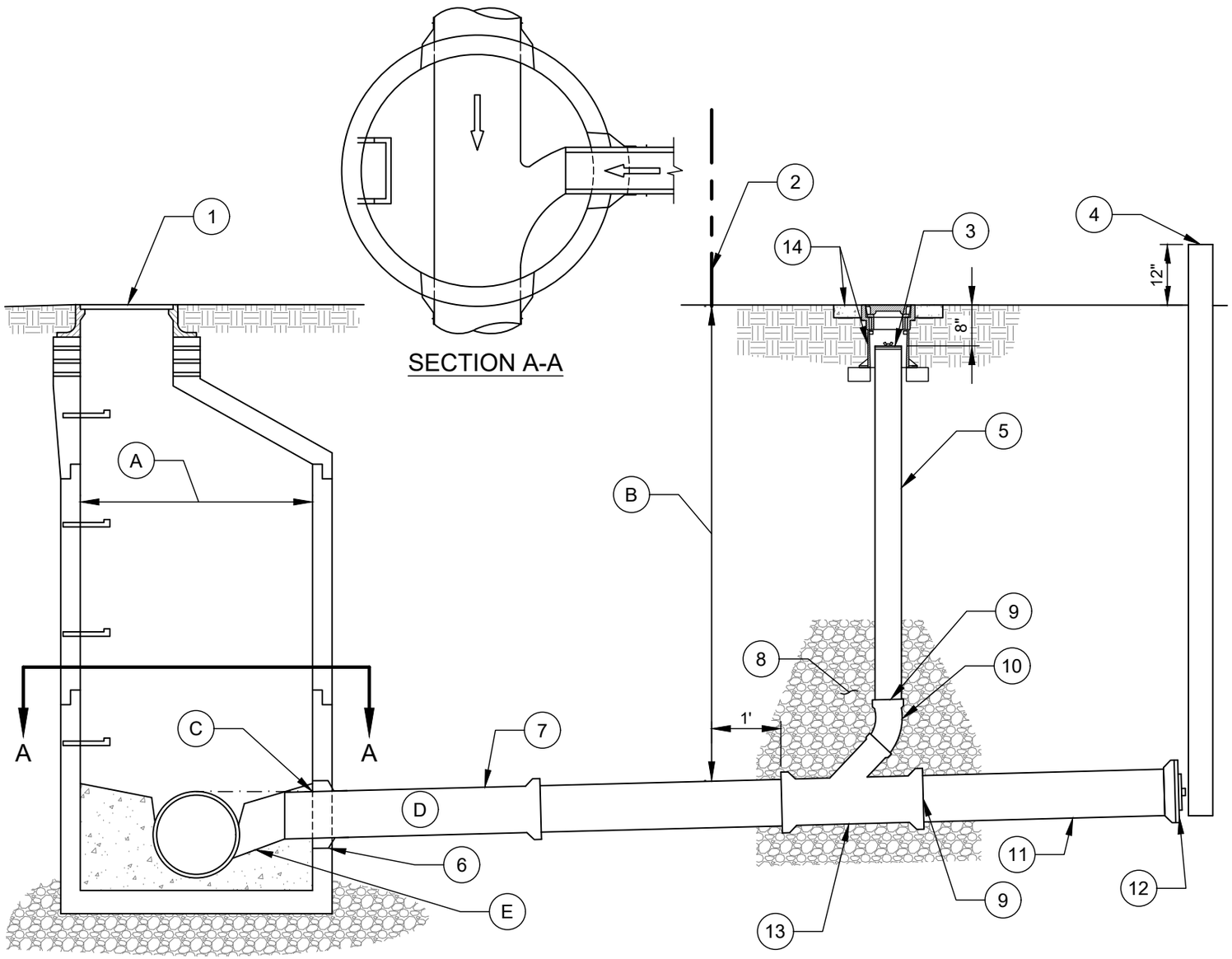
4" AND 6" SERVICE LATERAL TEE ON NEW 8" SDR 26 PVC SEWER MAIN

NO SCALE

VERSION 2.0

DATE 01/2026

DETAIL 11.1.3



NO. DESCRIPTION:

1. EXISTING OR PROPOSED MANHOLE CLTW STANDARD CAST IRON FRAME AND COVER.
2. PROPERTY LINE, ROAD R/W OR CLTW EASEMENT LINE.
3. GRIPPER (END OF PIPE- TYPE) PLUG SHALL BE SCH 40 FIPT ADAPTER WITH SCREW CAP.
4. 4" X 4" PRESSURE TREATED LUMBER POST.
5. 4" OR 6" SCH 40 PVC VERTICAL STANDPIPE.
6. MANHOLE/PIPE BOOT ON PRECAST MANHOLES AND CONCRETE COLLARS ON BRICK OR BLOCK MANHOLES.
7. 4" OR 6" DIP, OR 4" OR 6" DR 18 PVCP.
8. #57 STONE EMBEDMENT.
9. IPS (SCH 40 PVC) TRANSITION GASKET.
10. 4" OR 6" SXB 45° BEND (C900 DR18 PVC).
11. 4" OR 6" PVC PIPE TAILPIECE (SCH 40 PVC - LL + 36" MIN.).
12. TEST-KAP OR END-CAP TEST CAP BY CHERNE INDUSTRIES OR APPROVED EQUAL. SCH 40 GLUE ON CAP.
13. 4" X 4" X 4" OR 6" X 6" X 6" 45° ALL BELL WYE (C900 DR18 PVC).
14. VALVE BOX ASSEMBLY (TYP.). FOR 6" CLEANOUTS AND CONCRETE PAD, VALVE BOX TO BE REPLACED WITH US FOUNDRY MODEL 7610 COVER, EJ CORP #1570Z, OR APPROVED EQUAL.

NOTES:

A. 4' MIN. DIAMETER (5' MIN. DIAMETER FOR INSIDE DROP).

B. MINIMUM DEPTH OF COVER AT PROPERTY LINE SHALL BE 4'. UNLESS GREATER DEPTH IS REQUIRED TO SERVE THE BUILDING. MINIMUM DEPTH AT SIDE DITCH SHALL BE 2.5'.

C. MATCH CROWNS UNLESS THE LATERAL IS THE SAME DIAMETER AS THE MAIN LINE PIPE. THEN A DROP OF 0.2" BETWEEN INVERTS WILL BE PROVIDED.

D. MINIMUM PIPE SLOPES: 4" PIPE IS 1.50% AND 6" PIPE IS 1.25%. MAXIMUM SLOPE FOR ALL PIPE SHALL BE 10%.

E. CONCRETE THROUGH TO BE CUT TO DIRECT FLOW FROM PIPE CONNECTION TO EFFLUENT PIPE.

F. TRACER WIRE INSTALLED PER CLTW TRACER WIRE DETAIL AS APPLICABLE.

G. CUT LETTER "S" IN CURB WHERE PIPE CROSSING UNDER CURB AND PAINT WITH GREEN PAINT. IF NO CURB , PAINT "S" IN PVMT.

H. TYPE 3 GRANULAR BEDDING REQUIRED IF GROUNDWATER, ROCK, OR UNSTABLE SOIL IS ENCOUNTERED.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
GRAVITY SEWER

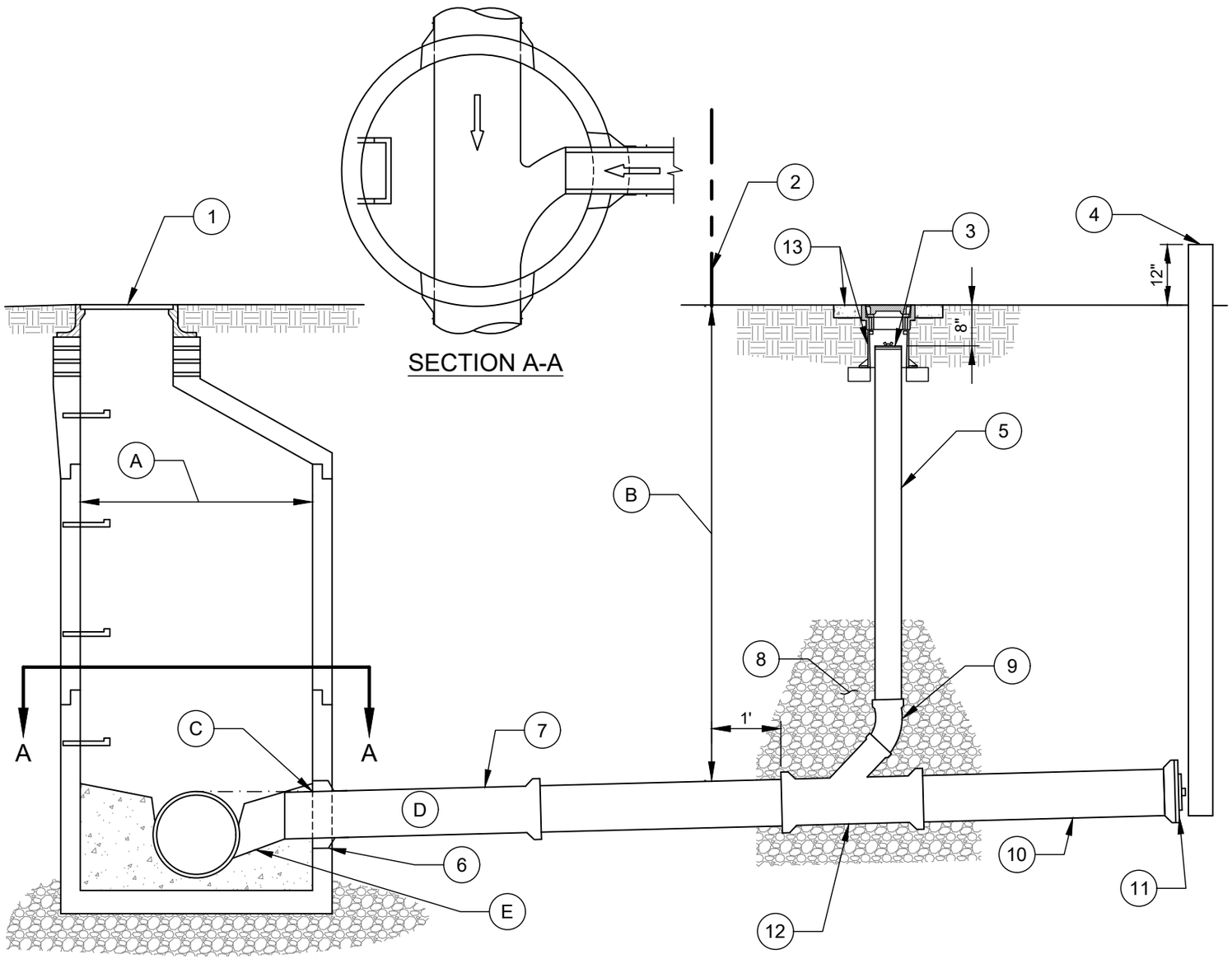
4" AND 6" SANITARY SEWER LATERAL CONNECTIONS TO MANHOLES - ON DR 25 PVC SEWER MAINS

NO SCALE

VERSION 1.0

DATE 04/2024

DETAIL 11.1.4



NO. DESCRIPTION:

1. EXISTING OR PROPOSED MANHOLE CLTW STANDARD CAST IRON FRAME AND COVER.
2. PROPERTY LINE, ROAD R/W OR CLTW EASEMENT LINE.
3. GRIPPER (END OF PIPE- TYPE) PLUG SHALL BE SCH 40 FIPT ADAPTER WITH SCREW CAP.
4. 4" X 4" PRESSURE TREATED LUMBER POST.
5. 4" OR 6" SCH 40 PVC VERTICAL STANDPIPE.
6. MANHOLE/PIPE BOOT ON PRECAST MANHOLES AND CONCRETE COLLARS ON BRICK OR BLOCK MANHOLES.
7. 4" OR 6" DIP, OR 4" OR 6" SCH 40 SOLID WALL PVC PIPE.
8. #57 STONE EMBEDMENT.
9. 4" OR 6" SXB 45° BEND (SCH 40 PVC).
10. 4" OR 6" PVC PIPE TAILPIECE (SCH 40 PVC - LL + 36" MIN.).
11. TEST-KAP OR END-CAP TEST CAP BY CHERNE INDUSTRIES OR APPROVED EQUAL. SCH 40 GLUE ON CAP.
12. 4" X 4" X 4" OR 6" X 6" X 6" 45° ALL BELL WYE (SCH 40 PVC).
13. VALVE BOX ASSEMBLY (TYP.). FOR 6" CLEANOUTS AND CONCRETE PAD, VALVE BOX TO BE REPLACED WITH US FOUNDRY MODEL 7610 COVER, EJ CORP #1570Z, OR APPROVED EQUAL.

NOTES:

A. 4' MIN. DIAMETER (5' MIN. DIAMETER FOR INSIDE DROP).

B. MINIMUM DEPTH OF COVER AT PROPERTY LINE SHALL BE 4'. UNLESS GREATER DEPTH IS REQUIRED TO SERVE THE BUILDING. MINIMUM DEPTH AT SIDE DITCH SHALL BE 2.5'.

C. MATCH CROWNS UNLESS THE LATERAL IS THE SAME DIAMETER AS THE MAIN LINE PIPE. THEN A DROP OF 0.2" BETWEEN INVERTS WILL BE PROVIDED.

D. MINIMUM PIPE SLOPES: 4" PIPE IS 1.50% AND 6" PIPE IS 1.25%. MAXIMUM SLOPE FOR ALL PIPE SHALL BE 10%.

E. CONCRETE THROUGH TO BE CUT TO DIRECT FLOW FROM PIPE CONNECTION TO EFFLUENT PIPE.

F. TRACER WIRE INSTALLED PER CLTW TRACER WIRE DETAIL AS APPLICABLE.

G. CUT LETTER "S" IN CURB WHERE PIPE CROSSING UNDER CURB AND PAINT WITH GREEN PAINT. IF NO CURB , PAINT "S" IN PVMT.

H. TYPE 3 GRANULAR BEDDING REQUIRED IF GROUNDWATER, ROCK, OR UNSTABLE SOIL IS ENCOUNTERED.

I. THIS STANDARD DETAIL IS FOR USE ON DEVELOPER INSTALLED GRAVITY SEWER PROJECTS ONLY.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
GRAVITY SEWER

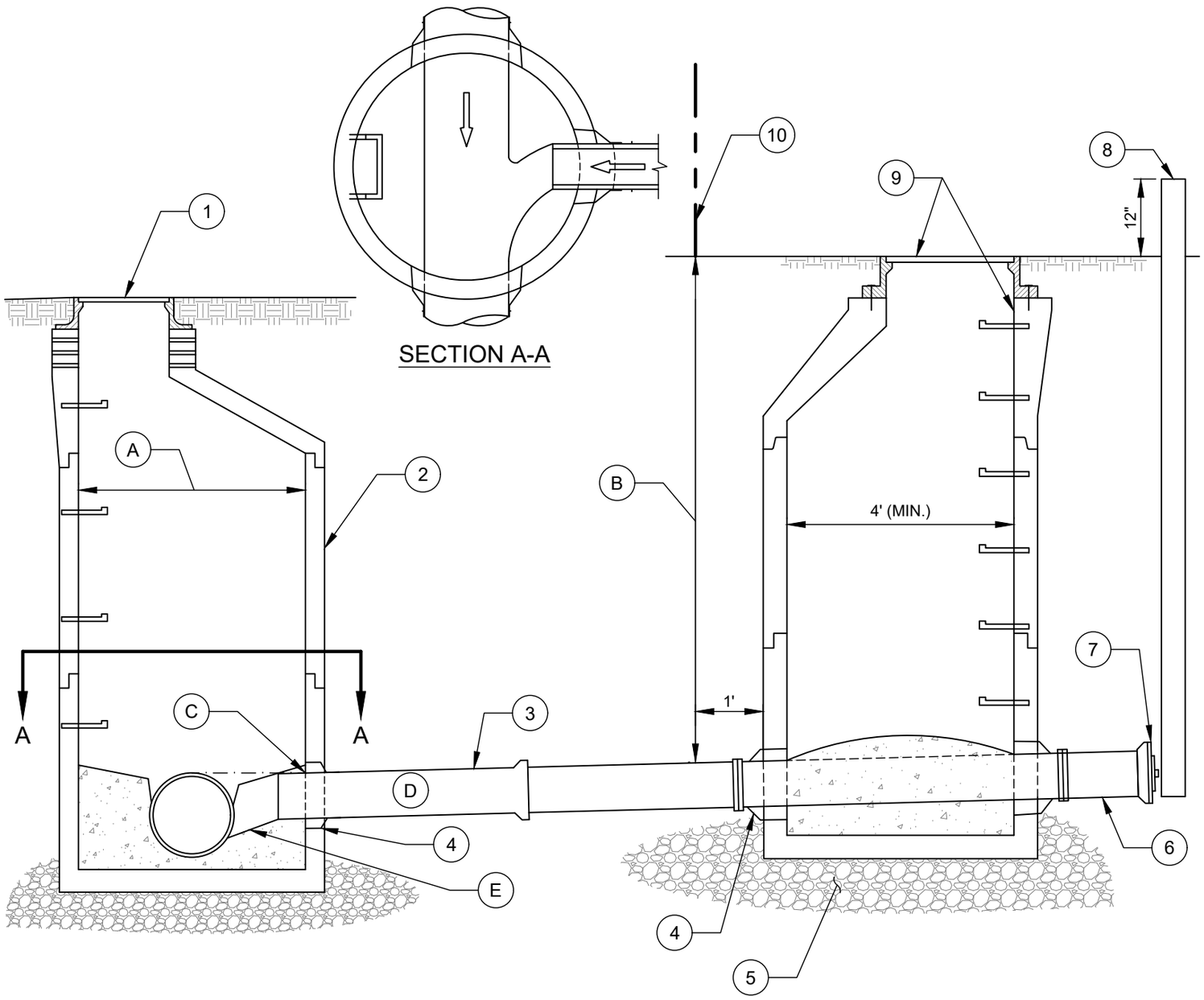
4" AND 6" SANITARY SEWER LATERAL CONNECTIONS TO MANHOLES - ON 8" SDR 26 PVC SEWER MAINS ONLY

NO SCALE

VERSION 1.0

DATE 04/2024

DETAIL 11.1.5



NO. DESCRIPTION:

1. EXISTING OR PROPOSED MANHOLE CLTW STANDARD CAST IRON FRAME AND COVER.
2. MANHOLE ASSEMBLY (TYP.). REFER TO APPROPRIATE CLTW STD. DETAIL.
3. 8"-16" DR 25 PVCP OR DUCTILE IRON PIPE. 8" SDR 26 SOLID WALL PVC PIPE ALLOWED ONLY WHEN THE NEW MAIN IS ALSO 8" SDR 26 PVC PIPE.
4. MANHOLE/PIPE BOOT ON PRECAST MANHOLES AND CONCRETE COLLARS ON BRICK OR BLOCK MANHOLES.
5. #57 STONE EMBEDMENT.
6. PVC PIPE TAILPIECE (SCH 40 PVC - LL + 36" MIN.).
7. TEST-KAP OR END-CAP TEST CAP BY CHERNE INDUSTRIES OR APPROVED EQUAL. SCH 40 GLUE ON CAP.
8. 4" X 4" PRESSURE TREATED LUMBER POST.
9. PRIVATE MANHOLE ASSEMBLY WHERE PRIVATE MANHOLE FRAME AND COVER SHALL NOT BE INTERCHANGEABLE WITH CLTW FRAME AND COVERS.
10. PROPERTY LINE, ROAD R/W OR CLTW EASEMENT LINE.

NOTES:

A. 4' MIN. DIAMETER (5'-0" MIN. DIAMETER FOR INSIDE DROP).

B. MINIMUM DEPTH OF COVER AT PROPERTY LINE SHALL BE 4'. UNLESS GREATER DEPTH IS REQUIRED TO SERVE THE BUILDING. MINIMUM DEPTH AT SIDE DITCH SHALL BE 2.5'.

C. MATCH CROWNS UNLESS THE LATERAL IS THE SAME DIAMETER AS THE MAIN LINE PIPE. THEN A DROP OF 0.2' BETWEEN INVERTS WILL BE PROVIDED.

D. MINIMUM PIPE SLOPES: 8" PIPE IS 0.60%, 10" PIPE IS 0.35%, 12" PIPE IS 0.28%, AND 16" PIPE IS 0.18%. MAXIMUM SLOPE FOR ALL PIPE SHALL BE 10%.

E. CONCRETE THROUGH TO BE CUT TO DIRECT FLOW FROM PIPE CONNECTION TO EFFLUENT PIPE.

F. TRACER WIRE INSTALLED PER CLTW TRACER WIRE DETAIL AS APPLICABLE.

G. CLEANOUTS NOT PERMITTED ON 8" AND LARGER PIPE.

H. CUT LETTER "S" IN CURB WHERE PIPE CROSSING UNDER CURB AND PAINT WITH GREEN PAINT. IF NO CURB , PAINT "S" IN PVMT.

I. TYPE 3 GRANULAR BEDDING REQUIRED.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
GRAVITY SEWER

8" AND LARGER SANITARY SEWER LATERAL CONNECTIONS TO MANHOLES

NO SCALE

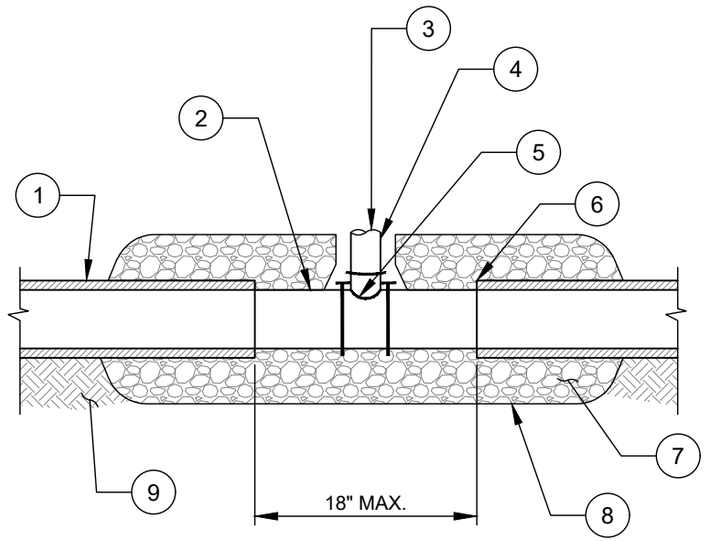
VERSION 1.0

DATE 04/2024

DETAIL 11.1.6

MANUFACTURER:

ROMAC INDUSTRIES, INC. ROMAC "CB" STRAP-ON SADDLE OR APPROVED EQUAL



PLAN

NO.	DESCRIPTION:
1.	EXISTING SEWER MAIN.
2.	CURED-IN-PLACE PIPE LINING (CIPP). SEE NOTE A.
3.	INSTALL NEW SERVICE LATERAL TO LIMITS SPECIFIED.
4.	STRAP-ON SADDLE. SEE NOTES A AND C.
5.	CORE HOLE IN EXISTING CIPP. SEE NOTES A AND D.
6.	CUT EXISTING SEWER. SEE NOTE B.
7.	#57 STONE ALL AROUND (MIN. 8" ABOVE AND BELOW PIPE).
8.	EXCAVATE BELOW THE EXISTING SEWER TO COMPLETE THE WORK. SEE NOTE F.
9.	UNDISTURBED EARTH.

NOTES:

A. REFER TO THIS DETAIL TO CONNECT NEW SERVICE LATERALS AFTER THE SEWERS HAVE BEEN LINED WITH CIPP. THIS DETAIL SHALL ALSO BE USED WHEN RECONNECTING SERVICES FOLLOWING PIPE BURSTING. IN THAT SITUATION, ALL REFERENCES TO CIPP IN THIS DETAIL SHALL BE HDPE. ELECTROFUSE SADDLE MAY BE USED AS AN ALTERNATE TO THE ROMAC SADDLE.

B. NEATLY CUT THE EXISTING SEWER WITH A CUTTER SPECIFICALLY DESIGNED FOR CUTTING THAT SPECIFIC PIPE MATERIAL TO EXPOSE THE CIPP. FOR VCP AND CONCRETE SEWERS, USE A CHAIN CUTTER TO NEATLY SCORE THE PIPE AND THEN BREAK THE PIPE AWAY. REGARDLESS OF THE CUTTER USED, USE EXTREME CAUTION TO PREVENT DAMAGE TO THE CIPP. REPAIR ANY DAMAGE AS APPROVED BY THE ENGINEER.

C. ANY PROPOSED STRAP-ON SADDLE EQUAL SHALL BE SUBMITTED TO THE ENGINEER FOR REVIEW AND APPROVAL. SADDLE SHALL BE PROVIDED FOR THE SPECIFIC TYPE OF LATERAL PIPE BEING INSTALLED.

D. THE FOLLOWING IS APPLICABLE WHERE A LATERAL IS REPLACED WITH A NEW SERVICE (REPLACE-IN-PLACE). CAREFULLY REMOVE THE EXISTING LATERAL TO LIMIT DAMAGE TO THE CIPP, INCREASE THE OPENING IN THE CIPP AS NECESSARY AND TO PROVIDE A CIRCULAR OPENING, BRUSH THE CIPP IN THE OPENING SMOOTH TO REMOVE ALL BURRS, INSTALL STRAP-ON SADDLE, AND REPLACE LATERAL TO THE SPECIFIED LIMITS. WHERE POSSIBLE, IMPROVE THE CONFIGURATION OF THE CONNECTION. A SADDLE IS PREFERABLE TO A TEE.

E. IF THE CIPP IS DAMAGED FROM OVERCUTTING THE NEW SERVICE CONNECTION, THEN THE NEXT LARGER SIZE HOLE SHALL BE CUT AND A SERVICE SADDLE WITH A BELL REDUCER SHALL BE INSTALLED FOR CONNECTING BACK TO THE NEW SERVICE DIAMETER.

F. SUPPORT THE EXISTING SEWER DURING THE WORK AS NECESSARY.

G. DEFECTS IDENTIFIED FROM THE POST-CIPP CCTV INSPECTIONS SHALL BE REPAIRED BY THE CONTRACTOR TO THE SATISFACTION OF THE ENGINEER.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
GRAVITY SEWER

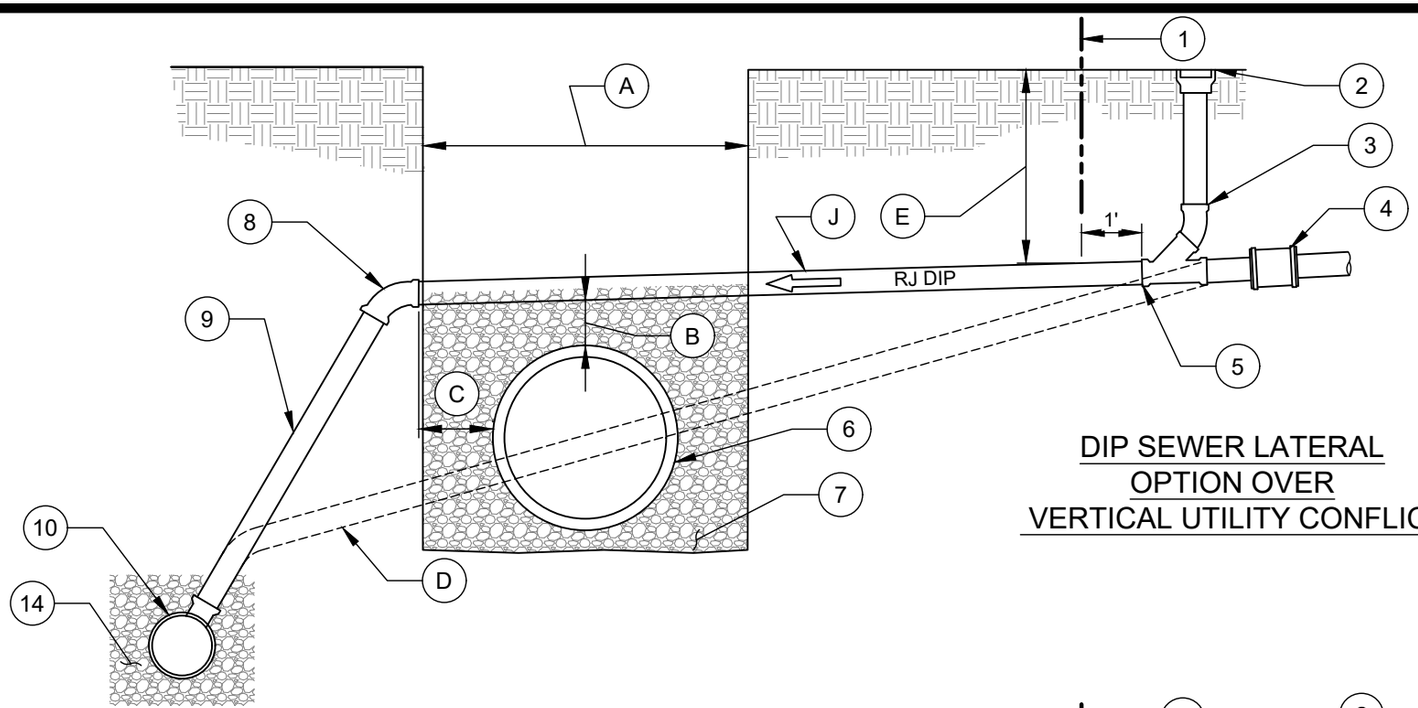
SERVICE LATERAL CONNECTING TO CURED-IN-PLACE PIPE LINING (CIPP)

NO SCALE

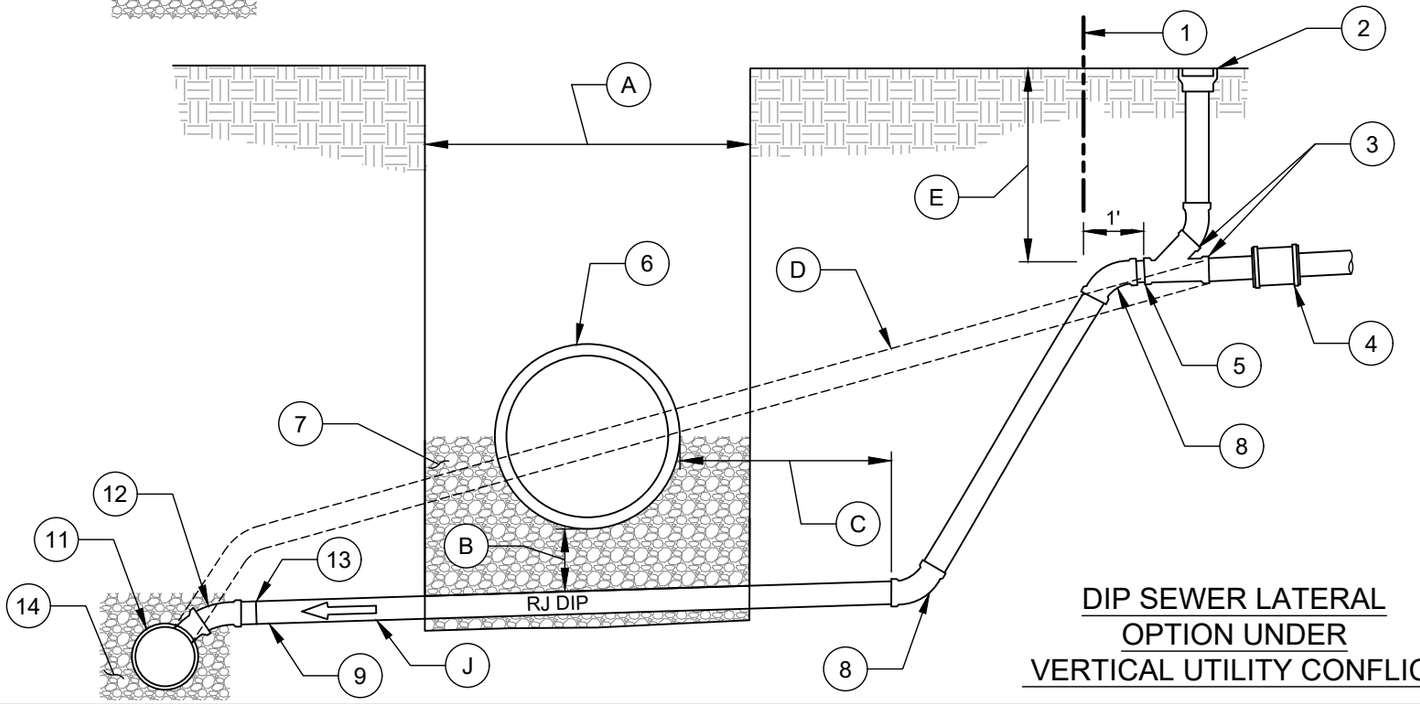
VERSION 1.0

DATE 04/2024

DETAIL 11.1.7



DIP SEWER LATERAL
OPTION OVER
VERTICAL UTILITY CONFLICT



DIP SEWER LATERAL
OPTION UNDER
VERTICAL UTILITY CONFLICT

NO.	DESCRIPTION:
1.	PROPERTY LINE, ROAD R/W OR CLTW EASEMENT LINE.
2.	CLEAN-OUT (SEE CLTW STD. DETAIL).
3.	IPS (SCH 40) TRANSITION GASKET.
4.	ADJUSTABLE REPAIR COUPLING.
5.	TRANSITION FROM DIP TO C900 DR 18 PVC.
6.	NEW UTILITY.
7.	TRENCH BACKFILL - TYPE #3 STONE BEDDING UNDER LOWER PIPE. UP TO SPRINGLINE OF UPPER PIPE.
8.	DUCTILE IRON BEND (45 OR 22.5 DEGREES). ALL BELL BENDS (TYP.).
9.	NEW RJ DIP SEWER LATERAL.
10.	DIP TEE.
11.	CONVENTIONAL TAP OR TEE.
12.	PVC BEND (45° OR 22.5°) (TYP.).
13.	TRANSITION FROM PVC TO DIP.
14.	BEDDING AND EMBEDMENT (WASHED STONE #57).

NOTES:

A. TRENCH FOR NEW CONSTRUCTION.

B. 12" MIN. VERTICAL CLEARANCE BETWEEN PIPES (O.D. TO O.D.). BACKFILL BETWEEN UTILITIES WITH #57 STONE.

C. BENDS 5' MINIMUM OFF OF UTILITY PIPE.

D. REMOVE EXISTING SEWER LATERAL.

E. MINIMUM DEPTH OF COVER AT PROPERTY LINE SHALL BE 4'. UNLESS GREATER DEPTH IS REQUIRED TO SERVE THE BUILDING. MINIMUM DEPTH AT SIDE DITCH SHALL BE 2.5'.

F. IF NEITHER OF THE OPTIONS SHOWN ARE FEASIBLE, THEN THE ELEVATION OF THE NEW FACILITY WILL NEED TO BE ADJUSTED AS REQUIRED.

G. CUMULATIVE BENDS FROM TEE TO CLEAN-OUT SHALL NOT EXCEED 90°.

H. INSTALL BENDS OUTSIDE OF TRENCH FOOTPRINT.

I. TYPE 3 GRANULAR BEDDING REQUIRED IF GROUNDWATER, ROCK, OR UNSTABLE SOIL IS ENCOUNTERED.

J. MINIMUM SLOPE SHALL BE 1.5% FOR 4" PIPE AND 1.25% FOR 6" PIPE.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
GRAVITY SEWER

4" OR 6" D.I.P. LATERAL WITH BENDS DUE TO VERTICAL UTILITY CONFLICTS

NO SCALE

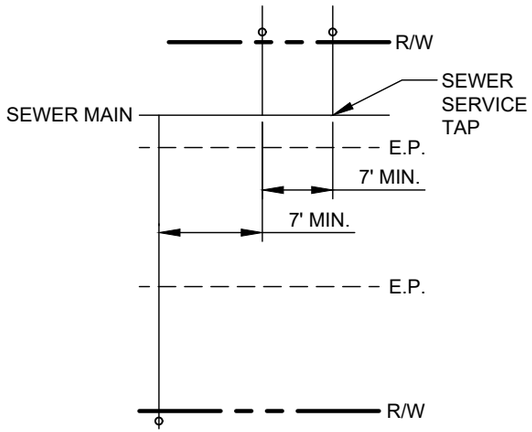
VERSION 1.0

DATE 04/2024

DETAIL 11.1.8

REQUIREMENT 1

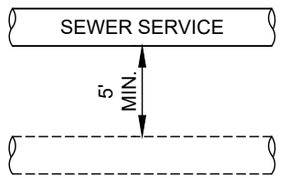
MINIMUM SPACING BETWEEN
SEWER TAPS: 7'



PLAN VIEW
(HORIZONTAL SEPARATION)

REQUIREMENT 2

MINIMUM SPACING BETWEEN SEWER SERVICES
AND PARALLEL STORM PIPES/CATCH BASINS: 5'

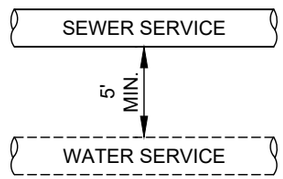


STORM SEWER, STORM WATER
FORCE MAIN, STORM CATCH BASIN

PLAN VIEW
(HORIZONTAL SEPARATION)

REQUIREMENT 3

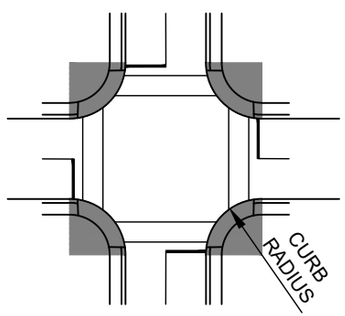
MINIMUM SPACING BETWEEN SEWER SERVICES
AND WATER SERVICES: 5'



PLAN VIEW
(HORIZONTAL SEPARATION)

REQUIREMENT 4

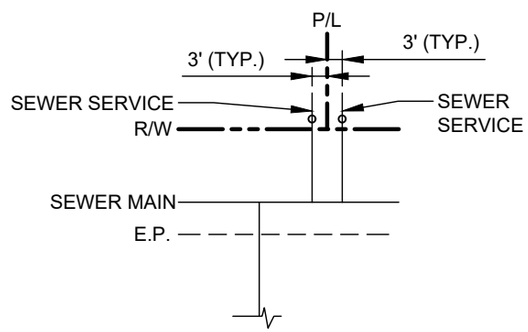
SEWER SERVICES PROHIBITED INSIDE CURB RADIUS
POINT OF PUBLIC AND PRIVATE ROAD INTERSECTIONS



PLAN VIEW

REQUIREMENT 5

MINIMUM CLEARANCE BETWEEN PROPERTY
LINE AND SEWER SERVICE: 3'



PLAN VIEW
(HORIZONTAL SEPARATION)

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

GRAVITY SEWER

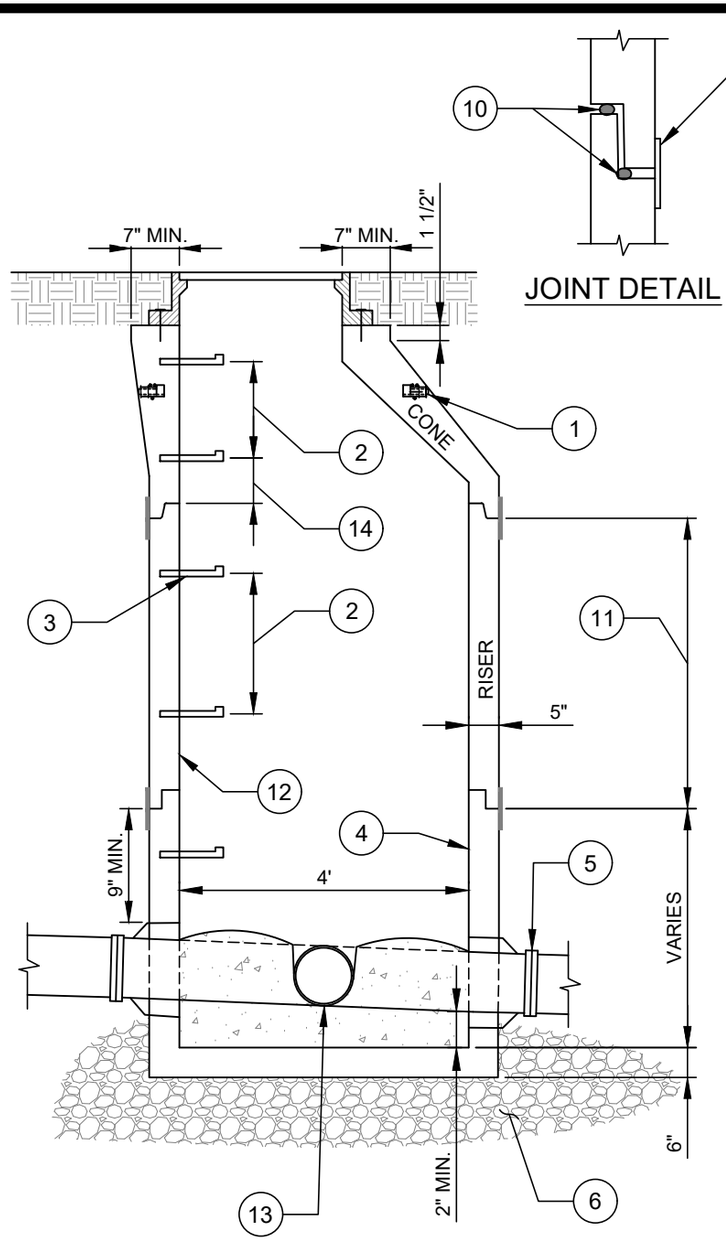
SEWER SERVICES - SCHEMATIC

NO SCALE

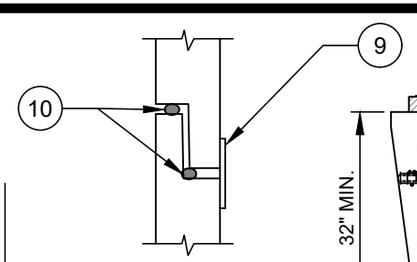
VERSION
1.0

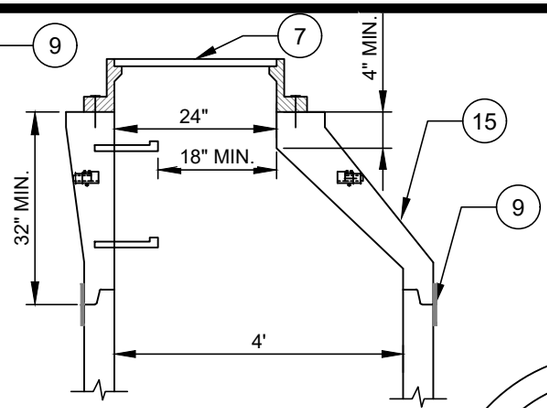
DATE
04/2024

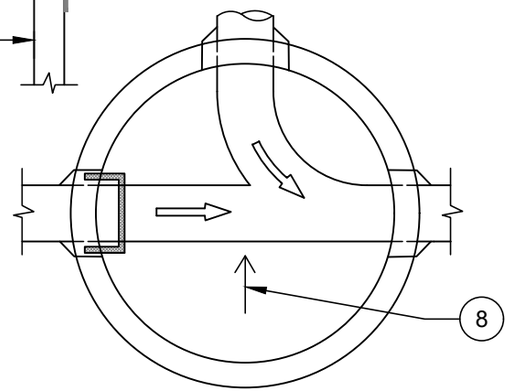
DETAIL
11.1.9



JOINT DETAIL







NO.	DESCRIPTION:
1.	LIFT INSERT.
2.	12" OR 16" ON-CENTER STEP SPACING. SPACING IN ANY SINGLE MANHOLE SHALL BE UNIFORM AND EITHER ALL 12" OR ALL 16". STEP SPACING SHALL BE CONSISTENT THROUGHOUT A PROJECT.
3.	STEPS (ON STRAIGHT WALL).
4.	MANHOLE BASE SECTION.
5.	FLEXIBLE COUPLING INSTALLED IN CORED HOLE WITH STAINLESS STEEL COMPRESSION DEVICE.
6.	MINIMUM 6" DEPTH OF #57 STONE BASE, SUITABLE BEARING CAPACITY AS APPROVED BY GEOTECHNICAL ENGINEER.
7.	CLTW STANDARD CAST IRON FRAME AND COVER.
8.	1 INCH PER FOOT FALL (TYP.).
9.	6" (MIN.) WIDE BUTYL RUBBER JOINT WRAP REQUIRED ON EXTERIOR OF ALL JOINTS.
10.	BUTYL RUBBER JOINT SEALANT-2 FULL CIRCLES EACH JOINT COMPRESSED (TYP.). USED BETWEEN PRECAST SECTIONS AND FRAME.
11.	VARIES - INCREMENTS SHALL BE 1 FOOT INCREMENTS FOR 12" STEP SPACING AND 16" INCREMENTS FOR 16" STEP SPACING.
12.	STRAIGHT WALL OF MH TO BE LOCATED OVER INFLUENT PIPE.
13.	FOR 8" AND 10" PIPE, INVERTS ARE TO BE 3/4" OF PIPE OUTSIDE DIAMETER AT TROUGH, FOR 12" AND LARGER PIPE, PROVIDE FULL INVERT AS SHOWN. THE SHELF SHALL SLOPE 1 INCH PER FOOT (MIN.) FROM THE MANHOLE WALL TO THE TROUGH.
14.	STEPS SHALL BE PLACED NO CLOSER THAN 1/2 THE STEP SPACING FROM A JOINT AND SHALL BE NO CLOSER THAN 6".
15.	CONE SLOPE SHALL BE THE FULL CONE HEIGHT AS SHOWN HERE. AN INTEGRAL VERTICAL WALL SKIRT IS ALLOWED ON CONE SECTIONS TALLER THAN REQUIRED MINIMUM CONE HEIGHT.

NOTES:

A. MANHOLE TO CONFORM WITH ASTM C478 EXCEPT AS MODIFIED BELOW.

B. MANHOLE BASE TO BE REINFORCED WITH A MINIMUM AREA OF 0.20 SQ. IN. PER LINEAR FOOT EACH WAY. WALL REINFORCING TO BE MINIMUM OF 0.12 SQ. IN. PER VERTICAL FOOT. EITHER TONGUE OR GROOVE SHALL HAVE REINFORCING EQUAL IN AREA TO MINIMUM OF WALL SECTION.

C. ALL JOINTS SHALL CONFORM WITH ASTM C990.

D. STEPS TO CONFORM TO CLTW STANDARD DETAIL.

E. ALL PIPE OPENINGS TO BE NO GREATER THAN 4" LARGER THAN OUTSIDE DIAMETER OF PIPE AND ADDITIONALLY REINFORCED WITH A MINIMUM OF 0.20 SQ. IN. OF STEEL AT 90°. (ADDITIONAL REINFORCING NOT REQUIRED FOR CORED OPENINGS).

F. ALL SURFACES SHALL BE SMOOTH EVEN TEXTURED WITH A MINIMUM OF HONEYCOMB, FINS AND OTHER IMPERFECTIONS.

G. PENETRATING LIFTING HOLES SHALL BE PLUGGED WITH EXPANSION GROUT OR HAVE WATERTIGHT PLASTIC INSERTS.

H. INVERTS TO BE PRECAST CONCRETE.

I. ALL MANHOLE SECTIONS SHALL BE DESIGNED FOR H-20 LOADING AND A MINIMUM HEIGHT OF 40 VERTICAL FEET.

J. WIRE TO CONFORM WITH ASTM A1064, LOCATED IN CENTER 1/3 OF WALL.

K. REBAR TO CONFORM WITH ASTM A615 OR A706, GRADE 60.

L. PRODUCT MARKINGS REQUIRED BY ASTM C478 SHALL BE MARKED ON BOTH THE INTERIOR AND EXTERIOR OF EACH PRECAST SECTION.

M. ALL STEPS SHALL BE PULLOUT TESTED TO A MINIMUM LOAD OF 1,000 LBS. TEST REPORTS REQUIRED.

N. PRECAST PRODUCT SHALL NOT BE SHIPPED FROM THE MANUFACTURER UNTIL IT HAS REACHED A MINIMUM OF 4,000 PSI COMPRESSIVE STRENGTH AND NO LESS THAN 7 DAYS AFTER CASTING, WHICHEVER IS GREATER.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
GRAVITY SEWER

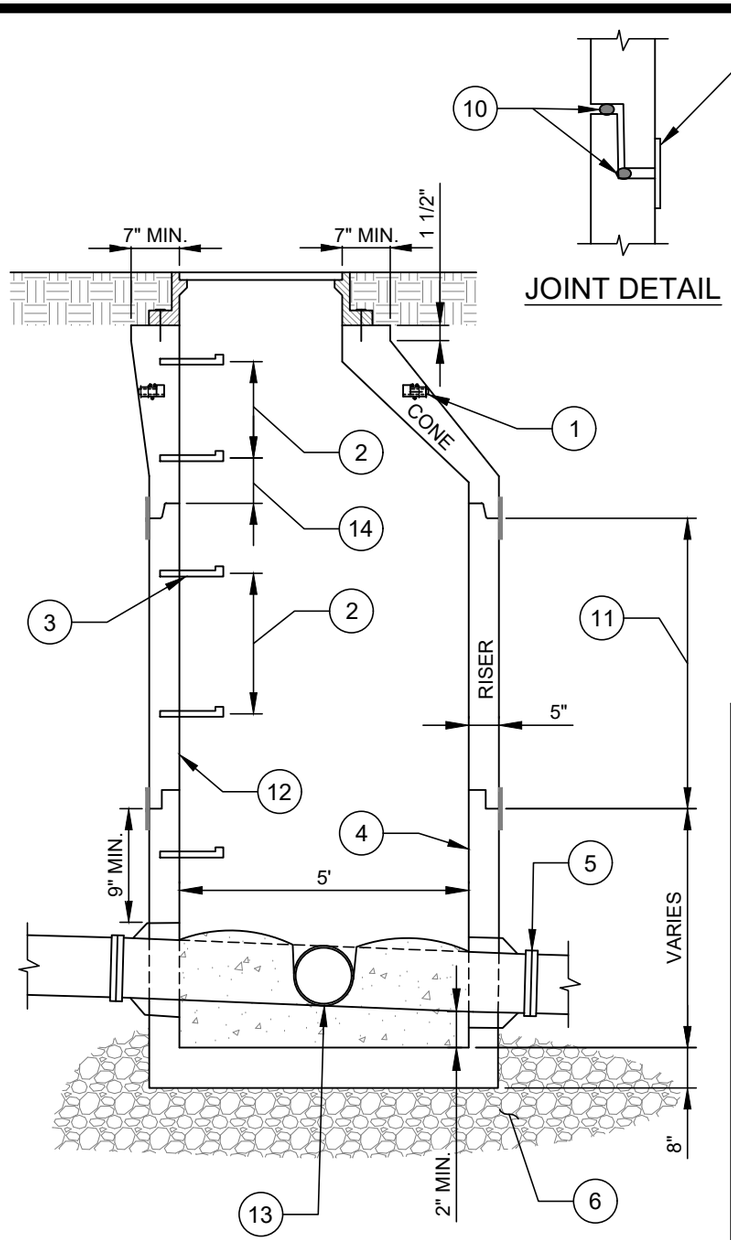
4' DIAMETER PRECAST MANHOLES (FOR 8" THROUGH 16" DIAMETER PIPE)

NO SCALE

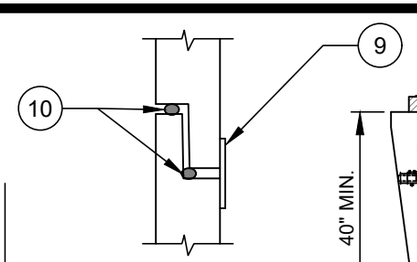
VERSION 2.0

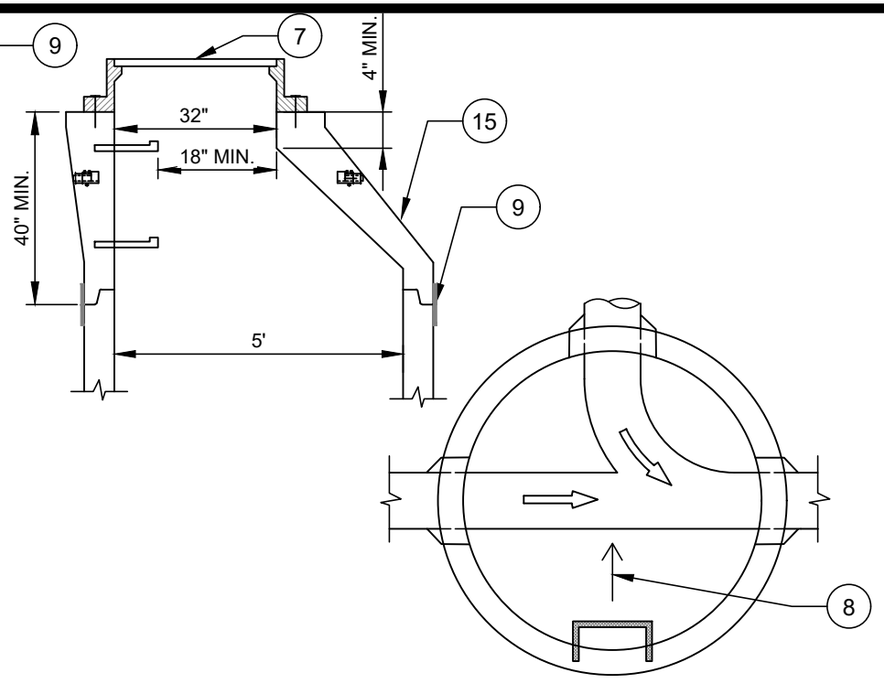
DATE 01/2026

DETAIL 11.2.1



JOINT DETAIL





NO.	DESCRIPTION:
1.	LIFT INSERT.
2.	12" OR 16" ON-CENTER STEP SPACING. SPACING IN ANY SINGLE MANHOLE SHALL BE UNIFORM AND EITHER ALL 12" OR ALL 16". STEP SPACING SHALL BE CONSISTENT THROUGHOUT A PROJECT.
3.	STEPS (ON STRAIGHT WALL).
4.	MANHOLE BASE SECTION.
5.	FLEXIBLE COUPLING INSTALLED IN CORED HOLE WITH STAINLESS STEEL COMPRESSION DEVICE.
6.	MINIMUM 6" DEPTH OF #57 STONE BASE, SUITABLE BEARING CAPACITY AS APPROVED BY GEOTECHNICAL ENGINEER.
7.	CLTW STANDARD CAST IRON FRAME AND COVER.
8.	1 INCH PER FOOT FALL (TYP.).
9.	6" (MIN.) WIDE BUTYL RUBBER JOINT WRAP REQUIRED ON EXTERIOR OF ALL JOINTS.
10.	BUTYL RUBBER JOINT SEALANT-2 FULL CIRCLES EACH JOINT COMPRESSED (TYP.). USED BETWEEN PRECAST SECTIONS AND FRAME.
11.	VARIES - INCREMENTS SHALL BE 1 FOOT INCREMENTS FOR 12" STEP SPACING AND 16" INCREMENTS FOR 16" STEP SPACING.
12.	STRAIGHT WALL OF MH TO BE LOCATED OVER WIDEST SHELF.
13.	FOR 8" AND 10" PIPE, INVERTS ARE TO BE 3/4" OF PIPE OUTSIDE DIAMETER AT TROUGH, FOR 12" AND LARGER PIPE, PROVIDE FULL INVERT AS SHOWN. THE SHELF SHALL SLOPE 1 INCH PER FOOT (MIN.) FROM THE MANHOLE WALL TO THE TROUGH.
14.	STEPS SHALL BE PLACED NO CLOSER THAN 1/2 THE STEP SPACING FROM A JOINT AND SHALL BE NO CLOSER THAN 6".
15.	CONE SLOPE SHALL BE THE FULL CONE HEIGHT AS SHOWN HERE. AN INTEGRAL VERTICAL WALL SKIRT IS ALLOWED ON CONE SECTIONS TALLER THAN REQUIRED MINIMUM CONE HEIGHT.

NOTES:

A. MANHOLE TO CONFORM WITH ASTM C478 EXCEPT AS MODIFIED BELOW.

B. MANHOLE BASE TO BE REINFORCED WITH A MINIMUM AREA OF 0.20 SQ. IN. PER LINEAR FOOT EACH WAY. WALL REINFORCING TO BE MINIMUM OF 0.15 SQ. IN. PER VERTICAL FOOT. EITHER TONGUE OR GROOVE SHALL HAVE REINFORCING EQUAL IN AREA TO MINIMUM OF WALL SECTION.

C. ALL JOINTS SHALL CONFORM WITH ASTM C990.

D. STEPS TO CONFORM TO CLTW STANDARD DETAIL.

E. ALL PIPE OPENINGS TO BE NO GREATER THAN 4" LARGER THAN OUTSIDE DIAMETER OF PIPE AND ADDITIONALLY REINFORCED WITH A MINIMUM OF 0.20 SQ. IN. OF STEEL AT 90°. (ADDITIONAL REINFORCING NOT REQUIRED FOR CORED OPENINGS).

F. ALL SURFACES SHALL BE SMOOTH EVEN TEXTURED WITH A MINIMUM OF HONEYCOMB, FINS AND OTHER IMPERFECTIONS.

G. PENETRATING LIFTING HOLES SHALL BE PLUGGED WITH EXPANSION GROUT OR HAVE WATERTIGHT PLASTIC INSERTS.

H. INVERTS TO BE PRECAST CONCRETE.

I. ALL MANHOLE SECTIONS SHALL BE DESIGNED FOR H-20 LOADING AND A MINIMUM HEIGHT OF 40 VERTICAL FEET.

J. WIRE TO CONFORM WITH ASTM A1064, LOCATED IN CENTER 1/3 OF WALL.

K. REBAR TO CONFORM WITH ASTM A615 OR A706, GRADE 60.

L. PRODUCT MARKINGS REQUIRED BY ASTM C478 SHALL BE MARKED ON BOTH THE INTERIOR AND EXTERIOR OF EACH PRECAST SECTION.

M. ALL STEPS SHALL BE PULLOUT TESTED TO A MINIMUM LOAD OF 1,000 LBS. TEST REPORTS REQUIRED.

N. PRECAST PRODUCT SHALL NOT BE SHIPPED FROM THE MANUFACTURER UNTIL IT HAS REACHED A MINIMUM OF 4,000 PSI COMPRESSIVE STRENGTH AND NO LESS THAN 7 DAYS AFTER CASTING, WHICHEVER IS GREATER.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

GRAVITY SEWER

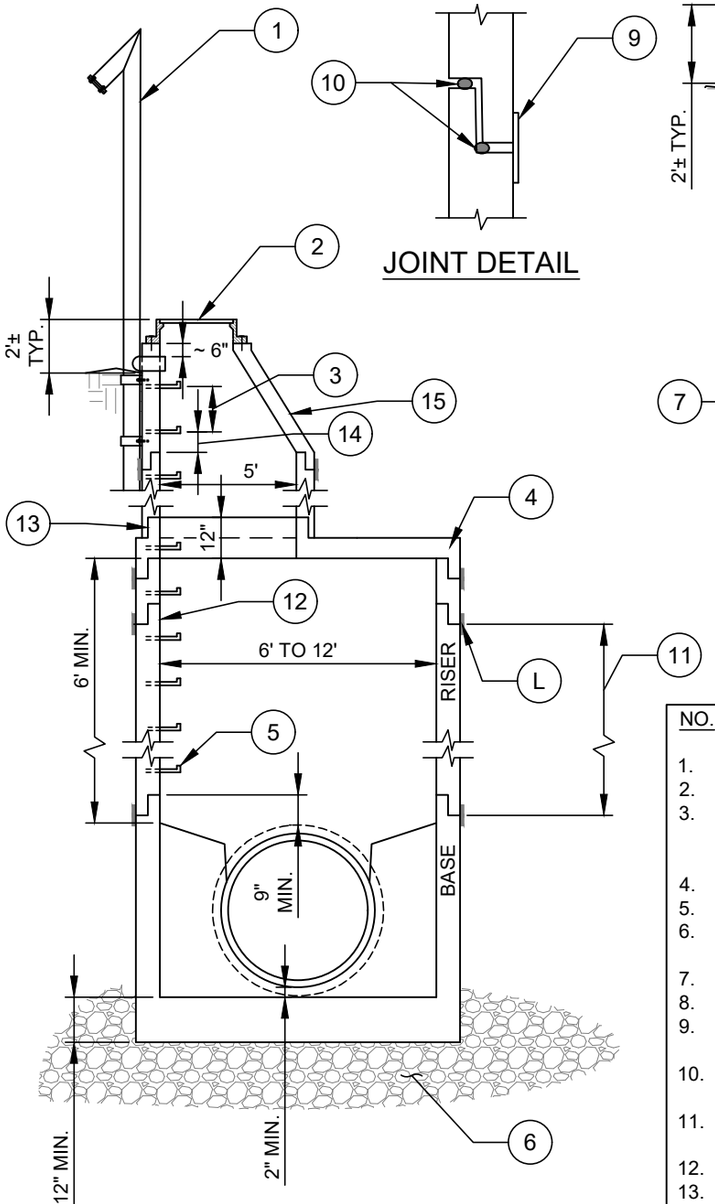
5' DIAMETER PRECAST MANHOLES
(FOR 18" THROUGH 36" DIAMETER PIPE)
(WHEN INSIDE DROPS ARE REQUIRED)

NO SCALE

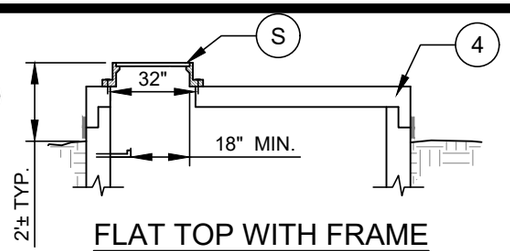
VERSION
2.0

DATE
01/2026

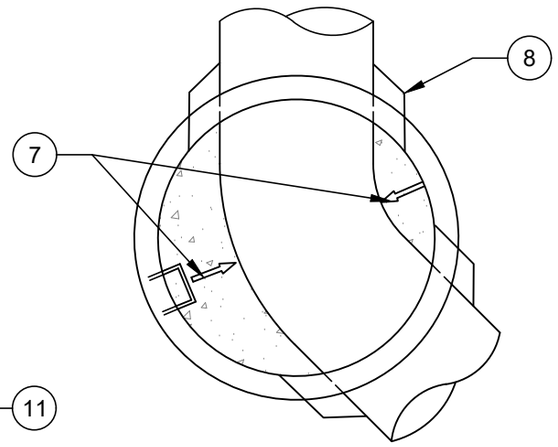
DETAIL
11.2.2



JOINT DETAIL



FLAT TOP WITH FRAME BOLTED TO MANHOLE



NO.	DESCRIPTION:
1.	VENT PER CLTW STANDARD DETAIL.
2.	CLTW STANDARD CAST IRON FRAME AND COVER.
3.	12" OR 16" ON-CENTER STEP SPACING. SPACING IN ANY SINGLE MANHOLE SHALL BE UNIFORM AND EITHER ALL 12" OR ALL 16". STEP SPACING SHALL BE CONSISTENT THROUGHOUT A PROJECT.
4.	TRANSITION OR FLAT TOP SLAB.
5.	STEP PER CLTW STANDARD DETAIL.
6.	6" MINIMUM #57 STONE BASE, SUITABLE BEARING CAPACITY AS APPROVED BY GEOTECHNICAL ENGINEER.
7.	1 INCH PER FOOT SLOPE (TYP.).
8.	FLEXIBLE WATERTIGHT CONNECTOR, (TYP.).
9.	6" (MIN.) WIDE BUTYL RUBBER JOINT WRAP REQUIRED ON EXTERIOR OF ALL JOINTS.
10.	BUTYL RUBBER JOINT SEALANT-2 FULL CIRCLES EACH JOINT COMPRESSED (TYP.). USED BETWEEN PRECAST SECTIONS AND FRAME.
11.	VARIES - INCREMENTS SHALL BE 1 FOOT INCREMENTS FOR 12" STEP SPACING AND 16" INCREMENTS FOR 16" STEP SPACING.
12.	STRAIGHT WALL OF MH TO BE LOCATED OVER WIDEST SHELF.
13.	TRANSITION TOP SHALL HAVE 12" OR 16" VERTICAL LAID LENGTH TO MAINTAIN STEP SPACING. TRANSITION AND FLAT TOP REINFORCEMENT SHALL BE SUBMITTED FOR REVIEW FOR STRUCTURAL INTEGRITY.
14.	STEPS SHALL BE PLACED NO CLOSER THAN 1/2 THE STEP SPACING FROM A JOINT AND SHALL BE NO CLOSER THAN 6".
15.	CONE SLOPE SHALL BE THE FULL CONE HEIGHT AS SHOWN HERE.

NOTES:

A. MANHOLE TO CONFORM WITH ASTM C478 EXCEPT AS MODIFIED BELOW.

B. MANHOLE BASE TO BE REINFORCED WITH A MINIMUM AREA OF 0.20 SQ. IN. PER LINEAR FOOT EACH WAY. WALL REINFORCING TO BE PER MANHOLE DIAMETER AS LISTED BELOW. EITHER TONGUE OR GROOVE SHALL HAVE REINFORCING EQUAL IN AREA TO MINIMUM OF WALL SECTION.

MANHOLE DIAMETER	MANHOLE REINFORCEMENTS (SQ. IN. PER VERTICAL FOOT)
6'	0.18
7'	0.21
8'	0.24
9'	0.27
10'	0.30
11'	0.33
12'	0.36

C. ALL JOINTS SHALL CONFORM WITH ASTM C990.

D. STEPS TO CONFORM TO CLTW STANDARD DETAIL.

E. ALL PIPE OPENINGS TO BE NO GREATER THAN 4" LARGER THAN OUTSIDE DIAMETER OF PIPE AND ADDITIONALLY REINFORCED WITH A MINIMUM OF 0.20 SQ. IN. OF STEEL AT 90°. (ADDITIONAL REINFORCING NOT REQUIRED FOR CORED OPENINGS).

F. ALL SURFACES SHALL BE SMOOTH EVEN TEXTURED WITH A MINIMUM OF HONEYCOMB, FINS AND OTHER IMPERFECTIONS.

G. PENETRATING LIFTING HOLES SHALL BE PLUGGED WITH EXPANSION GROUT OR HAVE WATERTIGHT PLASTIC INSERTS.

H. INVERTS TO BE PRECAST CONCRETE.

I. ALL MANHOLE SECTIONS SHALL BE DESIGNED FOR H-20 LOADING AND A MINIMUM HEIGHT OF 40 VERTICAL FEET.

J. WIRE TO CONFORM WITH ASTM A1064, LOCATED IN CENTER 1/3 OF WALL (IF IT IS A SINGLE REINFORCEMENT CAGE. IF 2 CAGES ARE USED, THEN EACH CAGE SHALL HAVE A MINIMUM OF 1 INCH COVER TO THE INNER OR OUTER WALL FACE).

K. REBAR TO CONFORM WITH ASTM A615 OR A706, GRADE 60.

L. PRODUCT MARKINGS REQUIRED BY ASTM C478 SHALL BE MARKED ON BOTH THE INTERIOR AND EXTERIOR OF EACH PRECAST SECTION.

M. ALL STEPS SHALL BE PULLOUT TESTED TO A MINIMUM LOAD OF 1,000 LBS. TEST REPORTS REQUIRED.

N. PRECAST PRODUCT SHALL NOT BE SHIPPED FROM THE MANUFACTURER UNTIL IT HAS REACHED A MINIMUM OF 4,000 PSI COMPRESSIVE STRENGTH AND NO LESS THAN 7 DAYS AFTER CASTING, WHICHEVER IS GREATER.

O. FOR 12" AND LARGER PIPE, PROVIDE FULL INVERT AS SHOWN. THE SHELF SHALL SLOPE 1 INCH PER FOOT (MIN.) FROM THE MANHOLE WALL TO THE TROUGH.

P. OUTSIDE DROP SHALL NOT ENTER 5' RISER SECTIONS.

Q. FOR 5' DIAMETER RISER AND CONES SECTIONS, REFER TO 5' DIAMETER MANHOLE DETAILS.

R. INSIDE DROPS OR OUTSIDE DROPS SHALL ONLY ENTER MANHOLE RISER SECTION BELOW THE TRANSITION SLAB.

S. FLUSH CAST IN PLACE FRAMES ARE PREFERRED ON FLAT TOP MANHOLES. BOLT DOWN FRAMES REQUIRE PRIOR APPROVAL BY CLT WATER.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
GRAVITY SEWER

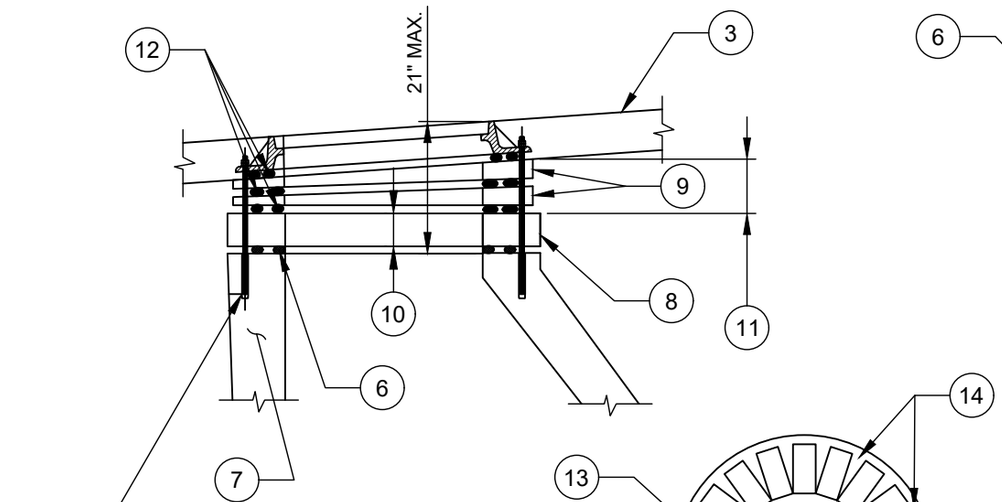
6' - 12' DIAMETER PRECAST MANHOLE (FOR 42" DIAMETER AND LARGER PIPE)

NO SCALE

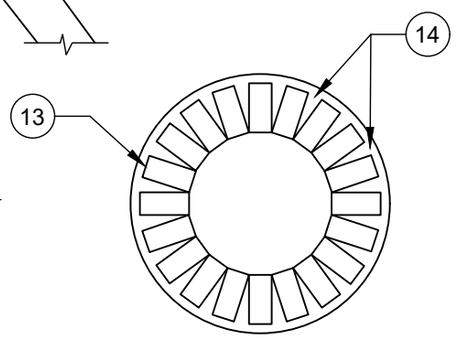
VERSION 2.0

DATE 01/2026

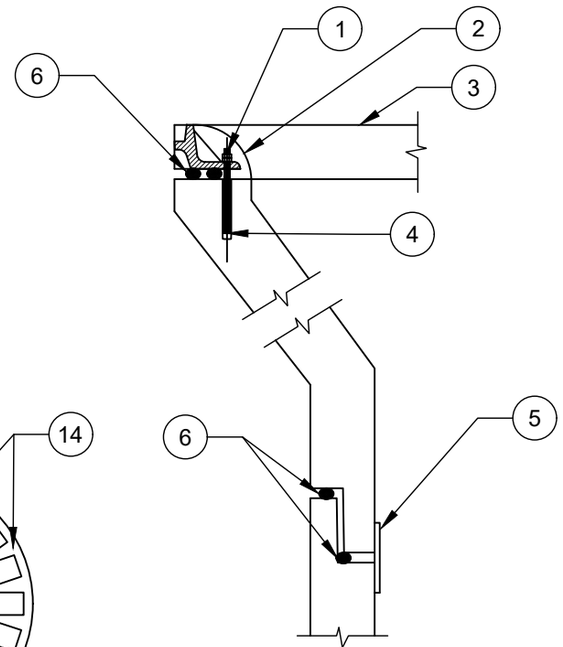
DETAIL 11.2.3



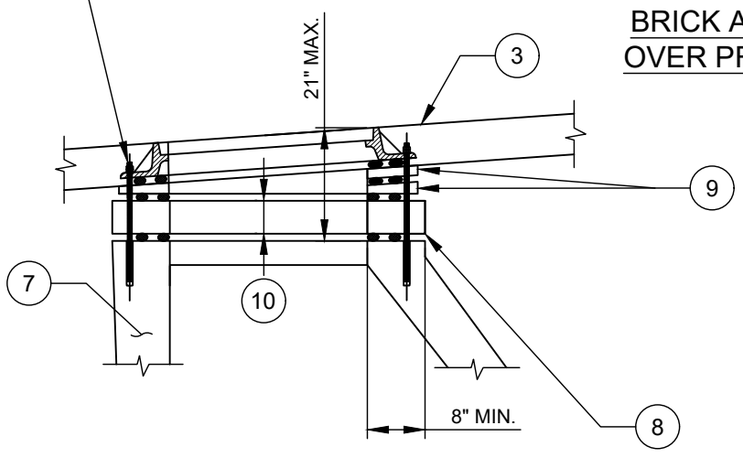
CONCRETE AND EPP GRADE RINGS



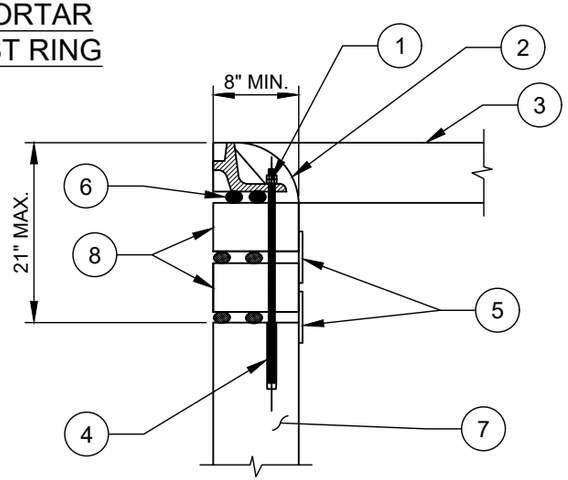
BRICK AND MORTAR OVER PRECAST RING



WITHOUT EPP GRADE RING



CONCRETE AND EPP GRADE RINGS



WITHOUT EPP GRADE RING

NO. DESCRIPTION:

1. 1/2" DIAMETER ZINC PLATED OR HOT DIP GALVANIZED THREADED ROD, 2 NUTS AND 2 DOUBLE WIDE WASHERS.
2. CEMENT MORTAR GROUT. INSTALL AFTER BOLT APPROVAL BY THE INSPECTOR.
3. FINISH GRADE.
4. EPOXY ADHESIVE ANCHORING SYSTEM WITH 5" MINIMUM EMBEDMENT. CLEAN HOLE PER ADHESIVE MANUFACTURING REQUIREMENTS.
5. 6" (MIN.) WIDE BUTYL RUBBER JOINT WRAP REQUIRED ON ALL EXTERIOR JOINTS.
6. BUTYL RUBBER JOINT SEALANT-2 FULL CIRCLES EACH JOINT COMPRESSED (TYP.). USED ONLY BETWEEN PRECAST SECTIONS AND FRAME.
7. CONE SECTION.
8. CONCRETE GRADE RING (2" MIN. HEIGHT) TO CONTAIN ONE RING OF REBAR (STEEL AREA = 0.07 SQ IN PER VERTICAL FOOT) BUT NOT LESS THAN 0.024 SQ IN ANY ONE GRADE RING.
9. RECYCLED RUBBER OR EXPANDED POLYPROPYLENE (EPP) ADJUSTMENT GRADE RING - FLAT, WITH KEYWAY (GROOVE) FOR VERTICAL ALIGNMENT, WITH ADHESIVE TRENCH, AND/OR WITH TAPER-ROTATE FOR SLOPE ADJUSTMENT - OR USE BRICK AND MORTAR OVER PRECAST RING. SEE DETAIL ON THIS SHEET.
10. 2", 4", 6", OR 8" TALL PRECAST GRADE RING SECTIONS.
11. 8" MAXIMUM HEIGHT OF RUBBER OR EXPANDED POLYPROPYLENE ADJUSTMENT RINGS, OTHERWISE USE CONCRETE.
12. EPOXY ADHESIVE USED BETWEEN RUBBER/RUBBER, EXPANDED POLYPROPYLENE/EXPANDED POLYPROPYLENE, FRAME/RUBBER OR EXPANDED POLYPROPYLENE, AND PRECAST SECTIONS/RUBBER OR EXPANDED POLYPROPYLENE. IF CONCRETE GRADE RING, USE BUTYL RUBBER JOINT SEALANT.
13. STANDARD NCDOT CONCRETE BRICK OR FLOOR TILE PAVERS.
14. FILL ALL VOIDS SOLID WITH MORTAR.

NOTES:

A. MINIMUM 8" WIDTH OF ALL GRADE RINGS.
   24" COVER = 40" (GROUND TO O.D.).
   30" COVER = 46" (GROUND TO O.D.).

B. NO MORE THAN 3 GRADE RINGS (21" MAXIMUM) INCLUDING FRAME HEIGHT.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
GRAVITY SEWER

SEWER MANHOLE GRADE RING

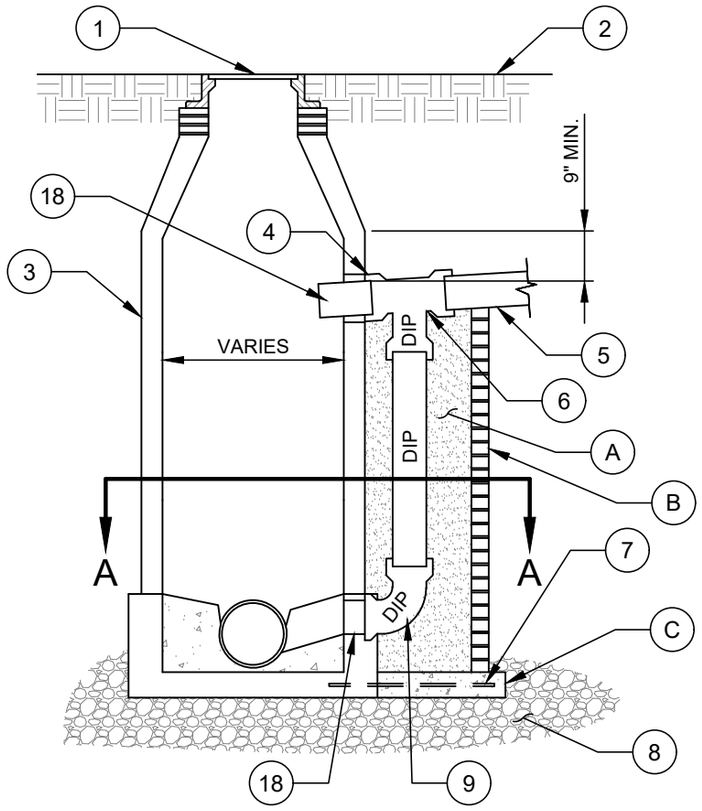
NO SCALE

VERSION 1.0

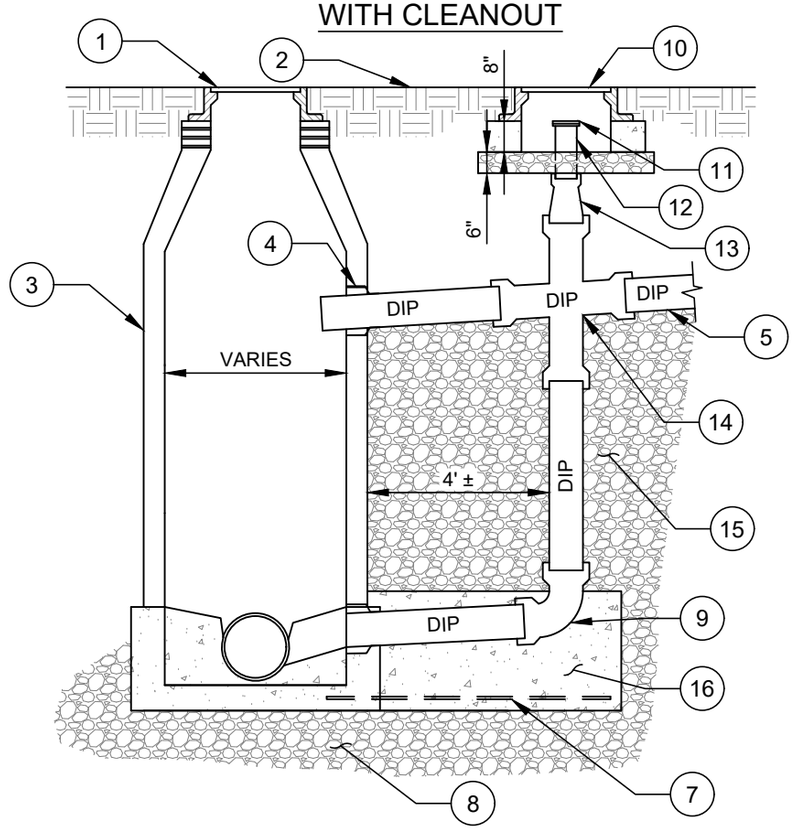
DATE 04/2024

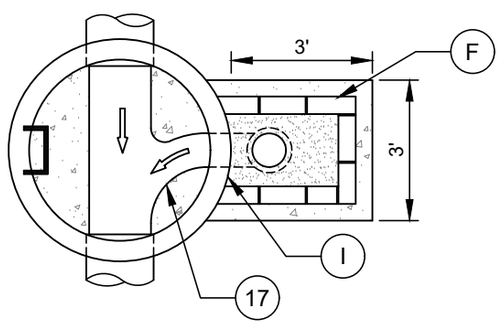
DETAIL 11.2.4

TYPE A - ATTACHED DROP



TYPE B - DETACHED DROP WITH CLEANOUT





SECTION A-A

NOTES:

K. OUTSIDE DROP SHALL NOT ENTER MH IN CONE SECTION.

L. MATCH DROP INFLUENT CROWN TO CROWN WITH EFFLUENT PIPE.

M. DROP PIPING SHALL BE ALL DIP PIPE AND FITTINGS. ALL FITTINGS IN THE DETACHED/CLEANOUT DROP BE RJ.

N. OPTION B ONLY TO BE USED AT CHARLOTTE WATER DIRECTION.

O. MAX DROP HEIGHT SHALL BE 10'.

P. UPPER PIPE - EXTEND PIPE INSIDE FACE OF MANHOLE APPROX. 2 INCHES.
LOWER PIPE - FLUSH WITH INSIDE WALL.

NO.	DESCRIPTION:
1.	STANDARD FRAME AND COVER.
2.	ASPHALT/GROUND.
3.	EXISTING BRICK OR BLOCK MANHOLE.
4.	RUBBER MANHOLE/PIPE CONNECTOR BOOT.
5.	18' JOINT DIP (MIN.) OR DIP TO UNDISTURBED GROUND.
6.	DUCTILE IRON TEE, ALL MJ.
7.	3 - #6 REBARS.
8.	6 INCH MINIMUM OF #57 STONE BASE, SUITABLE BEARING CAPACITY AS APPROVED BY GEOTECHNICAL ENGINEER.
9.	DUCTILE IRON 90° BEND, ALL MJ BELL.
10.	24" STANDARD FRAME AND COVER ON 8" TALL PRECAST CONCRETE GRADE RING AND 6" WASHED #57 STONE.
11.	8" BLIND FLANGE (TYPE 304 S.S. HARDWARE).
12.	8" FL x PE DIP CLEANOUT.
13.	8" REDUCER DUCTILE IRON (OMIT ON 8" MAINS).
14.	DUCTILE IRON CROSS OR TEE, ALL MJ BELL, SEE NOTE N.
15.	BACKFILL WITH #57 STONE-TYPICAL.
16.	3,600 PSI CONCRETE BLOCKING.
17.	RESHAPE INVERT.
18.	SHORT DIP.

NOTES:

A. VOID TO BE MASONRY FILLED OR WASHED STONE AND FLOWABLE FILL.

B. PROTECTIVE WALL FOR OUTSIDE DROP SHALL BE A MINIMUM OF 4" MASONRY.

C. POUR 3' X 3' CONCRETE FOOTING 6" THICK TO SUPPORT DROP STRUCTURE.

D. ALL MASONRY MORTAR SHALL BE PORTLAND CEMENT 1:3 MIX.

E. CARE MUST BE TAKEN TO FORM A SMOOTH FINISHED TROUGH FROM ENTRANCE PIPES TO EXIT PIPE, AND IN CURVED MANHOLES THE TROUGH MUST BE A SMOOTH CIRCULAR ARC TANGENT TO THE INSIDE WALLS OF THE PIPES. AT THEIR ENDS.

F. DROP STRUCTURE MAY BE FORMED AND POURED OF EXCAVATABLE 150 PSI FLOWABLE FILL IN LIEU OF MASONRY.

G. THE SLOPE OF THE OUTSIDE DROP TROUGH SHALL BE 1/4" PER FOOT.

H. ALL PIPE OPENINGS TO BE NO GREATER THAN 4" LARGER THAN O.D. OF PIPE.

I. RAMSET MASONRY TIES EVERY 12" VERTICALLY AND HORIZONTALLY.

J. THREE EQUALLY SPACED #6 REBARS DOWELED INTO MANHOLE BASE 2" FROM TOP OF SLAB. GROUT INTO 8" DEEP HOLES WITH EXPANSION GROUT.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
GRAVITY SEWER

OUTSIDE DROP ON EXISTING BRICK OR BLOCK MANHOLE

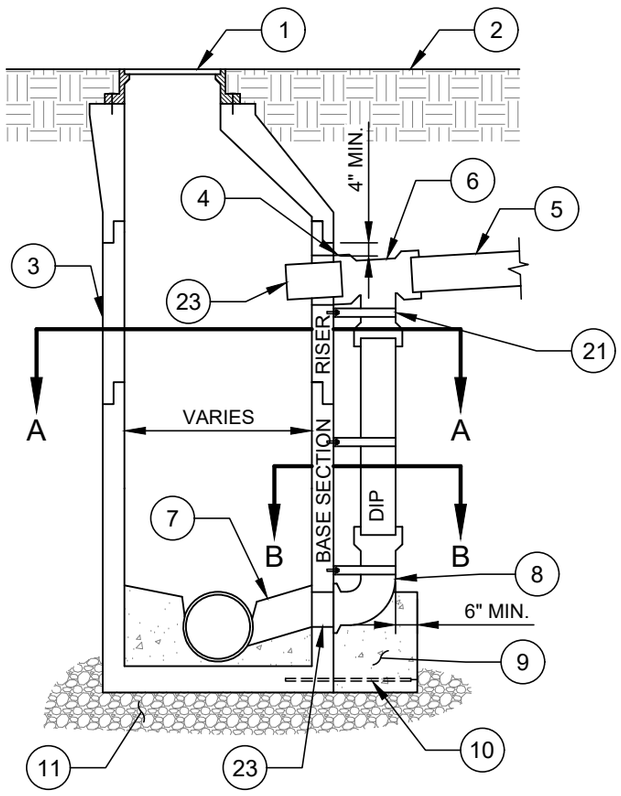
NO SCALE

VERSION 2.0

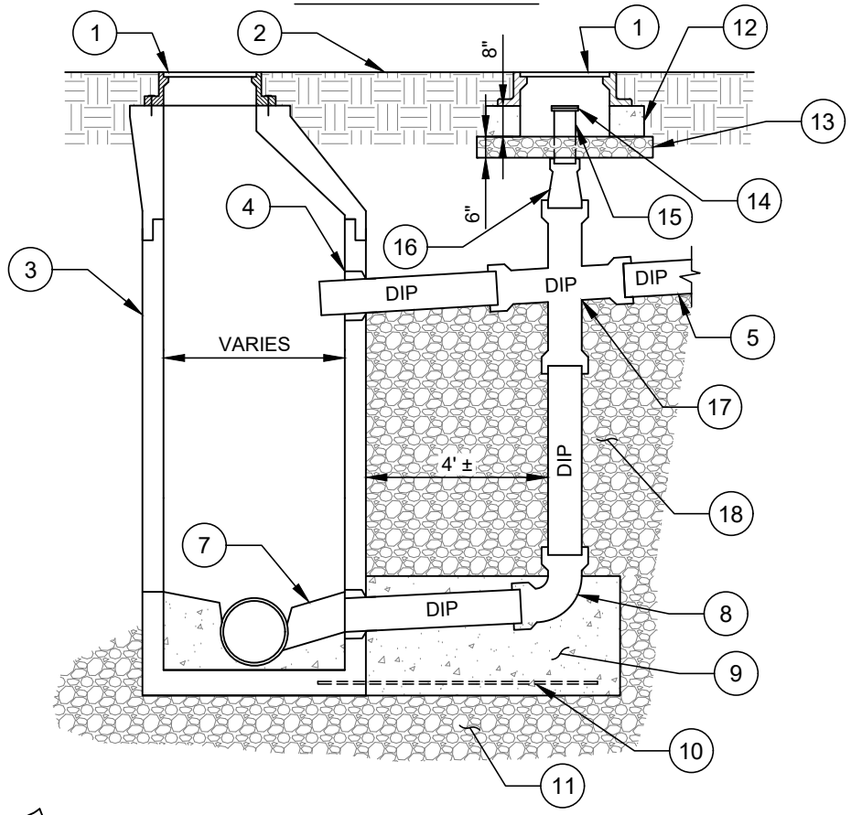
DATE 01/2026

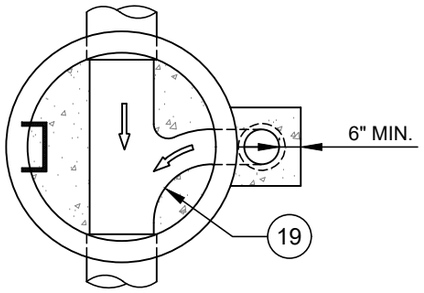
DETAIL 11.2.5

TYPE A - ATTACHED DROP

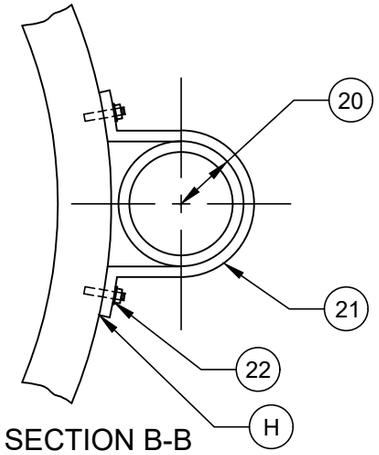


TYPE B - DETACHED DROP WITH CLEANOUT





SECTION A-A



SECTION B-B

NO.	DESCRIPTION:
1.	STANDARD FRAME AND COVER.
2.	ASPHALT/GROUND.
3.	EXISTING OR PROPOSED PRECAST CONCRETE MANHOLE.
4.	RUBBER MANHOLE/PIPE CONNECTOR BOOT.
5.	18' JOINT DIP (MIN.) OR DIP TO UNDISTURBED GROUND.
6.	DUCTILE IRON TEE, ALL MJ.
7.	SHELF SHALL SLOPE 1" PER FOOT (MIN.) FROM MANHOLE WALL TO THE TROUGH (TYP.).
8.	DUCTILE IRON 90° BEND, ALL MJ BELL.
9.	3,600 PSI CONCRETE BLOCKING.
10.	3 - #6 REBARS.
11.	6" MINIMUM OF #57 STONE BASE, SUITABLE BEARING CAPACITY AS APPROVED BY GEOTECHNICAL ENGINEER.
12.	8" TALL PRECAST CONCRETE GRADE RING.
13.	6" WASHED #57 STONE.
14.	8" BLIND FLANGE (TYPE 304 S.S. HARDWARE).
15.	8" FL x PE DIP CLEANOUT.
16.	8" REDUCER DUCTILE IRON (OMIT ON 8" MAINS).
17.	DUCTILE IRON CROSS OR TEE, ALL MJ BELL, SEE NOTE F.
18.	BACKFILL WITH #57 STONE-TYPICAL.
19.	RESHAPE INVERT.
20.	R = 1/2 O.D. PIPE BARREL (DROP PIPE).
21.	1/4" x 2" TYPE 304 STAINLESS STEEL STRAP. SEE NOTE H.
22.	1/2" DIAMETER x 3" TYPE 316 S.S. ALL THREAD ANCHOR W/ S.S. NUT AND WASHER. USE EPOXY IN CLEANED DRILLED HOLE. SEE NOTE H.
23.	SHORT DIP.

NOTES:

A. CARE MUST BE TAKEN TO FORM A SMOOTH FINISHED TROUGH FROM ENTRANCE PIPES TO EXIT PIPE, AND IN CURVED MANHOLES THE TROUGH MUST BE A SMOOTH CIRCULAR ARC TANGENT TO THE INSIDE WALLS OF THE PIPES AT THEIR ENDS.

B. THE SLOPE OF THE OUTSIDE DROP TROUGH SHALL BE 1/4" PER FOOT UNLESS PIPES ARE THE SAME DIAMETER.

C. OUTSIDE DROP SHALL NOT ENTER MANHOLE IN CONE SECTION OR WITHIN 4" OF MANHOLE JOINTS.

D. MATCH DROP INFLUENT CROWN TO CROWN WITH EFFLUENT PIPE.

E. PIPE CORES SHALL NOT PENETRATE THE MANHOLE JOINTS. PROVIDE MIN. 4" CLEARANCE.

F. FOR DETACHED DROP, DELETE CLEANOUT AND USE TEE IN LIEU OF CROSS. CLEANOUT DROPS WILL BE SPECIFIED ON CONSTRUCTION PLANS.

G. MAXIMUM DROP HEIGHT SHALL BE 10'.

H. PIPE STRAPS SHALL TIGHTLY COMPRESS DROP TO MANHOLE WALL. GAPS BETWEEN STRAP AND MANHOLE SHALL BE FILLED WITH OVERSIZE S.S. WASHERS. ANCHOR EXTENSIONS ARE NOT ALLOWED. CUSTOM STRAP LENGTHS MAY BE REQUIRED.

I. UPPER PIPE - EXTEND PIPE INSIDE FACE OF MANHOLE APPROX. 2 INCHES.
LOWER PIPE - FLUSH WITH INSIDE WALL.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
GRAVITY SEWER

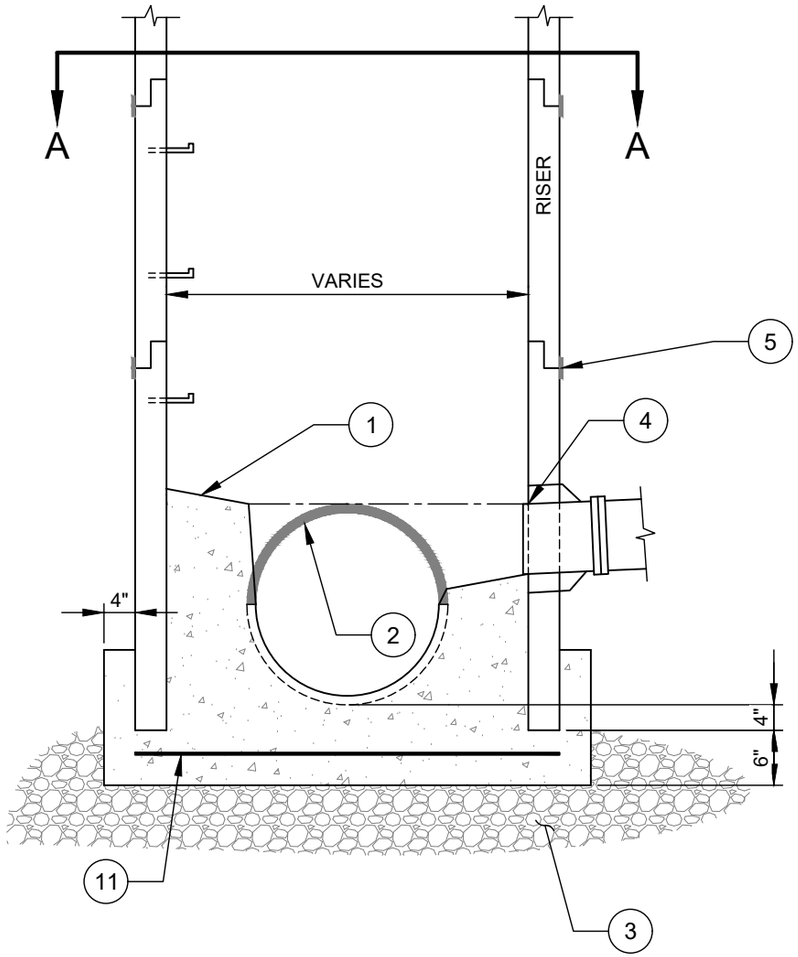
OUTSIDE DROP ON EXIST. OR PROP. PRECAST CONCRETE MANHOLE

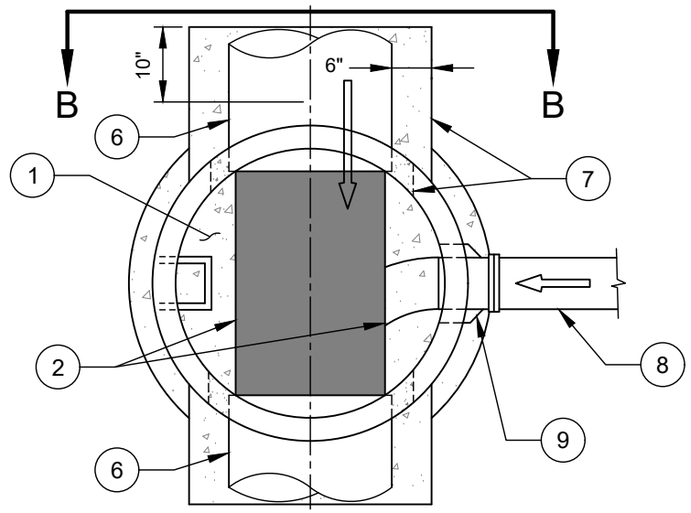
NO SCALE

VERSION 2.0

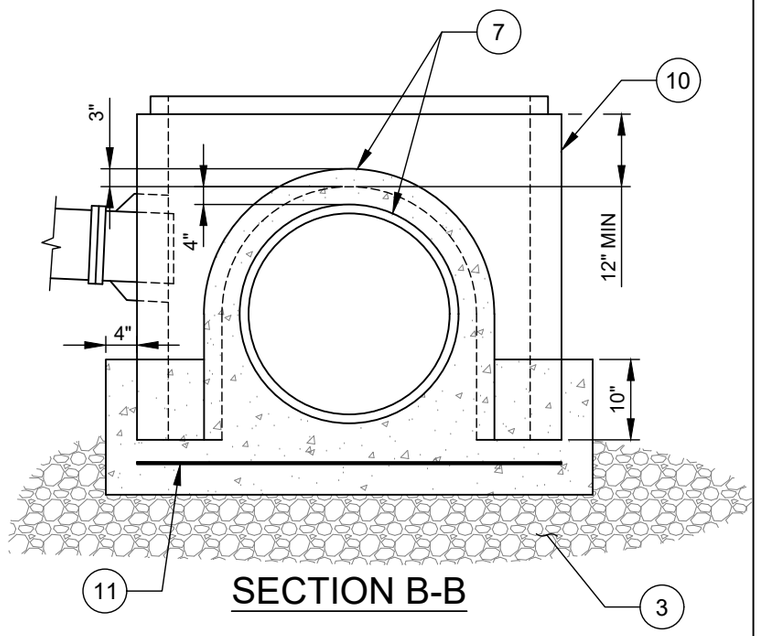
DATE 01/2026

DETAIL 11.2.6





SECTION A-A



SECTION B-B

NO. DESCRIPTION:

1. THE SHELF SHALL SLOPE 1 INCH PER FOOT FROM THE MANHOLE WALL TO THE TROUGH.
2. TOP HALF OF PIPE SHALL BE CUT AND REMOVED FROM MANHOLE WHEN APPROVED BY THE INSPECTOR.
3. 6" MINIMUM #57 STONE BASE, SUITABLE BEARING CAPACITY AS APPROVED BY GEOTECHNICAL ENGINEER.
4. MATCH CROWNS UNLESS THE PIPE IS THE SAME DIAMETER AS THE MAIN LINE PIPE. THEN A DROP OF 0.2' BETWEEN INVERTS WILL BE PROVIDED.
5. 6" (MIN.) WIDE BUTYL RUBBER JOINT WRAP REQUIRED ON EXTERIOR OF ALL JOINTS.
6. EXISTING SEWER PIPE.
7. CONCRETE COLLAR (TYP.).
8. PROPOSED SEWER PIPE OR LATERAL PIPE.
9. FLEXIBLE WATERTIGHT CONNECTOR.
10. SECTION OF PRECAST MANHOLE.
11. #5 REBARS AT 6" ON CENTER EACH WAY.

NOTES:

A. MANHOLES SHALL ALSO COMPLY WITH CLTW STANDARD DETAILS AS APPLICABLE.

B. USE 3,600 PSI CONCRETE.

C. ALL PIPE OPENINGS SHALL BE NO GREATER THAN 4" LARGER THAN OUTSIDE DIAMETER OF PIPE AND SHALL BE ADDITIONALLY REINFORCED WITH A MINIMUM OF 0.20 SQ. IN. OF STEEL AT 90°.

D. STEPS SHALL BE OVER THE WIDEST SHELF.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
GRAVITY SEWER

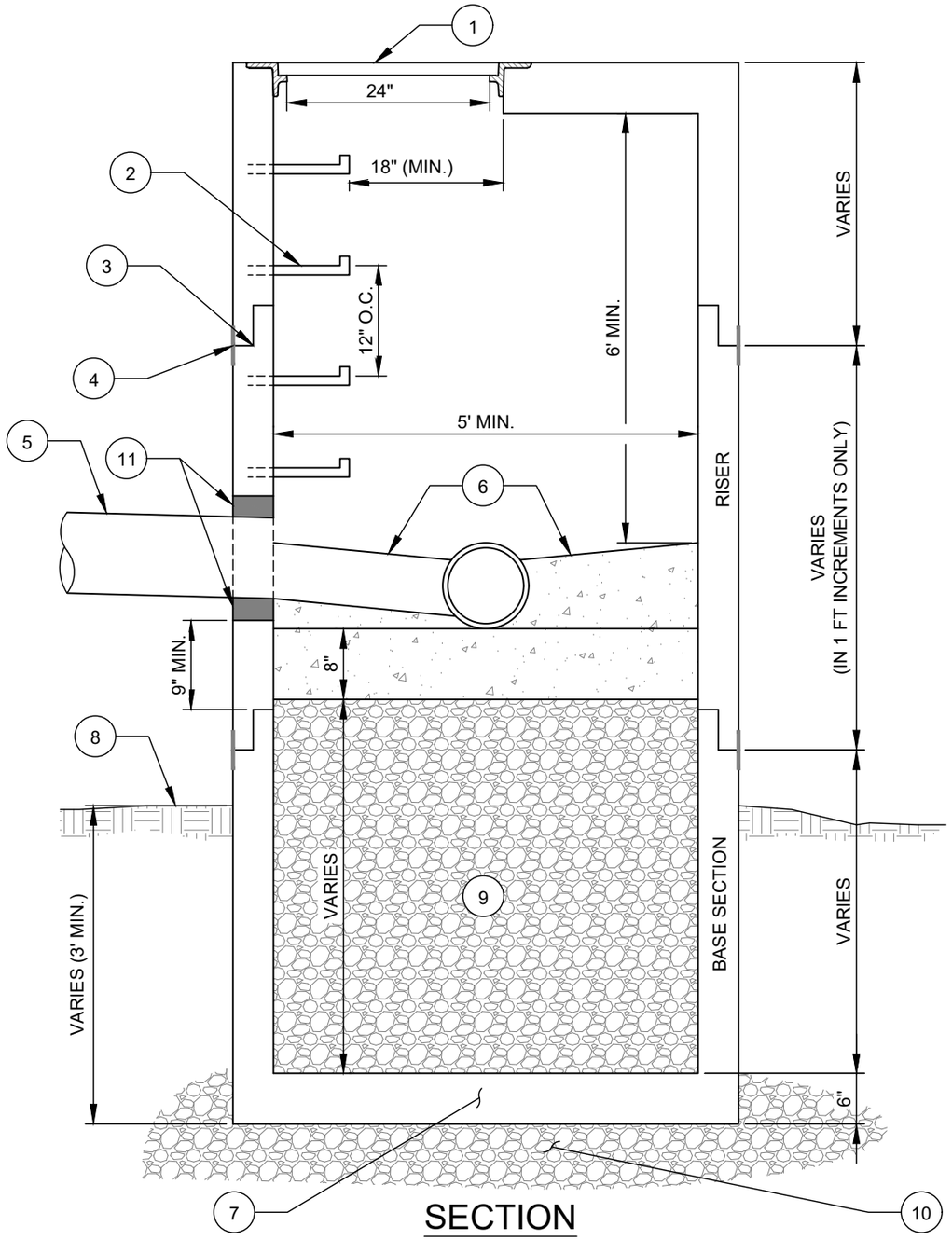
PRECAST STRADDLE (DOGHOUSE) MANHOLE

NO SCALE

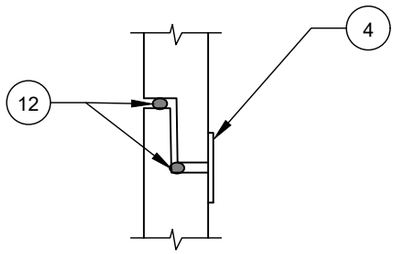
VERSION 1.0

DATE 04/2024

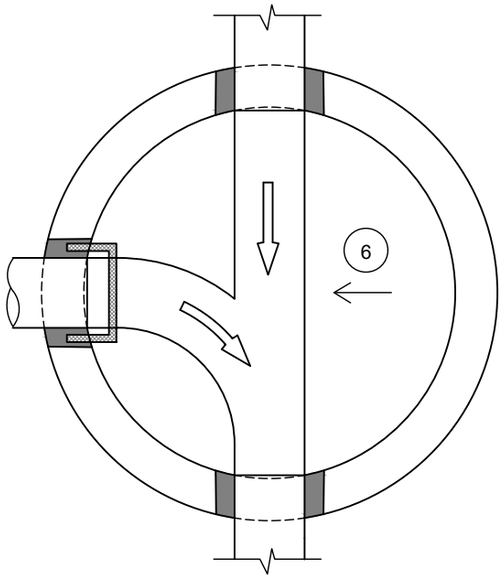
DETAIL 11.2.7



SECTION



JOINT DETAIL



PLAN

NO. DESCRIPTION:

1. CLTW STANDARD INVERTED/REVERSIBLE CAST IRON FRAME AND COVER CAST IN PLACE FLUSH WITH TOP OF MANHOLE SLAB.
2. STEPS PER CLTW STANDARD DETAIL.
3. JOINT.
4. 6" (MIN.) WIDE BUTYL RUBBER JOINT WRAP REQUIRED ON EXTERIOR OF ALL JOINTS.
5. STEEL OR DIP.
6. THE SHELF SHALL SLOPE 1 INCH PER FOOT (MIN.) FROM THE MANHOLE WALL TO THE TROUGH.
7. MANHOLE BASE SHALL BE REINFORCED WITH A MINIMUM AREA OF 0.20 SQ. IN. PER LINEAR FOOT EACH WAY.
8. FINISH GRADE.
9. NON-COMPRESSIBLE MATERIAL (#57 STONE SHOWN).
10. 6" MIN. #57 STONE BASE, SUITABLE BEARING CAPACITY AS APPROVED BY GEOTECHNICAL ENGINEER.
11. NON-SHRINK GROUT PIPE IN MANHOLE (DO NOT USE RUBBER BOOT).
12. BUTYL RUBBER JOINT SEALANT-2 FULL CIRCLES EACH JOINT COMPRESSED (TYP.). USED BETWEEN PRECAST SECTIONS AND FRAME.

NOTES:

A. STRAIGHT WALL OF MANHOLE AND STEPS TO BE LOCATED OVER INFLUENT PIPE.

B. THIS DETAIL IS TO BE USED WHERE THE INVERT OF THE MANHOLE IS ABOVE THE EXISTING GROUND.

C. FILLING BETWEEN THE BASE AND ELEVATED FLOOR MAY BE CRUSHED STONE (#57 STONE), BRICK BATS, OR ANY NON-COMPRESSIBLE MATERIAL. THIS FILLING SHALL BE COVERED WITH HDPE OR PVC LINER BEFORE THE CONCRETE IS POURED IN PLACE.

D. MANHOLES SHALL ALSO COMPLY WITH CLTW STANDARD DETAILS AS APPLICABLE.

E. FIELD PLACED CONCRETE TO BE 3,600 PSI.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
GRAVITY SEWER

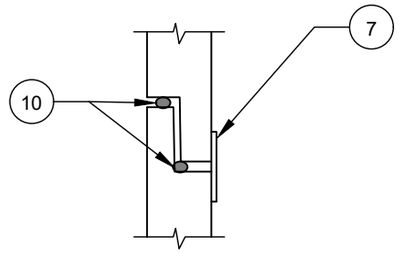
PRECAST MANHOLE
INVERT ABOVE GROUND
(FOR 8" THROUGH 16" DIAMETER PIPE)

NO SCALE

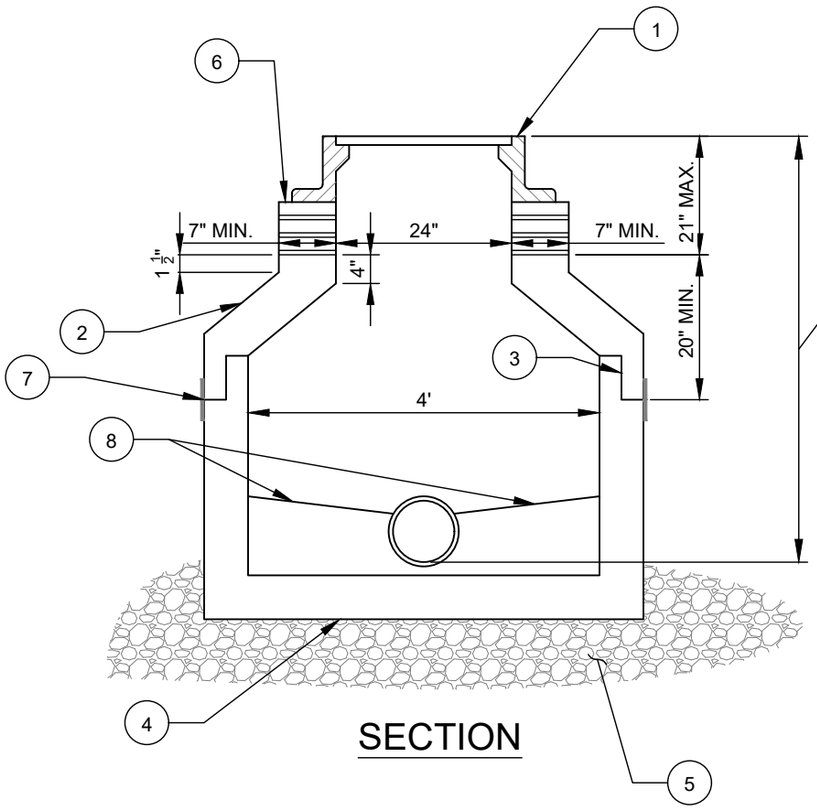
VERSION
1.0

DATE
04/2024

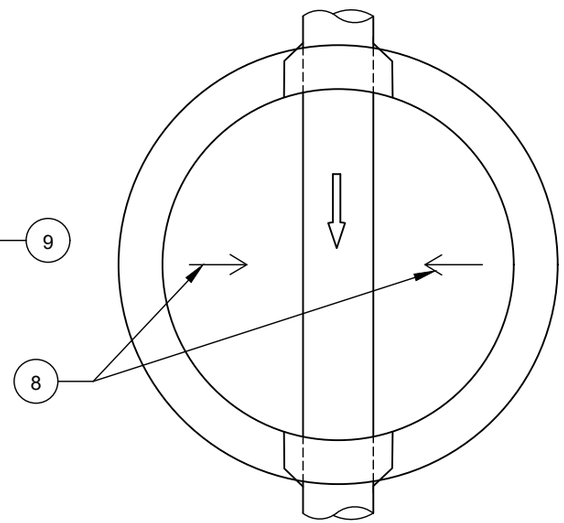
DETAIL
11.2.8



JOINT DETAIL



SECTION



PLAN

NO.	DESCRIPTION:
1.	CLTW STANDARD FRAME AND COVER.
2.	CONCENTRIC CONCRETE CONE SECTION.
3.	JOINT.
4.	MIN. 6" CONCRETE BASE.
5.	6" MIN. #57 STONE BASE, SUITABLE BEARING CAPACITY AS APPROVED BY GEOTECHNICAL ENGINEER.
6.	PRECAST CONCRETE, RUBBER, OR EPP GRADE RINGS PER TECHNICAL SPECIFICATIONS.
7.	6" (MIN.) WIDE BUTYL RUBBER JOINT WRAP REQUIRED ON EXTERIOR OF ALL JOINTS.
8.	THE SHELF SHALL SLOPE 1" PER FOOT (MIN.) FROM THE MANHOLE WALL TO THE TROUGH.
9.	5' MAX. (FROM RIM TO INVERT).
10.	BUTYL RUBBER JOINT SEALANT-2 FULL CIRCLES EACH JOINT COMPRESSED (TYP.). USED BETWEEN PRECAST SECTIONS AND FRAME.

NOTES:

A. MANHOLE TO CONFORM TO ASTM C478 EXCEPT AS MODIFIED BELOW.

B. MANHOLE BASE TO BE REINFORCED WITH A MINIMUM AREA OF 0.20 SQ. IN. PER LINEAR FOOT EACH WAY. WALL REINFORCING TO BE A MINIMUM OF 0.12 SQ. IN. PER LINEAR FOOT. EITHER TONGUE OR GROOVE OF JOINTS SHALL HAVE REINFORCING EQUAL IN AREA TO MINIMUM OF WALL SECTION.

C. ALL JOINTS SHALL CONFORM TO ASTM C443.

D. ALL PIPE OPENINGS TO BE NO GREATER THAN 4" LARGER THAN O.D. OF PIPE AND ADDITIONALLY REINFORCED WITH A MINIMUM OF 0.20 SQ. IN. OF STEEL AT 90°. ADDITIONAL REINFORCING NOT REQUIRED FOR CORED OPENINGS.

E. ALL SURFACES SHALL BE SMOOTH, EVEN TEXTURED WITH A MINIMUM OF HONEYCOMB, FINS AND IMPERFECTIONS.

F. PENETRATING LIFTING HOLES SHALL BE PLUGGED WITH EXPANSION GROUT OR HAVE WATERTIGHT PLASTIC INSERTS.

G. SEE CLTW 4' DIAMETER MANHOLE STANDARD DETAIL FOR ADDITIONAL REQUIREMENTS.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
GRAVITY SEWER

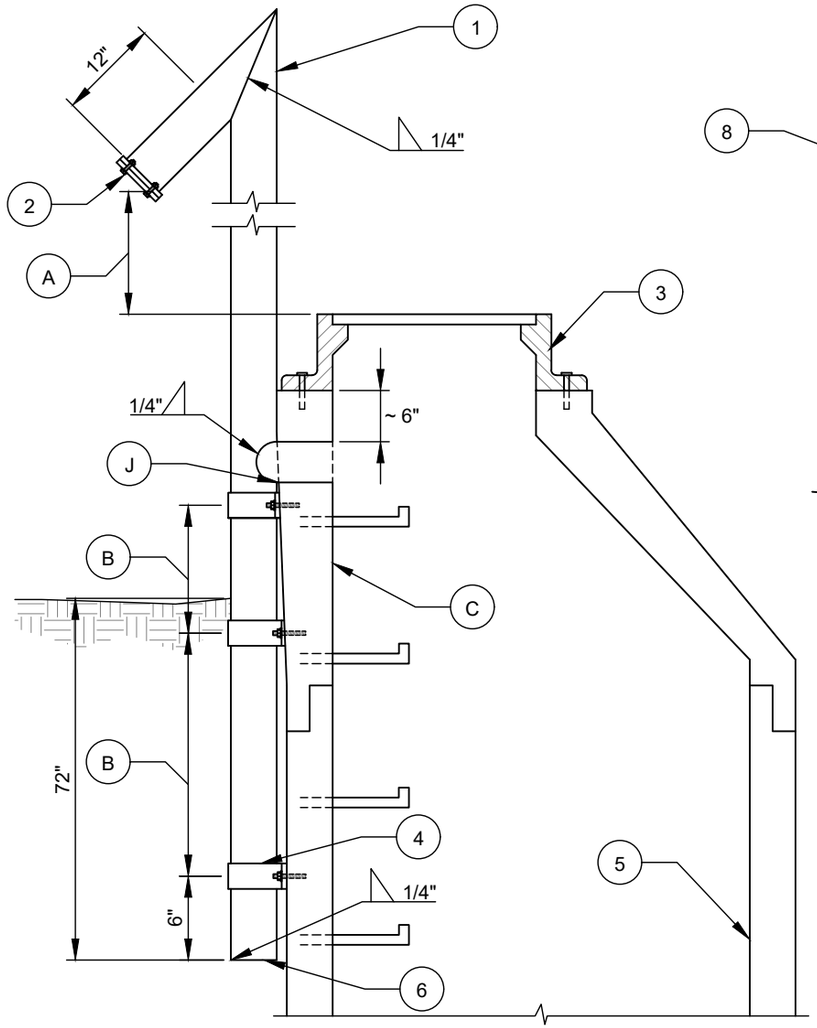
PRECAST SHORT MANHOLE - 4' DIAMETER

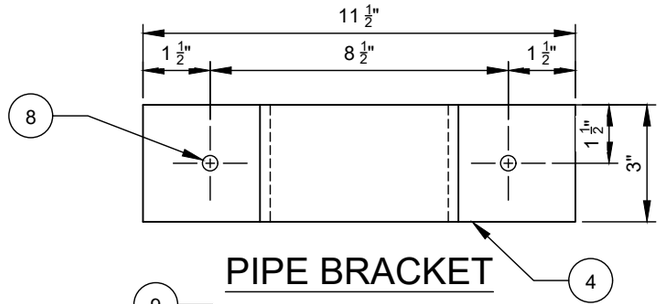
NO SCALE

VERSION 1.0

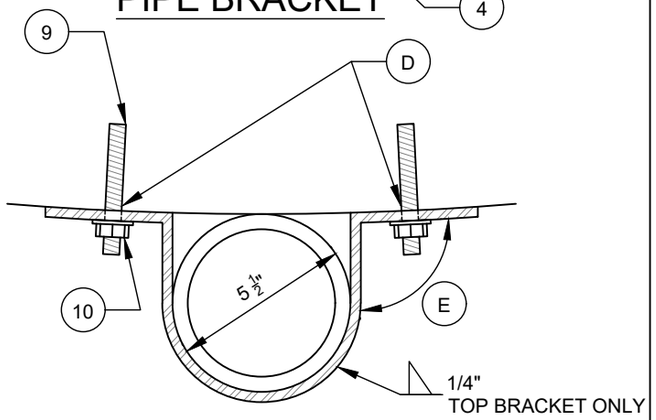
DATE 04/2024

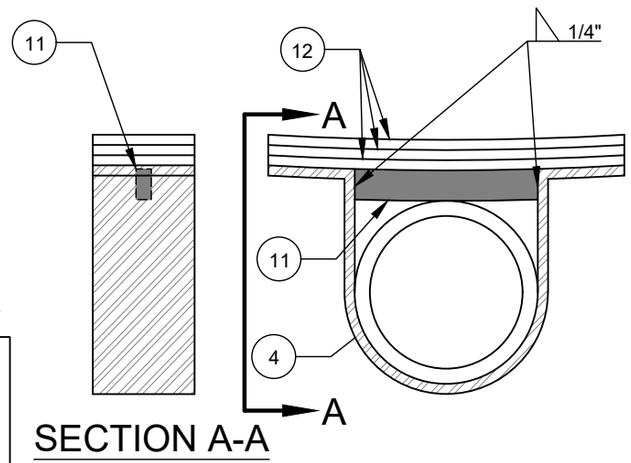
DETAIL 11.2.9



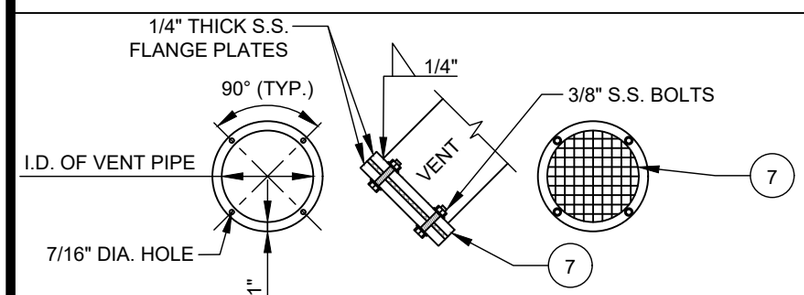


PIPE BRACKET





SECTION A-A



BOLT ON BIRD SCREEN

NO.	DESCRIPTION:
1.	5" DIAMETER STEEL OR TYPE 316 S.S. PIPE.
2.	SEE BOLT ON BIRD SCREEN DETAIL THIS SHEET.
3.	WATERTIGHT FRAME AND COVER (BOLTED DOWN).
4.	PIPE BRACKET FABRICATED FROM 1/4" STEEL PLATE (SEE THIS SHEET).
5.	PRECAST CONCRETE MANHOLE.
6.	1/4" STEEL PLUG.
7.	TYPE 316 STAINLESS STEEL MESH BIRD SCREEN BOLTED BETWEEN TWO STAINLESS STEEL PLATES AND WELDED TO VENT PIPE AS SHOWN. USE ALL TYPE 316 STAINLESS STEEL BOLTS, NUTS AND WASHERS. SCREEN SHALL BE CONSTRUCTED OF 1/4" STAINLESS STEEL MESH BIRD SCREEN (WIRE DIAMETER 0.047").
8.	11/16" DIAMETER HOLES DRILLED AS SHOWN.
9.	5/8" x 4" TYPE 316 S.S. ALL THREAD ROD.
10.	TYPE 316 STAINLESS STEEL NUT AND WASHER WITH ANTI-SEIZE COMPOUND.
11.	1/4" TYPE 304 STAINLESS STEEL SPACER PLATE.
12.	1/4" TYPE 304 STAINLESS STEEL WASHER PLATES TO PLUMB VENT.

NOTES:

A. 2' ABOVE 100 YEAR FLOOD ELEV. OR 6' ABOVE FRAME (WHICHEVER IS GREATER).

B. 1'-3" (MAX SPACING). AVOID PLACING PIPE BRACKET AT MANHOLE JOINTS OR STEPS. MINIMUM OF 3 PIPE BRACKETS REQUIRED PER VENT PIPE.

C. STEPS AND VENT INSTALLED ON STRAIGHT WALL OF MANHOLE.

D. USE EPOXY ADHESIVE, IN CLEANED DRILLED HOLE.

E. ANGLE AS REQUIRED TO SEAT SQUARELY ON MANHOLE.

F. VENT SHALL BE ON STRAIGHT WALL SIDE AND POINT DOWNSTREAM.

G. VENT AND BRACKETS SHALL BE COATED PER SPECS (INTERNAL COATING NOT REQUIRED ON S.S. PIPE).

H. ALL THREAD ROD, WASHER, AND NUT SHALL BE STAINLESS STEEL.

I. ACCORDING TO THE TYPE OF PRECAST MANHOLE, WASHER SPACERS MAY BE REQUIRED ON LOWER BRACKETS. VENT SHALL BE PLUMB AND STRAPS SHALL PULL VENT TIGHT AGAINST THE MANHOLE WALL.

J. SEAL AROUND VENT PIPE OUTLET WITH NON-SHRINK WATERPROOF GROUT.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

GRAVITY SEWER

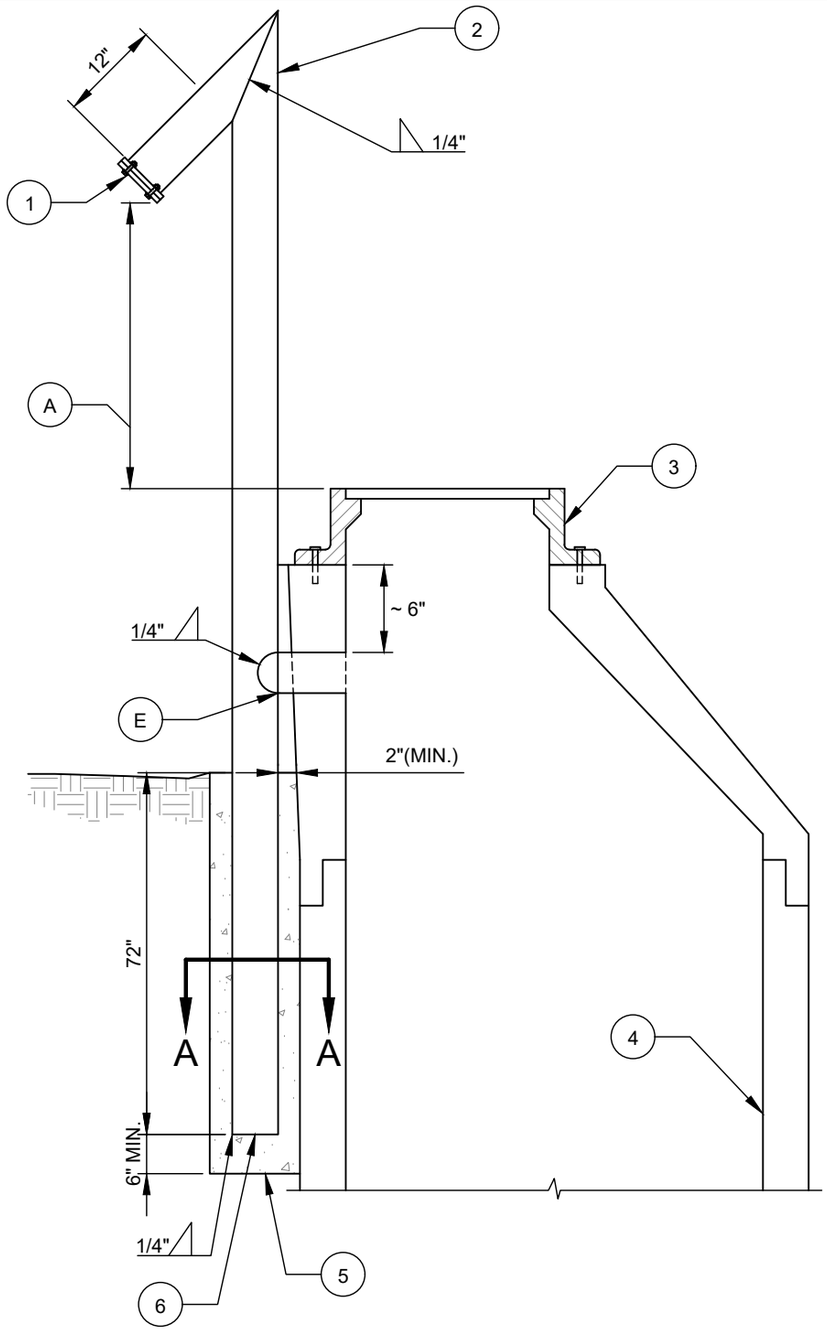
VENT PIPE - PRECAST MANHOLE

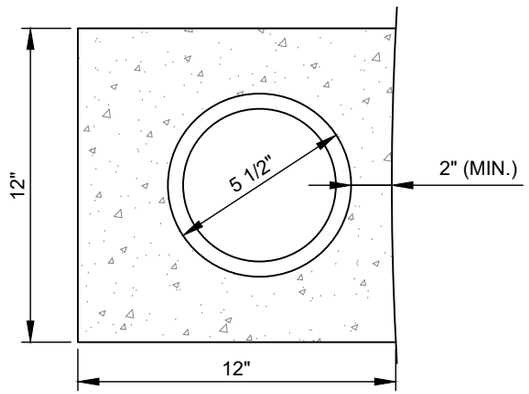
NO SCALE

VERSION 2.0

DATE 01/2026

DETAIL 11.2.10





SECTION A-A

NO. DESCRIPTION:

1. BOLT ON BIRD SCREEN. SEE DETAIL THIS SHEET.
2. 5" DIAMETER STEEL OR TYPE 314 S.S. PIPE.
3. WATERTIGHT FRAME AND COVER (BOLTED DOWN).
4. FIBERGLASS OR POLYMER CONCRETE MANHOLE.
5. 3,600 P.S.I. CONCRETE FLUSH WITH GRADE.
6. STEEL PLUG.
7. TYPE 316 STAINLESS STEEL BIRD SCREEN BOLTED BETWEEN TWO STAINLESS STEEL PLATES AND WELDED TO VENT PIPE AS SHOWN. USE ALL TYPE 316 STAINLESS STEEL BOLTS, NUTS AND WASHERS.

NOTES:

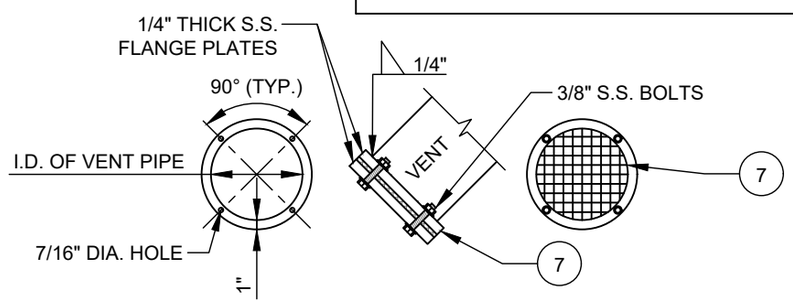
A. 2' ABOVE 100 YEAR FLOOD ELEVATION OR 6' ABOVE FRAME (WHICHEVER IS GREATER).

B. VENT SHALL BE ON STRAIGHT WALL SIDE AND POINT DOWNSTREAM.

C. VENT AND BRACKETS SHALL BE COATED PER SPECS (INTERIOR LINING NOT REQUIRED ON STAINLESS STEEL PIPE).

D. STAINLESS STEEL BIRD SCREEN BOLTED BETWEEN TWO STAINLESS STEEL PLATES AND WELDED TO VENT PIPE AS SHOWN. USE ALL STAINLESS STEEL BOLTS, NUTS, AND WASHERS. SCREEN SHALL BE SIZED TO FIT AND INSTALLED SECURELY INSIDE THE HUB OR COUPLING OF THE VENT PIPE. SCREEN SHALL BE CONSTRUCTED OF 1/4" STAINLESS STEEL MESH BIRD SCREEN (WIRE DIAMETER 0.047").

E. SEAL AROUND VENT PIPE OUTLET WITH NON-SHRINK WATERPROOF GROUT.



BOLT ON BIRD SCREEN

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
GRAVITY SEWER

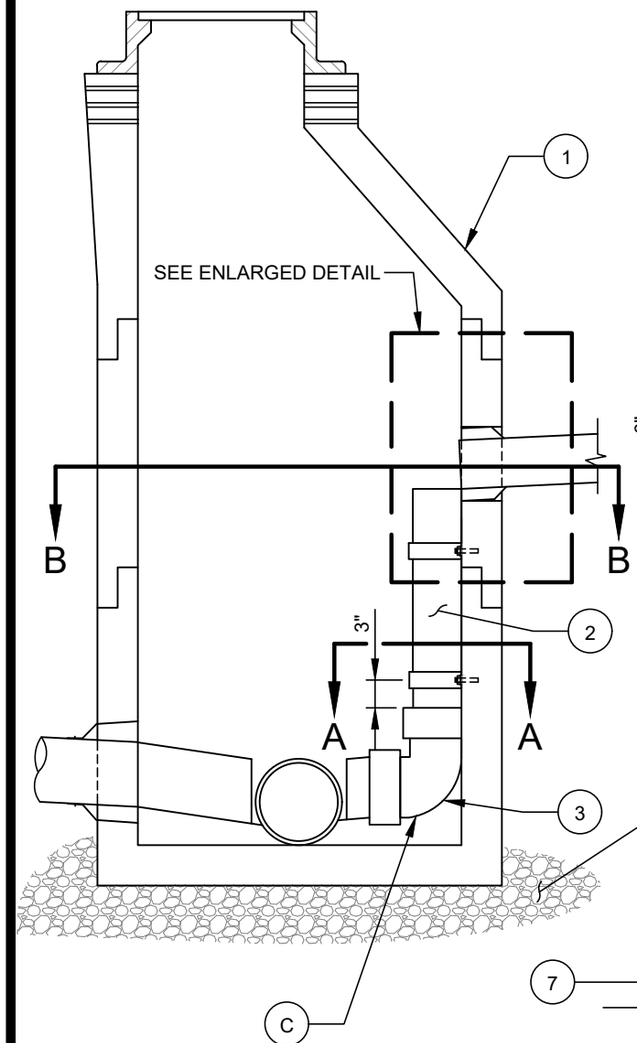
MANHOLE VENT PIPE - FIBERGLASS OR POLYMER CONCRETE MANHOLES

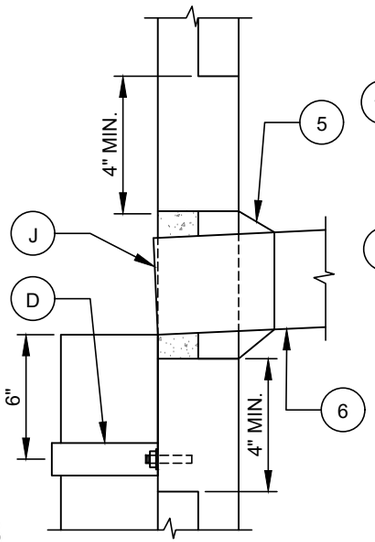
NO SCALE

VERSION 2.0

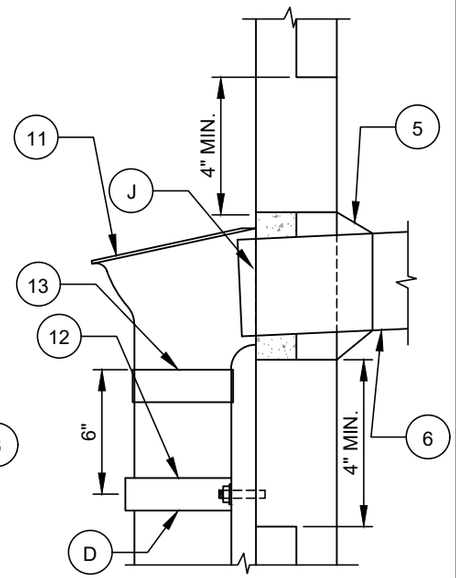
DATE 01/2026

DETAIL 11.2.11

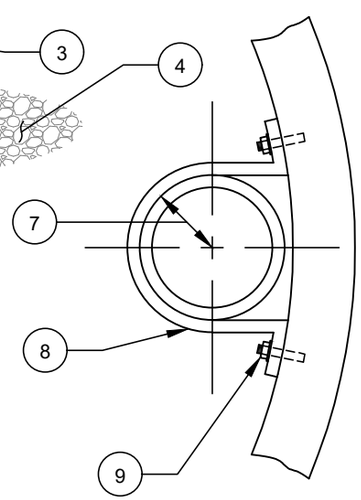




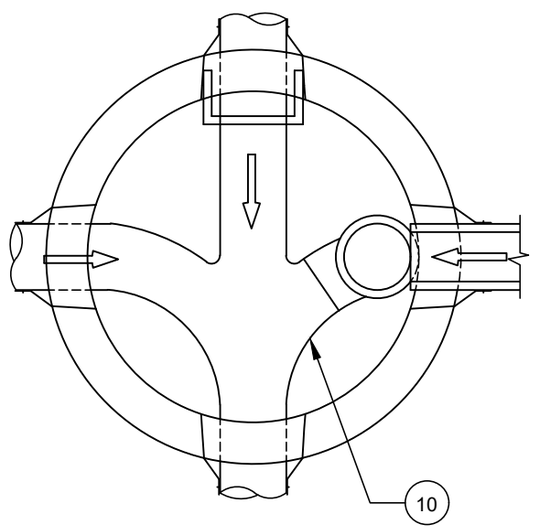
ENLARGED DETAIL



ENLARGED DETAIL
ALTERNATE INSTALL



SECTION A-A



SECTION B-B

NO.	DESCRIPTION:
1.	MANHOLE - MIN. 5' DIAMETER.
2.	SCH 40 PVC VERTICAL STANDPIPE. SEE NOTE A.
3.	SCH 40 PVC 90° BEND. SEE NOTE C.
4.	6" MINIMUM OF #57 STONE BASE, SUITABLE BEARING CAPACITY AS APPROVED BY GEOTECHNICAL ENGINEER.
5.	RUBBER MANHOLE/PIPE CONNECTOR BOOT. GROUT IN WITH NON SHRINK GROUT.
6.	MINIMUM 18" LINEAR FEET DIP OR TO UNDISTURBED SUPPORT SOIL.
7.	R = 1/2 O.D. PIPE BARREL.
8.	1/4" X 2" TYPE 304 STAINLESS STEEL STRAP. STRAP SHALL PULL PIPE TIGHT AGAINST THE MANHOLE WALL.
9.	1/2" DIAMETER X 3" TYPE 316 S.S. ALL THREAD ANCHOR W/ S.S. NUT AND WASHER. USE EPOXY IN CLEANED DRILLED HOLE.
10.	RESHAPE INVERT.
11.	RELINER DROP BOWL (MODEL D8BD DROP BOWL FOR 8" DROP PIPE).
12.	RELINER TYPE 304 STAINLESS STEEL PIPE SUPPORT BRACKET @ MAX. 4' SPACING (MIN. OF 2 PER DROP).
13.	FLEXIBLE PIPE COUPLING.

NOTES:

A. DROP PIPE AND FITTING SHALL BE ONE PIPE SIZE LARGER THAN INFLUENT PIPE (IE. 4" INFLUENT PIPE REQUIRES 6" DROP PIPE AND FITTINGS). IF USING ALTERNATE RELINER DROP BOWL DROP PIPE SHALL BE SAME SIZE AS INFLUENT PIPE.

B. PVC PIPE SHALL BE SCH 40 DWV PER ASTM D2665. PVC FITTINGS SHALL BE SCH 40 DWV MOLDED FITTINGS. PVC PIPE AND FITTINGS SHALL BE SOLVENT WELD.

C. BEND SHALL BE BELL X BELL AND SHALL REST ON CUT INTO THE BENCH. GROUT BEND INTO THE TROUGH. MATCH CROWNS UNLESS THE PIPE IS THE SAME DIAMETER. IF SAME DIAMETER, THEN A DROP OF 0.2' ACROSS INVERTS SHALL BE PROVIDED.

D. LOCATE STRAPS AS SHOWN AT PIPE ENDS (MIN. OF 2 PER DROP). ADD ADDITIONAL STRAPS AS NECESSARY TO MAINTAIN MAXIMUM SPACING OF 4'.

E. HOLE IN MANHOLE WALL SHALL BE MADE USING A CORING MACHINE. INSTALL WATERTIGHT RUBBER MANHOLE PIPE CONNECTOR BOOT.

F. CORE HOLE SHALL NOT ENTER CONE SECTION, OR PENETRATE MANHOLE JOINTS. PROVIDE A MINIMUM 4" CLEAR.

G. STEPS SHALL BE RELOCATED IF THEY CONFLICT WITH THE DROP PIPE.

H. CONE SECTION SHALL BE ROTATED IF NEEDED TO ALIGN STEPS. MAXIMUM OF 2 INSIDE DROPS IN A MANHOLE, UNLESS APPROVED BY CHARLOTTE WATER.

I. MAXIMUM DROP HEIGHT SHALL BE 10'.

J. DIP SHALL END AT THE INSIDE FACE OF THE VERTICAL STANDPIPE.

K. IF USING ALTERNATE RELINER DROP BOWL, MUST USE RELINER PIPE SUPPORT BRACKETS.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
GRAVITY SEWER

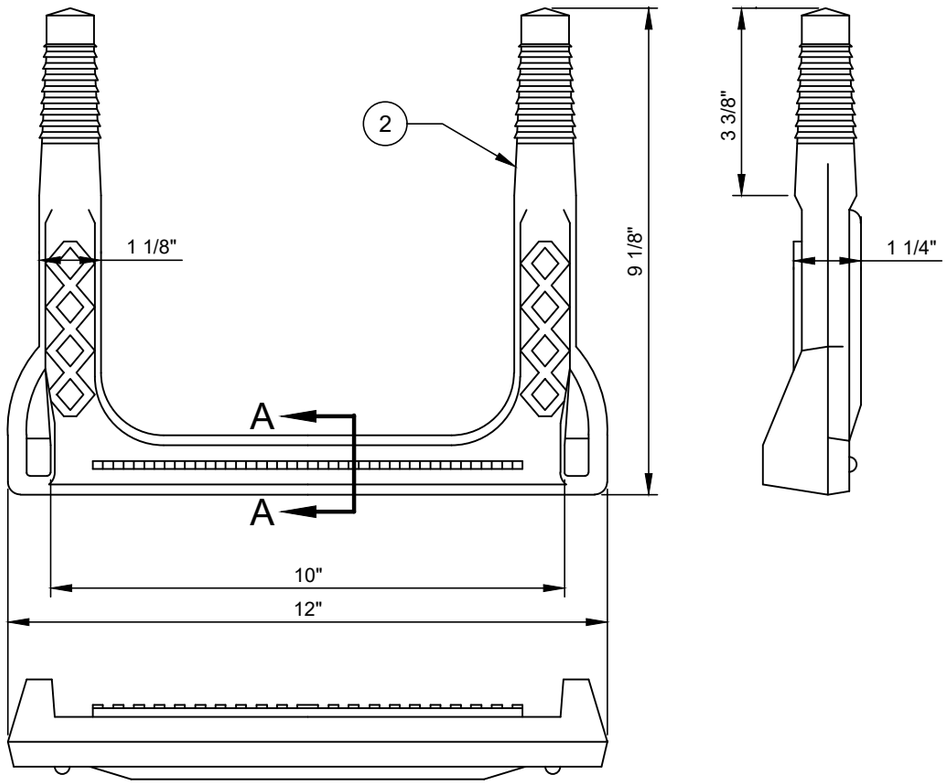
4" THROUGH 12" DIA. INSIDE DROP IN 5 FT. AND LARGER MANHOLE ONLY

NO SCALE

VERSION 2.0

DATE 01/2026

DETAIL 11.2.12



PLASTIC STEP

NO.	DESCRIPTION:
1.	1/2" GRADE 60 STEEL REINFORCEMENT.
2.	COPOLYMER POLYPROPYLENE PLASTIC.

NOTES:

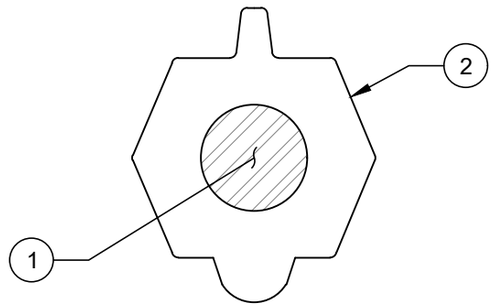
A. MANHOLES STEPS SHALL BE MODEL PS1-PF OR PS1-PF-DF AS MANUFACTURED BY MA INDUSTRIES - OR - ML-10-NCR BY AMERICAN STEP COMPANY - OR - 93810R BY BOWCO INDUSTRIES.

B. STEPS MAY BE BLACK, ORANGE, OR GLOW IN THE DARK.

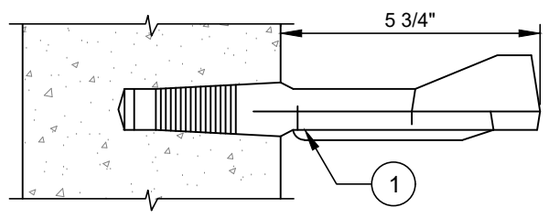
C. STEPS ARE TO BE DRIVEN INTO TAPERED HOLES IN PRECAST MANHOLE SECTIONS. DO NOT USE AS A GROUTED-IN STEP.

D. MIN. RUNG WIDTH IS 10".

E. 1,000 LB. PULL OUT TEST REPORT REQUIRED ON EACH STEP.



SECTION A-A



SIDE VIEW OF STEP IN MANHOLE WALL

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

GRAVITY SEWER

PLASTIC STEP PRECAST FORMED HOLE DRIVEN IN PLACE

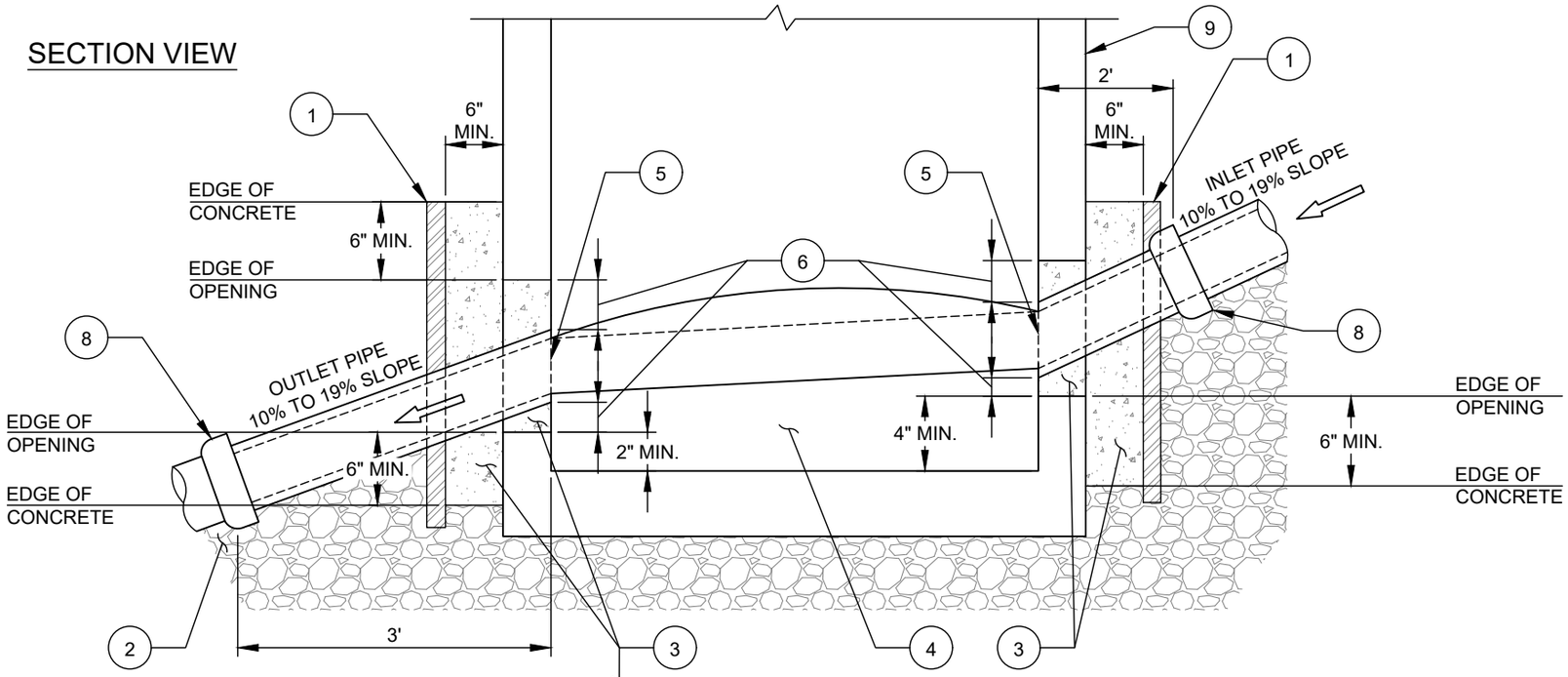
NO SCALE

VERSION
2.0

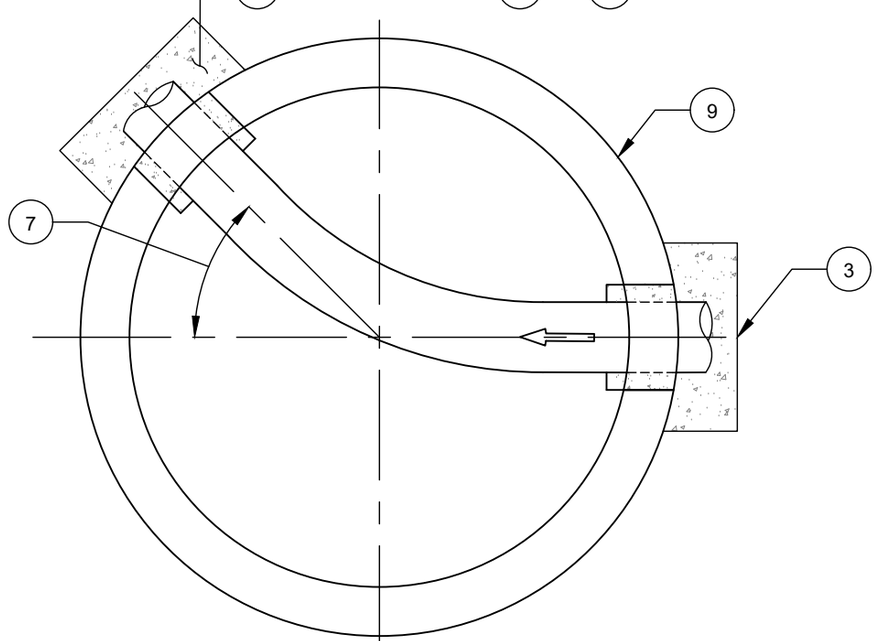
DATE
01/2025

DETAIL
11.2.13

SECTION VIEW



PLAN VIEW



NO.	DESCRIPTION:
1.	PROVIDE FORM FOR CONCRETE. LUMBER MAY REMAIN IN-PLACE.
2.	WASHED STONE (#57) BEDDING.
3.	MONOLITHIC CONCRETE POUR.
4.	CONCRETE CHANNEL.
5.	CUT PIPE AT ENTRY ANGLE.
6.	ANNULAR SPACE BETWEEN PIPE AND MANHOLE OPENING (MINIMUM 2", MAXIMUM 4").
7.	MAXIMUM DEFLECTION ANGLE OF 45 DEGREES.
8.	REQUIRED PIPE JOINT.
9.	PRECAST MANHOLE BASE SECTION.

NOTES:

A. USE THIS DETAIL FOR 8" SEWER PIPE CONNECTIONS TO MANHOLES WHEN SLOPE OF PIPE IS GREATER THAN 10% BUT NOT GREATER THAN 19%.

B. OPENINGS IN MANHOLE SHALL BE IN ACCORDANCE WITH MANHOLE MANUFACTURERS PRE-APPROVED SUBMITTALS AND SIZED TO ACCOMMODATE SEWER PIPE AND ANNULAR SPACE. ENLARGEMENT OF THE HOLE IN THE FIELD WILL BE PERMITTED BY THE MANHOLE MANUFACTURER ONLY.

C. DO NOT PROVIDE FLEXIBLE MANHOLE BOOT CONNECTIONS WHEN THE SLOPE IS GREATER THAN 10 PERCENT.

D. USE ONLY DUCTILE IRON PIPE WITH SPECIAL INTERIOR LINING, SEE SPECIFICATIONS, OR AWWA C900 DR 25 SOLID WALL PVC PIPE.

E. PIPE INVERT ELEVATIONS AT THE MANHOLES ARE SHOWN ON THE CONSTRUCTION PLANS.

F. SLOPE ACROSS THE MANHOLE CHANNEL MAY BE 2 INCHES TO 6 INCHES.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
GRAVITY SEWER

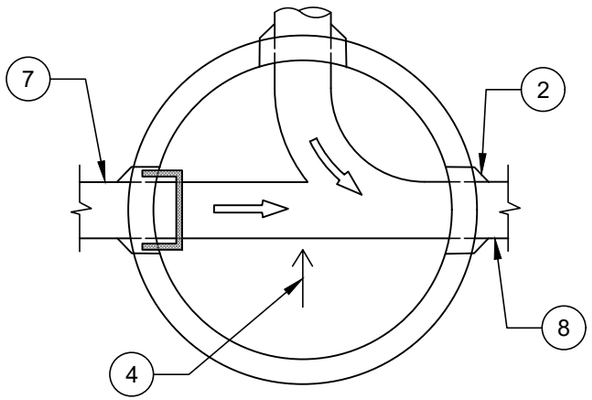
PIPE TO MANHOLE CONNECTION FOR 8-INCH PIPES ON STEEP SLOPES BETWEEN 10% AND 19%

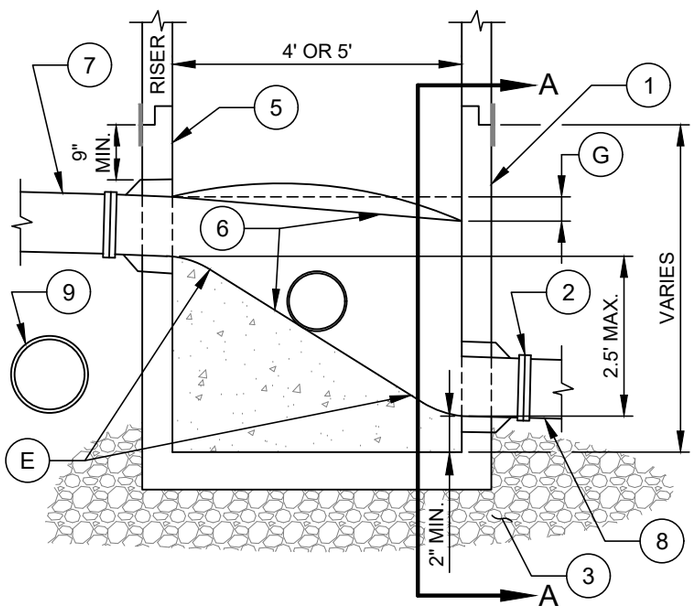
NO SCALE

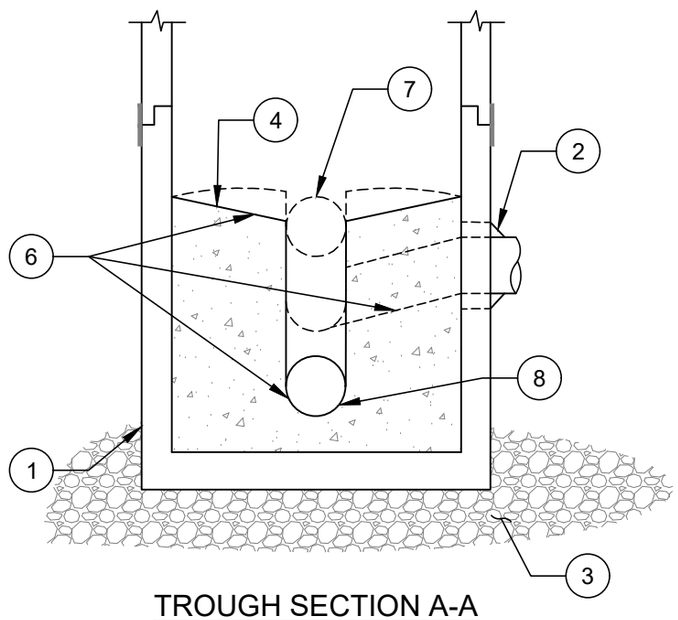
VERSION 1.0

DATE 04/2024

DETAIL 11.2.14







TROUGH SECTION A-A

NO. DESCRIPTION:

1. MANHOLE BASE SECTION.
2. FLEXIBLE COUPLING INSTALLED IN CORED HOLE WITH STAINLESS STEEL COMPRESSION DEVICE.
3. MINIMUM 6" DEPTH OF #57 STONE BASE, SUITABLE BEARING CAPACITY AS APPROVED BY GEOTECHNICAL ENGINEER.
4. 1 INCH PER FOOT FALL (TYP.). THE SHELF SHALL SLOPE 1 INCH PER FOOT (MIN.) FROM THE MANHOLE WALL TO THE TROUGH.
5. STRAIGHT WALL OF MH TO BE LOCATED OVER INFLUENT PIPE (FOR A 4' DIA. MH) AND OVER WIDEST SHELF (FOR 5' DIA. MH).
6. PRECAST CONCRETE (3600 PSI) INVERT/SHELF OR CAST ON SITE.
7. DUCTILE IRON INLET PIPE.
8. OUTLET PIPE.
9. UTILITY CONFLICT.

NOTES:

A. THIS DETAIL SHALL ONLY BE USED WHEN AN INSIDE DROP IS NOT POSSIBLE AND A STEEP SLOPE INVERT IS APPROVED BY THE ENGINEER.

B. THIS DETAIL SHALL ONLY BE USED DUE TO A UTILITY CONFLICT AND WHEN APPROVED BY THE ENGINEER.

C. THIS DETAIL SHALL NOT BE USED WHEN THE CHANGE IN INVERT ELEVATION IS 2.5 FT OR GREATER. REFER TO THE INSIDE DROP STANDARD DETAIL.

D. MANHOLE TO CONFORM WITH ASTM C478 EXCEPT AS MODIFIED. REFER TO MANHOLE STANDARD DETAILS FOR ALL MANHOLE REQUIREMENTS.

E. THE TROUGH SHALL INCLUDE VERTICAL CURVES AS SHOWN AT THE INLET AND OUTLET PIPES TO PROVIDE LAMINAR WATER FLOW.

F. INVERTS TO BE PRECAST CONCRETE OR CAST ON SITE.

G. THE MAXIMUM SHELF DROP ACROSS THE MANHOLE FROM THE INLET PIPE TO THE OUTLET PIPE SHALL BE 5 INCHES.

H. THIS DETAIL SHALL ONLY BE USED WITH 8 INCH PIPE.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
GRAVITY SEWER

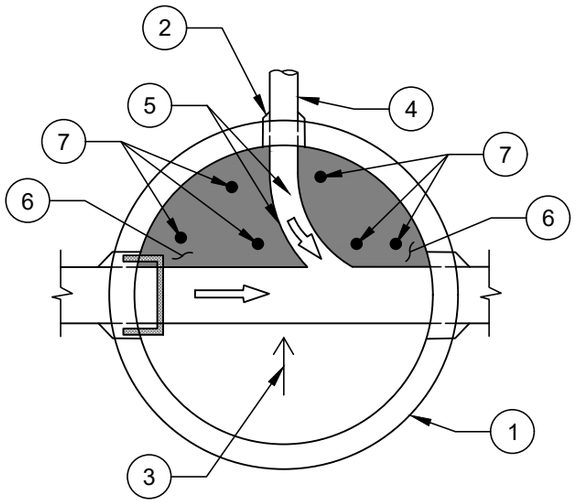
STEEP SLOPE INVERT MANHOLE DUE TO UTILITY CONFLICT

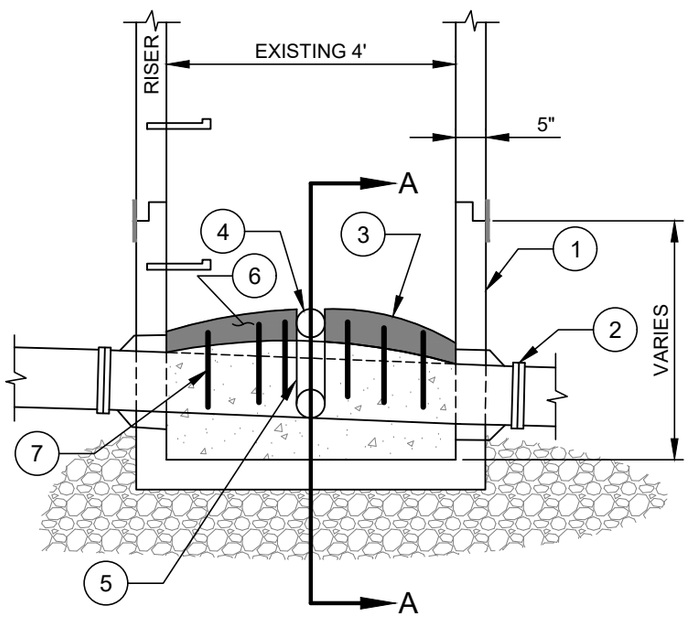
NO SCALE

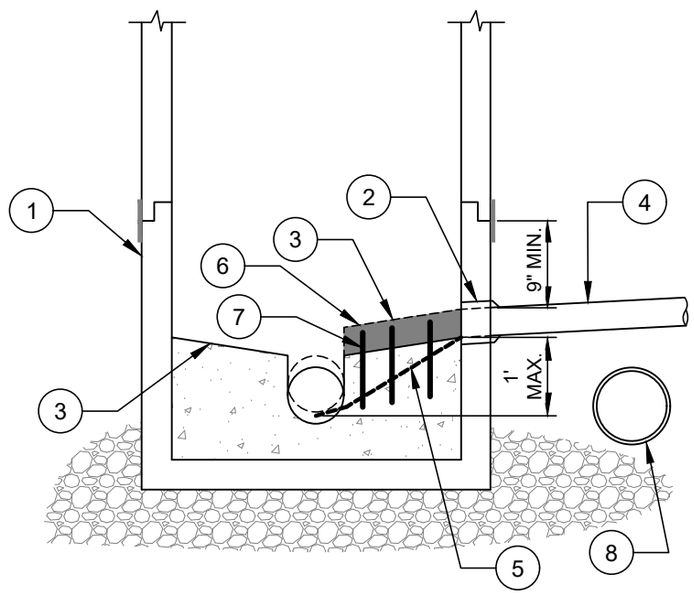
VERSION 1.0

DATE 04/2024

DETAIL 11.2.15







TROUGH SECTION A-A

NO. DESCRIPTION:

1. EXISTING MANHOLE BASE SECTION.
2. FLEXIBLE COUPLING INSTALLED IN CORED HOLE WITH STAINLESS STEEL COMPRESSION DEVICE.
3. 1 INCH PER FOOT FALL (TYP.). THE SHELF SHALL SLOPE 1 INCH PER FOOT (MIN.) FROM THE MANHOLE WALL TO THE TROUGH.
4. 4", 6", OR 8" DUCTILE IRON LATERAL CONNECTION.
5. NEW INVERT TROUGH CUT INTO EXISTING SHELF.
6. NEW CAST IN PLACE CONCRETE (3600 PSI) SHELF.
7. SIX (6) #3 REBARS, GROUTED (OR EPOXIED) IN EXISTING SHELF, MIN. 6" DEEP DRILLED HOLES. EXTEND REBARS TO WITHIN 2 INCHES OF NEW SHELF SURFACE.
8. UTILITY CONFLICT.

NOTES:

A. THIS DETAIL SHALL ONLY BE USED WHEN AN INSIDE DROP IS NOT POSSIBLE AND A STEEP SLOPE INVERT IS APPROVED BY THE ENGINEER.

B. THIS DETAIL SHALL ONLY BE USED DUE TO A UTILITY CONFLICT AND WHEN APPROVED BY THE ENGINEER.

C. THIS DETAIL SHALL NOT BE USED WHEN THE CHANGE IN INVERT ELEVATION IS GREATER THAN ONE FOOT. REFER TO THE INSIDE DROP STANDARD DETAIL.

D. MANHOLE TO CONFORM WITH ASTM C478 EXCEPT AS MODIFIED. REFER TO MANHOLE STANDARD DETAILS FOR ALL MANHOLE REQUIREMENTS.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
GRAVITY SEWER

LATERAL STEEP SLOPE INVERT DUE TO UTILITY CONFLICT

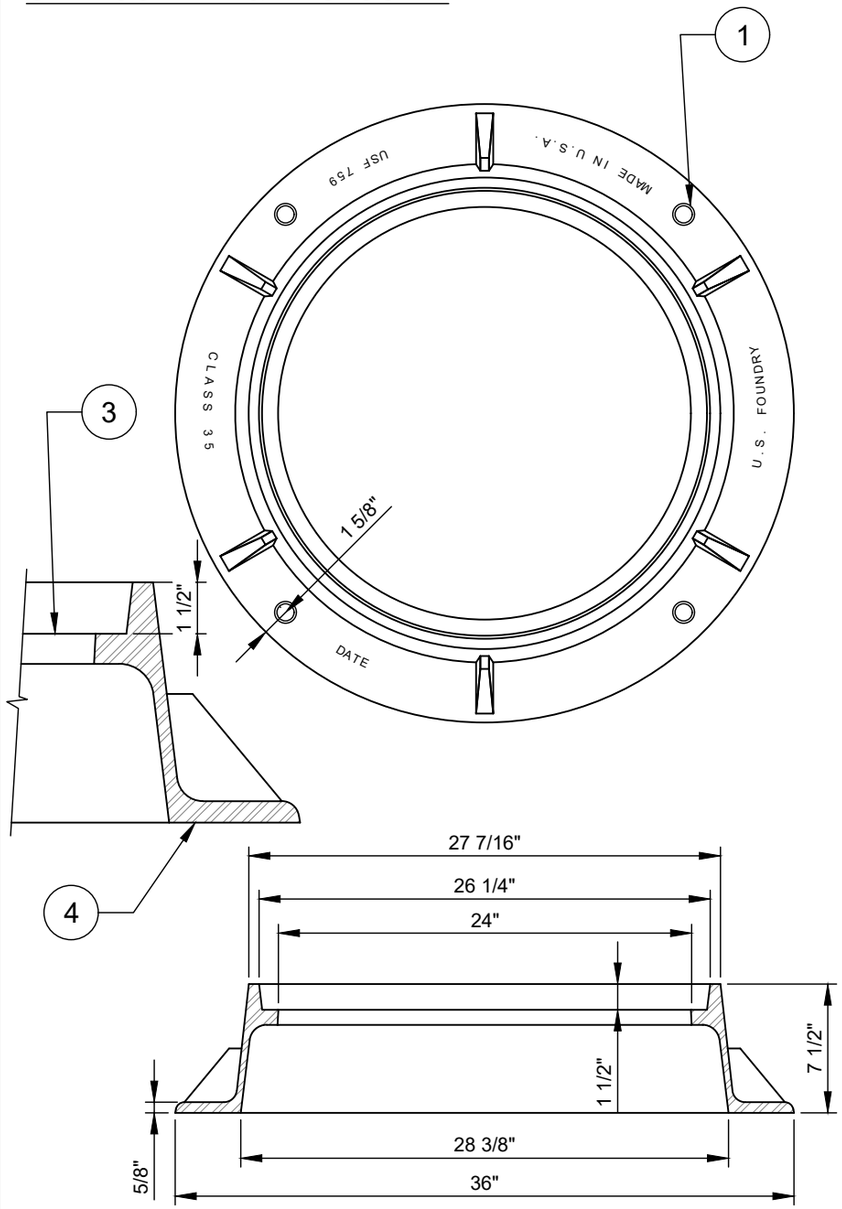
NO SCALE

VERSION 1.0

DATE 04/2024

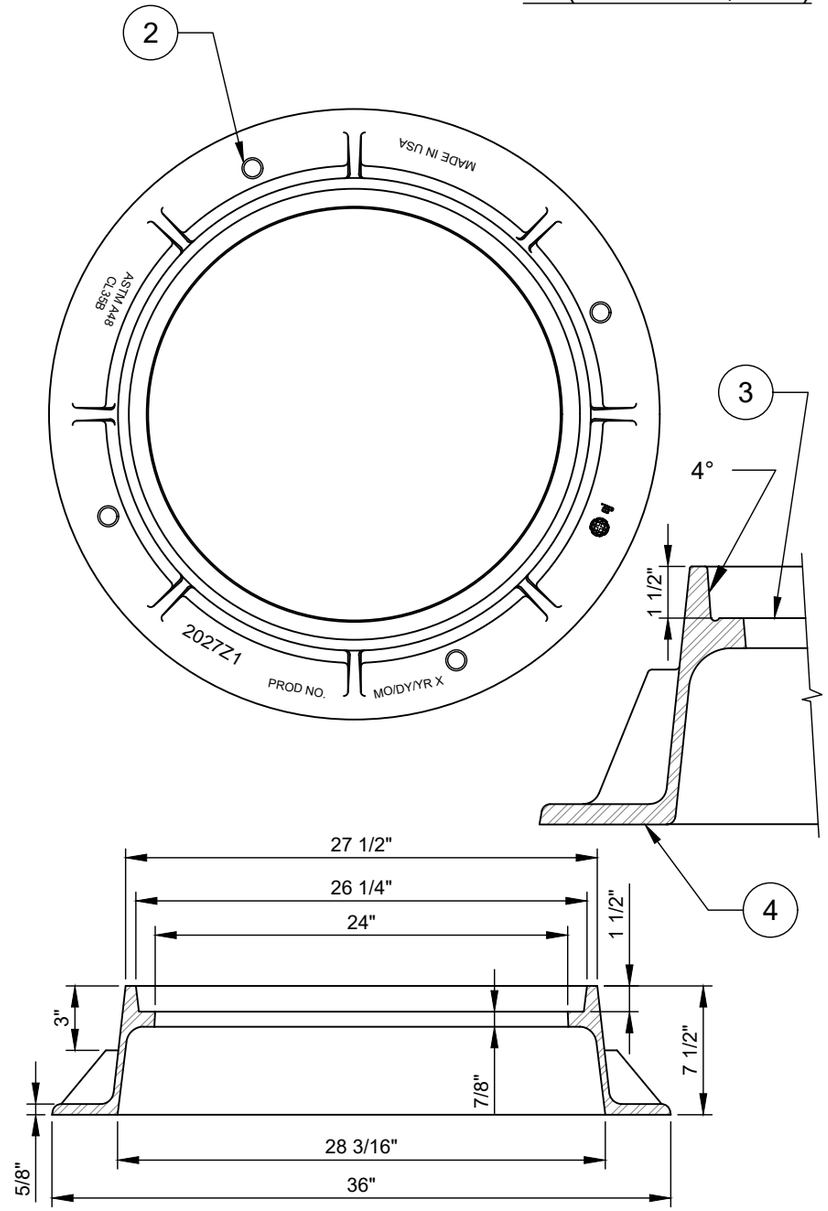
DETAIL 11.2.16

U.S. FOUNDRY & MFG. CORP.



WEIGHT - 170 LB. MIN., 0% MINUS TOLERANCE

EJ (EJ GROUP, INC.)



WEIGHT - 173 LB. MIN., 0% MINUS TOLERANCE

NO.	DESCRIPTION:
1.	(4) - 1 INCH DIAMETER ANCHOR HOLES ON A 32 3/4" DIAMETER B.C.D.
2.	(4) - 1 INCH DIAMETER ANCHOR HOLES ON A 31" DIAMETER B.C.D.
3.	MACHINED SURFACE.
4.	FRAME.

NOTES:

A. LOAD RATING - HEAVY DUTY.

B. MATERIAL - ASTM A48 - CLASS 35 GRAY IRON.

C. COATING - UNDIPPED.

D. FRAME SHALL CONFORM TO DIMENSION AND WEIGHT REQUIREMENTS.

E. FRAME SHALL NOT BE OUT OF ROUND.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
GRAVITY SEWER

TYPE A MANHOLE FRAME 24-INCHES DIAMETER (CLEAR OPENING) 7 1/2-INCHES TALL

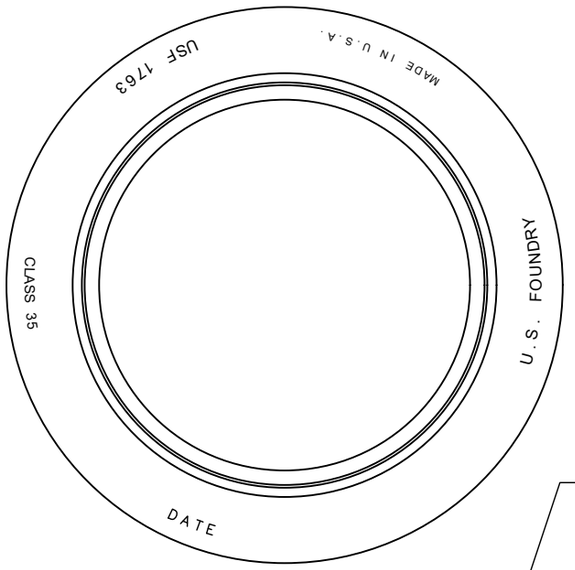
NO SCALE

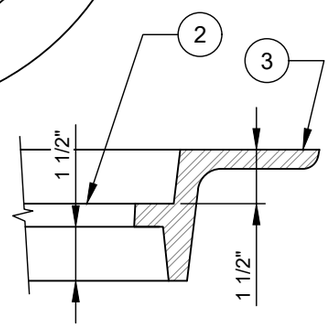
VERSION 1.0

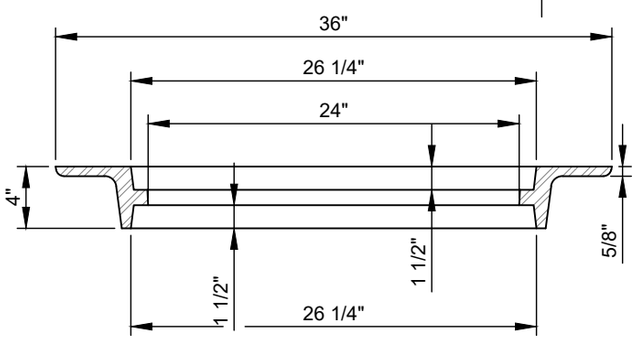
DATE 04/2024

DETAIL 11.3.1

U.S. FOUNDRY & MFG. CORP.

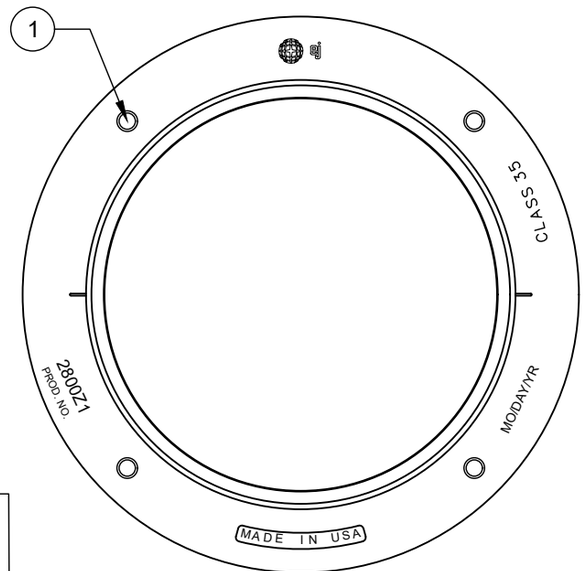


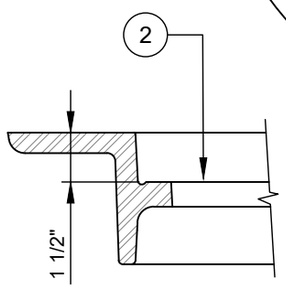


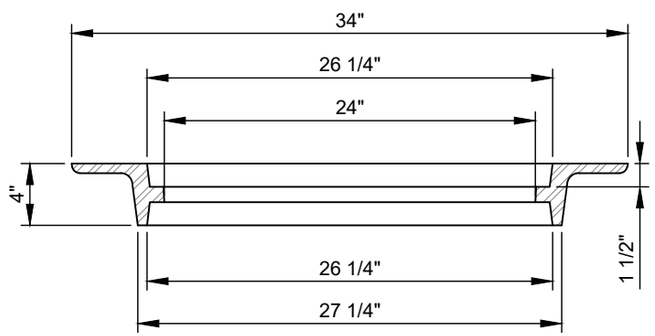


WEIGHT - 150 LB. MIN., 0% MINUS TOLERANCE

EJ (EJ GROUP, INC.)







WEIGHT - 121 LB. MIN., 0% MINUS TOLERANCE

NO.	DESCRIPTION:
1.	(4) -1 INCH DIAMETER ANCHOR HOLES ON A 31" DIAMETER B.C.D.
2.	MACHINED SURFACE.
3.	FRAME.

NOTES:

A. LOAD RATING - HEAVY DUTY.

B. MATERIAL - ASTM A48 - CLASS 35 GRAY IRON.

C. COATING - UNDIPPED.

D. FRAME SHALL CONFORM TO DIMENSION AND WEIGHT REQUIREMENTS.

E. FRAME SHALL NOT BE OUT OF ROUND.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

GRAVITY SEWER

TYPE C MANHOLE FRAME
24-INCHES DIAMETER (CLEAR OPENING)
4-INCHES TALL - INVERTED (CAST IN)

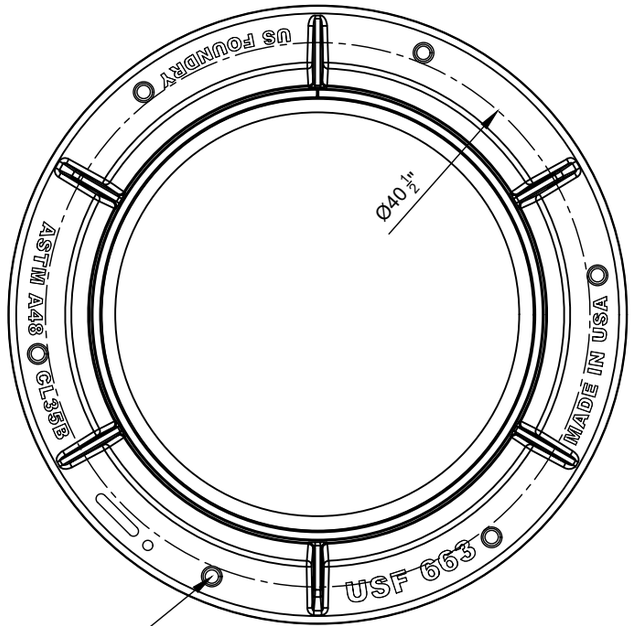
NO SCALE

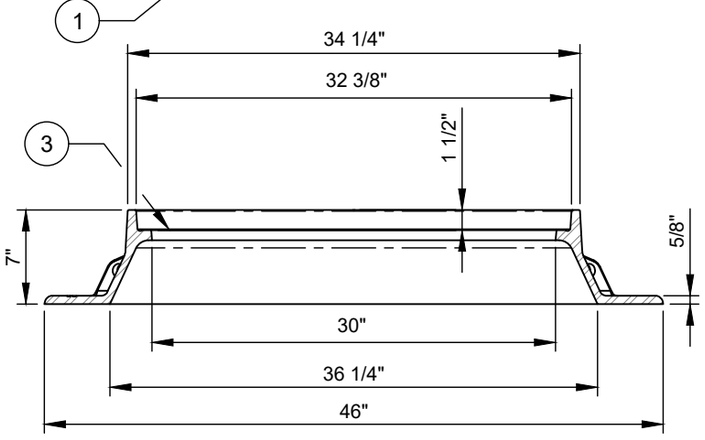
VERSION
1.0

DATE
04/2024

DETAIL
11.3.2

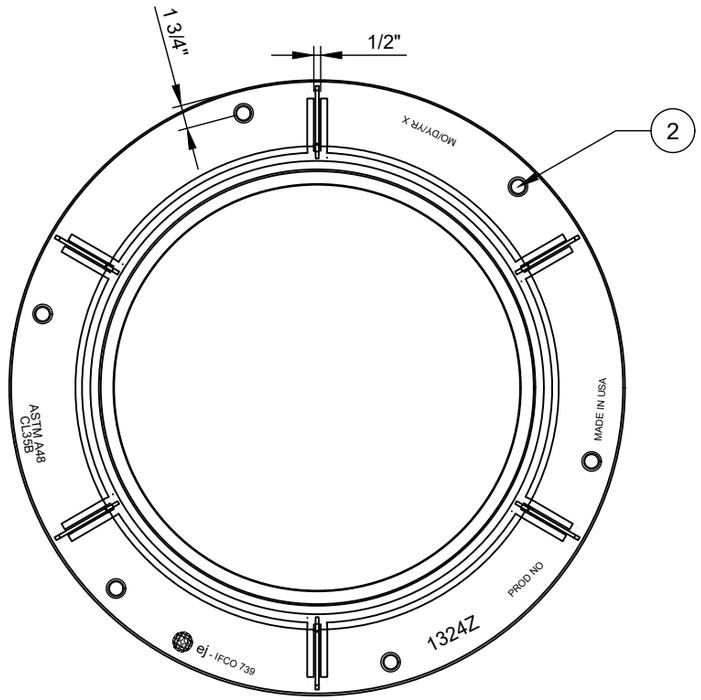
U.S. FOUNDRY & MFG. CORP.

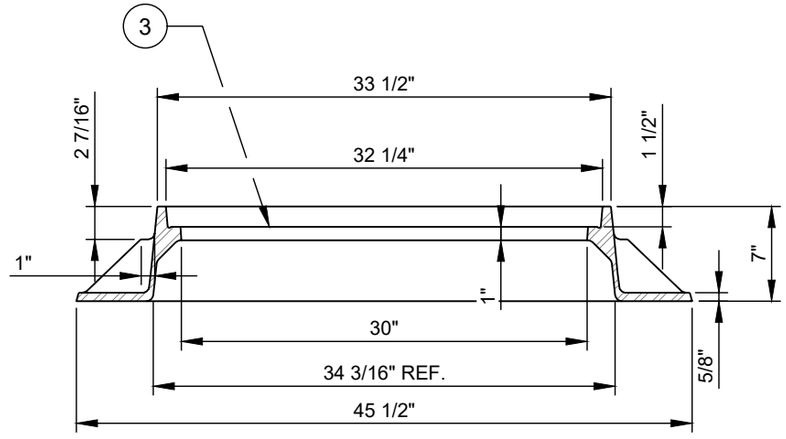




WEIGHT - 320 LB. MIN., 0% MINUS TOLERANCE

EJ (EJ GROUP, INC.)





WEIGHT - 270 LB. MIN., 0% MINUS TOLERANCE

NO.	DESCRIPTION:
1.	(6) - 1 INCH DIAMETER THRU HOLES EQUALLY SPACED ON A 41" DIAMETER B.C.D.
2.	(6) - 1 INCH DIAMETER THRU HOLES EQUALLY SPACED ON A 42" DIAMETER B.C.D.
3.	MACHINED SURFACE.

NOTES:

A. LOAD RATING - HEAVY DUTY.

B. MATERIAL - ASTM A48 - CLASS 35 GRAY IRON.

C. COATING - UNDIPPED.

D. FRAME SHALL CONFORM TO DIMENSION AND WEIGHT REQUIREMENTS.

E. FRAME SHALL NOT BE OUT OF ROUND.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
GRAVITY SEWER

TYPE D MANHOLE FRAME
30-INCH DIAMETER (CLEAR OPENING)
7-INCHES TALL

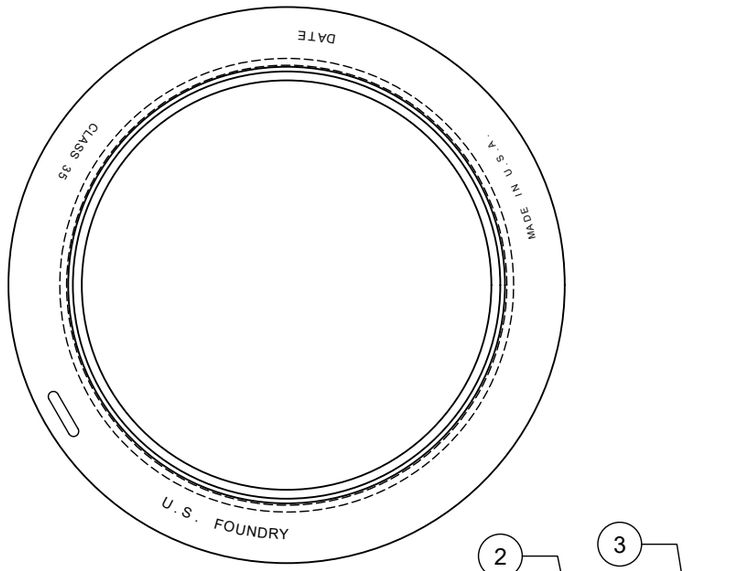
NO SCALE

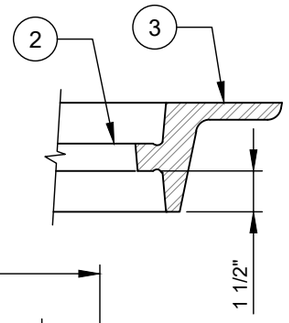
VERSION
1.0

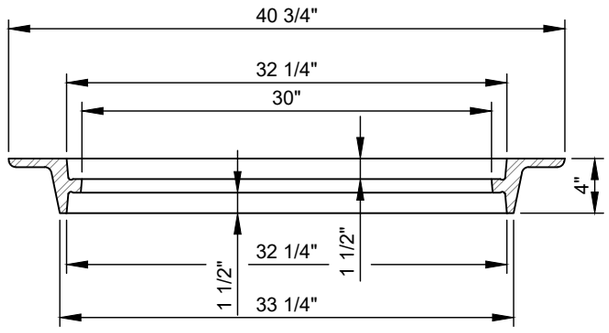
DATE
04/2024

DETAIL
11.3.3

U.S. FOUNDRY & MFG. CORP.

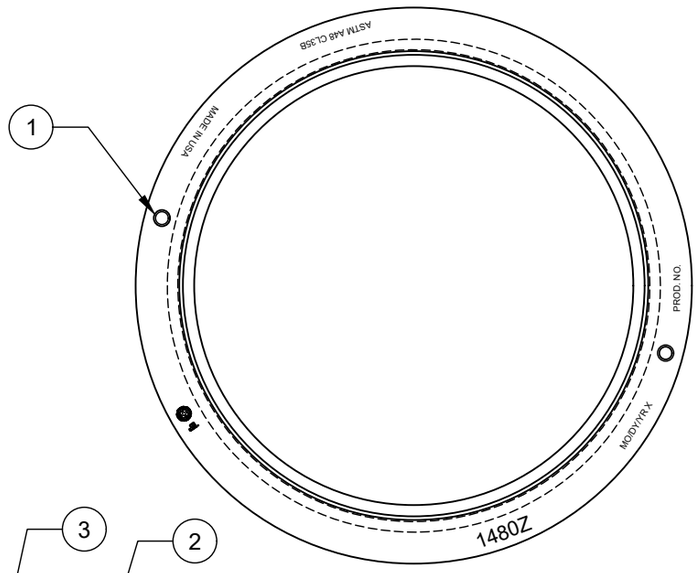


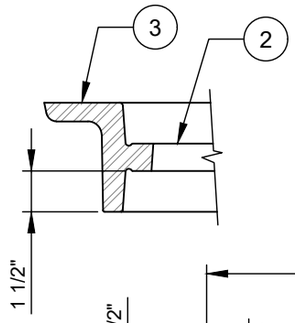


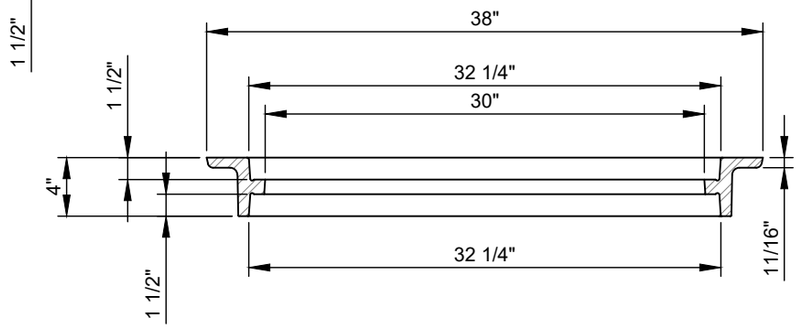


WEIGHT - 175 LB. MIN., 0% MINUS TOLERANCE

EJ (EJ GROUP, INC.)







WEIGHT - 154 LB. MIN., 0% MINUS TOLERANCE

NO.	DESCRIPTION:
1.	(2) - 1 INCH DIAMETER ANCHOR HOLES ON A 35 5/8" DIAMETER B.C.D.
2.	MACHINED SURFACE.
3.	FRAME.

NOTES:

A. LOAD RATING - HEAVY DUTY.

B. MATERIAL - ASTM A48 - CLASS 35 GRAY IRON.

C. COATING - UNDIPPED.

D. FRAME SHALL CONFORM TO DIMENSION AND WEIGHT REQUIREMENTS.

E. FRAME SHALL NOT BE OUT OF ROUND.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
GRAVITY SEWER

TYPE E MANHOLE FRAME
30-INCHES DIAMETER (CLEAR OPENING)
4-INCHES TALL - INVERTED (CAST IN)

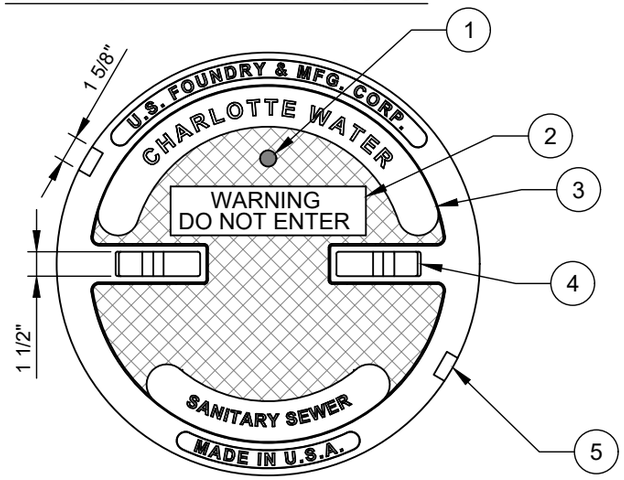
NO SCALE

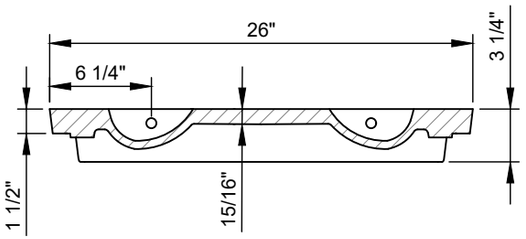
VERSION 1.0

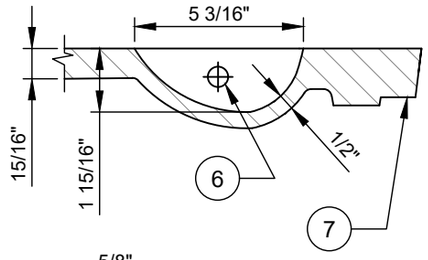
DATE 04/2024

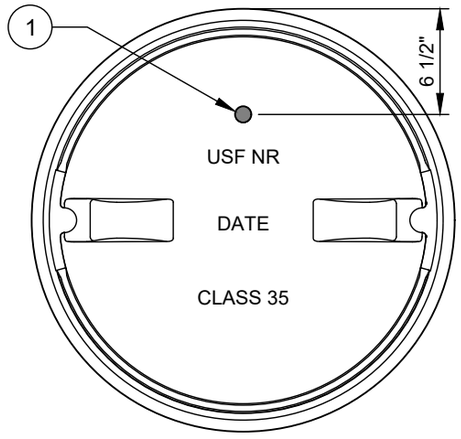
DETAIL 11.3.4

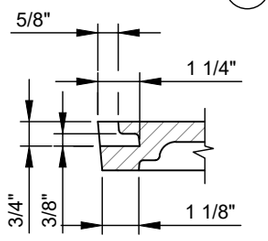
U.S. FOUNDRY & MFG. CORP.







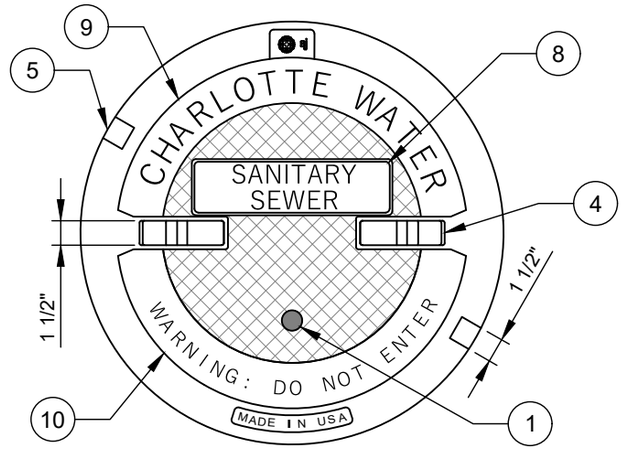


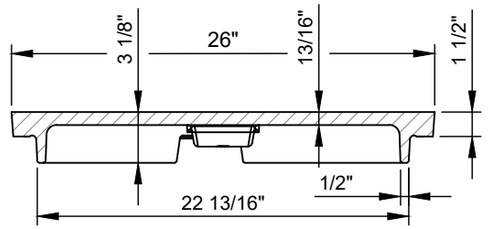


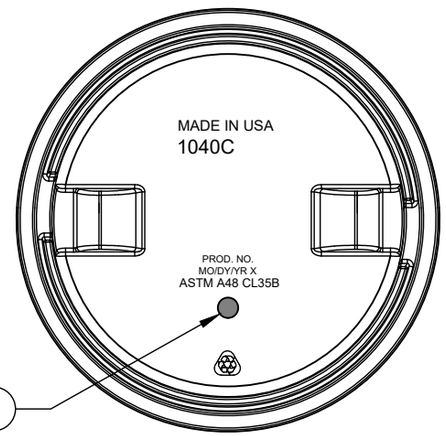
PICK HOLE DETAIL

WEIGHT - 150 LB. MIN., 0% MINUS TOLERANCE

EJ (EJ GROUP, INC.)







WEIGHT - 145 LB. MIN., 0% MINUS TOLERANCE

NO.	DESCRIPTION:
1.	1 INCH DIAMETER VENT HOLE.
2.	1 INCH ARIAL TEXT.
3.	5/8" ARIAL STYLE TEXT.
4.	(2) - LIFTING BARS.
5.	(2) - NON PENETRATING PICK HOLES.
6.	5/8" TYPE 304 S.S. ROD.
7.	MACHINED SURFACE.
8.	1 INCH SHARP FACE GOTHIC TEXT.
9.	1 1/4" SHARP FACE GOTHIC TEXT.
10.	3/4" SHARP FACE GOTHIC TEXT.

NOTES:

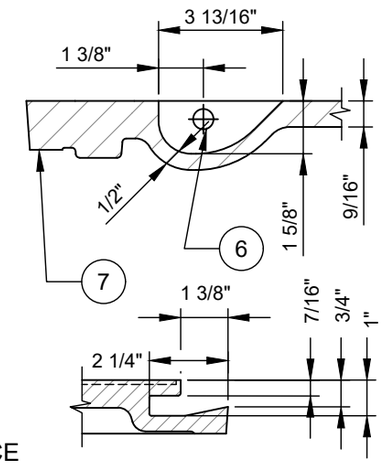
A. LOAD RATING - HEAVY DUTY.

B. MATERIAL - ASTM A48 - CLASS 35 GRAY IRON.

C. COATING - UNDIPPED.

D. COVER SHALL CONFORM TO DIMENSION AND WEIGHT REQUIREMENTS.

E. COVER SHALL NOT BE OUT OF ROUND.



PICK HOLE DETAIL

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
GRAVITY SEWER

TYPE 1 MANHOLE COVER
24-INCHES DIAMETER (CLEAR OPENING)
VENTED-ONE VENT HOLE, NO GASKET, NO CAM LOCK

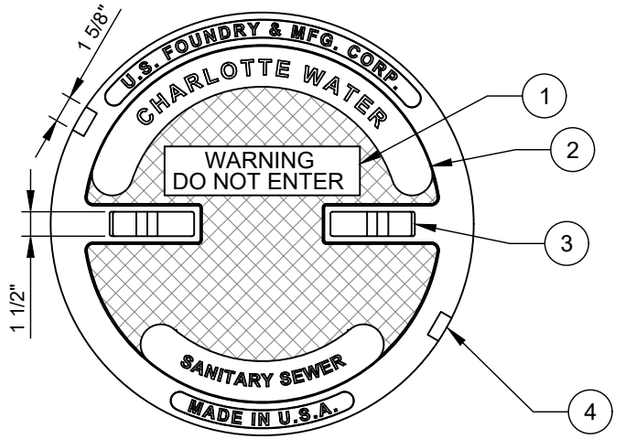
NO SCALE

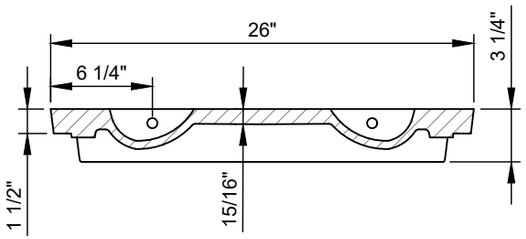
VERSION
1.0

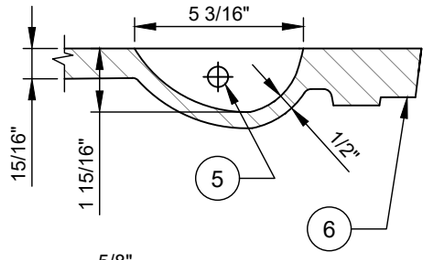
DATE
04/2024

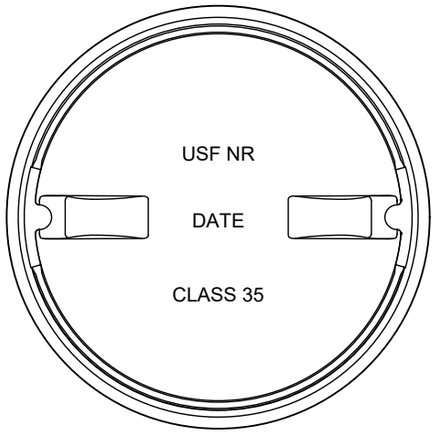
DETAIL
11.3.5

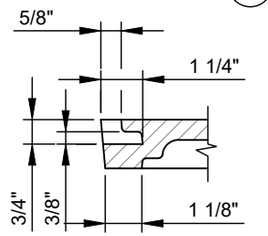
U.S. FOUNDRY & MFG. CORP.







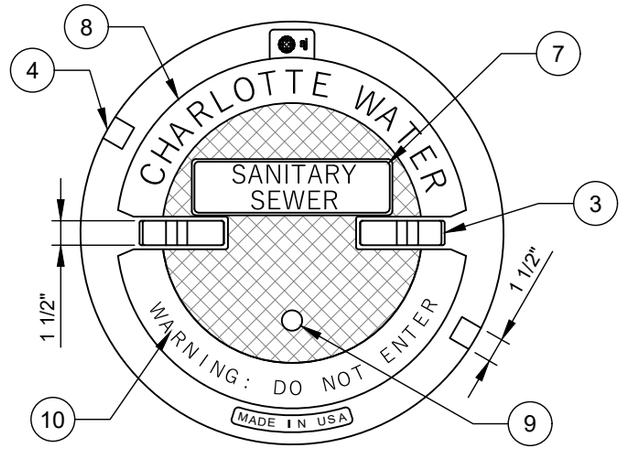


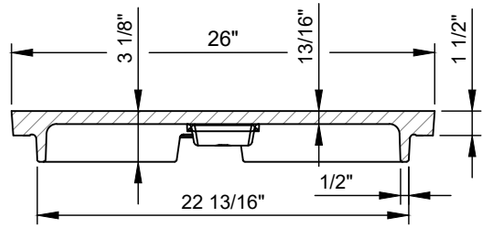


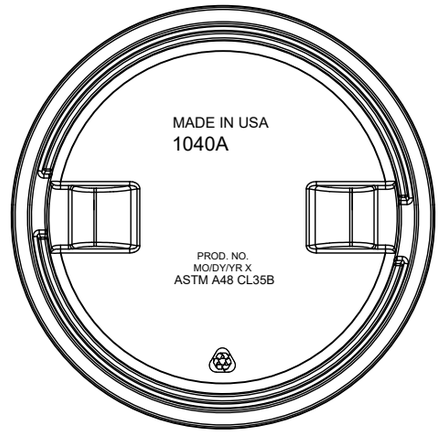
PICK HOLE DETAIL

WEIGHT - 150 LB. MIN., 0% MINUS TOLERANCE

EJ (EJ GROUP, INC.)







WEIGHT - 145 LB. MIN., 0% MINUS TOLERANCE

NO.	DESCRIPTION:
1.	1 INCH ARIAL TEXT.
2.	5/8" ARIAL STYLE TEXT.
3.	(2) - LIFTING BARS.
4.	(2) - NON PENETRATING PICK HOLES.
5.	5/8" TYPE 304 S.S. ROD.
6.	MACHINED SURFACE.
7.	1 INCH SHARP FACE GOTHIC TEXT.
8.	1 1/4" SHARP FACE GOTHIC TEXT.
9.	1 1/8" BOSS.
10.	3/4" SHARP FACE GOTHIC TEXT.

NOTES:

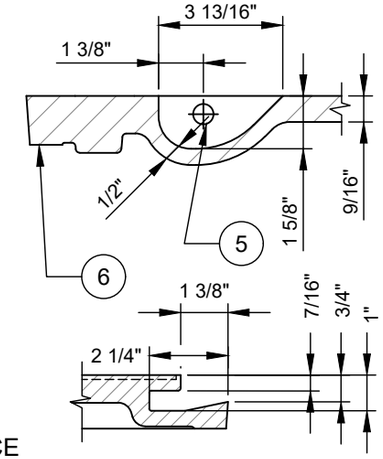
A. LOAD RATING - HEAVY DUTY.

B. MATERIAL - ASTM A48 - CLASS 35 GRAY IRON.

C. COATING - UNDIPPED.

D. COVER SHALL CONFORM TO DIMENSION AND WEIGHT REQUIREMENTS.

E. COVER SHALL NOT BE OUT OF ROUND.



PICK HOLE DETAIL

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
GRAVITY SEWER

TYPE 2 MANHOLE COVER
24-INCHES DIAMETER (CLEAR OPENING)
SOLID - NO VENT HOLE, NO GASKET, NO CAM LOCK

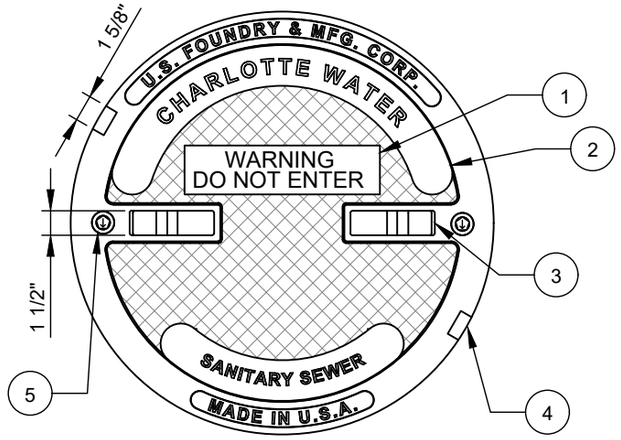
NO SCALE

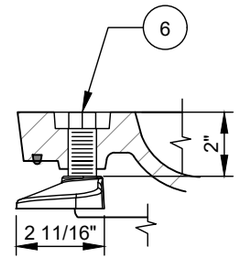
VERSION
1.0

DATE
04/2024

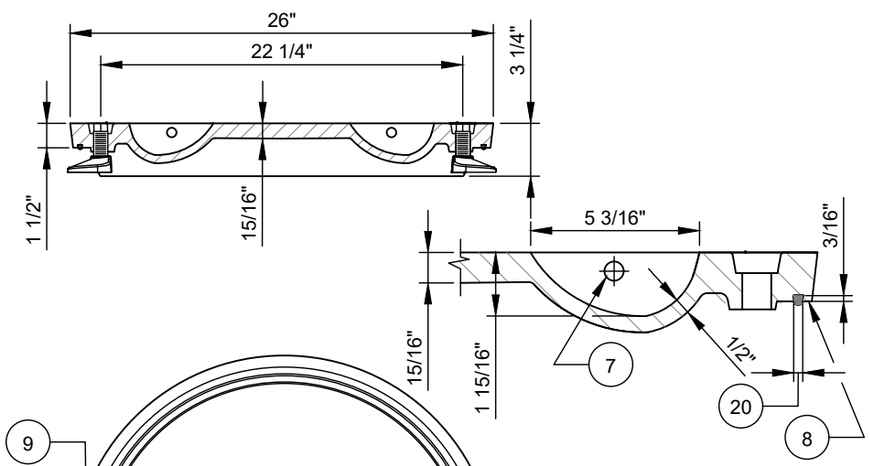
DETAIL
11.3.6

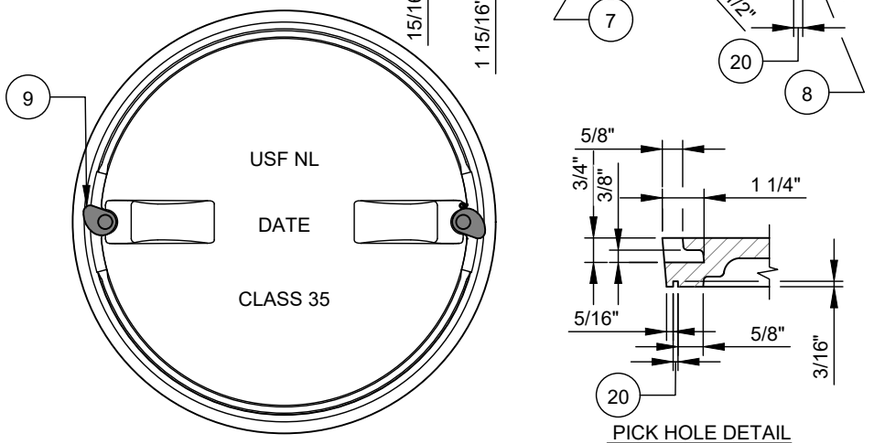
U.S. FOUNDRY & MFG. CORP.





CAM ASSEMBLY DETAIL

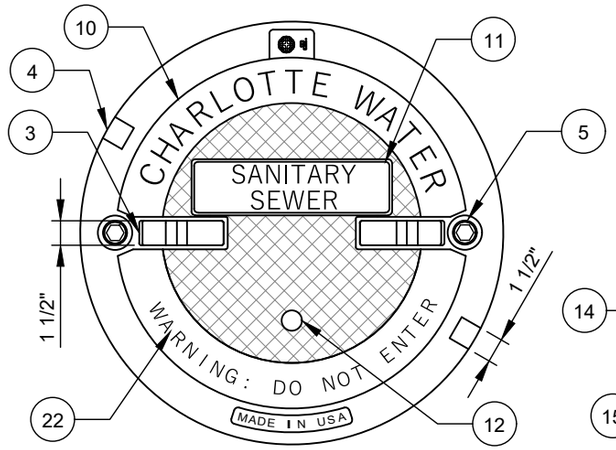


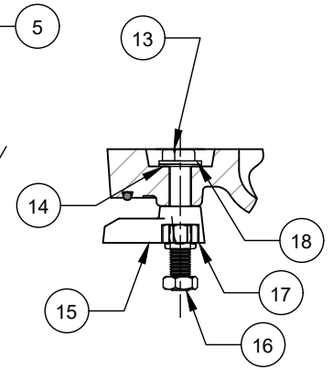


PICK HOLE DETAIL

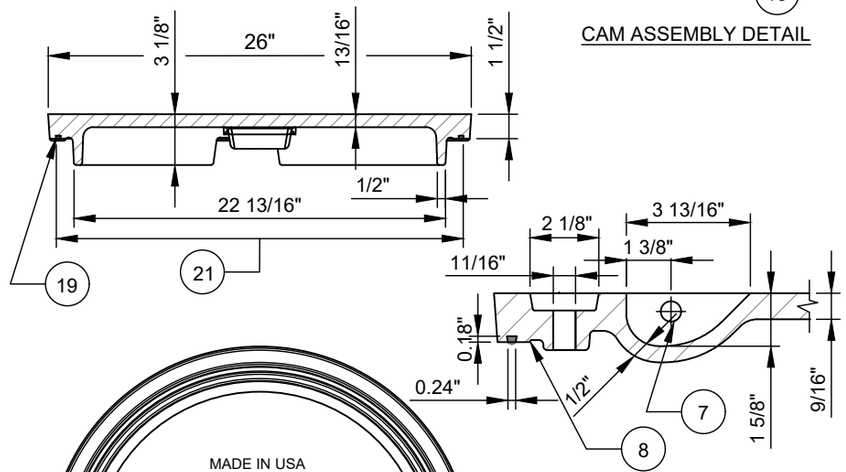
WEIGHT - 150 LB. MIN., 0% MINUS TOLERANCE

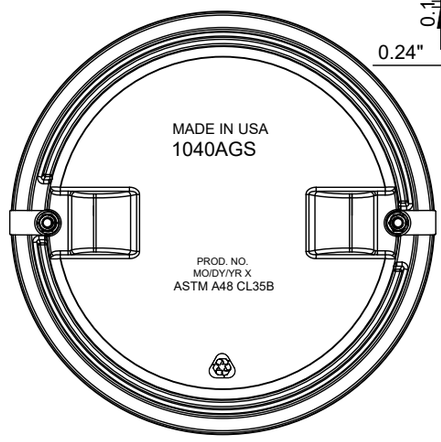
EJ (EJ GROUP, INC.)

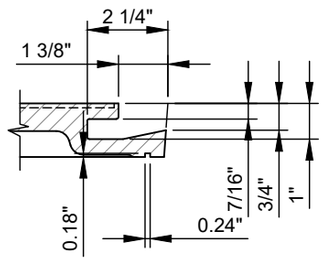




CAM ASSEMBLY DETAIL







PICK HOLE DETAIL

WEIGHT - 145 LB. MIN., 0% MINUS TOLERANCE

NO.	DESCRIPTION:
1.	1 INCH ARIAL TEXT.
2.	5/8" ARIAL STYLE TEXT.
3.	(2) - LIFTING BARS.
4.	(2) - NON PENETRATING PICK HOLES.
5.	CAM LOCK SEE ASSEMBLY DETAIL.
6.	USF WEDGE LOC 5/8" HEX HEAD BOLT ALL GRADE S.S. TYPE 304.
7.	5/8" TYPE 304 S.S. ROD.
8.	MACHINED SURFACE.
9.	7/8" DIA. CAM LOCK HOLE @ 22" DIA.
10.	1 1/4" SHARP FACE GOTHIC TEXT.
11.	1 INCH SHARP FACE GOTHIC TEXT.
12.	1 1/8" BOSS.
13.	BOLT HEX 5/8"-11 X 4" TYPE 304 S.S.
14.	WASHER 1/16" X 5/8" X 1 1/2" RUBBER.
15.	LOCK LUG.
16.	NUT HEX JAM 5/8"-11 TYPE 304 S.S.
17.	NUT HEX 5/8"-11 TYPE 304 S.S. NYLK.
18.	WASHER 5/8" ID1.50 OD TYPE 304 S.S.
19.	1/4" NEOPRENE GASKET.
20.	3/16" DOVETAIL GROOVE.
21.	25" DIAMETER (O.D. OF GKT GROOVE).
22.	3/4" SHARP FACE GOTHIC TEXT.

NOTES:

A. LOAD RATING - HEAVY DUTY.

B. MATERIAL - ASTM A48 - CLASS 35 GRAY IRON.

C. COATING - UNDIPPED.

D. COVER SHALL CONFORM TO DIMENSION AND WEIGHT REQUIREMENTS.

E. COVER SHALL NOT BE OUT OF ROUND.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
GRAVITY SEWER

TYPE 3 MANHOLE COVER
24-INCHES DIAMETER (CLEAR OPENING)
WATERTIGHT - NO VENT HOLE, GASKET, CAM LOCK

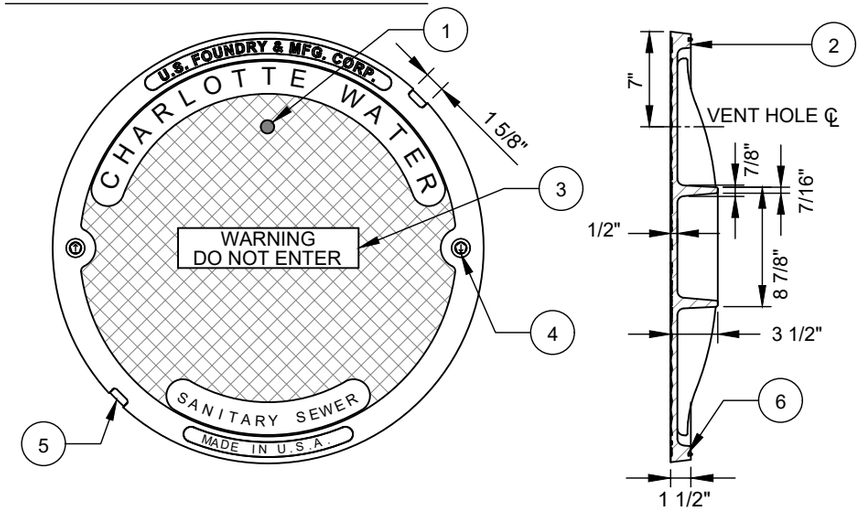
NO SCALE

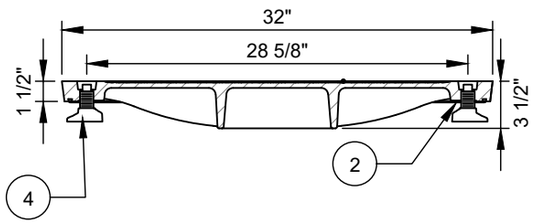
VERSION 1.0

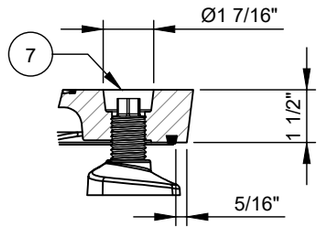
DATE 04/2024

DETAIL 11.3.7

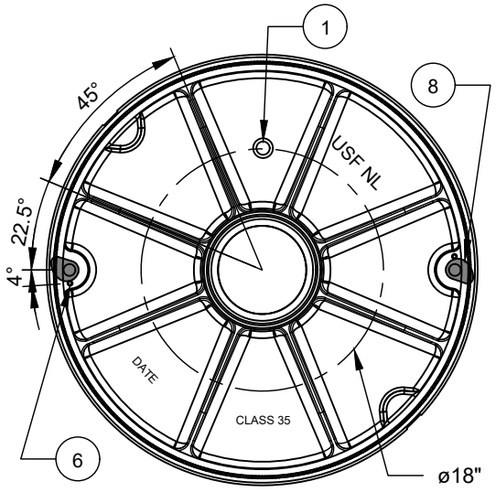
U.S. FOUNDRY & MFG. CORP.

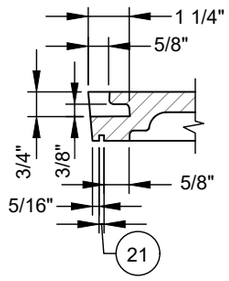






CAM ASSEMBLY DETAIL



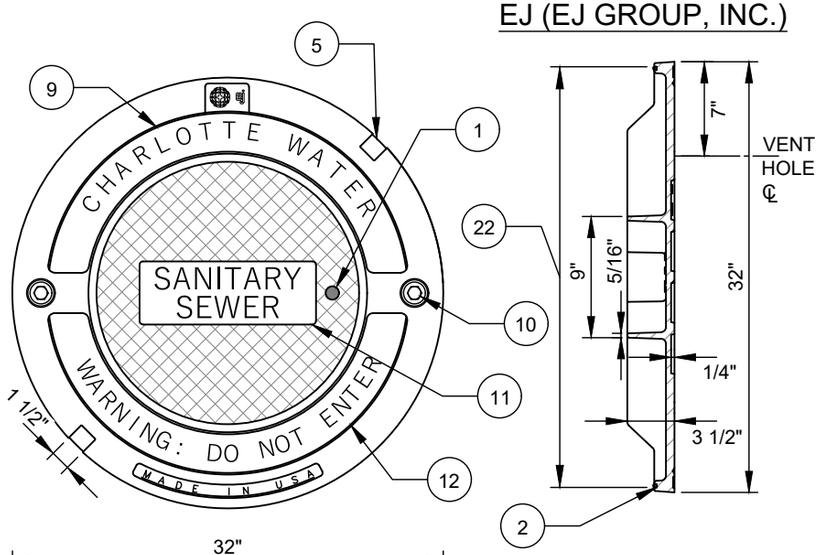


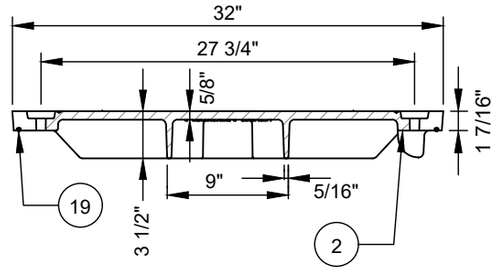
PICK HOLE DETAIL

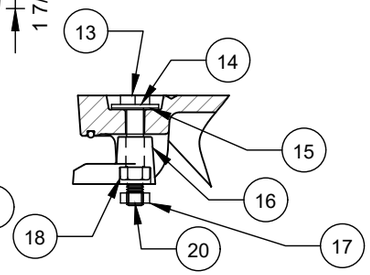
WEIGHT - 165 LB. MIN., 0% MINUS TOLERANCE

MATERIAL - ASTM A48 CLASS 35 - CAST IRON

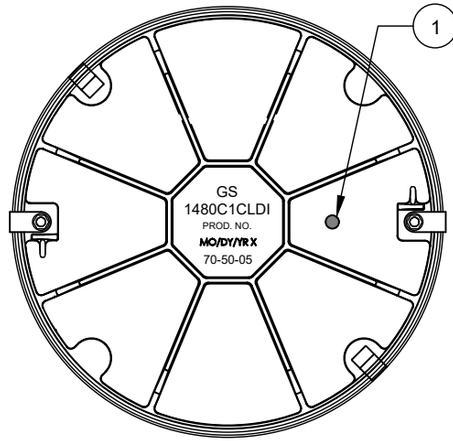
EJ (EJ GROUP, INC.)

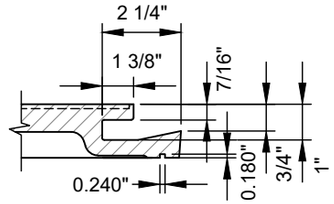






CAM ASSEMBLY DETAIL





PICK HOLE DETAIL

WEIGHT - 173 LB. MIN., 0% MINUS TOLERANCE

MATERIAL - ASTM A536 DUCTILE IRON - GRADE 70-50-05

NO.	DESCRIPTION:
1.	1 INCH DIAMETER VENT HOLE.
2.	MACHINED SURFACE.
3.	1 INCH ARIAL STYLE TEXT TYP.
4.	WEDGE CAM LOCK. SEE ASSEMBLY DETAIL.
5.	(2)-NON PENETRATING PICKHOLES.
6.	ORS GASKET NEOPRENE RUBBER 60 DUROMETER.
7.	USF WEDGE LOC 5/8" HEX HEAD BOLT ALL GRADE S.S. TYPE 304.
8.	ø7/8" CAM LOCK HOLE @ 28 5/8" DIAMETER.
9.	1 INCH SHARP FACE GOTHIC TEXT.
10.	(2) CAMS (SEE DETAIL).
11.	1 3/4" SHARP FACE GOTHIC TEXT.
12.	1 INCH SHARP FACE GOTHIC TEXT.
13.	5/8"-11 X 3 1/2" LG TYPE 304 SS HEX BOLT.
14.	5/8" I.D. 1 1/2" O.D. TYPE 304 SS FLAT WASHER.
15.	5/8" I.D. 1 1/2" O.D. SS FLAT WASHER AND RUBBER WASHER.
16.	BRONZE LOCK LUG.
17.	5/8" HEX JAM NUT TYPE 304 SS.
18.	5/8" - 11 TYPE 304 SS NYLOK NUT.
19.	1/4" NEOPRENE GASKET.
20.	WELD ON JAM NUT OR PEEN END THREADS ON BOLT.
21.	3/16" DOVETAIL GROOVE.
22.	31 1/4" (OUTSIDE OF GROOVE).

NOTES:

A. LOAD RATING - HEAVY DUTY.

B. MATERIAL - DUCTILE IRON OR CAST IRON AS INDICATED IN THE DETAIL.

C. COATING - UNDIPPED.

D. COVER SHALL CONFORM TO DIMENSION AND WEIGHT REQUIREMENTS.

E. COVER SHALL NOT BE OUT OF ROUND.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

GRAVITY SEWER

TYPE 4 MANHOLE COVER
30-INCHES DIAMETER (CLEAR OPENING)
VENTED - ONE VENT HOLE, GASKET, CAM LOCK

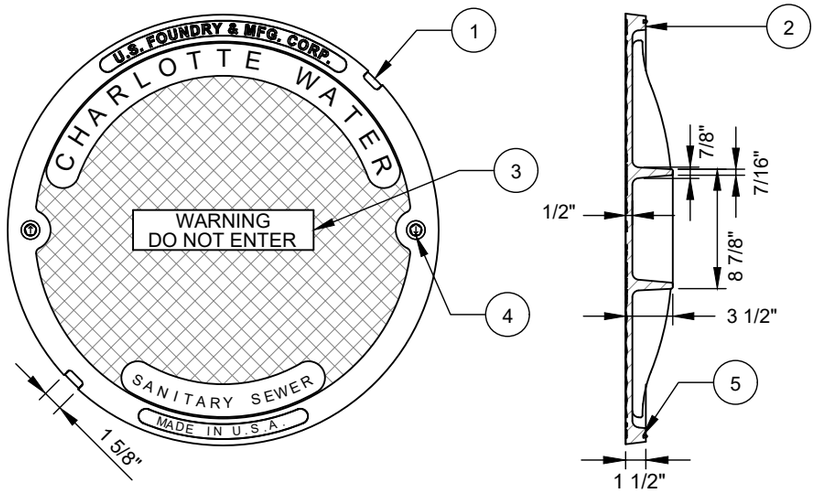
NO SCALE

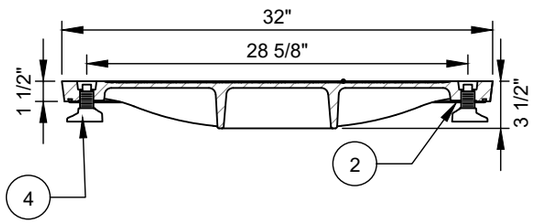
VERSION 1.0

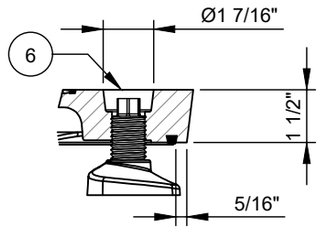
DATE 04/2024

DETAIL 11.3.8

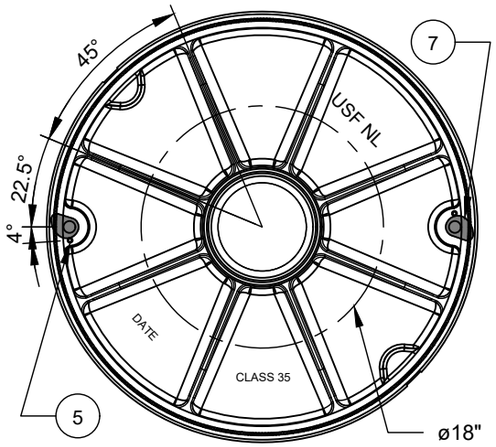
U.S. FOUNDRY & MFG. CORP.

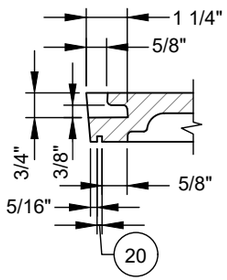






CAM ASSEMBLY DETAIL



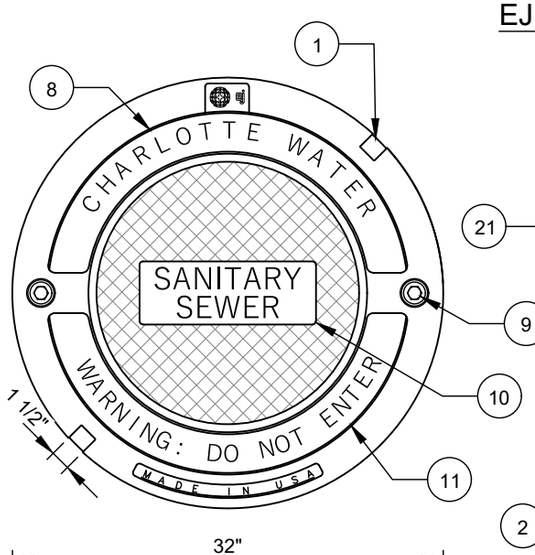


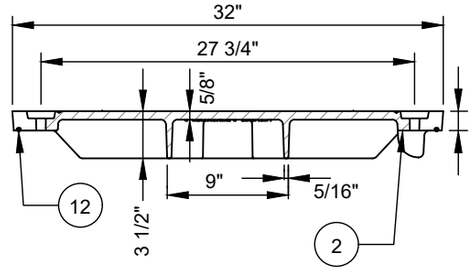
PICK HOLE DETAIL

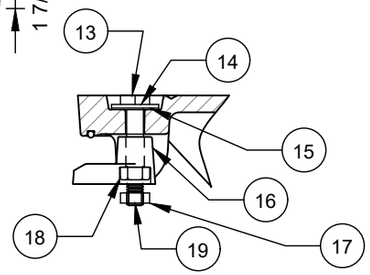
WEIGHT - 165 LB. MIN., 0% MINUS TOLERANCE

MATERIAL - ASTM A48 CLASS 35 - CAST IRON

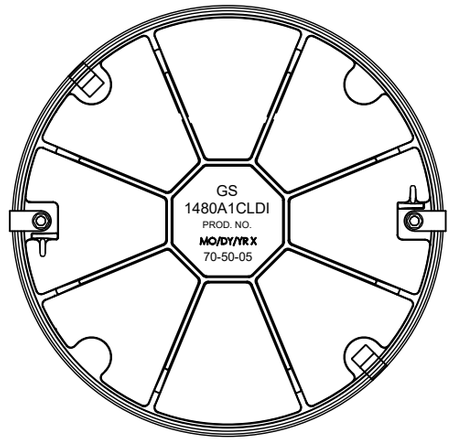
EJ (EJ GROUP, INC.)

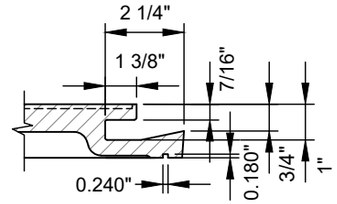






CAM ASSEMBLY DETAIL





PICK HOLE DETAIL

WEIGHT - 173 LB. MIN., 0% MINUS TOLERANCE

MATERIAL - ASTM A536 DUCTILE IRON - GRADE 70-50-05

NO.	DESCRIPTION:
1.	(2)-NON PENETRATING PICKHOLES.
2.	MACHINED SURFACE.
3.	1 INCH ARIAL STYLE TEXT TYP.
4.	WEDGE CAM LOCK. SEE ASSEMBLY DETAIL.
5.	ORS GASKET NEOPRENE RUBBER 60 DUROMETER.
6.	USF WEDGE LOC 5/8" HEX HEAD BOLT ALL GRADE S.S. TYPE 304.
7.	7/8" DIAMETER CAM LOCK HOLE @ 28 5/8" DIAMETER.
8.	1 INCH SHARP FACE GOTHIC TEXT.
9.	(2) CAMS (SEE DETAIL).
10.	1 3/4" SHARP FACE GOTHIC TEXT.
11.	1 INCH SHARP FACE GOTHIC TEXT.
12.	1/4" NEOPRENE GASKET.
13.	5/8"-11 X 3 1/2" LG TYPE 304 SS HEX BOLT.
14.	5/8" I.D. 1 1/2" O.D. TYPE 304 SS FLAT WASHER.
15.	5/8" I.D. 1 1/2" O.D. SS FLAT WASHER AND RUBBER WASHER.
16.	BRONZE LOCK LUG.
17.	5/8" HEX JAM NUT TYPE 304 SS.
18.	5/8"-11 TYPE 304 SS NYLOK NUT.
19.	WELD ON JAM NUT OR PEEN END THREADS ON BOLT.
20.	3/16" DOVETAIL GROOVE.
21.	31 1/4" (OUTSIDE OF GROOVE).

NOTES:

A. LOAD RATING - HEAVY DUTY.

B. MATERIAL - DUCTILE IRON OR CAST IRON AS INDICATED IN THE DETAIL.

C. COATING - UNDIPPED.

D. COVER SHALL CONFORM TO DIMENSION AND WEIGHT REQUIREMENTS.

E. COVER SHALL NOT BE OUT OF ROUND.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

GRAVITY SEWER

TYPE 5 MANHOLE COVER
30-INCHES DIAMETER (CLEAR OPENING)
WATERTIGHT - NO VENT HOLE, GASKET, CAM LOCK

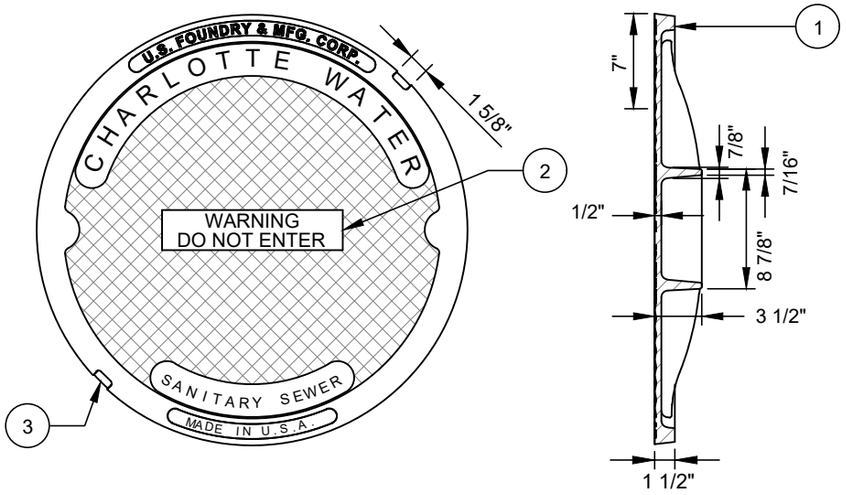
NO SCALE

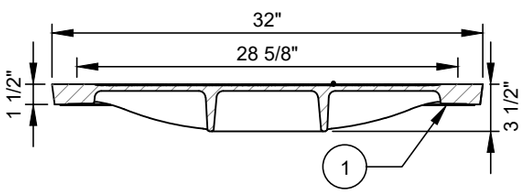
VERSION 1.0

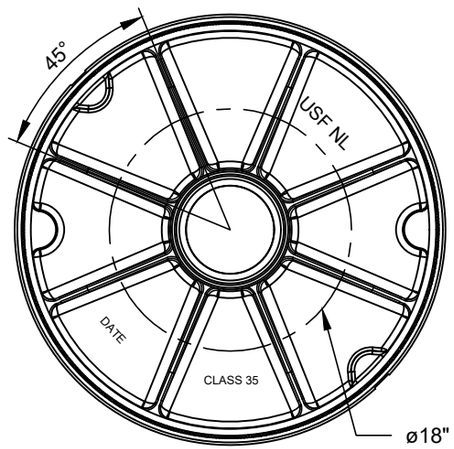
DATE 04/2024

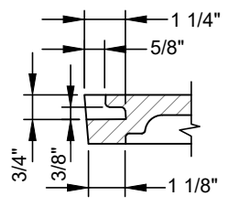
DETAIL 11.3.9

U.S. FOUNDRY & MFG. CORP.







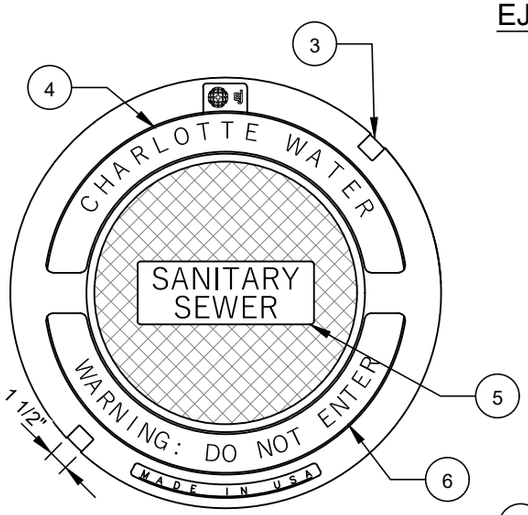


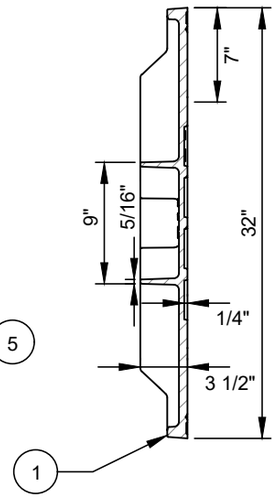
PICK HOLE DETAIL

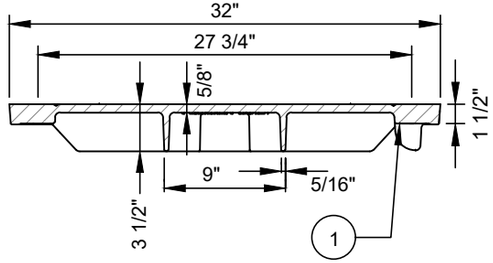
WEIGHT - 165 LB. MIN., 0% MINUS TOLERANCE

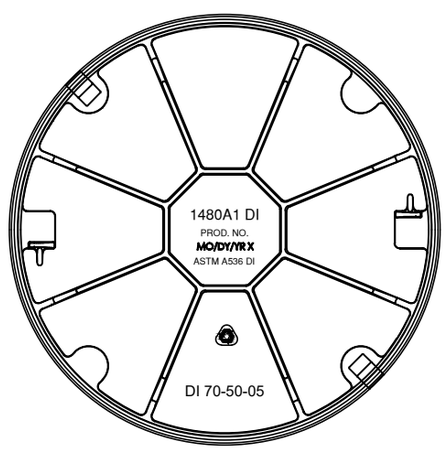
MATERIAL - ASTM A48 CLASS 35 - CAST IRON

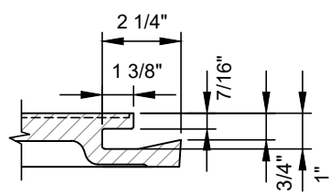
EJ (EJ GROUP, INC.)











PICK HOLE DETAIL

WEIGHT - 150 LB. MIN., 0% MINUS TOLERANCE

MATERIAL - ASTM A536 DUCTILE IRON - GRADE 70-50-05

NO.	DESCRIPTION:
1.	MACHINED SURFACE.
2.	1 INCH ARIAL STYLE TEXT TYP.
3.	TWO (2) NON PENETRATING PICKHOLES.
4.	1 INCH SHARP FACE GOTHIC TEXT.
5.	1 3/4 INCH SHARP FACE GOTHIC TEXT.
6.	1 INCH SHARP FACE GOTHIC TEXT.

NOTES:

A. LOAD RATING - HEAVY DUTY.

B. MATERIAL - DUCTILE IRON OR CAST IRON AS INDICATED IN THE DETAIL.

C. COATING - UNDIPPED.

D. COVER SHALL CONFORM TO DIMENSION AND WEIGHT REQUIREMENTS.

E. COVER SHALL NOT BE OUT OF ROUND.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

GRAVITY SEWER

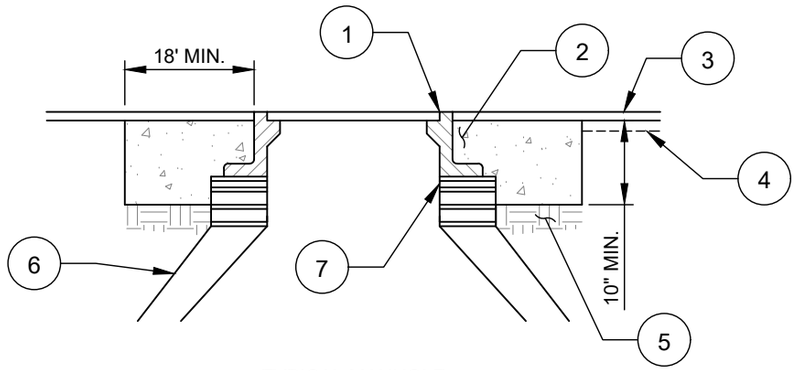
TYPE 6 MANHOLE COVER
30-INCHES DIAMETER (CLEAR OPENING)
SOLID - NO VENT HOLE, NO GASKET, NO CAM LOCK

NO SCALE

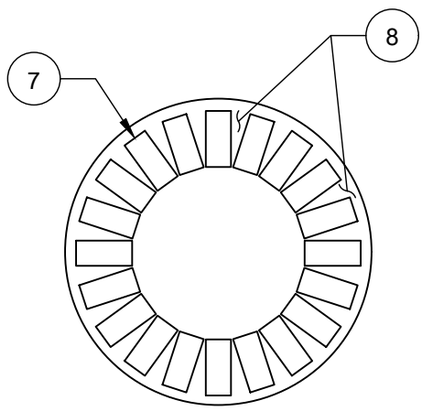
VERSION
2.0

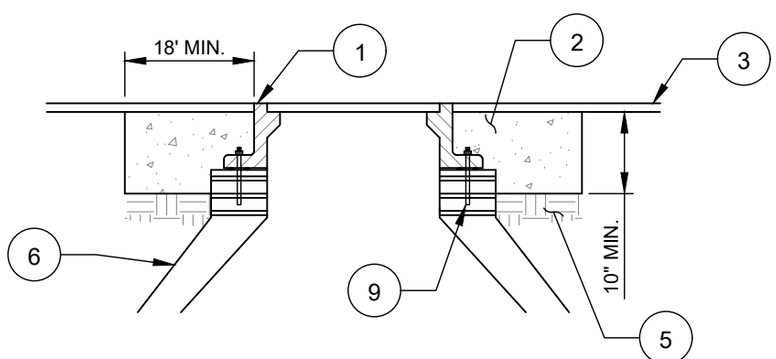
DATE
01/2025

DETAIL
11.3.10



TYPICAL MANHOLE





TYPICAL MANHOLE

NO.	DESCRIPTION:
1.	CLTW STANDARD FRAME AND COVER.
2.	CONCRETE - 3,600 PSI.
3.	NEW ASPHALT OVERLAY.
4.	OLD PAVEMENT.
5.	COMPACTED SUBGRADE.
6.	MANHOLE CONE.
7.	USE MIN. 1/2" BRICK PAVERS FOR ADJUSTMENT WITH 1/4" MORTAR JOINTS.
8.	FILL ALL VOIDS SOLID WITH MORTAR.
9.	4 ANCHOR BOLTS ANCHOR FRAME TO SOLID BRICK, BLOCK OR CONCRETE. SET FRAME ON 2 RINGS OF BUTYL RUBBER MASTIC ROPE.

NOTES:

A. FOR TYPICAL MANHOLES, REMOVE AND REPLACE ANCHOR NUTS AND WASHERS. REMOVE OLD BUTYL RUBBER MASTIC AS APPROVED.

B. MANHOLE ADJUSTMENTS WILL BE COMPLETED AT LEAST 36 HOURS BEFORE RESURFACING.

C. 18" MINIMUM WIDTH OF EXCAVATION AROUND MANHOLE.

D. DISTURBED AREAS AROUND STRUCTURE ADJUSTMENTS ARE TO BE TAMPED AND FILLED WITH 3,600 PSI "HIGH EARLY" PORTLAND CEMENT CONCRETE.

E. MORTAR USED TO ADJUST STRUCTURES IS TO COMPLY WITH THE N.C. DEPARTMENT OF TRANSPORTATION'S STANDARD SPECIFICATIONS FOR ROADS AND STRUCTURES.

F. BRICK PAVERS USED TO ADJUST STRUCTURES MUST HAVE A MINIMUM THICKNESS OF 1/2 INCH AND A COMPRESSIVE STRENGTH OF AT LEAST 6,000 PSI.

G. WOODEN WEDGES DRIVEN INSIDE THE BASE OF THE MANHOLE RING SHALL BE UTILIZED TO PREVENT THE STRUCTURE FROM SETTLING BEFORE CONCRETE AND MORTAR SET.

H. THE BRICK PAVERS WILL BE LAID ON A FULL MORTAR BED SO THAT THE LONGEST DIMENSION OF THE BRICK WILL BE PERPENDICULAR TO THE MANHOLE STRUCTURE WALL. ALL VOIDS BETWEEN PAVERS SHALL BE FILLED WITH MORTAR.

I. NO MORE THAN A 3/8 INCH JOINT WILL BE ALLOWED BETWEEN THE BRICK.

J. ALL DAMAGED OR DETERIORATED STRUCTURE WALL ARE TO BE REPORTED TO THE INSPECTOR OTHERWISE CONTRACTOR ASSUMES RESPONSIBILITY FOR STRUCTURE FAILURE.

K. IF THE SUM OF PREVIOUS ADJUSTMENTS PLUS THE NEW ONE ARE EQUAL OR GREATER THAN A STANDARD BRICK COURSE, OLD MORTAR AND SHIMS SHALL BE REMOVED DOWN TO THE PREVIOUS FULL BRICK COURSE AND A NEW STANDARD BRICK LAYER SHALL BE INSTALLED.

L. ALL CONCRETE SHALL BE VIBRATED IN ACCORDANCE WITH N.C. DEPARTMENT OF TRANSPORTATION SPECIFICATIONS.

M. CONCRETE ON MANHOLE TO BE POURED TO THE BOTTOM OF THE FIRST FULL COURSE OF BRICK OR 10" MINIMUM.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
GRAVITY SEWER

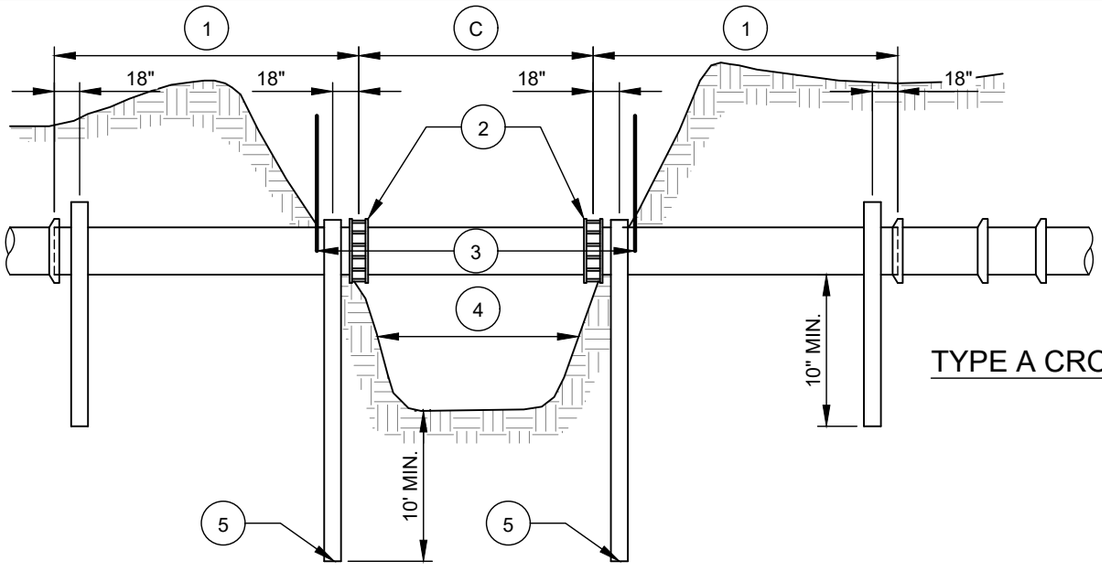
RESURFACING VERTICAL FRAME AND COVER ADJUSTMENT FOR PAVEMENT

NO SCALE

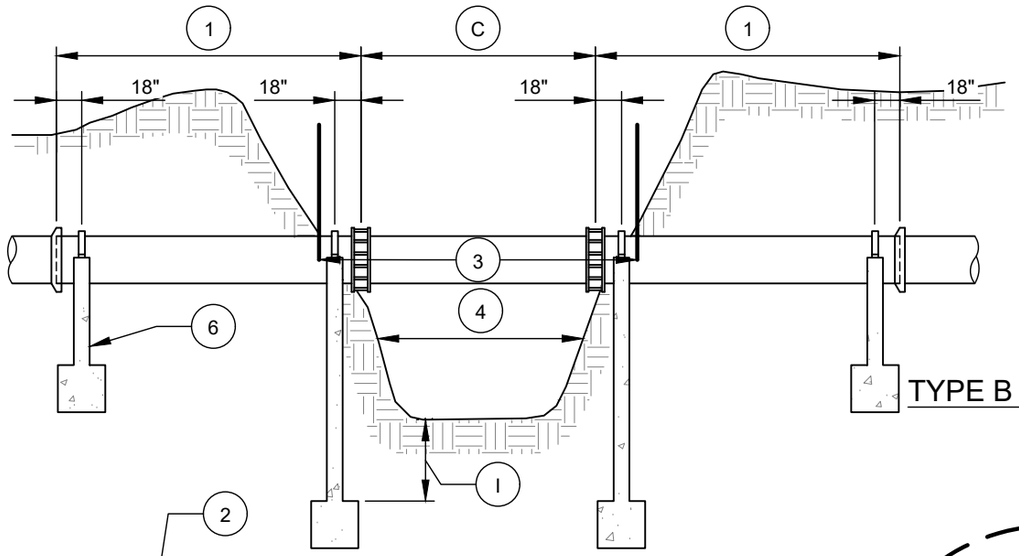
VERSION 1.0

DATE 04/2024

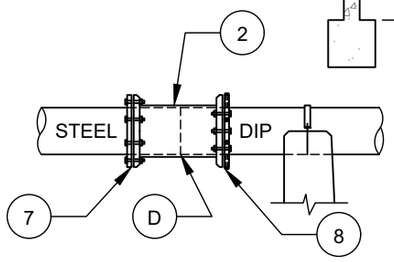
DETAIL 11.3.11



TYPE A CROSSING



TYPE B CROSSING



ENLARGED DETAIL

NOTES FOR TYPE A CROSSING:

A. MINIMUM DEPTH IS BASED ON BLOW COUNTS/BEARING CAPACITY AS SPECIFIED.

B. MAXIMUM HEIGHT FROM PIPE TO UNDISTURBED SOIL IS 20'.

NOTES FOR TYPE A AND B CROSSING:

C. VARIES (40' MAX. 8" & 10" PIPE) (50' MAX. 12" AND LARGER PIPE) "HIGH STRENGTH" STEEL PIPE WITH LINING/COATING PER SPECIFICATIONS (SEE NOTE E).

D. END OF STEEL PIPE TO BE CENTERED INSIDE COUPLING.

E. STEEL PIPE MUST BE SEAMLESS OR STRAIGHT SEAM OR SPIRAL WELD.

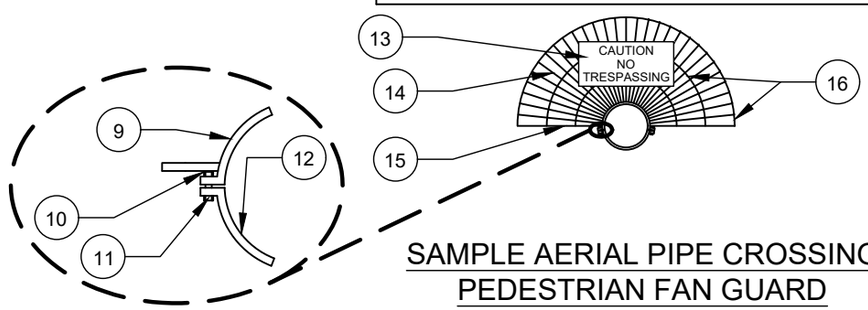
F. TRANSITION COUPLING SHALL BE A LONG PATTERN SOLID SLEEVE AND RESTRAINED ON D.I.P. END.

G. FOR CREEK CHANNELS LESS THAN 20' IN WIDTH, THE PIPE CAN BE R.J. D.I.P. WITHOUT TRANSITION COUPLINGS.

H. TERMINATE TRACER WIRE AT PEDESTRIAN GUARD OR PIPE.

NOTES FOR TYPE B CROSSING:

I. 4' MINIMUM. FOOTING DEPTH SHALL BE TO SUITABLE GRADE AS DETERMINED BY THE ENGINEER, SHALL NOT BE LESS THAN SHOWN (EXCEPT WHERE PIER IS ANCHORED TO SOLID ROCK. TOP OF FOOTING SHALL NOT BE ABOVE TOP OF SOLID ROCK).



SAMPLE AERIAL PIPE CROSSING
PEDESTRIAN FAN GUARD

NO.	DESCRIPTION:
1.	FULL JOINT DIP.
2.	LONG PATTERN SLEEVE. LENGTH VARIES DEPENDING ON PIPE DIAMETER.
3.	PEDESTRIAN FAN GUARD (SEE DET. ON THIS SHEET). INSTALLATION AS PER CLTW.
4.	CREEK CHANNEL.
5.	STEEL H-PILE PIERS. SEE CLTW STD. DETAIL.
6.	REINFORCED CONCRETE PIER. SEE CLTW STD. DETAIL.
7.	NON-RESTRAINED JOINT (STANDARD MJ GLAND PACK) WITH OVERSIZE (IPS) TRANSITION GASKET.
8.	WEDGE ACTION JOINT RESTRAINT (MEGA-LUG).
9.	3/8" X 3" STEEL BAR.
10.	ADEQUATE CLEARANCE FOR BOLTS.
11.	5/8" X 3" BOLTS.
12.	O.D. OF PIPE.
13.	"NO TRESPASSING" SIGN.
14.	31-5/8" DIAMETER RODS @ 6" O.C.. WELD EACH ROD TO PIPE CLAMP.
15.	EPOXY COATING (TYP.).
16.	5/8" DIAMETER ROD WELDED TO END OF EACH RADIAL ROD (TYP.).

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
GRAVITY SEWER

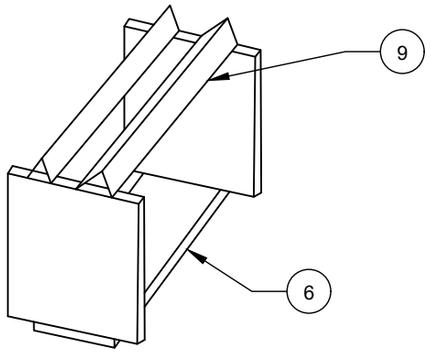
ELEVATED CREEK CROSSING

NO SCALE

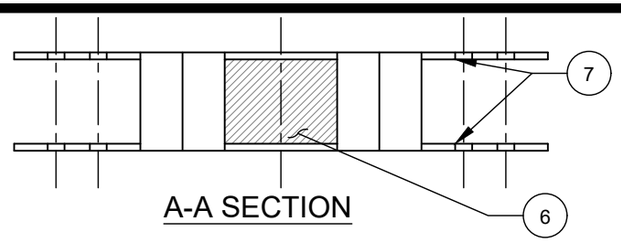
VERSION
1.0

DATE
04/2024

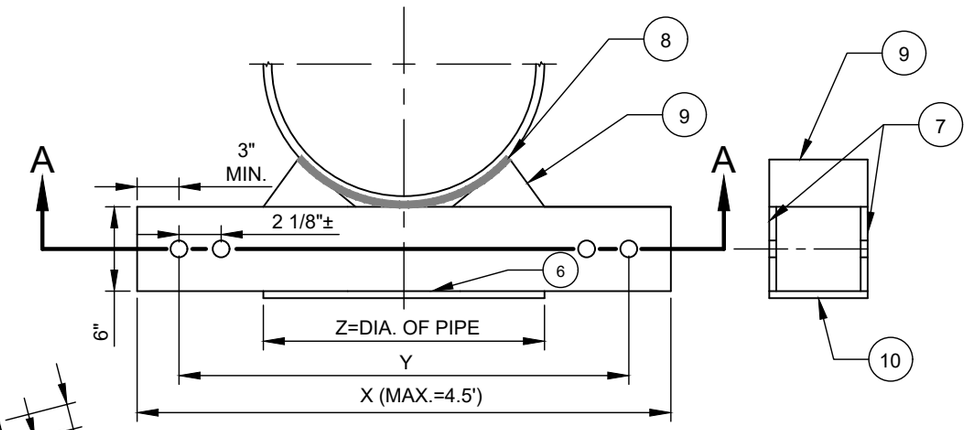
DETAIL
11.4.1



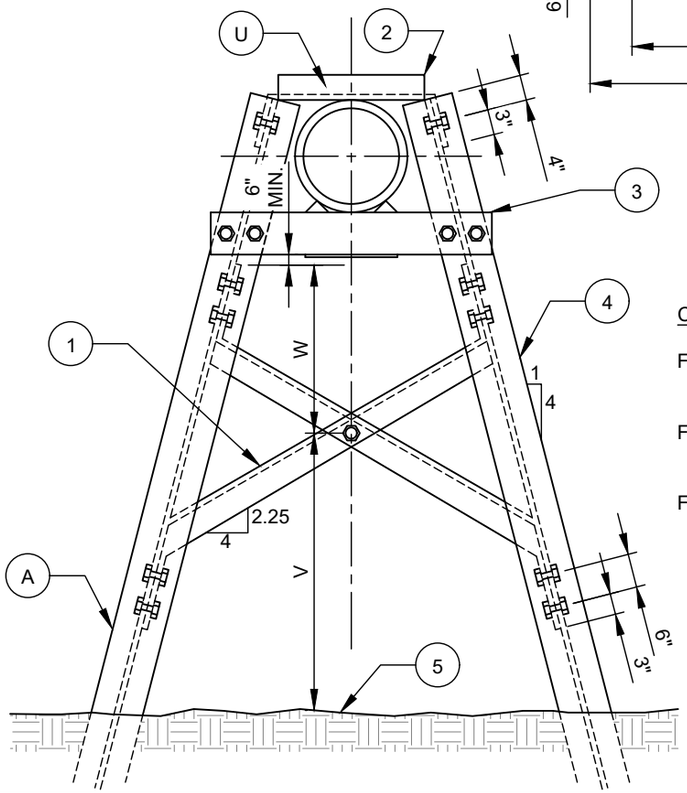
CRADLE ISOMETRIC VIEW



A-A SECTION



CRADLE DETAIL



CROSS BRACING SIZES

FOR 12" PIPE AND SMALLER:
USE 3" X 3" X 7/16" ANGLES

FOR 15"-18" PIPE:
USE 4" X 4" X 5/16" ANGLES

FOR 20"-24" PIPE:
USE 5" X 5" X 3/8" ANGLES

NO.	DESCRIPTION:
1.	CROSS BRACING (CUT WEB AND BEND).
2.	C 6x10.5 TOP BRACE (CUT FLANGE AND BEND WEB).
3.	CRADLE (SEE CRADLE DETAIL).
4.	HP 8 X 36, HP 10 X 42, HP 12 X 53, HP 12 X 69 OR HP 12 X 74 OR W 8 X 8 X 48, W 8 X 8 X 58, W 10 X 10 X 60, W 10 X 10 X 68, W 12 X 12 X 72 OR W 12 X 12 X 79 PILES.
5.	FINISHED GRADE.
6.	1/2" STEEL BOTTOM PLATE.
7.	3/4" STEEL PLATE.
8.	1/4" NEOPRENE PAD.
9.	1/2" STEEL ANGLE WITH EQUAL SIDES.

NOTES:

A. ALL FIELD CUTS BY TORCH SHALL BE GROUND TO FLAT TRUE 90° ANGLES.

B. DIMENSIONS X AND Y VARY ACCORDING TO PIPE SIZE AND ELEVATION OF PIPE. THE MAXIMUM LENGTH OF X IS 4.5'.

C. DIMENSION Z IS EQUAL TO THE DIAMETER OF THE PIPE.

D. ALL STEEL PLATES SHALL MEET ASTM A36.

E. FOR 8" TO 18" PIPE, ALL BOLTS SHALL BE 7/8" IN DIAMETER AND MEET ASTM A325. FOR 24" PIPE, BOLTS ON THE CRADLE SHALL BE 1 INCH IN DIAMETER AND MEET ASTM A490. BOLTS SHALL BE AT LEAST 2 1/2" LONG. PLAIN ROUND WASHERS WILL BE REQUIRED.

F. BOLT HOLES SHALL BE 1/16" LARGER THAN THE DIAMETER OF THE BOLT AND SHALL BE DRILLED.

G. THIS CRADLE SHALL NOT BE USED FOR PIPE LARGER THAN 24" IN DIAMETER.

H. ATTACH THE CRADLE TO THE PILES WITH 4 BOLTS ON EACH SIDE [TOTAL OF 8 BOLTS].

I. ATTACH BOTTOM PLATE TO CRADLE SIDES WITH A CONTINUOUS 3/8" FILLET WELD.

J. THE 1/2" STEEL ANGLES SHALL BE SPOT WELDED TO THE SIDES OF THE CRADLE AND SHALL BE 1/4TH OF THE PIPE DIAMETER.

K. ADD 1/4" NEOPRENE PAD OR SIMILAR TO PROTECT PIPE FROM CRADLE.

L. MAXIMUM HEIGHT FROM PIPE TO UNDISTURBED SOIL IS 20'.

M. PIPE SHALL FIT SNUGLY.

N. V SHALL EQUAL W OR AS APPROVED.

O. SEE STEEL H-PILE SPECIFICATIONS.

P. PILES SHALL BE DRIVEN TO A MINIMUM DEPTH OF 10' BELOW GROUND OR AS DIRECTED BY THE ENGINEER.

Q. PILES SHALL BE DRIVEN TO A DEPTH AT WHICH PILE BEARING CAPACITY IS 20 TONS OR AS APPROVED BY THE ENGINEER.

R. THESE PIERS SHALL BE USED FOR DUCTILE IRON PIPE OR HIGH STRENGTH STEEL PIPE ONLY.

S. ALL STEEL TO BE HOT DIP GALVANIZED. SEE GALVANIZED SPECIFICATIONS.

T. PAINTING IN BLACK OVER THE HOT DIP GALVANIZED COMPONENTS IS ACCEPTABLE TO CLTW.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
GRAVITY SEWER

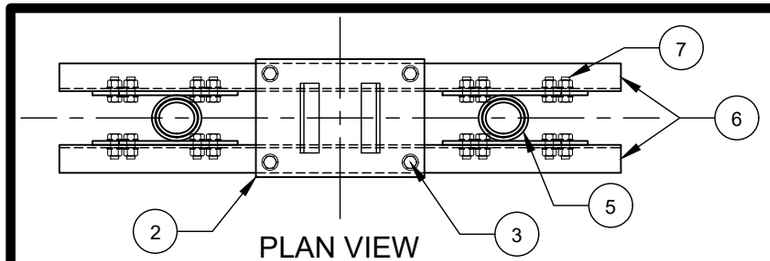
STEEL H-PILE PIERS FOR 24" PIPE AND SMALLER

NO SCALE

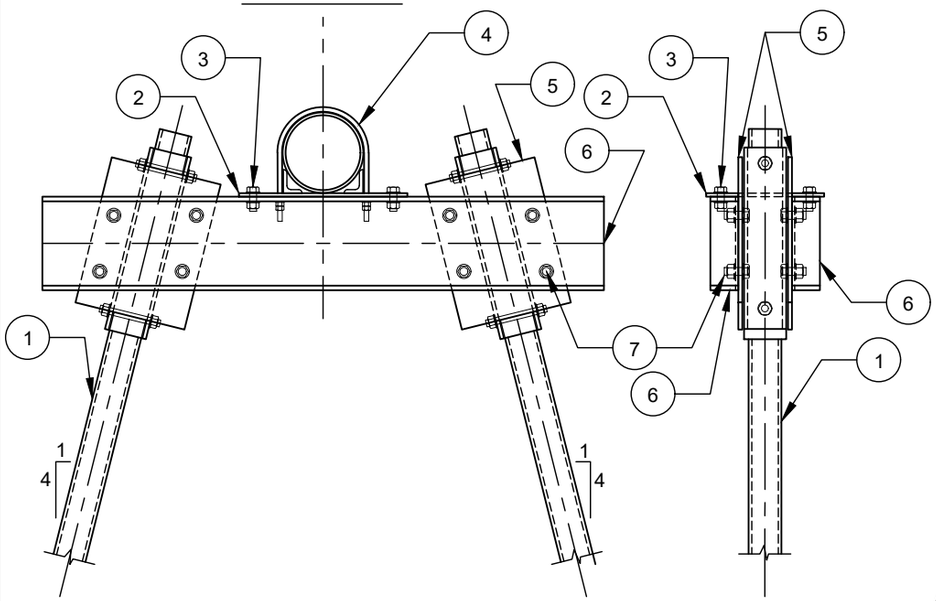
VERSION 1.0

DATE 04/2024

DETAIL 11.4.2



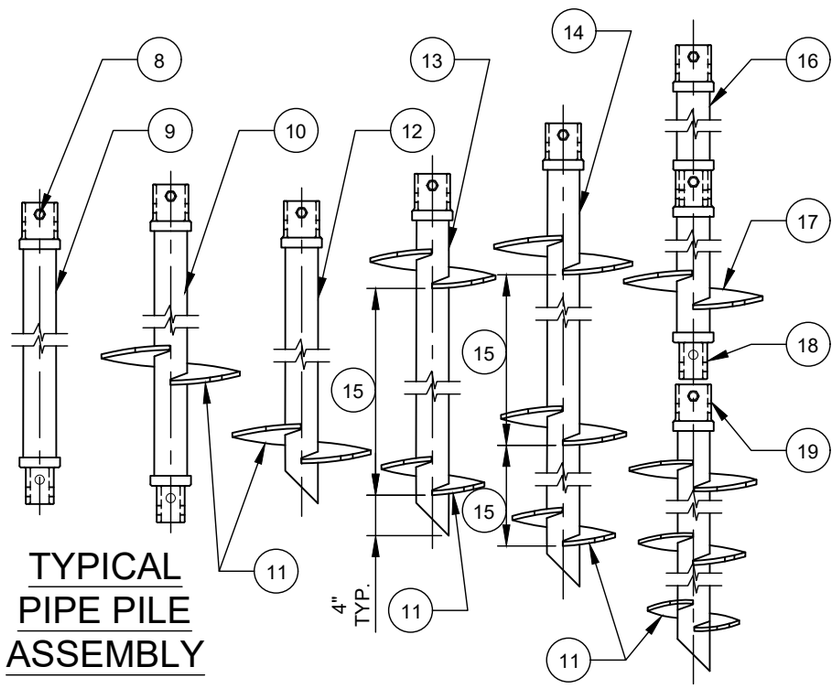
PLAN VIEW



ELEVATION VIEW

SIDE VIEW

TWO-PILE HELICAL PIER PILE CAP



TYPICAL PIPE PILE ASSEMBLY

NO.	DESCRIPTION:
1.	HELICAL PIER.
2.	PIPE SADDLE COMPRISED OF STEEL ANGLE AND STEEL PLATE.
3.	BOLTS AT PIPE SADDLE CONNECTION.
4.	CLAMPING U-ROD WITH THREADED ENDS.
5.	COLLAR ASSEMBLY INSTALLED OVER HELICAL PIER LEAD SECTION AFTER CUTTING SQUARE END JOINT OFF LEAD.
6.	CHANNEL INSTALLED ON EASCH SIDE OF COLLAR ASSEMBLY.
7.	BOLTS AT CHANNEL TO COLLAR CONNECTION EACH SIDE AT EACH COLLAR. HOLES IN CHANNEL WEB TO BE FIELD DRILLED.
8.	HEX HEAD BOLT & NUT.
9.	PIPE PILE EXTENSION.
10.	PIPE PILE EXTENSION WITH HELIX.
11.	HELIX.
12.	SINGLE HELIX LEAD.
13.	DOUBLE HELICES LEAD.
14.	TRIPLE HELICES LEAD.
15.	3 X LOWER HELIX DIAMETER.
16.	EXTENSION SHAFT.
17.	SINGLE HELIX EXTENSION.
18.	CAST STEEL MALE COUPLING.
19.	CAST STEEL FEMALE COUPLING.

NOTES:

A. SINGLE OR MULTI HELIX, NUMBER AND DIAMETER OF HELIX PLATE(S) VARY DEPENDING ON PIER LOAD AND SOIL CONDITIONS.

B. FINISH TO BE HOT DIP GALVANIZED.

C. DIMENSIONS OF THE CENTRAL SHAFT AND THE NUMBER, SIZE, SPACING, AND THICKNESS OF THE HELICAL BEARING PLATES SHALL BE DESIGNED AND FABRICATED TO SUPPORT SPECIFIED DESIGN LOADS.

D. HELICAL PIERS MAY ONLY BE USED ON MINOR CREEKS NEAR THE CREEK HEADWATERS WITHOUT A 100 YEAR FLOODPLAIN ELEVATION.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

GRAVITY SEWER

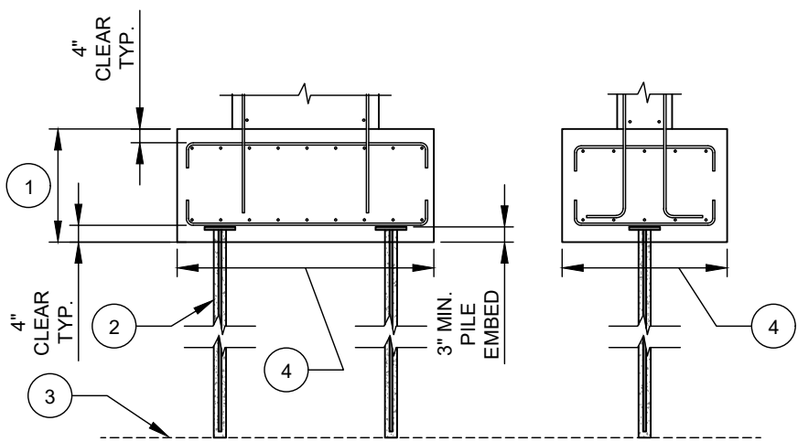
HELICAL STEEL PILE FOR USE ON 8 INCH PIPE ONLY

NO SCALE

VERSION 1.0

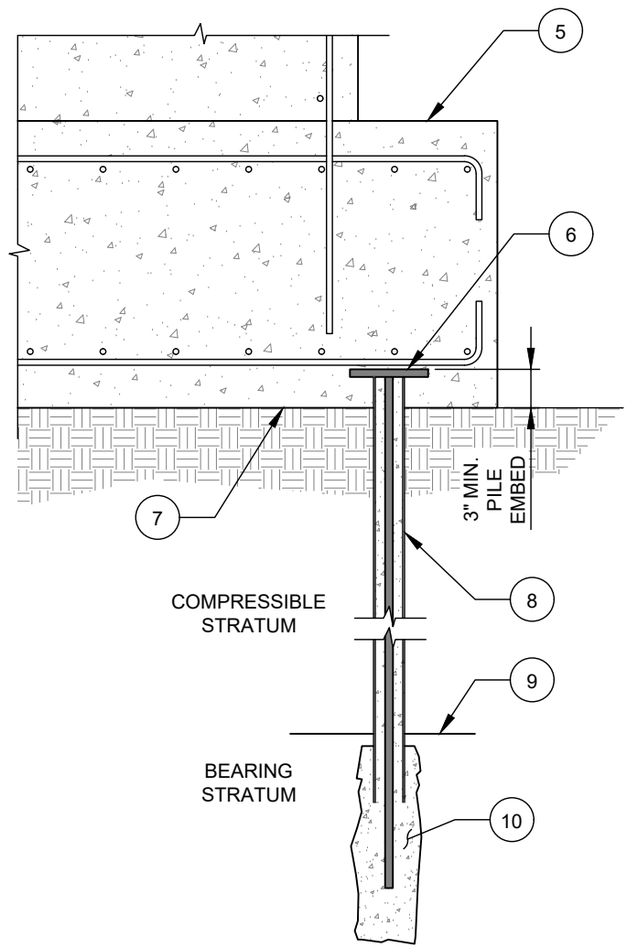
DATE 04/2024

DETAIL 11.4.3



FRONT VIEW SIDE VIEW

PIER W/ MICROPILE



MICROPILE

NO.	DESCRIPTION:
1.	PILE CAP THICKNESS. SEE NOTE B.
2.	MICROPILE.
3.	PILE DEPTH.
4.	PILE CAP LENGTH OR WIDTH. SEE NOTE B.
5.	TOP OF FOOTING.
6.	PILE CAP ANCHORAGE.
7.	BOTTOM OF FOOTING.
8.	TEMPORARY CASING. UPON COMPLETION OF PILE, CASING MAY BE LEFT IN PLACE THROUGH THE COMPRESSIBLE STRATUM.
9.	TOP OF DENSE ROCK/SOIL.
10.	GROUT.

NOTES:

A. CONCRETE PIER TO BE MIN. 4,000 P.S.I. CONCRETE.

B. ENGINEER OF RECORD TO DETERMINE EXTENT OF PILE CAP REQUIRED AND REINFORCEMENT REQUIRED WITHIN PILE CAP.

C. MICROPILE SPACING AND PLACEMENT SHALL BE DETERMINED BY THE DESIGN ENGINEER.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
GRAVITY SEWER

MICROPILE

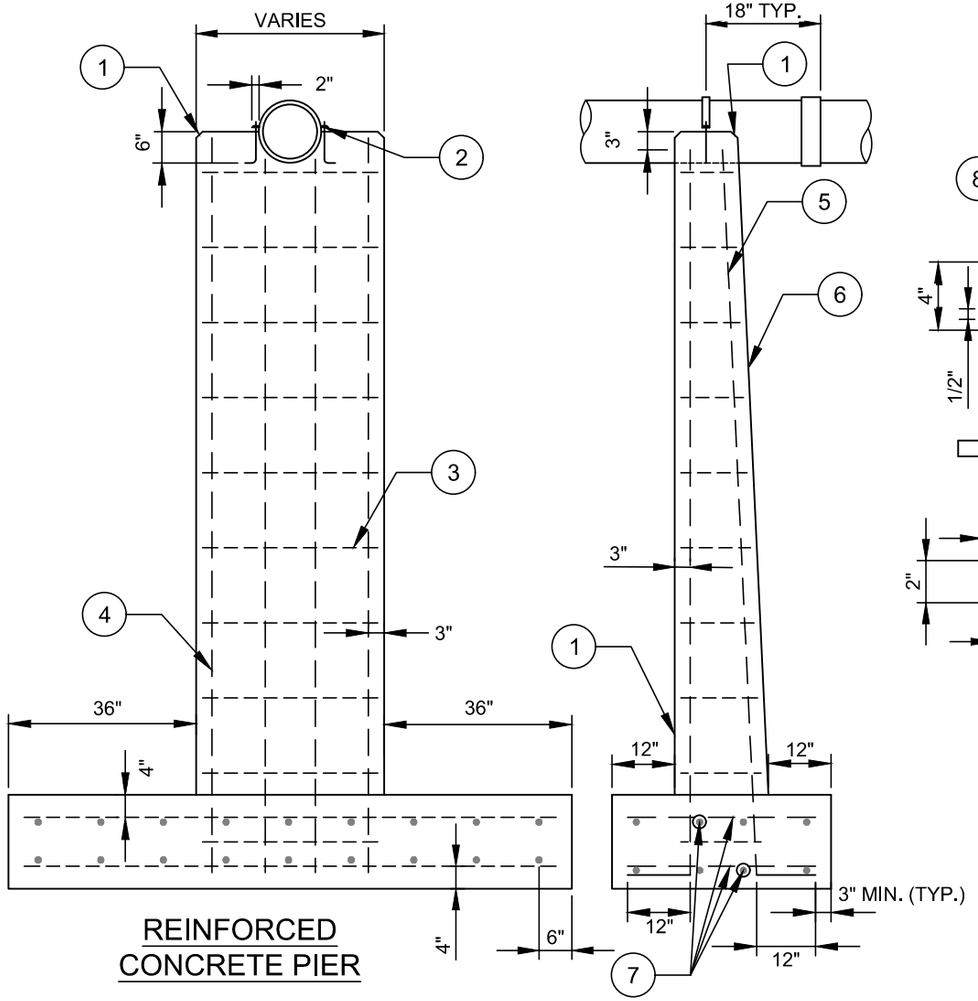
NO SCALE

VERSION 1.0

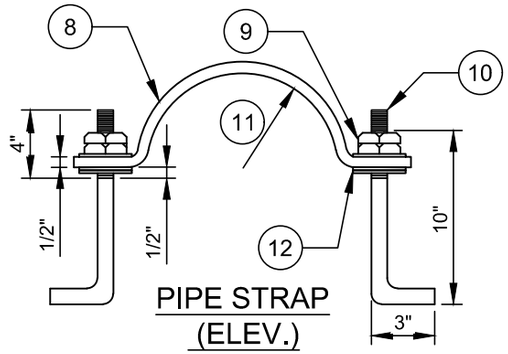
DATE 04/2024

DETAIL 11.4.4

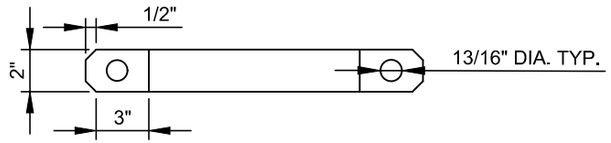
PIPE SIZE	PIER WIDTH FOR 90° CROSSING
15"	3'-0"
18"	3'-6"
24"	4'-0"
30"	4'-9"
36"	5'-6"
42"	6'-6"
48"	7'-0"



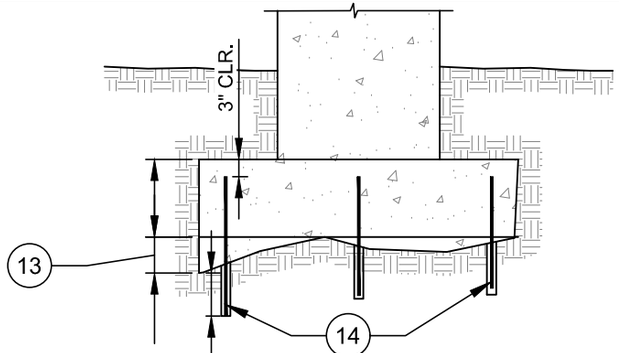
REINFORCED CONCRETE PIER



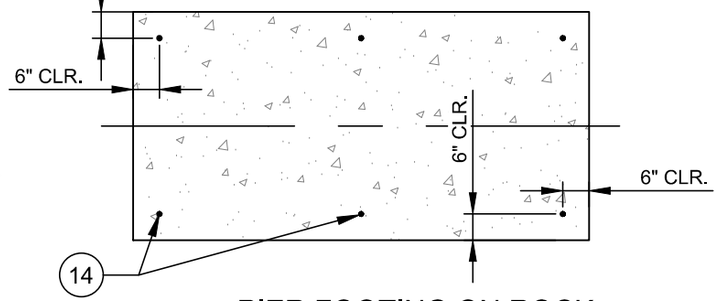
PIPE STRAP (ELEV.)



PIPE STRAP (PLAN)



PIER FOOTING ON ROCK (ELEV.)



PIER FOOTING ON ROCK (PLAN)

NO. DESCRIPTION:

1. 1 INCH CHAMFER ALL CORNERS.
2. PIPE STRAPS FOR PIERS AND BOLT (ELEVATION AND PLAN VIEW ON THIS SHEET).
3. #3 REBAR TIES @ 12" O.C.
4. #6 REBAR @ 10" O.C.
5. LAP REBAR 24" IF SPLICE IS REQUIRED.
6. TAPER 1 INCH PER FOOT (TOWARD CREEK).
7. #6 REBAR @ 12" O.C.
8. 2" x 1/2" STRAP - 304 S.S.
9. DOUBLE JAM NUT 316 STAINLESS STEEL.
10. 3/4" DIAMETER ANCHOR BOLT - 316 S.S.
11. R=1/2 OUTSIDE DIAMETER PIPE BARREL.
12. PROVIDE MULTIPLE 316 S.S. WASHERS UNDER STRAP SUCH THAT STRAP IS PULLED DOWN TIGHT ON PIPE AND PIER.
13. CONCRETE FOR LEVELING MAY BE POURED WITH FOOTING.
14. #8 REBAR DOWELS, TYPICAL. GROUT DOWELS WITH NON-SHRINK GROUT IN 2" DIAMETER HOLES. HOLES TO BE CLEANED WITH WATER AND COMPRESSED AIR.

NOTES:

A. MAT STEEL FOR FOOTING SHALL BE TIED TO DOWELS.
B. ALL CONCRETE TO BE 3,600 PSI.
C. MAXIMUM HEIGHT REINFORCED CONCRETE PIERS TO BE 20'.
D. FOOTING THICKNESS SAME AS BASE THICKNESS OF PIER, BUT NOT TO EXCEED 2'.
E. PIERS TO BE BUILT WITH LONG SIDE PARALLEL TO CREEK FLOW.
F. PIER TO BE CENTERED ON FOOTING WHEN PIPE IS PARALLEL TO CREEK.
G. PIPE TO BE SET 1/2 IN PIER AND 1/2 PROTRUDING ABOVE PIER. WHEN PIERS ARE PLACED PARALLEL TO THE FLOW OF THE CREEK AND THE PIPE IS ON A SKEW WITH THE PIER, HOLDING STRAPS MAY STILL BE PLACED AT RIGHT ANGLES TO THE PIPE, PROVIDING THE ANCHOR BOLTS ARE NOT SET WITH A CLEARANCE OF LESS THAN 2" TO THE SURFACE OF THE PIER.
H. NO REINFORCING STEEL TO BE PLACED WITH A CLEARANCE OF LESS THAN 3" TO THE SURFACE OF THE PIER.
I. ANCHOR BOLTS, NUTS, WASHERS, AND STRAPS SHALL BE STAINLESS STEEL.
J. STAINLESS STEEL ANTI-SEIZE COMPOUND SHALL BE LIBERALLY APPLIED TO THE THREADS.
K. FOR PIPES 24" AND LARGER, USE 1 INCH DIAMETER BOLTS AND 1 1/16" DIAMETER HOLE IN STRAP.
L. HOLES TO BE DRILLED IN STRAP.
M. PROVIDE MULTIPLE WASHERS UNDER STRAP SUCH THAT STRAP IS PULLED DOWN TIGHT ON THE PIPE AND PIER.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
GRAVITY SEWER

REINFORCED CONCRETE PIER

NO SCALE

VERSION 1.0

DATE 04/2024

DETAIL 11.4.5

NO.	DESCRIPTION:
1.	18" (UNLESS FIELD CONDITIONS DICTATE OTHERWISE).
2.	CONCRETE OR COMPACTED CLAY (BENTONITE). COMPACTED CLAY MINIMUM 12" THICK LAYER OUTSIDE TRENCH SHALL BE 95% OF THE STANDARD PROCTOR DRY DENSITY TO MINIMUM OF 5% OF THE OPTIMUM COMPACTION MOISTURE CONTENT.
3.	TRENCH.
4.	PIPE O.D..
5.	TRACER WIRE INSTALLED OVER TOP OF COLLAR PER CLTW STANDARD DETAIL.

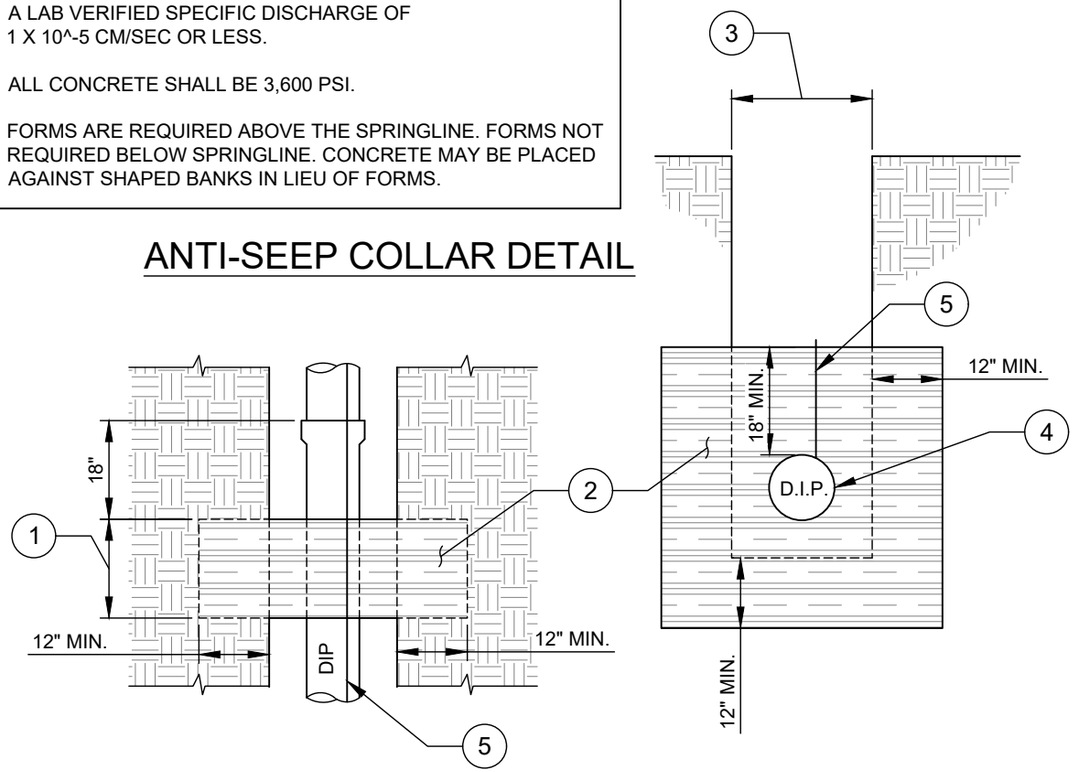
NOTES:

A. THE CLAY SHALL BE TESTED BY AN INDEPENDENT SOILS LAB TO VERIFY ITS SUITABILITY. COMPACTED CLAY SHALL HAVE A LAB VERIFIED SPECIFIC DISCHARGE OF 1 X 10^-5 CM/SEC OR LESS.

B. ALL CONCRETE SHALL BE 3,600 PSI.

C. FORMS ARE REQUIRED ABOVE THE SPRINGLINE. FORMS NOT REQUIRED BELOW SPRINGLINE. CONCRETE MAY BE PLACED AGAINST SHAPED BANKS IN LIEU OF FORMS.

ANTI-SEEP COLLAR DETAIL



PLAN VIEW

VERTICAL VIEW

NO.	DESCRIPTION:
1.	CONCRETE TO BE 3,600 PSI.
2.	3 No. 4 REBARS.
3.	CONCRETE PLACED ON UNDISTURBED SOIL AS APPROVED BY THE ENGINEER.
4.	PIPE O.D..
5.	INSTALL 1" CONDUIT FOR TRACER WIRE TO RUN THROUGH. TRACER WIRE INSTALLED PER CLTW STANDARD DETAIL.

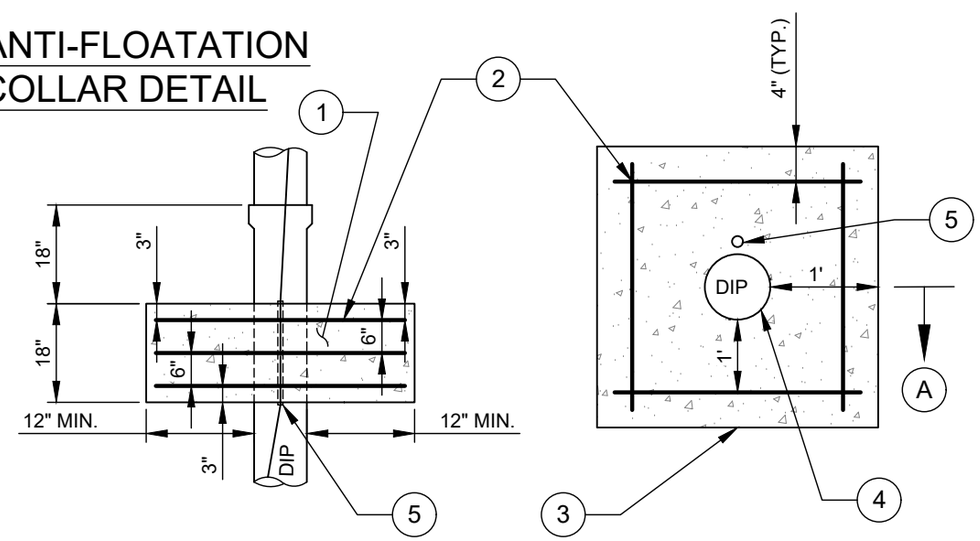
NOTES:

A. FORMS ARE REQUIRED ABOVE THE SPRINGLINE. FORMS NOT REQUIRED BELOW SPRINGLINE. CONCRETE MAY BE PLACED AGAINST SHAPED BANKS IN LIEU OF FORMS.

B. PROVIDE PE STAMPED ANTI-FLOATATION CALCULATION. A LARGER CONCRETE COLLAR MAY BE REQUIRED IF BUOYANCY IS NOT PREVENTED.

C. NO PIPE JOINTS IN THE CONCRETE BLOCK. JOINTS SHALL BE 18" BEHIND THE BELL.

ANTI-FLOATATION COLLAR DETAIL



PLAN VIEW

VERTICAL VIEW

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
GRAVITY SEWER

ANTI-SEEP COLLAR & ANTI-FLOATATION COLLAR

NO SCALE

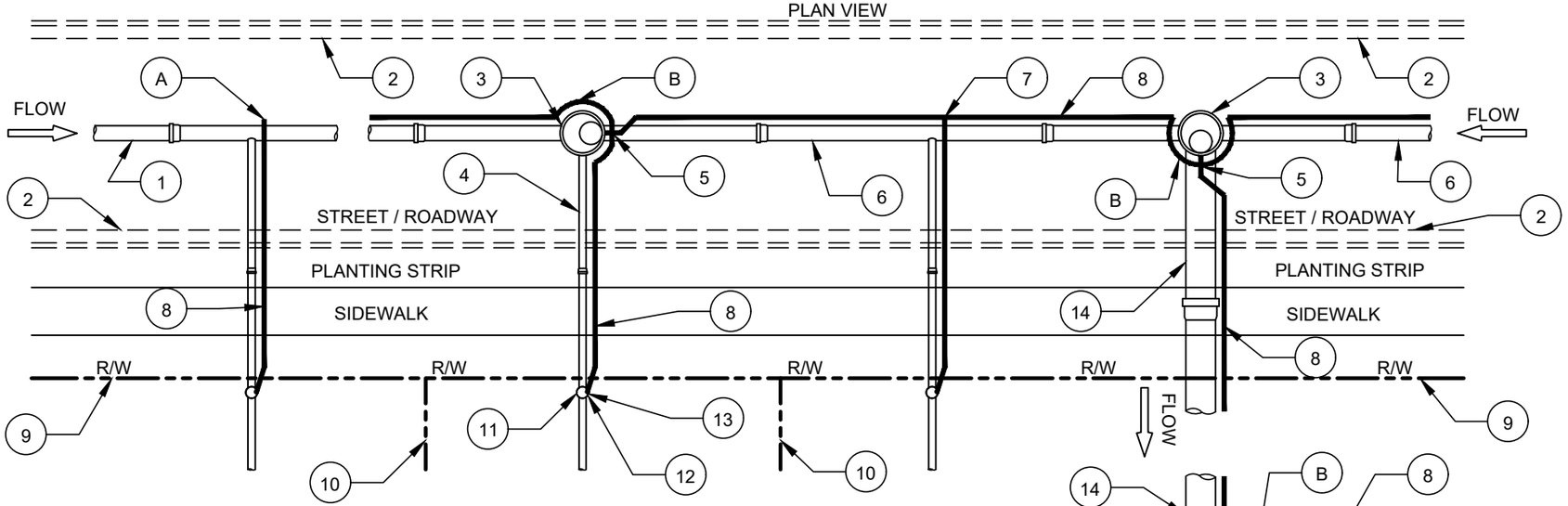
VERSION 1.0

DATE 04/2024

DETAIL 11.4.6

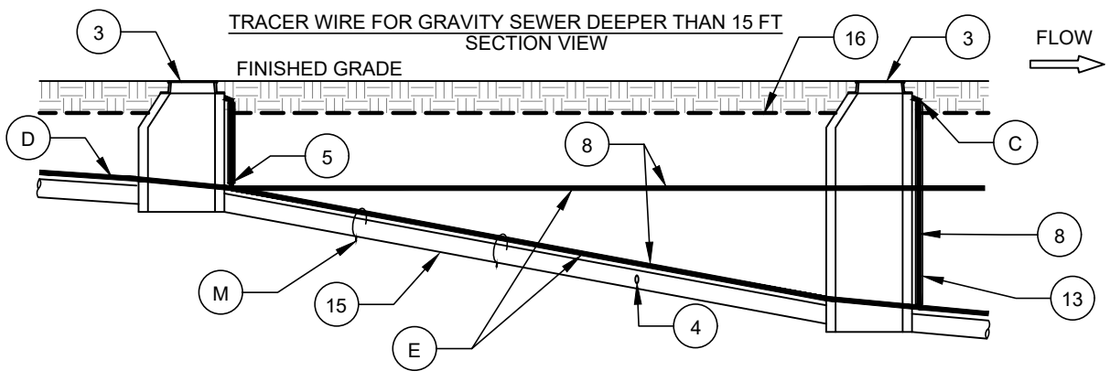
STREET VIEW - GRAVITY SEWER TRACER WIRE

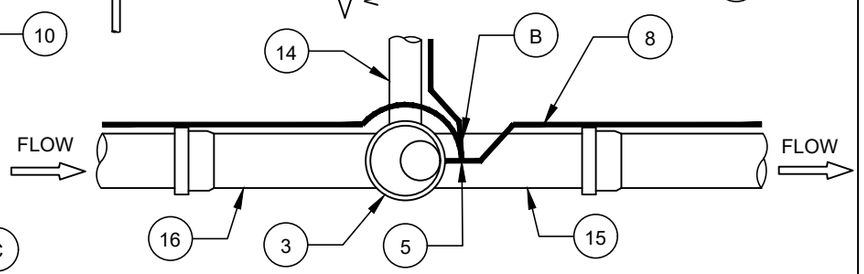
PLAN VIEW

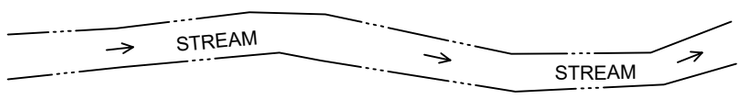


TRACER WIRE FOR GRAVITY SEWER DEEPER THAN 15 FT

SECTION VIEW



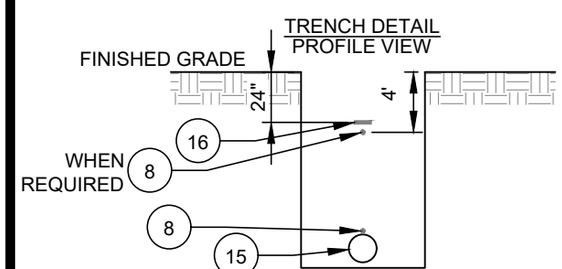




NO.	DESCRIPTION:
1.	EXISTING SEWER MAIN LINE WITHOUT TRACER WIRE.
2.	CURB.
3.	SEWER MANHOLE (TYP.).
4.	SEWER SERVICE LATERAL (TYP.).
5.	NO SPLICE.
6.	SEWER MAIN LINE.
7.	SPLICE (SEE CLTW STD. DETAIL).
8.	#12 GAUGE SOLID COPPER TRACER WIRE WITH 30 MILS GREEN HDPE INSULATION (TYP.).
9.	R/W / EASEMENT LINE (TYP.).
10.	PROPERTY / EASEMENT LINE.
11.	CLEANOUT (TYP.).
12.	VALVE BOX ASSEMBLY (TYP.) (SEE CLTW STD. DETAIL).
13.	CONDUIT FOR VERTICAL WIRE
14.	SEWER TRUNK LINE.
15.	SEWER PIPE.
16.	6" WIDE GREEN SEWER WARNING TAPE.

TRENCH DETAIL

PROFILE VIEW



NOTES:

A. FOR NEW SERVICE ON EXISTING MAIN WHERE NO TRACER WIRE IS LOCATED ON SEWER MAIN, PLACE TRACER WIRE END AT BOTTOM EDGE OF TRENCH AWAY FROM MAIN AND LATERAL.

B. WRAP TRACER WIRE AROUND OUTSIDE OF MANHOLE (SEE CLTW STD. DETAIL).

C. SEE MANHOLE CONNECTION DETAIL.

D. GRAVITY SEWER MAIN LESS THAN 15' DEPTH TRACING WIRE SHALL BE ATTACHED TO PIPE.

E. GRAVITY SEWER MAIN AND LATERAL GREATER THAN 15' DEPTH. TRACER WIRE SHALL BE ATTACHED TO PIPE AND PLACED AT A DEPTH OF 4' BELOW GROUND DIRECTLY ABOVE SEWER PIPE.

F. TRACER WIRE SHOWN AWAY FROM PIPE FOR CLARITY. TRACER WIRE SHALL BE INSTALLED IMMEDIATELY ADJACENT TO THE SEWER PIPE. TRACER WIRE SHALL BE FASTENED TO THE PIPE WITH ZIP TIES OR DUCT TAPE AT 10' INTERVALS.

G. TRACER WIRE SHALL BE SOLID COPPER #12 GAUGE WITH 30 MILS GREEN HDPE INSULATION.

H. TRACER WIRE SHALL BE CONTINUOUS FROM MANHOLE TO MANHOLE WITHOUT IN-LINE SPLICES EXCEPT WHERE REQUIRED FOR SEWER SERVICE LATERALS.

I. SPLICED CONNECTIONS SHALL BE ALLOWED BETWEEN THE MAIN LINE TRACER WIRE AND THE SERVICE LATERAL TRACER WIRE.

J. TRACER WIRE SHALL BE PROTECTED FROM DAMAGE DURING THE EXECUTION OF THE WORK. NO BREAKS OR CUTS IN THE TRACER WIRE OR INSULATION SHALL BE PERMITTED.

K. PRIOR TO ACCEPTANCE (POST PUNCH LIST) EACH WIRE SEGMENT SHALL PASS A CONDUCTIVITY TEST, WITNESSED BY THE ENGINEER OR ENGINEER'S REPRESENTATIVE.

L. FOR INSTALLING A NEW SERVICE LINE ON AN EXISTING MAIN WITH TRACER WIRE, INCLUDE 2' OF SLACK IN NEW TRACER WIRE AT THE SPLICE. THE CLEANOUT SHALL SERVE AS THE TEST PORT.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

GRAVITY SEWER

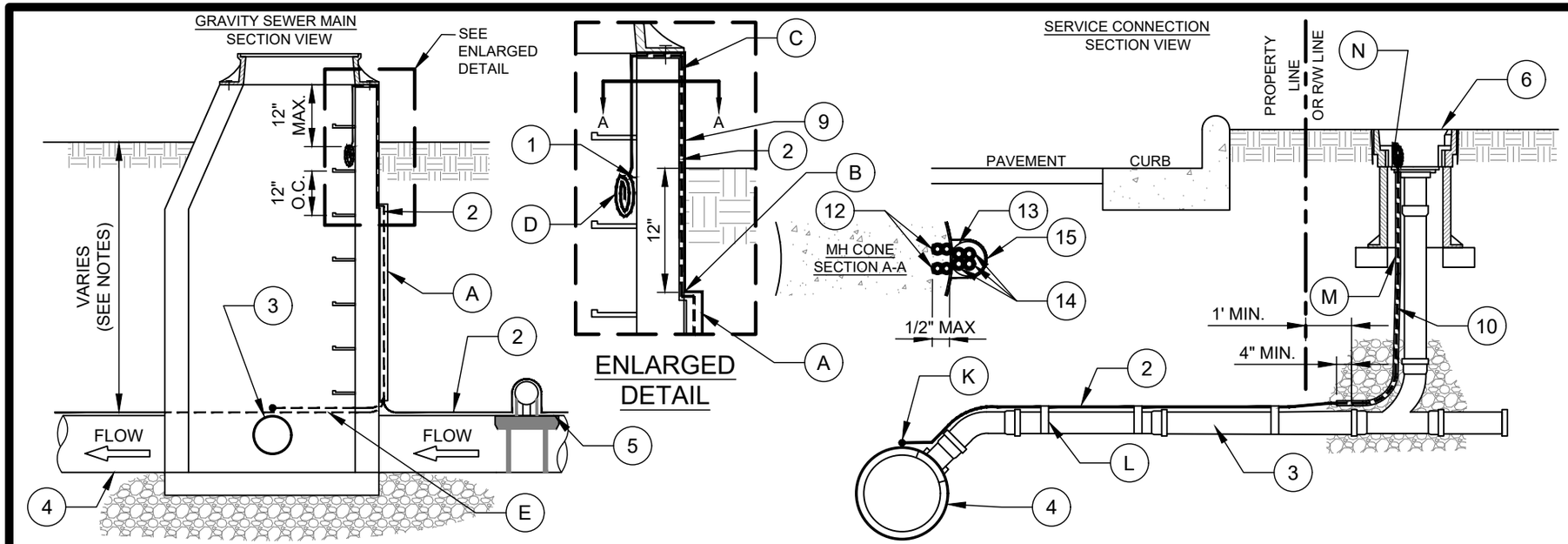
TRACER WIRE

NO SCALE

VERSION 2.0

DATE 01/2026

DETAIL 11.5.1



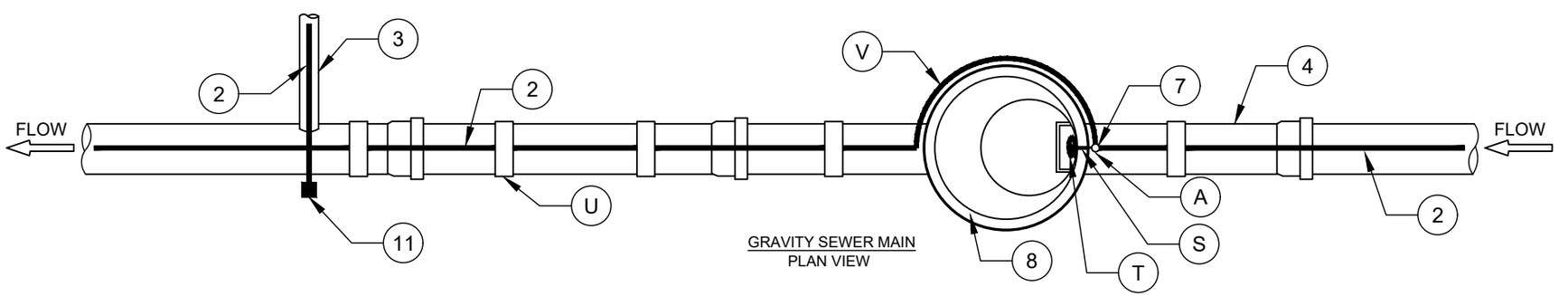
NO.	DESCRIPTION:
1.	NON-CORROSIVE FASTENER FOR TRACER WIRE (TYP.) 12" MAX. FROM TOP OF CONE.
2.	#12 GAUGE SOLID COPPER TRACER WIRES WITH 30 MILS GREEN HDPE INSULATION (TYP.).
3.	SEWER LATERAL.
4.	GRAVITY SEWER MAIN.
5.	SEWER SADDLE TAP.
6.	VALVE BOX ASSEMBLY (SEE CLTW STD. DETAIL).
7.	NO SPLICE.
8.	SEWER MANHOLE.
9.	6" WIDE BUTYL RUBBER JOINT SEALANT.
10.	1/4" OR 3/8" SDR9 PEX TUBING CONDUIT.
11.	ANODE.
12.	NOTCH CUT INTO CONCRETE.
13.	1" PVC CONDUIT.
14.	MULTIPLE TRACER WIRES.
15.	6" WIDE BUTYL RUBBER JOINT WRAP.

NOTES FOR GRAVITY SEWER MAIN (SECTION VIEW):

A. ALL VERTICAL WIRES AT MANHOLES SHALL BE PLACED IN 1 INCH ID PVC ELECTRICAL CONDUIT.
B. EXTEND CONDUIT UP AND TURN INTO NOTCH. TURN IN CONDUIT 12" BELOW GRADE FOR ALL MANHOLES. NEED 12" SO THE CONDUIT IS NOT IN ASPHALT IN ROADWAYS.
C. 1/2" MAX. DEEP NOTCH INTO CONCRETE (SIDE OF MANHOLE). ADD NOTCH IN TOP OF CONE FOR WIRE BETWEEN FRAME AND CONE. COVER NOTCH AND CONDUIT WITH 6" WIDE BUTYL RUBBER JOINT WRAP.
D. COIL AND SECURE WIRE TO FASTENER. LEAVE ENOUGH FREE WIRE TO EXTEND A MIN. OF 24".
E. WRAP EACH TRACER WIRE WIRE AROUND OUTSIDE OF MANHOLE (NO SPLICE).
F. TRACER WIRE SHALL BE AWG #12 GAUGE SOLID COPPER WITH 30 MILS GREEN HDPE INSULATION.
G. FOR GRAVITY MAIN AND OR LATERAL INSTALLATIONS LESS THAN 15', THE TRACING WIRE SHALL BE ATTACHED TO THE PIPE. TRACER WIRE SHALL BE LAID FLAT AND SECURELY AFFIXED TO THE PIPE AT 10' INTERVALS USING ZIP TIES OR DUCT TAPE. FOR GRAVITY MAIN AND OR LATERAL INSTALLATION DEEPER THAN 15', THE TRACING WIRE SHALL BE ATTACHED TO THE PIPE AND PLACED AT A DEPTH OF 4' DIRECTLY ABOVE THE SEWER PIPE. THE WIRE SHALL BE PROTECTED FROM DAMAGE DURING THE EXECUTION OF THE WORK. NO BREAKS OR CUTS IN THE TRACER WIRE OR INSULATION SHALL BE PERMITTED.
H. WHERE LATERAL TAPS ARE MADE BY SERVICE SADDLES, THE TRACER WIRE SHALL NOT BE PLACED BETWEEN THE SADDLE AND MAIN.
I. SPLICES IN THE PRIMARY TRACER WIRE ALONG THE SEWER MAIN SHALL INCLUDE 2' OF SLACK WIRE ON EACH SIDE OF EACH SPLICE.
J. FOR INSTALLING A NEW LATERAL ON AN EXISTING MAIN WITH TRACER WIRE, ONLY SPLICE TO EXISTING WIRE WITH 2' OF SLACK ON NEW LATERAL.

NOTES FOR SERVICE CONNECTION (SECTION VIEW):

K. SPLICE TO PRIMARY MAIN TRACER WIRE FOR SERVICE LATERAL. THE TRACER WIRE SHALL BE CONTINUOUS TO THE GREATEST EXTENT POSSIBLE. WHERE SPLICES ARE NECESSITATED IN THE WIRE, THE SPLICES SHALL BE SECURELY BONDED TOGETHER WITH AN APPROVED INDUSTRIAL CONNECTOR TO PROVIDE ELECTRICAL CONTINUITY. CONNECTOR SHALL BE COPPER AND INSULATION SHALL BE REPAIRED TO SEAL OUT MOISTURE AND CORROSION AND SHALL BE INSTALLED IN A MANNER SO AS TO PREVENT ANY UNINSULATED WIRE EXPOSURE. (SEE CLTW STD. DETAIL).
L. FASTEN TRACER WIRE TO PIPE WITH ZIP TIES OR DUCT TAPE AROUND THE CIRCUMFERENCE OF PIPE AT 10' INTERVALS. (TYP.)
M. ALL VERTICAL WIRE AT CLEANOUTS SHALL BE PLACED IN 1/4" OR 3/8" ID CONDUIT SDR 9 PEX TUBING - ASTM F876. (TYP.)
N. EXTEND CONDUIT TO JUST ABOVE CLEANOUT PLUG. PROVIDE 24" NEATLY COILED WIRE IN BOX.
O. THE CLEANOUT AT THE RIGHT OF WAY AND OR EASEMENT SHALL SERVE AS THE TEST PORT.
P. SPLICED CONNECTIONS SHALL BE ALLOWED BETWEEN THE PRIMARY MAIN LINE TRACER WIRE AND THE LATERAL TRACER WIRE.
Q. 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. PLACE ANODE AT BOTTOM EDGE OF TRENCH AWAY FROM MAIN & LATERAL.
R. PRIOR TO ACCEPTANCE (POST PUNCH LIST) EACH WIRE SEGMENT SHALL PASS A CONDUCTIVITY TEST, WITNESSED BY THE ENGINEER OR ENGINEER'S REPRESENTATIVE.



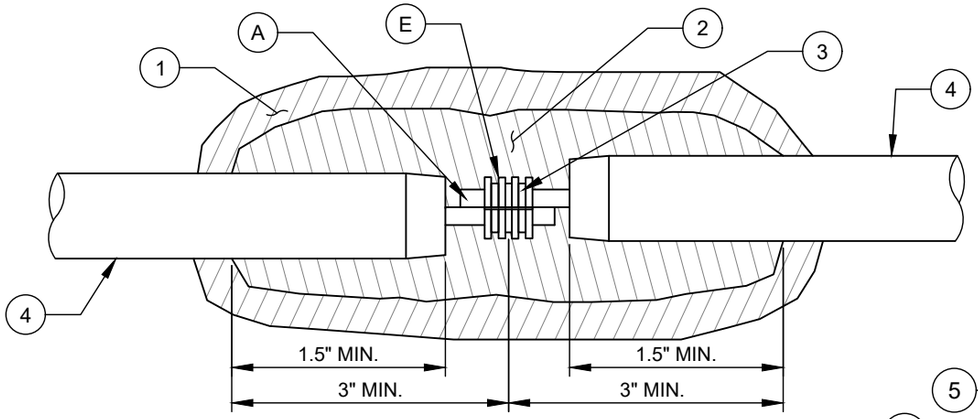
NOTES FOR GRAVITY SEWER MAIN (PLAN VIEW):

S. NOTCH ON TOP OF CONE (BETWEEN CONE AND FRAME) FOR TRACER WIRE.
T. MULTIPLE COILED AND SECURED WIRES.
U. FASTEN TRACER WIRE TO PIPE WITH ZIP TIES OR DUCT TAPE AROUND THE CIRCUMFERENCE OF PIPE OR AT 10' INTERVALS (TYP.).
V. WRAP TRACER WIRE AROUND OUTSIDE OF MANHOLE.

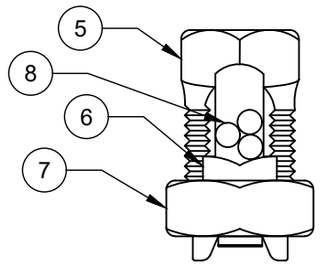
CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
GRAVITY SEWER

TRACER WIRE - GRAVITY SEWER

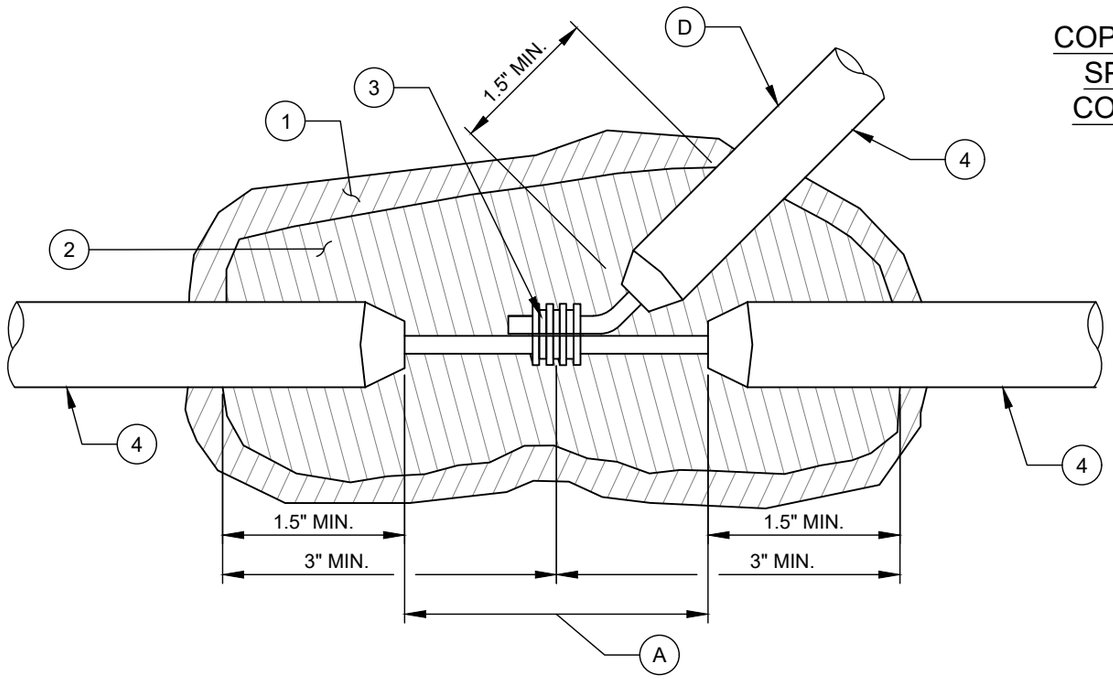
NO SCALE
VERSION 1.0
DATE 04/2024
DETAIL 11.5.2



IN-LINE OR REPAIR SPLICE



COPPER ALLOY SPLIT BOLT CONNECTOR



BRANCH IN-LINE SPLICE FOR SERVICE LATERAL

NO.	DESCRIPTION:
1.	3-LAYERS OF HALF LAPPED VINYL TAPE.
2.	3-LAYERS OF HALF LAPPED RUBBER TAPE.
3.	COPPER CRIMP CONNECTOR OR COPPER ALLOY SPLIT BOLT CONNECTOR.
4.	SOLID COPPER WITH 30 MILS GREEN HDPE INSULATION (AWG #12 TRACER WIRE).
5.	COPPER ALLOY SPLIT BOLT.
6.	COPPER ALLOY PRESSURE BAR.
7.	COPPER ALLOY HEX NUT.
8.	SOLID COPPER TRACER WIRES.

NOTES:

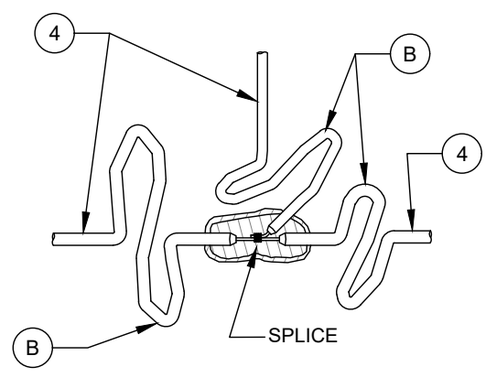
A. REMOVE MAINLINE (PRIMARY) TRACER WIRE INSULATION MATERIAL TO EXPOSE COPPER CORE WIRE.

B. IN LINE SPLICES SHALL BE LIMITED TO THE GREATEST EXTENT POSSIBLE. TRACER WIRE SHALL BE AS CONTINUOUS AS POSSIBLE WITHOUT SPLICES.

C. SPLICES SHALL INCLUDE 2' OF SLACK WIRE ON EACH SIDE OF EACH SPLICE (SEE DETAIL ON THIS SHEET).

D. 4 WAY WIRE SPLICES ARE ACCEPTABLE, WHERE NEEDED FOR 2 LATERALS CLOSELY SPACED, TO REDUCE THE NUMBER OF SPLICES.

E. THE CRIMPING TOOL USED TO COMPLETE THE CRIMP SHALL BE DESIGNED SPECIFICALLY FOR USE WITH THE CONNECTOR USED. GENERIC CRIMPING TOOLS ARE NOT ACCEPTABLE.



SPLICES WITH 2 FEET OF SLACK WIRE

CHARLOTTE WATER

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A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

GRAVITY SEWER

TRACER WIRE - SPLICE

NO SCALE

VERSION 1.0

DATE 04/2024

DETAIL 11.5.3

CHAPTER 12
LOW PRESSURE SANITARY SEWERS

CHAPTER 12
LOW PRESSURE SANITARY SEWER DESIGN

1. GENERAL

A. This chapter covers the minimum design criteria to be used for designing low pressure sanitary sewer (LPSS) private home or commercial pump stations, pipelines, and appurtenances including those portions of low-pressure sewer service connections that lie in public rights-of-way and in easements granted to Charlotte Water. All other systems are the responsibility of the respective property owner unless otherwise documented by an agreement with Charlotte Water.

B. Low pressure sewers are only allowed in the areas designated in the *2022 Lake Area Study* and generally include the areas bordering Lake Norman, Lake Wylie, and Mountain Island Lake where gravity service would involve numerous, small lift stations. LPSS will only be considered where a thorough study of all alternatives clearly indicates a gravity collection and disposal system with or without a central lift station is not practical or feasible.

C. All engineering plans for low pressure sewers must meet the Charlotte Water design standards as presented, the State standards as indicated in the most recent amended *Administrative Code, Title 15A, Subchapter 2T Waste Not Discharged to Surface Waters* by the North Carolina Department of Environmental Quality (NCDEQ), and the most current edition of the North Carolina State Plumbing Code. In general, the Charlotte Water standards should be the primary source for design guidance with the State standards as a supplement. In some cases, the Charlotte Water standard is more stringent than the State standard.

D. These design standards do not apply to private home pump stations pumping into the public gravity sewer system.

E. These design standards do not apply to Septic Tank Effluent Pump (STEP) systems. Any proposed STEP system must be reviewed by Charlotte Water and permitted by NCDEQ. Conversion of septic tanks for use with a low-pressure sewer system must first be approved by the Mecklenburg County Water Quality Program.

F. Inspection and testing by a Charlotte Water inspector will be required of the new LPSS system prior to acceptance of the system.

2. SUBMITTAL REQUIREMENTS

A. All low-pressure sewers must be designed by a professional engineer licensed in the state of North Carolina and submitted to NCDEQ and Charlotte Water for technical review and approval for conformance to *15A NCAC 02T Section .0300 Sewer Extensions* and utilizing the most current *Form ASEA: Alternative Sewer Extension Application with Supporting Documentation*.

B. In addition to the application documentation required under Paragraph 2.A, the Engineer of Record shall provide Charlotte Water a Customer Information Packet that shall include:

1) Installation Checklist

2) Maintenance Checklist

3) Commonly asked questions and answers

4) Typical installation drawings

5) Pump manufacturer's literature such as pump curves, features, and specifications

6) List of all lots to be served by the proposed system with the following information:

    a. Address

    b. Tax parcel number

    c. Pump elevation

    d. Pump design point

    e. Pump on/off float switch elevations

    f. High level alarm float elevation

    g. Top of the wet well elevation

    h. Ballast data (dimensions, material)

3. HYDRAULIC DESIGN

A. Calculating Flows

1) Flow analysis shall include a sewer basin map showing the project's total potential sewered area and downstream connection to an existing sewer.

2) Populations to be served shall be calculated from Future Land Use (FLU) plans for the sewer basin. Population may include residential, commercial, industrial, and institutional categories. Population should be estimated based on developable area. Depending on complexity of the project, Charlotte Water may request the population projection calculations. For subdivisions, populations may be based on planned lots to be built in the subdivision including all future phase lots.

3) All residential, commercial, industrial, and institutional unit wastewater design flow rates shall be as per 15A NCAC 02T .0114 unless that design flow has been adjusted as granted pursuant to paragraph (f) of that regulation.

4) Peak daily flow shall be proportional to population and calculated using the following equation:

$$PF = \frac{18 + \sqrt{P}}{4 + \sqrt{P}}$$

Where:

PF = peaking factor, minimum of 2.5

P = service population in thousands

B. System Design

1) Residential LPSS systems may be served by a simplex grinder pump if average daily design is less than or equal to 600 gpd. Larger residential, commercial, industrial, and institutional land uses must be served by a duplex grinder pump system as required by State regulations.

2) A separate private pump station and lateral shall be provided for each residential, commercial, industrial, or institutional building and for each parcel.

3) The private pressure sewer shall connect to the Charlotte Water maintained system at a stub from the property line side of the dual ball valve/check valve assembly in accordance with the service connection Standard Detail.

4) The LPSS system shall be under positive pressure at all time with the discharge elevation above all intermediate high points.

5) Cleanouts/manual air release valves shall be provided at all high points along the force main.

6) Cleanouts shall be provided at 500-foot intervals along mains and placed on the upstream side of a main line isolation plug valve.

7) A hydraulic model of the LPSS system may be used to provide output including the network layout, nodes, actual internal diameter of pipe sizes between nodes, expected velocity and flow in each line segment, and TDH. Manufacturer's software can be utilized; however, the Engineer of Record shall seal the model as to the accuracy of the input and output values. The model shall reflect the use of the appropriate average and peak flows as calculated in Section B, a Hazen-Williams "C" coefficient for the pipe material used, and an allowance for minor losses associated with the network. The model shall account for connections to existing pressure sewer systems and not affect the operation of the existing system (i.e., shut other pumps out).

   a. A Hazen-Williams “C” coefficient of 130 to 140 may be used for PVC and HDPE.

   b. Hydraulic Calculations shall demonstrate pumps selected are capable of meeting TDH conditions at any proposed or potential grinder pump location.

8) The hydraulic model shall provide an initial activation, an average flow discharged from the LPSS system, and a maximum flow discharged with all pumps operating. The maximum flow condition will be experienced upon restoration of power following a system-wide power outage.

9) The hydraulic model shall confirm the downstream capacity of the receiving gravity sewer at both full-pipe flow at peak flow and half-full pipe at average flow.

4. PRIVATE PUMPS

A. Private pumps must be centrifugal design; no positive displacement pumps are allowed.

B. LPSS pump manufactures include Pentair/Myers, Keen, Xylem, or approved equal by Charlotte Water.

C. The impeller diameter of individual pumps in a system with varying pump elevations shall be sized such that full size impellers are used at pumps at the lowest elevations and reduced size impellers are used at higher pumps such that the total TDH of any one pump is within 20% of all other pumps.

D. Pressure shall not exceed pump and/or pipe pressure limitations.

5. PRIVATE SINGLE FAMILY WET WELL

A. The wet well shall be a minimum of 3 feet in diameter and a minimum of 6 feet deep and be provided with a screened vent. Other sizes may be considered for individual site constraints at Charlotte Water's discretion.

B. The wet well shall be designed to prevent flotation.

C. The wet well shall provide a minimum of 240 gallons or 24 hours of wastewater storage above the pump on level and under the wet well lid, no higher than 1-foot below finished floor elevation unless otherwise approved by Charlotte Water.

D. In general, the wet well shall contain the grinder pump(s), pump on/off float switches, high level alarm float, pump discharge pipe(s) and check valve(s). The control panel shall be mounted for easy access on the building served and contain an audible and visual high-water alarm.

E. Large residential, commercial, industrial, and institutional duplex lift stations are required to have a standby power source and telemetry system to provide remote notification of a problem condition.

6. PUBLIC LOW-PRESSURE MAINS

A. Minimum pipe size is 2 inches; maximum pipe size is 4 inches. Service lines shall be provided per the standard details.

B. Minimum velocity in any pipe segment shall be 2 fps with a minimum of 2 pumps operating simultaneously and maximum velocity 10 fps under simultaneous pump operating conditions.

C. Pipe shall be located in publicly maintained road right of way or properly recorded public easements on private property at Charlotte Water's discretion.

D. Pipe shall not be located in either public or private alleys.

E. Pipe material for various size LPSS pipes is provided in Table 12.2.

Table 12.2: Pipe Material for LPSS Sewers

Sewer Pipe Size (inches)	Material
2 - 4	PVC, SDR 13.5, ASTM D2241, IPS
2 – 3	HDPE, SDR 9, AWWA C901, IPS
4	HDPE, SDR 9, AWWA C906, IPS

F. Pipe size and material shall be listed on the design drawings.

7. UTILITY SETBACKS AND SEPARATIONS

The minimum clearance requirements for conflicts with utilities and other features, in accordance with NCAC 02T.0305 and governing utility guidelines, is shown in Table 12.3. Depth of cover shall be defined from the top of the pipe.

Table 12.3: Minimum Separations for Sewers per NCAC 02T.0305

Setback Parameter	Separation Requirements*
Storm Sewers and other utilities not listed below (vertical) Where separation cannot be met, DIP or structural bridging to prevent crushing the underlying pipe shall be used.	2 feet
Water Lines	
Vertical, water over sewer including in shared, benched trenches	18 inches
Horizontal	10 feet
Where a water main crosses over a sewer, one full length of water pipe shall be located so that both joints will be as far from the sewer as possible.	
Reclaimed Water Lines	
Vertical, reclaimed over sewer	18 inches

Horizontal, reclaimed over sewer	2 feet
Any private or public water supply source, including any wells, WS-I waters of Class I or Class II impounded reservoirs used as a source of drinking water (stream classifications from Division's NC Surface Water Classifications webpage) For public or private wells where minimum separation cannot be met, piping materials, testing methods and acceptability standards meeting water main standards shall be used. All appurtenances shall be outside the 100' radius. The minimum separation shall however not be less than 25' from a private well or 50' from a public well.	100 feet
Waters classified WS (except WS-I or WS-V), B, SA, ORW, HQW, or SB from normal high water (or tide elevation) and wetlands (stream classifications from Division's NC Surface Water Classifications webpage)	50 feet
Any other stream, lake, impoundment, or ground water lowering and surface drainage ditches	10 feet
Any building foundation	10 feet
Any basement	10 feet
Top slope of embankment or cut of 2 feet or more vertical height	10 feet
Drainage systems and interceptor drains	5 feet
Swimming pools	10 feet
Final earth grade (vertical) Where minimum cover cannot be met, DIP casing pipes shall be used. Where sewers are subject to traffic bearing loads, pipe with proper bedding to develop design supporting strength shall be provided.	5 feet
For all other separations, materials, testing methods, and acceptability standards meeting water main standards (15A NCAC 18C) shall be required in any alternative.	

1

Table 12.4: Minimum Separations for Sewers to Other Features	
Stormwater BMP	Sewer easement remains outside 1:1 slope to the BMP easement
Retaining Wall	Sewer to remain a minimum of 5 feet from footings and outside of geogrid area/structural impact of retaining wall
Roadways and Driveways	2 feet from edge of pavement and/or back of curb measured to center of pipe

2

8. CORROSION PROTECTION

A corrosion resilient manhole shall be provided where the low-pressure sewer discharges into a downstream manhole. Corrosion protection may include protective coatings on exposed concrete surfaces, concrete additives, or polymer concrete structures at Charlotte Water's discretion.

9. DESIGN OF EROSION AND SEDIMENT CONTROL MEASURES

Regardless of size, all LPSS projects shall include measures and/or devices to prevent erosion and to contain sediment within the limits of the right-of-way and/or proposed easements. Design and permitting of erosion and sediment control devices shall be in accordance with Charlotte Land Development Standards including the City of Charlotte Soil Erosion and Sedimentation Control Ordinance for Developer-Donated projects. Charlotte Water designed projects shall meet NCDEQ requirements, as outlined in the North Carolina Erosion and Sediment Control Planning and Design Manual. Projects outside of City limits but within Mecklenburg County or outside of Mecklenburg County shall follow the appropriate county, town, and/or state requirements.

END OF SECTION

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CHAPTER 12
LOW PRESSURE SANITARY SEWERS

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PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. PVC Pipe and Fittings
2. HDPE Pipe and Fittings
3. Ductile-iron Pipe and Fittings
4. Valves
5. Service Boxes and Lids

1.2 RELATED DOCUMENTS

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

1.3 DEFINITIONS AND ABBREVIATIONS

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

1.4 SUBMITTALS

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

1. Product brochures
2. Catalog cut sheets
3. Shop drawings including dimensions and part/material lists
4. Certification of compliance
5. Prior product acceptance test reports
6. Reference contact data
7. Shipping tickets and purchase invoices

B. Provide product data for the following:

1. PVC Pipe and fittings
2. HDPE Pipe and Fittings
3. Ductile Iron Pipe and Fittings
4. Valves
5. Service Boxes and Lids

C. Shop Drawings:

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

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

E. Product Certificates: Required for all products.

F. Qualification Data: For qualified testing agency.

G. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:

1. Classification according to ASTM D 2487.

2. Laboratory compaction curve according to ASTM D 698.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic pipe and fittings in direct sunlight. All pipe must be in brand new factory condition, and no more than one year old from manufacturer date to installation. Pipe manufacturer must provide letter regarding exposure requirements.

B. Valves must be stored such that they are protected from freezing.

C. Protect pipe, pipe fittings, and seals from dirt and damage.

D. All PVC and HDPE pipe will be shipped, stored, and strung at the project in such a manner as to be protected from total accumulated exposure to sunlight and possible ultraviolet radiation of no more than two (2) weeks. Pipe must be installed within one year from the manufacturer date printed on the pipe wall.

E. The Contractor shall be responsible for the safe storage of materials furnished by or to them, and accepted by them and intended for the work, until they have been incorporated in the completed project. Handling and storage of all project materials are to be in compliance with the manufacturer's recommendations for handling and storage. The interior of all pipe, manholes and other accessories shall be kept free from dirt and foreign materials at all times.

F. Transportation of Materials and Equipment: The Contractor and their Suppliers are directed to contact the North Carolina Department of Transportation to verify axle load limits on State maintained roads (and bridges) which would be used for hauling of equipment and materials for this project. The Contractor and their Suppliers shall do all that is necessary to satisfy the Department of Transportation requirements and will be responsible for any damage to said roads which may be attributed to this project. All materials required to construct this project shall be furnished by the Contractor and shall be delivered and distributed at the site by the Contractor or their material supplier.

G. Loading and Unloading Materials: Pipe and pipe accessories shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Pipe and precast manholes will be unloaded with hoists and/or as recommended by the respective manufacturers. Under no circumstances shall such materials be dropped. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground.

H. Responsibility for Materials on Site: In distributing the material at the site of the work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench. Each piece shall be redundantly chocked at each end to prevent movement or rolling. Pedestrian or vehicular traffic shall not be unduly inconvenienced in placing of material along the streets or right-of-way, as applicable.

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

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

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

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

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

1.6 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 PIPE, GENERAL

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

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

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

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

2.2 PVC SERVICE PIPE AND FITTINGS

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

B. Pipe markings shall meet the following minimum requirements:

1. Manufacturer
2. Manufacturer Number (identifies factory, location, date manufactured, shift and sequence)
3. Nominal diameter
4. Beam load
5. Laying length
6. ASTM designation

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

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

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

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

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

H. Whenever a PVC pressure sewer crosses over or within1.5 feet below a water main, the PVC pipe shall be installed within a length of 3-inch, 4-inch, or 6-inch diameter Ductile Iron Pipe. The ductile iron pipe shall extend not less than 10 feet on each side of the water main. The ductile iron pipe shall be standard Pressure Class 350 cement lined pipe.

I. Manufacturers:

1. PVC pipe shall be as furnished by the following or pre-approved equal:
    a. North American Pipe Corporation, NAPCO
    b. JM Eagle
    c. Diamond Plastics
    d. National Pipe
    e. Sanderson Pipe
    f. Jetstream (by Pipelife)
2. PVC fittings shall be as furnished by the following or pre-approved equal:
    a. North American Pipe Corporation, NAPCO
    b. IPEX

J. PVC Solid Wall Sewer Pipe for Service Laterals:

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

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

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

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

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

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

2.3 HIGH DENSITY POLYETHYLENE (HDPE) PIPE AND FITTINGS

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

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

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

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

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

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

G. Pipe Markings:

1. Meet the minimum requirements of AWWA C901 and C906. Minimum pipe markings shall be as follows:
    a. Manufacturer's Name or Trademark and production record
    b. Nominal pipe size
    c. IPS
    d. Dimension Ratio (SDR 9)
    e. AWWA C901 or C906
    f. Seal of testing agency that verified the suitability of the pipe
    g. Resin type (PE4710)
2. Color identification to identify pipe service is required:
    a. Conform to ASME A13.1.
        1) Color: Sewer/wastewater – green.
        2) For pipes 4-inches and larger in diameter: Stripes or colored exterior pipe product shall be green.
            a. Permanent identification of piping shall be provided by co-extruding multiple equally spaced color stripes into the pipe outside surface or by solid colored pipe shell.
            b. The striping material shall be the same material as the pipe material except for the color.
        3) Pipe interior shall be gray for visual inspection.
        4) Plain Black HDPE Pipe without color code markings may not be used.

H. Only smooth wall HDPE will be permitted.

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

1. 3 and 4-inch pipe shall connect to main line iron bodied plug valves with HDPE butt fusion mechanical joint adaptor fittings. 2-inch and smaller pipe shall connect to iron bodied main line plug valves and PVC service valves with a SDR 9 HDPE socket fusion stainless steel threaded adaptor, as manufactured by DriscoPlex, Integrity Fusion Products, Georg Fischer Central Plastics, or approved equal.

2. Reducers: For reducers to pipes 2-inches and smaller reducers shall be socket fusion fittings conforming to ASTM 1056 and larger than 2-inches shall be butt fusion conforming to ASTM F 2620.

J. Acceptable manufacturers of HDPE piping and fittings shall be as specified in Charlotte Water's standard specification for High Density Polyethylene (HDPE) Sanitary Sewer Piping.

K. HDPE Laterals:

1. HDPE laterals shall be in accordance with ASTM D-2239 and shall meet or exceed the minimum wall thickness for HDPE IPS Pressure Pipe PE4710 SDR 9.

2. Connections to a new HDPE main shall be performed using electrofusion and or butt fusion. Fittings shall be made of polyethylene pipe compound that meets the requirements of ASTM D1248, Class C and suitable for fusion welding to polyethylene pipe.

3. New service connections to existing active mains Connections to an existing sewer house connection pipe shall be made using sleeved stainless-steel couplings on each side of a new service cut-in wye.

L. Pipe Manufacturers: Performance Pipe, GF Piping Systems, JM Eagle, Driscoplex, WL Plastics or approved equal.

M. Butt Fusion Fittings Manufacturers: ISCO, IPEX, Georg Fisher, or approved equal.

N. Electrofusion Fittings Manufacturers: Agru America, GF Piping Systems, Integrity Fusion Products, IPEX, MT Deason Company, NUPI Americas Inc, or approved equal.

2.4 DUCTILE-IRON PIPE AND FITTINGS

A. All materials furnished in accordance with these specifications shall be new and unused, unless otherwise specified in the project Special Provisions. Unless superseded or modified by a Special Provision, all materials, apparatus, supplies, methods of manufacture, or construction shall conform to the specification for same contained in this Section. National material standards (ASTM, ANSI, etc.) referred to herein shall be considered to be the latest revisions only.

B. Pipe: At a minimum, all Ductile Iron Pipe shall conform to the requirements of AWWA C151/A21.51, and ASTM A-746, pressure class 350, with Protecto 401 lining or approved equal.

1. The pipe class selection for all diameters shall be based on the installation conditions and existing or proposed depth of cover. Special thickness class pipe up to and including thickness class 56 shall be required when specified, based on installation conditions and depth of cover.

2. The pipe shall contain all product markings required by ASTM A-746 and AWWA C-151. The minimum pipe markings shall include the weight, class or nominal thickness, casting date. The manufacturer's mark, the country where cast, the

production year, and the letters “DI” or “DUCTILE” shall be cast or metal stamped on the pipe, and on pipe sizes 14-inch and larger shall not be less than ½-inch in height. All markings shall be clear and legible, and all cast or metal-stamped marks shall be on or near the bell.

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

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

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

E. Manufacturers:

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

a. American Cast Iron Pipe

b. McWane Cast Iron Pipe

c. US Pipe Company

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

a. American Cast Iron Pipe

b. McWane Cast Iron Pipe

c. Star Pipe Products

d. Sigma Corporation

e. SIP Industries

f. Tyler Union Pipe

g. US Pipe Company

F. HDPE to Ductile Iron Transition Assembly:

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

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

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

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

G. PVC to Ductile Iron Transition Assembly:

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

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

2.5 VALVES

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

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

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

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

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

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

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

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

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

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

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

10. Manufacturers:
    a. Plug valves shall be as manufactured by Dezurik Corporation, Milliken Valve Co., Keystone Valve, or approved equal.

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

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

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

2.6 SERVICE BOXES AND LIDS

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

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

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

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

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

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

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

C. Identification

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

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

¼-inch stencil and engraving shall be with a high-speed rotary tool with a ¼-inch oval or ball bit.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION GENERAL

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3.2 INSTALLATION OF PVC LOW PRESSURE SEWER PIPE AND FITTINGS

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

B. PVC Pipe: PVC pressure sewer main shall be installed substantially in accordance with the Standard Recommended Practices for UNDERGROUND INSTALLATION OF FLEXIBLE THERMOPLASTIC SEWER PIPE, ASTM D-2321.

C. Valves and Fittings: Valves and fittings shall be installed in the manner specified for cleaning, laying and jointing pipe. Valves shall be installed at locations shown on the Plans and/or as directed by the Engineer.

D. Valve Boxes: A valve box shall be installed at every buried plug valve. The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the operating nut, with the box cover flush with the pavement or other existing surface. Where the box is not in pavement or sidewalk, the top section shall be anchored by an 24" diameter pre-cast concrete pad, or cast in place concrete pad, set flush with the existing terrain. The top section of the valve box will be grouted into the pre- cast concrete pad, with the full annular space filled with grout. The location of the valve will be identified by the letter "PSV" imprinted onto the curb adjacent to the pressure sewer valve, with the “PSV” pointing at the valve location.

E. Blocking Fittings: All plugs, caps, tees, wyes, bends, and valves on pressure mains shall be provided with thrust blocking, placed as shown on the plans, standard details, and/or as directed by the Engineer, and consisting of ready-mix concrete having a compressive strength of not less than 3,600 LBS per square inches at 28 days. Bagged mix concrete may be used for blocking, anchorage, etc. on sewer mains and valves. Blocking shall be placed between solid ground and the fittings to be anchored. The area of bearing on the pipe and on the ground in each instance shall be that shown or directed by the Engineer.

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

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

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

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

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

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

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

B. Installers

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

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

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

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

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

C. Joining Methods

1. Butt Fusion: Butt fusion shall be done in accordance with ASTM F 2620, Plastic Pipe Institute (PPI) TR-33 and PPI TN-13. All fusion joints shall be made in compliance with the pipe or fitting manufacturer's recommendations.

2. Saddle fusion: Saddle fusion shall be done in accordance with ASTM F 2620 PPI TR-41 and PPI TN-13. All saddle fusion joints shall be made in compliance with the pipe or fitting manufacturer's recommendations.

3. Electrofusion: Electrofusion joining shall be done in accordance with the manufacturers recommended procedure. Other sources of electrofusion joining information are ASTM F 1290 and PPI TN 34. The process of electrofusion requires an electric source, a transformer, commonly called an electrofusion box that has wire leads, a method to read electronically (by laser) or otherwise input the barcode of the fitting, and a fitting that is compatible with the type of electrofusion box used. The electrofusion box must be capable of reading and storing the input parameters and the fusion results for later download to a record file.

4. Socket Fusion: Socket fusion shall be done in accordance with ASTM 1056 and PPI TN-13. All socket fusion joints shall be made in compliance with the pipe or fitting manufacturer's recommendations. Socket fusion made be used for pipes smaller than 2-inches in diameter.

D. Mechanical

1. Mechanical connection of HDPE to auxiliary equipment such as valves, and fittings shall use restrained joint mechanical joint HDPE adapters and other devices in conformance with the PPI Handbook of Polyethylene Pipe, Chapter 9 and AWWA Manual of Practice M55, Chapter 6.

2. Unless specified by the fitting manufacturer, a restraint harness or concrete anchor is recommended with mechanical couplings to prevent pullout.

3. Mechanical coupling shall be made by qualified technicians.

E. Joint Recording

1. Butt Fusion: The butt fusion equipment must be capable of reading and storing the input parameters and the fusion results for later download to a record file.

2. Saddle Fusion: The saddle fusion equipment must be capable of reading and storing the input parameters and the fusion results for later download to a record file.

3. Electrofusion: The electrofusion equipment must be capable of reading and storing the input parameters and the fusion results for later download to a record file.

4. Socket fusion: The socket fusion equipment must be capable of reading and storing the input parameters and the fusion results for later download to a record file.

5. The critical parameters of each fusion joint, as required by the manufacturer and these specifications, shall be recorded by an electronic data logging device. All fusion joint data shall be included in the fusion technician's joint report.

F. Installation

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

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

2. Trenching:

   a. Trench Length: The length of open trench required for fused pipe sections should be such that bending and lowering the pipe into the ditch does not exceed the manufacturer's minimum recommended bending radius and result in kinking.

   b. Trench Width: The trench width at pipe grades for pipes less than 24-inches diameter shall be equal to the pipe outer diameter plus 12-inches.

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

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

   a. Granular and free flowing

   b. Generally meets or exceeds the limits on deleterious substances per Table 1 for fine aggregate according to ASTM C 33.

   c. Reasonably free of organic material.

   d. Gradation:

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

5. Compact backfill per ASTM D 698 and AASHTO T-99 as modified by NCDOT to 85% of maximum density or 95% maximum density within a road right-of-way. Compact the top 12-inches below the road sub-grade to 100% of maximum density within a road right-of-way.

6. Valves and Fittings: Valves and fittings shall be installed in the manner specified for cleaning, laying and jointing pipe. Valves shall be installed at locations shown on the Plans and/or as directed by the Engineer.

7. Valve Boxes: A valve box shall be installed at every buried plug valve. The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the operating nut, with the box cover flush with the pavement or other existing surface. Where the box is not in pavement, the top section shall be anchored by an 24" diameter precast concrete pad, set flush with the existing terrain. The top section will be grouted into the precast concrete pad. The location of pressure sewer valves will be identified by the letters "P.S.V." imprinted onto the curb adjacent to the pressure sewer valve.

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

3.4 CONNECTIONS TO EXISTING SEWERS

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

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

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

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

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

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

5. 1.5-inch Service Connections to PVC Mains: On 4-inch and smaller mains, the 1.5" laterals shall be connected to the street main with schedule 80 PVC solvent weld wyes. The 1.5" service lateral shall be completed to the property line using Schedule 80 solvent weld PVC pipe and fittings as detailed in the Standard Details. The service connection meter box shall be installed one foot outside the road right of way, and shall not be located in a driveway, or sidewalk. The service box shall include a true union ball valve, a ¾ inch brass hose bib/air release, true union ball check valve, and true union property lineball valve. All fittings shall connect to the schedule 80 pipe with solvent welds. The service connection shall be in accordance with the Standard Details. An “S” shall be cut into the top of the curb in line with the service box.

6. 1.5-inch through 4-inch Service Connections to HDPE Mains: On 4-inch and smaller mains, the 1.5" laterals shall be connected to the existing low pressure sewer main with SDR 9 HDPE fussed wyes. The 1.5" service lateral shall be completed to the first true union ball valve in the service connection vault using SDR 9 HDPE fused pipe adaptor with stainless steel threaded end. The buried true union ball valve on the roadside of the service connection vault shall connect to the HDPE pipe with union by female threaded ends. The pipe shall be SDR 9 HDPE by stainless steel male threaded adaptor. The pipe between the buried ball valve and the first ball valve in the service connection vault shall be SDR 9 HDPE pipe. All remaining pipe from the ball valve to the property line cap shall be schedule 80 PVC pipe with solvent welds/flanges, as detailed in the Standard Details. The service connection vault/box shall be installed one foot outside the road right of way, and shall not be located in a driveway, pavement, or sidewalk. The service vault/box shall include a true union ball valve, a ¾ inch brass ball valve, hose bib/air release, true union ball check valve, and true union property lineball valve. All 1.5-inch diameter fittings shall connect to the schedule 80 PVC pipe with solvent welds. All 2-inch and larger diameter fittings shall connect to the schedule 80 PVC pipe with flanges as shown on the standard details. The service connection shall be in accordance with the Standard Details. An “S” shall be cut into the top of the curb in line with the service box.

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

3.5 TRACER WIRE, PIPE MARKING, AND IDENTIFICATION

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

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

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

1. The wire shall be secured to the pipe with zip ties or duct tape (2-inches in width) near every bell and at the midpoint of each pipe joint, or at a minimum, every 10 feet. The wire shall be a single continuous conductor from valve/service box or vault to valve/service box or vault. When the distance between valve/service box or vault exceeds 500 feet, splices will be permitted at 500 feet (or greater) intervals, if needed. The splice shall be made watertight as indicated in the standard detail as approved by the Engineer. Splices shall be isolated from direct tension on the wires in accordance with the Standard Details.

2. When wire splices are required, the splices shall be securely bonded together with an approved industrial connector to provide electrical continuity. Connector shall be copper, and insulation shall be repaired as detailed to seal out moisture and corrosion and shall be installed so as to prevent any uninsulated wire exposure. See Standard Details.

3. At valve/service boxes, vaults or tracer wire termination valve boxes, the wire shall be installed along the outside of the box/vault assembly from the pipe to the top section of the box/vault. The wire shall enter the box/vault assembly, directly below the top section of the box/vault. The wire shall extend through the top section and shall terminate 24 inches above the top section. This excess wire shall be coiled and stored in the top section, directly below the box/vault cover.

4. Contractor shall perform post installation testing of the tracer wire system to confirm conductivity from valve/service box/vault to valve/service box/vault on a daily basis during construction. Immediately prior to, or during the final inspection, the Contractor shall perform post installation testing of the tracer wire system to confirm conductivity from box/vault to box/vault. The test shall consist of applying an alternating High/Low tone voltage to the conductor at one valve box and testing the conductor at the next box/vault with Fluke Networks PRO3000 Tone Generator and Probe Kit or approved equal. Every service line pipe segment shall be tested in addition to all main line pipe segments. Alternate testing methods will be subject to approval by the Engineer. The testing shall be witnessed by the Engineer. The repair or replacement of any defective or improperly installed systems shall be the responsibility of the Contractor. Any and all repairs or replacement of defective or improperly installed tracer wire systems shall be performed by the Contractor and at no cost to the Engineer. Method of repairs or replacement shall be subject to approval of the Engineer. Upon acceptance by the Engineer, the wires in each valve box shall be connected together with a wire-nut wire connector, coiled and stored in the top section, directly below the valve box cover. The official Tracer Wire Conductivity test shall be performed by the contractor at the time of the Final inspection.

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

3.6 HYDROSTATIC TESTING

A. General

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

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

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

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

B. Testing of PVC Low Pressure Sewer Piping

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

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

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

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

5. Specific procedures for testing mains are as follows:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3.7 RECORD DRAWINGS

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

B. Record Drawings shall meet the following minimum requirements and standards:

1. General to all projects:

    a. Annotations shall be in red ink only.

b. Annotations shall be neatly printed and legible.

c. Add existing facilities encountered but not shown on plans.

d. Revise existing facilities encountered differently from plans.

e. Traffic control, erosion control and other temporary facilities shall not be recorded.

f. Mark through changed stations, bearings, distances, slopes, etc., and print actual station, bearing, distance, slopes, etc.

g. Mark through “proposed” for items that were actually installed.

h. Mark completely through items that were proposed but were not installed.

i. Correct notes, sizes, diameters, dimensions, classes, types, etc. to actual as installed.

j. Revise profile of proposed facilities to within 0.1 feet of actual vertical and within 1.0 feet of actual horizontal, based on contractor field survey of each pipe joint.

k. Revise plan view of proposed facilities to within 1.0 feet of actual.

l. The following sheets are excluded, and do not require updating by the Contractor:

m. Cover Sheet, Permit Sheet. Vicinity/Location Map Sheets

n. Traffic Control Sheets, Erosion Control Sheets

o. Standard Detail Sheets

2. General to all new force main projects:

a. Indicate pipe manufacturer, type and class of pipe.

b. Indicate station for transition in pipe materials.

c. Indicate restraint type, manufacturer, and beginning and ending stations in profile, or on plan views without profiles.

d. Indicate bedding type and location in profile, or on plan views without profiles.

e. Indicate solid ledge rock in profile to within 0.1 feet of actual vertical and within 1.0 feet of actual horizontal, or on plan views without profiles.

f. All fittings, valves, air releases, casings, tunnels, etc. shall be stationed.

g. Indicate survey grade northing and easting coordinates for all appurtenances and provide GPS locations along the main.

h. At air releases, indicate station for tee or plug, control valve and standpipe. Detail required, if not directly adjacent to the main.

i. At ALL valves, indicate valve manufacturer, model, and actual number of turns to operate.

j. At ALL valves, indicate if valve extension stem was installed, and actual height of extension stem (valve nut to operating nut length, measured to closest 0.1 feet.

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

END OF SECTION

LOW PRESSURE SANITARY SEWER DETAILS
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12.1 VALVE ASSEMBLY WITH CLEANOUT/MANUAL AIR RELEASE - HDPE PIPE

12.2 HDPE 2" CLEANOUT/MANUAL AIR RELEASE AT END OF MAIN

12.3 HEAVY DUTY PLASTIC SERVICE BOX

12.4 HEAVY DUTY PLASTIC CLEANOUT/MANUAL AIR RELEASE BOX

12.5 SERVICE CONNECTION - HDPE

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12.7 INDIVIDUAL GRINDER PUMP SYSTEM

12.8 TRACER WIRE

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12.12 HDPE 3-INCH LOW PRESSURE SEWER SERVICE

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12.14 VALVE ASSEMBLY WITH CLEANOUT/MANUAL AIR RELEASE - PVC PIPE

12.15 PVC 2" CLEANOUT/MANUAL AIR RELEASE AT END OF MAIN

12.16 SERVICE CONNECTION - PVC

12.17 PVC SERVICE LATERAL

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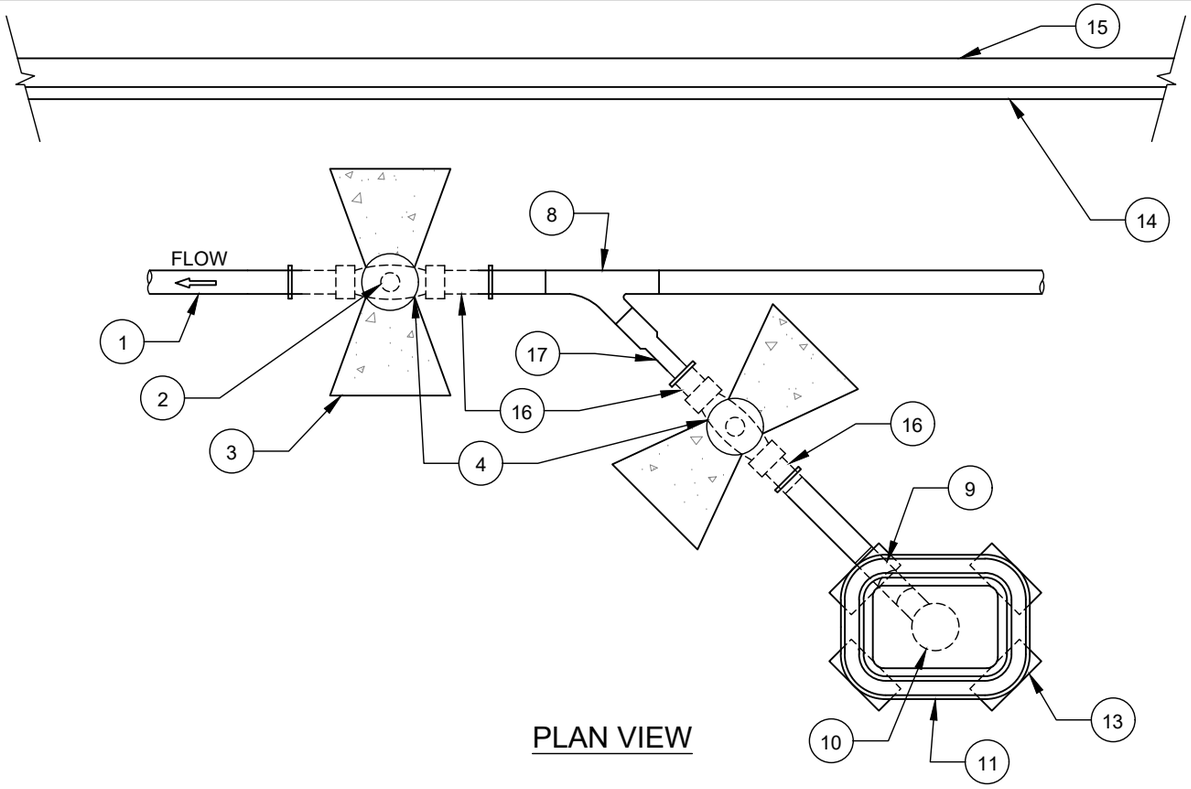
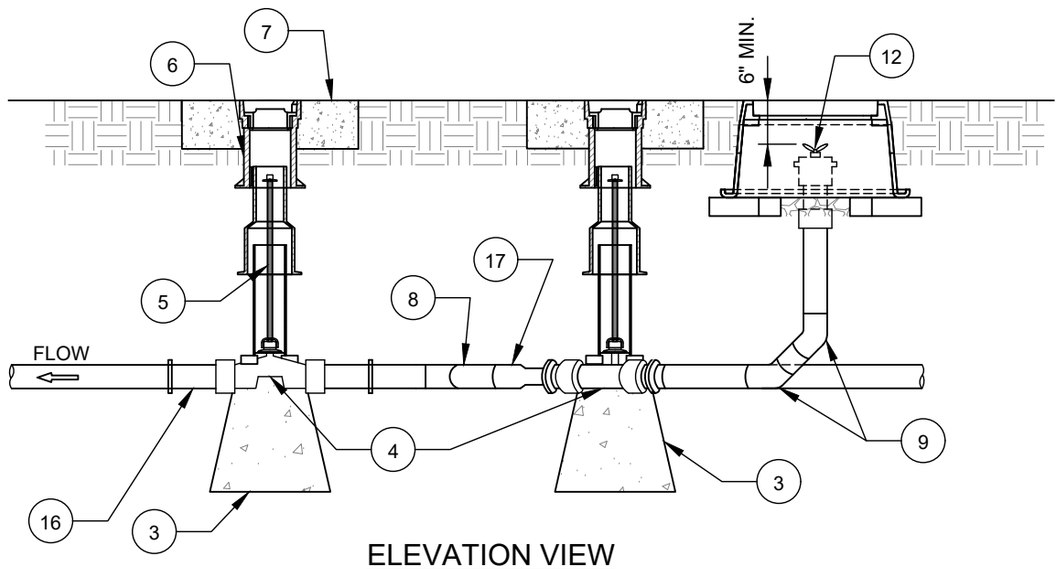


PLAN VIEW



ELEVATION VIEW

NO. DESCRIPTION:

1. LOW PRESSURE SEWER PIPE (SDR 9 HDPE).
2. IRON BODY PLUG VALVE (2" - WITH THREADED ENDS) (3 & 4" - MJ ENDS WITH IPS TRANSITION GASKETS).
3. CAST IN PLACE CONC. SUPPORT/THRUST BLOCK (TYP. ALL VALVES).
4. POLYETHYLENE WRAP, 4 MILS. EACH, 2 LAYERS, 12" EACH SIDE OF VALVE BODY.
5. EXTENSION STEM W/ 2" SQUARE OPERATING NUT, 10" BELOW GRADE (TYP. ALL VALVES).
6. VALVE BOX ASSEMBLY, PER CLTW STANDARD DETAIL (TYP. ALL VALVES).
7. 24" PRECAST CONCRETE DONUT.
8. WYE (SDR 9 HDPE).
9. 45° BEND (SDR 9 HDPE).
10. 2" CLEANOUT/MANUAL AIR RELEASE (SDR 9 HDPE).
11. 2" CLEANOUT/AIR RELEASE BOX (PLASTIC).
12. 1 INCH GALVANIZED QUICK CONNECT WITH GALVANIZED PLUG AND 2 S.S. COTTER PINS.
13. SOLID STANDARD CONCRETE BRICK DIAGONAL AT CORNER.
14. BACK OF CURB.
15. EDGE OF PAVEMENT.
16. 2" SDR 9 HDPE BY S.S. THREADED ADAPTOR OR 3 OR 4" SDR 9 HDPE MJ ADAPTOR.
17. SDR 9 REDUCER WHEN REQUIRED.

NOTES:

A. ALL HDPE PIPE AND FITTING JOINTS SHALL BE FUSED (SOCKET, BUTT OR ELECTROFUSED).

B. USE OF MECHANICAL COUPLINGS IN THE HDPE PIPE SYSTEM ARE NOT PERMITTED WITHOUT SPECIFIC APPROVAL OF THE ENGINEER.

C. TRACER WIRE NOT SHOWN FOR CLARITY. FOR TRACER WIRE INSTALLATION, REFER TO APPROPRIATE STANDARD DETAIL.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

LOW PRESSURE SEWER

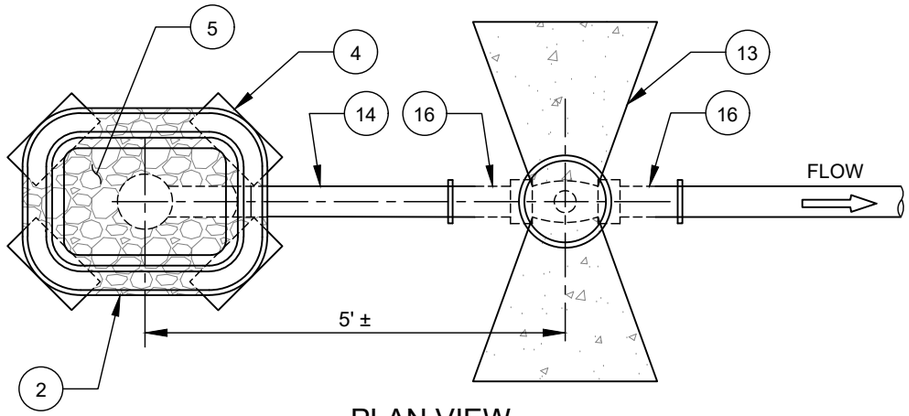
VALVE ASSEMBLY WITH CLEANOUT/ MANUAL AIR RELEASE - HDPE PIPE

NO SCALE

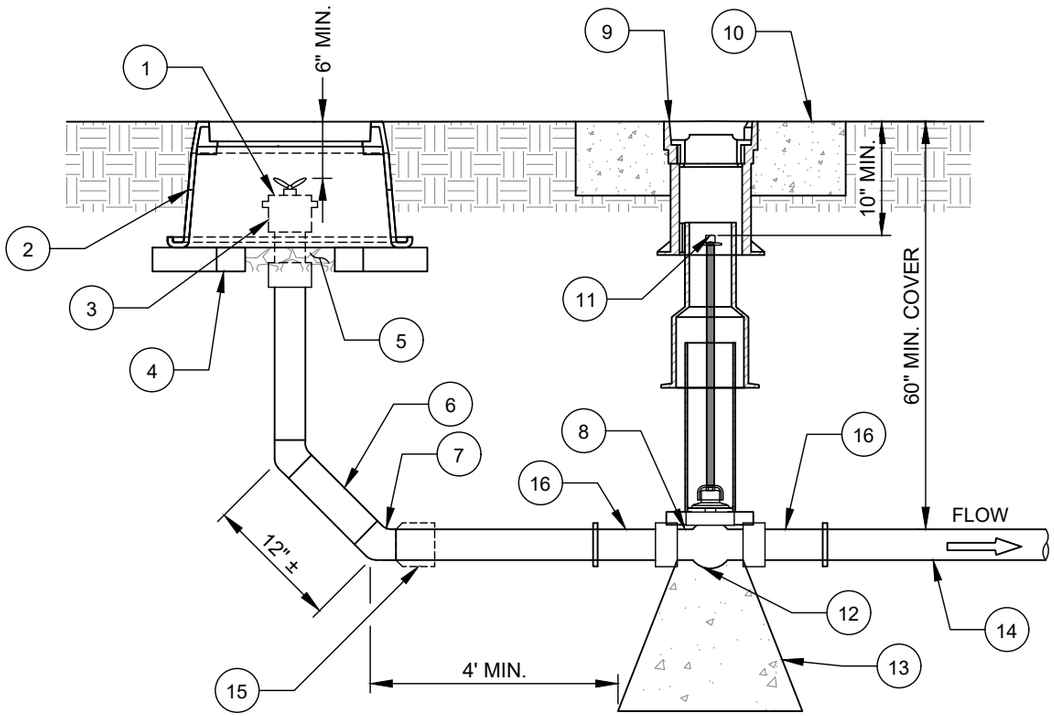
VERSION 1.0

DATE 04/2024

DETAIL 12.1



PLAN VIEW



ELEVATION VIEW

NO.	DESCRIPTION:
1.	1" QUICK CONNECT WITH PLUG AND 2 S.S. COTTER PINS.
2.	CLEANOUT BOX (PLASTIC).
3.	2" X 1" HDPE WITH THREADED OUTLET (2" SDR 9 HDPE).
4.	SOLID STANDARD CONCRETE BRICK DIAGONAL AT CORNER.
5.	6" MIN. OF #57 STONE BASE, SUITABLE BEARING CAPACITY AS APPROVED BY GEOTECHNICAL ENGINEER.
6.	2" CLEANOUT PIPE (SDR 9 HDPE).
7.	45° BEND (2" SDR 9 HDPE).
8.	POLYETHYLENE WRAP, 4 MILS EACH, TWO LAYERS, 12" EACH SIDE OF VALVE BODY.
9.	VALVE BOX ASSEMBLY, PER CLTW STANDARD DETAIL (TYP. ALL VALVES).
10.	24" PRECAST CONCRETE DONUT.
11.	EXTENSION STEM WITH 2" SQUARE OPERATING NUT, 10" BELOW GRADE (TYP. ALL VALVES).
12.	IRON BODY PLUG VALVE (2" - WITH THREADED BY SOLVENT WELD SDR 9 HDPE ADAPTORS) (3 & 4" - WITH MJ ENDS AND IPS TRANSITION GASKETS).
13.	CAST IN PLACE CONCRETE SUPPORT/THRUST BLOCK.
14.	LOW PRESSURE SEWER PIPE (SDR 9 HDPE).
15.	SDR 9 HDPE REDUCER (WHEN REQUIRED).
16.	SDR 9 ADAPTOR (2" WITH S.S. THREADED END), (3 & 4" WITH HDPE MJ END).

NOTES:

A. ALL HDPE PIPE AND FITTING JOINTS SHALL BE FUSED (SOCKET, BUTT OR ELECTROFUSED).

B. USE OF MECHANICAL COUPLINGS IN THE HDPE PIPE SYSTEM ARE NOT PERMITTED WITHOUT SPECIFIC APPROVAL OF THE ENGINEER.

C. TRACER WIRE NOT SHOWN FOR CLARITY. FOR TRACER WIRE INSTALLATION, REFER TO APPROPRIATE STANDARD DETAIL.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

LOW PRESSURE SEWER

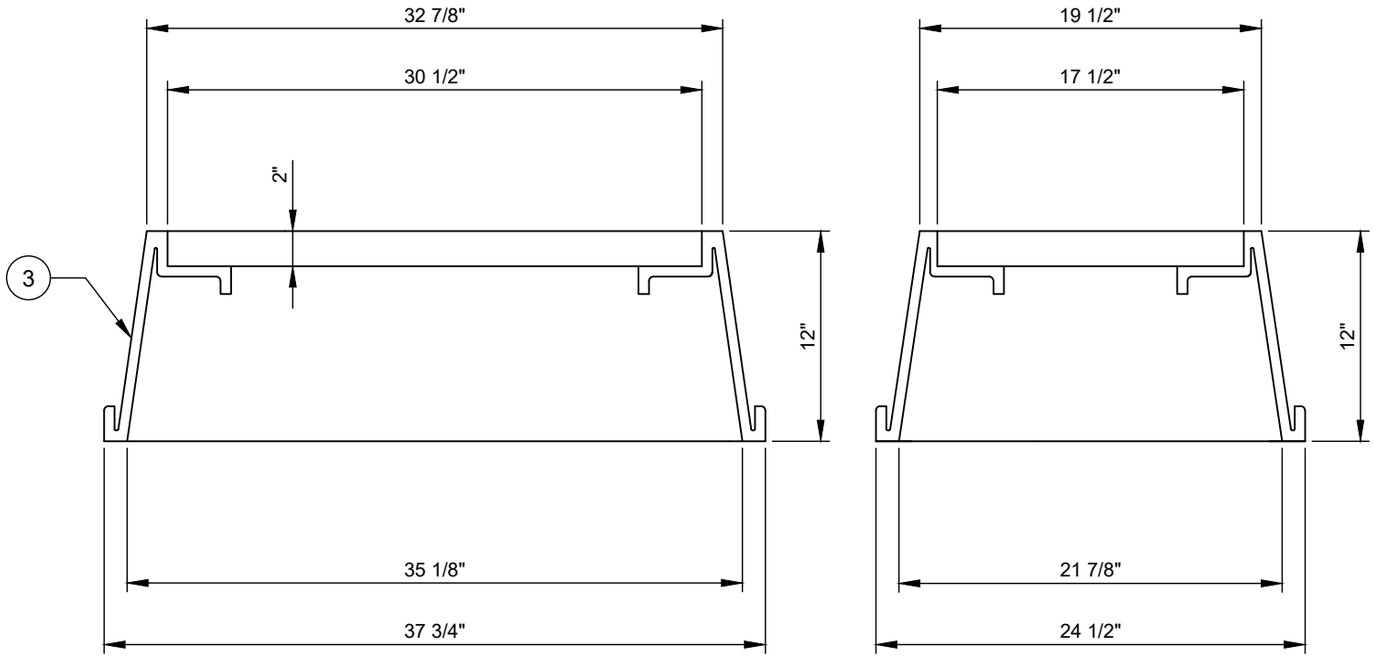
HDPE 2" CLEANOUT / MANUAL AIR RELEASE AT END OF MAIN

NO SCALE

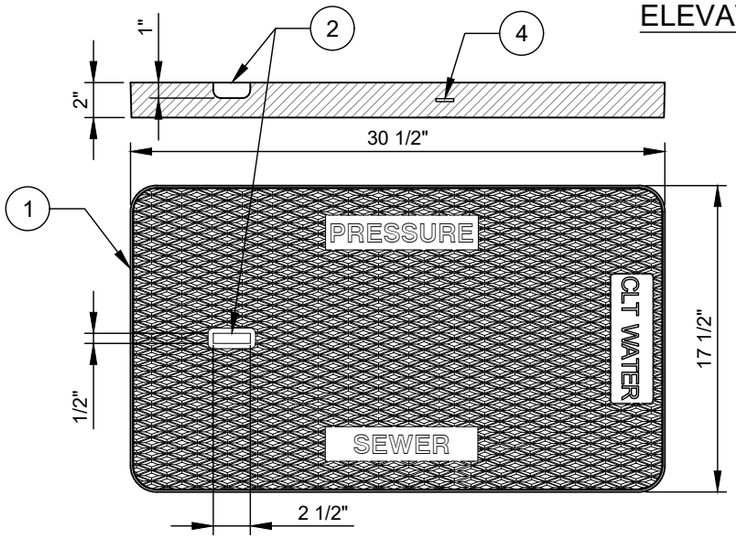
VERSION 1.0

DATE 04/2024

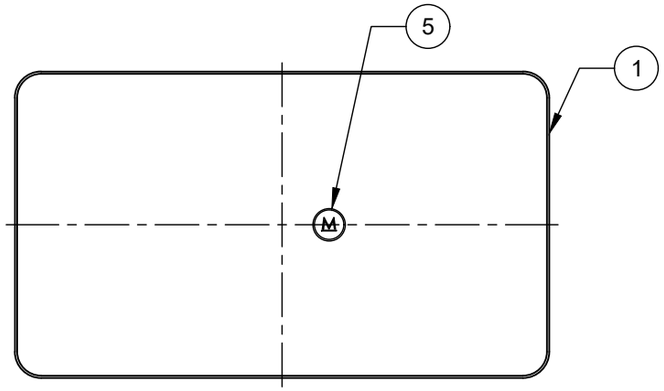
DETAIL 12.2



ELEVATION VIEW



COVER PLAN VIEW



BOTTOM VIEW

NO.	DESCRIPTION:
1.	GREEN VIRGIN PLASTIC SERVICE LID.
2.	3/4" DIAMETER PICK HOLE.
3.	GREEN VIRGIN PLASTIC SERVICE BOX.
4.	1/8" X 3/4" DIAMETER RARE EARTH MAGNET.
5.	IMPRINTED "M" UNDER MAGNET.

NOTES

A. MATERIAL SHALL BE HIGH DENSITY POLYETHYLENE.

B. LOAD RATING = HS20.

C. COLOR SHALL BE CHARLOTTE GREEN.

D. SUPPLIER/MANUFACTURER: SOUTHEASTERN DISTRIBUTORS MODEL MB 19 - HD.

METER BOX BODY WEIGHT= ##.# LBS.

LID WEIGHT - INCLUDING MAGNET - # LBS.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

LOW PRESSURE SEWER

HEAVY DUTY PLASTIC SERVICE BOX

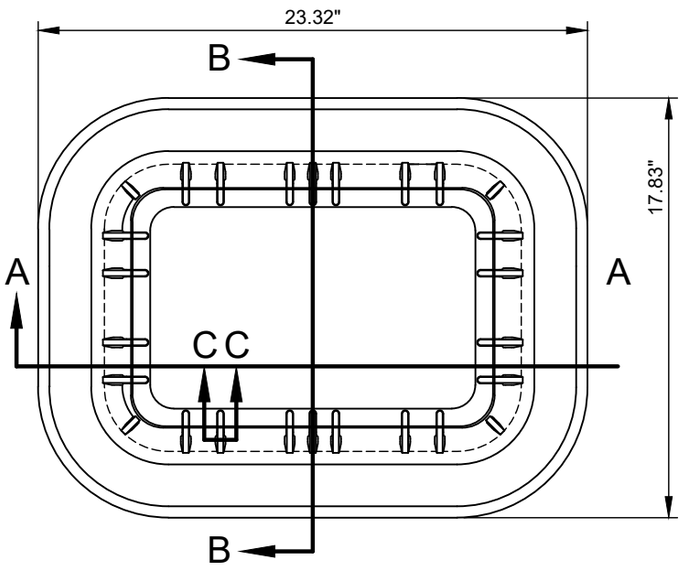
NO SCALE

VERSION 1.0

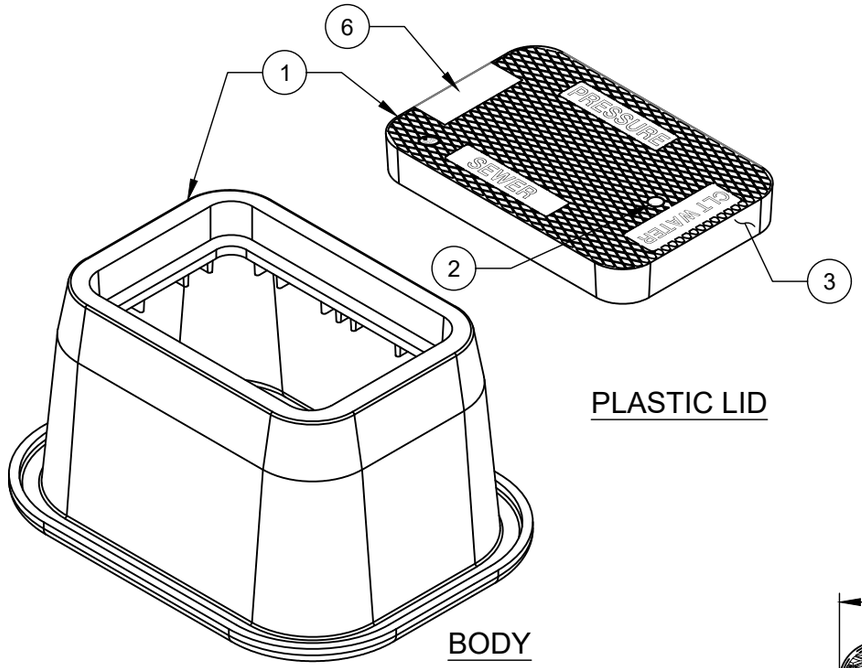
DATE 04/2024

DETAIL 12.3

CLEANOUT/MANUAL AIR RELEASE BOX



PLAN VIEW



PLASTIC LID

BODY

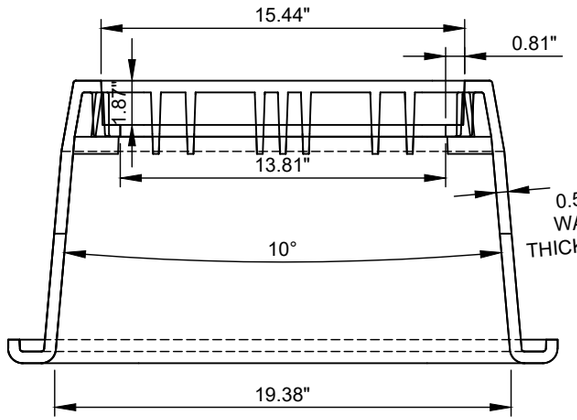
NO.	DESCRIPTION:
1.	MATERIAL SHALL BE HIGH DENSITY POLYETHYLENE.
2.	3/4" DIAMETER PICK HOLE.
3.	GREEN PLASTIC LID.
4.	1/8" X 3/4 DIAMETER" RARE EARTH MAGNET.
5.	IMPRINTED "M" UNDER MAGNET.
6.	MANUFACTURER NAME.

NOTES:

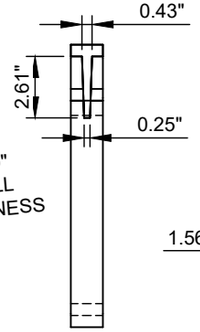
A. LOAD RATING = HS20.

B. COLOR SHALL BE CHARLOTTE GREEN.

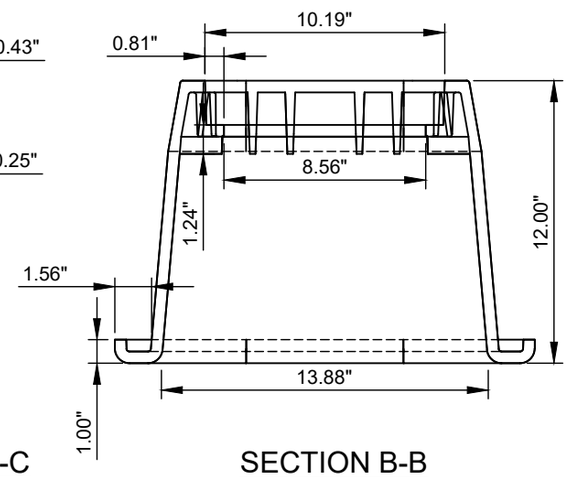
C. SUPPLIER/MANUFACTURER: SOUTHEASTERN DISTRIBUTORS.



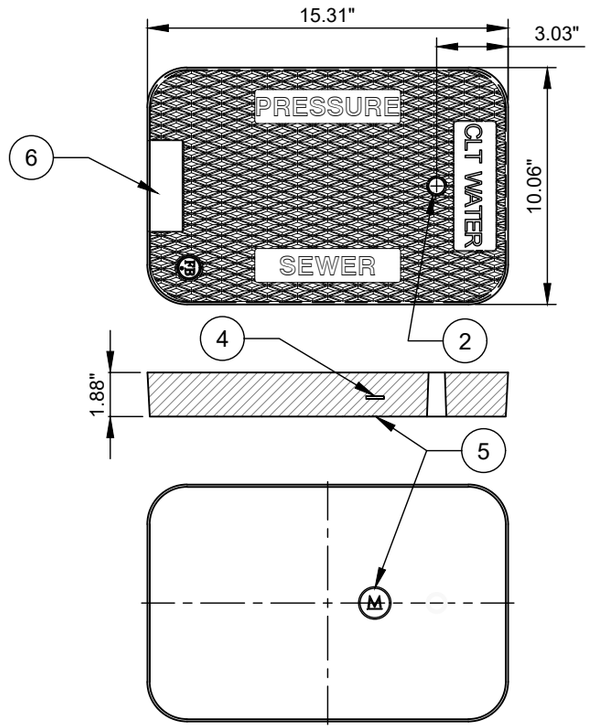
SECTION A-A



SECTION C-C
RIB DETAIL



SECTION B-B



BOTTOM VIEW

METER BOX BODY WEIGHT= 13.5 LBS.

LID WEIGHT - INCLUDING MAGNET - 6 LBS.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

LOW PRESSURE SEWER

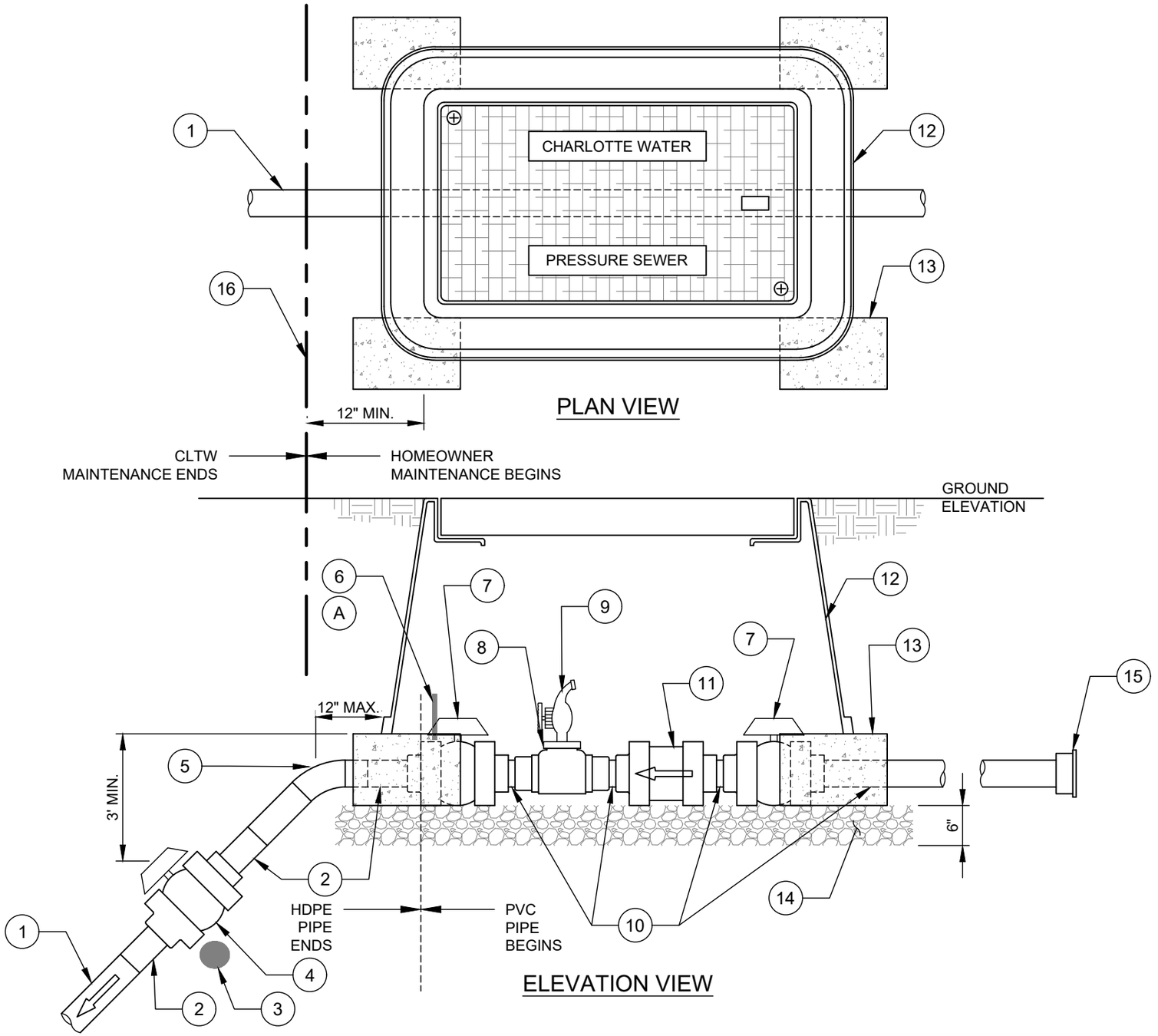
HEAVY DUTY PLASTIC CLEANOUT/ MANUAL AIR RELEASE BOX

NO SCALE

VERSION 2.0

DATE 01/2026

DETAIL 12.4



NO. DESCRIPTION:

1. 1.5" SERVICE PIPE - SDR 9 HDPE PIPE.
2. 1.5" SDR 9 HDPE ADAPTOR WITH S.S. THREAD END.
3. PVC ENCAPSULATED MAGNET.
4. 1 1/2" TRUE UNION PVC BALL VALVE WITH THREADED ENDS.
5. 1.5" SDR 9 HDPE 45° BEND.
6. BARREL LOCK WITH RED CAP AND LOCKOUT TAG (FURNISHED BY CLTW) - LOCK BALL VALVE CLOSED.
7. 1.5" TRUE UNION PVC BALL VALVE WITH THREADED BY SOLVENT WELD ENDS.
8. 1 1/2" THREADED OUTLET PVC TEE W/1 1/2" X 3/4" THREADED REDUCING BUSHING (SCH 80 PVC).
9. 3/4" BALL VALVE HOSE BIB (BRASS).
10. 1.5" SCH 80 PVC PIPE.
11. 1 1/2" TRUE UNION PVC BALL CHECK VALVE.
12. SERVICE BOX.
13. NCDOT SOLID CONCRETE CAPBLOCK (4" X 4" X 8").
14. 6" #57 STONE BASE.
15. SCH 80 PVC BUSHING TO REDUCE SERVICE SIZE AND CAP.
16. PROPERTY LINE, ROAD R/W OR CLTW EASEMENT LINE.

NOTES:

A. BARREL LOCK AND LOCKOUT TAG TO BE INSTALLED AFTER PRESSURE TEST, AND WILL BE REMOVED AFTER CLTW INSPECTION OF PRIVATE LOW PRESSURE PUMP STATION - (CERTIFICATE OF OCCUPANCY HOLD WILL ALSO BE REMOVED).

B. SERVICE BOX SHALL NOT BE IN SIDEWALKS OR DRIVEWAYS.

C. TOP OF BOX SHALL BE FLUSH WITH FINISHED GRADE OF LOT.

D. ALL HDPE PIPE AND FITTING JOINTS SHALL BE FUSED (SOCKET, BUTT OR ELECTROFUSED).

E. USE OF MECHANICAL COUPLINGS IN THE HDPE PIPE SYSTEM ARE NOT PERMITTED WITHOUT SPECIFIC APPROVAL OF THE ENGINEER.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

LOW PRESSURE SEWER

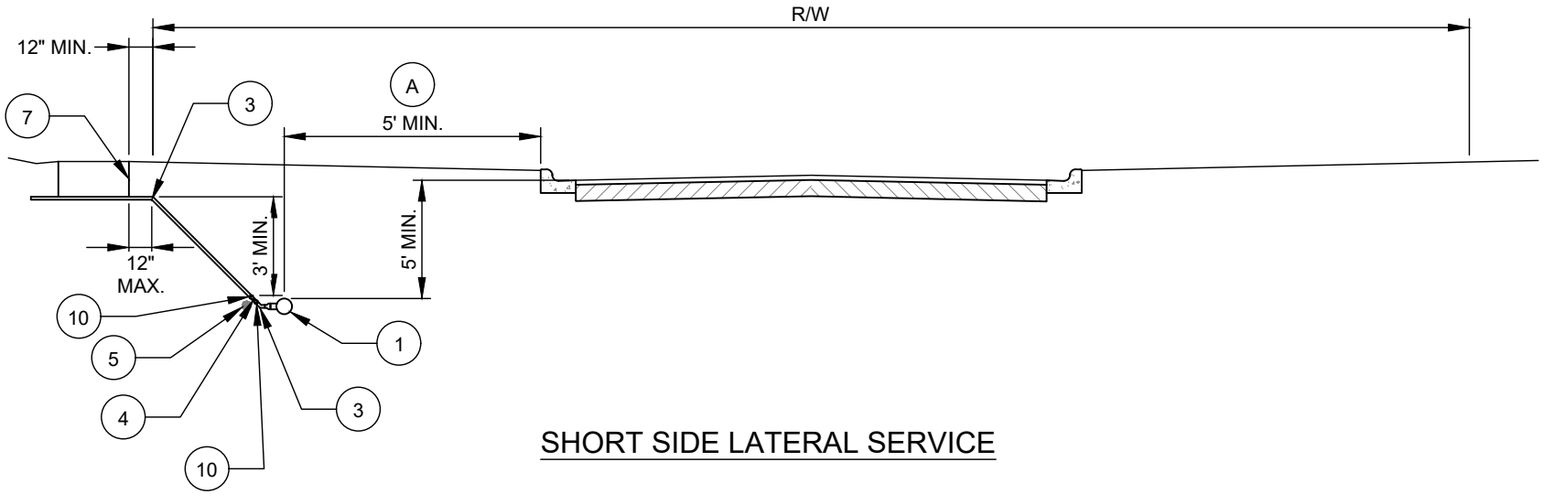
SERVICE CONNECTION - HDPE

NO SCALE

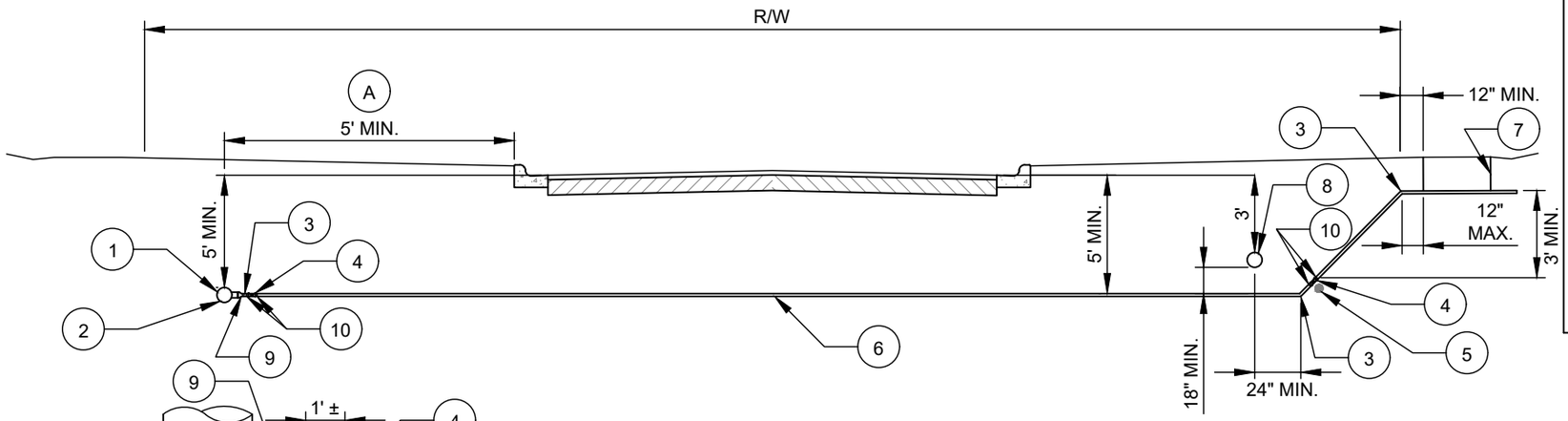
VERSION
1.0

DATE
04/2024

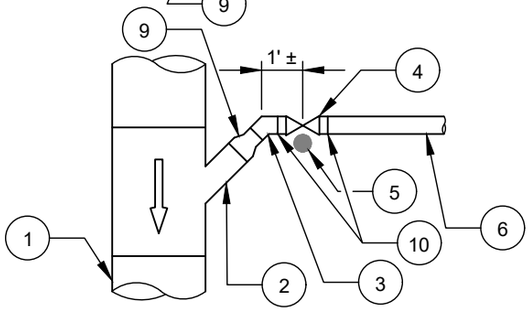
DETAIL
12.5



SHORT SIDE LATERAL SERVICE



LONG SIDE LATERAL SERVICE



PLAN VIEW

NO.	DESCRIPTION:
1.	LOW PRESSURE SEWER MAIN (SDR 9 HDPE).
2.	HORIZONTAL SERVICE WYE (SDR 9 HDPE).
3.	45° BEND (SDR 9 HDPE).
4.	1.5" TRUE UNION PVC BALL VALVE WITH THREADED END SOCKET (NO VALVE BOX ASSEMBLY).
5.	PVC ENCAPSULATED MAGNET.
6.	1 1/2" SERVICE PIPE (SDR 9 HDPE).
7.	SERVICE CONNECTION BOX.
8.	WATER MAIN.
9.	REDUCER (SDR 9 HDPE).
10.	SDR 9 HDPE ADAPTOR WITH S.S. THREADED END.

NOTES:

A. MINIMUM 5' FROM BOC AND OUTSIDE PLANTING STRIP. MUST MEET THE MOST STRINGENT GOVERNING AUTHORITY CRITERIA FOR MINIMUM SEPARATION FROM ALL OTHER UTILITIES.

B. ALL H.D.P.E. PIPE AND FITTING JOINTS SHALL BE FUSED (SOCKET, BUTT OR ELECTROFUSED).

C. USE OF MECHANICAL COUPLINGS IN THE H.D.P.E. PIPE SYSTEM ARE NOT PERMITTED WITHOUT SPECIFIC APPROVAL OF THE ENGINEER.

D. TRACER WIRE NOT SHOWN FOR CLARITY. FOR TRACER WIRE INSTALLATION, REFER TO APPROPRIATE STANDARD DETAIL.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

LOW PRESSURE SEWER

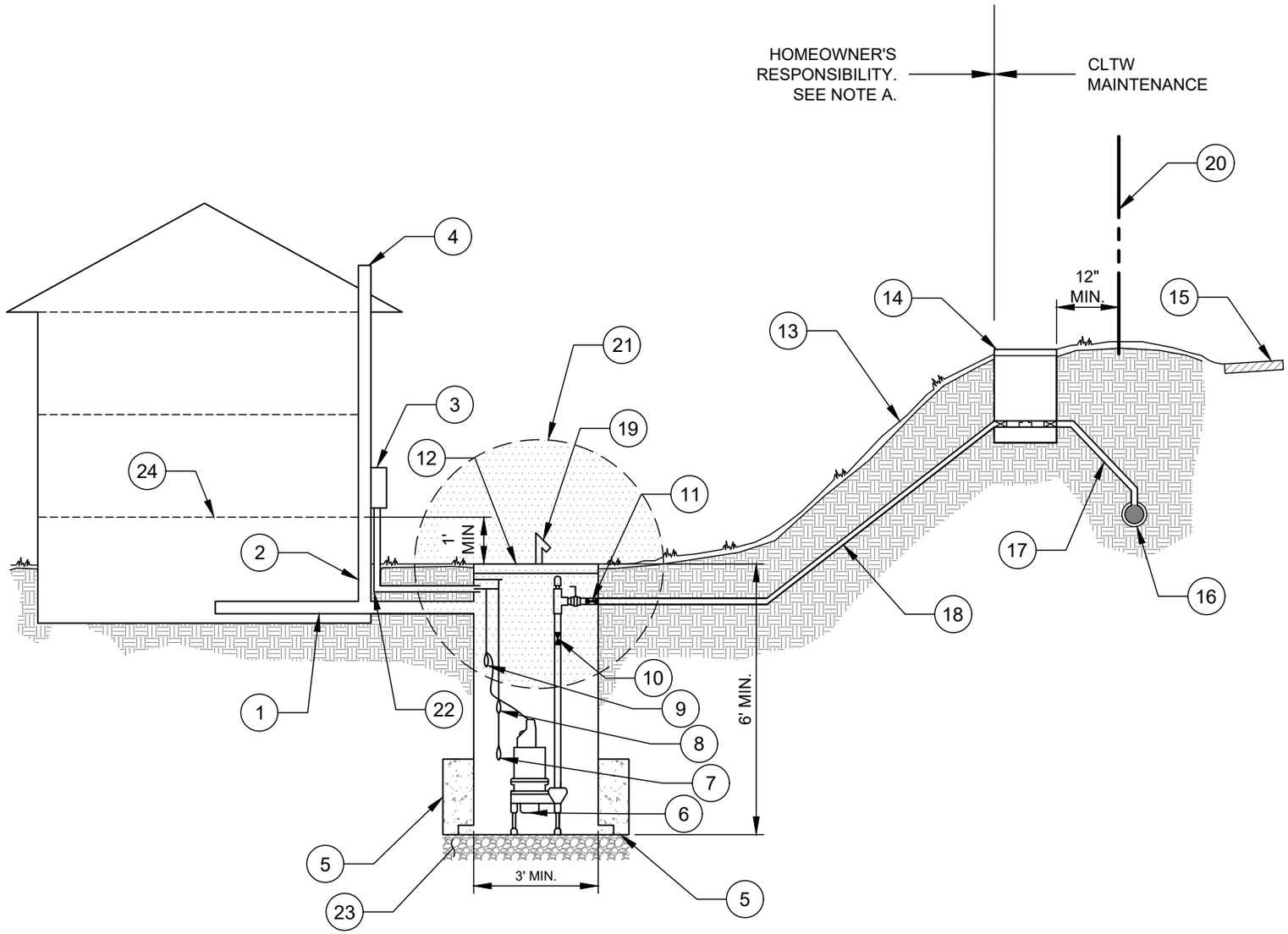
HDPE SERVICE LATERAL

NO SCALE

VERSION
1.0

DATE
04/2024

DETAIL
12.6



NO. DESCRIPTION:

1. BUILDING DRAIN.
2. VENT.
3. CONTROL BOX WITH VISUAL AND AUDIBLE HIGH LEVEL ALARMS.
4. MAIN VENT STACK.
5. CONCRETE BALLAST PER STATE MINIMUM. ADEQUATE BALLAST IS REQUIRED TO INSURE PROPER ANCHORING OF THE WET WELL.
6. NON-POSITIVE DISPLACEMENT GRINDER PUMP. MINIMUM 2 HP PUMP, CONFIRM WITH CLTW ENGINEER PRIOR TO PURCHASE.
7. OFF SWITCH FLOAT.
8. ON SWITCH FLOAT.
9. HIGH LEVEL ALARM FLOAT.
10. CHECK VALVE. PREVENTS CLOGS.
11. TRUE UNION BALL VALVE.
12. PUMP BASIN WITH SOLID, WATERTIGHT, BOLTED-DOWN COVER. ALSO SEE NOTE B.
13. FINISHED GRADE (VARIES).
14. SERVICE BOX.
15. PUBLIC ROAD.
16. PRESSURE SEWER STREET MAIN.
17. 1-1/2" SERVICE LINE.
18. 1-1/4" OR 1-1/2" INDIVIDUAL PUMP LINE.
19. VENT WITH S.S. INSECT SCREEN.
20. ROAD R/W.
21. 3' RADIUS EXPLOSION PROOF ZONE AROUND VENT PER NFPA 820.
22. NFPA 820 CONNECTION AND FIRE BLOCK.
23. 6" MIN. COMPACTED SUBBASE.
24. FINISHED FLOOR ELEVATION.

NOTES:

A. RESPONSIBILITY IS DELEGATED BY CLTW TO HOMEOWNER, HOA, OR UTILITY OWNER.
B. CONFIGURATION MAY VARY SLIGHTLY DEPENDING ON PRIVATE PLUMBING CONTRACTOR AS PUMP BASIN TO BE PLACED ON PROPERTY AT LOCATION DETERMINED BY PLUMBER.
C. TOP OF WET WELL SHALL BE INSTALLED A MINIMUM OF TWO (2) FEET ABOVE THE 100-YEAR FLOOD ELEVATION.
D. RIM ELEVATION OF WET WELL SHALL BE A MINIMUM OF 1' BELOW FINISHED FLOOR ELEVATION.
E. CONTROL PANEL SHALL BE LABELED WITH PLACARD OR STICKER WITH 24-HOUR EMERGENCY CONTACT NAME AND TELEPHONE NUMBER.
F. CONTROL BOX: WHICH PROVIDES THE PUMP POWER, THERMAL CIRCUIT BREAKER, AUDIBLE & VISUAL HIGH WATER ALARMS, SYSTEM STATUS AND COMPUTER PORT FOR ALTERING LEVEL SETTINGS.
G. CLTW TO USE DISCRETION IN DETERMINING WHEN AND WHERE MODIFICATIONS TO THIS DETAIL ARE SUITABLE.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

LOW PRESSURE SEWER

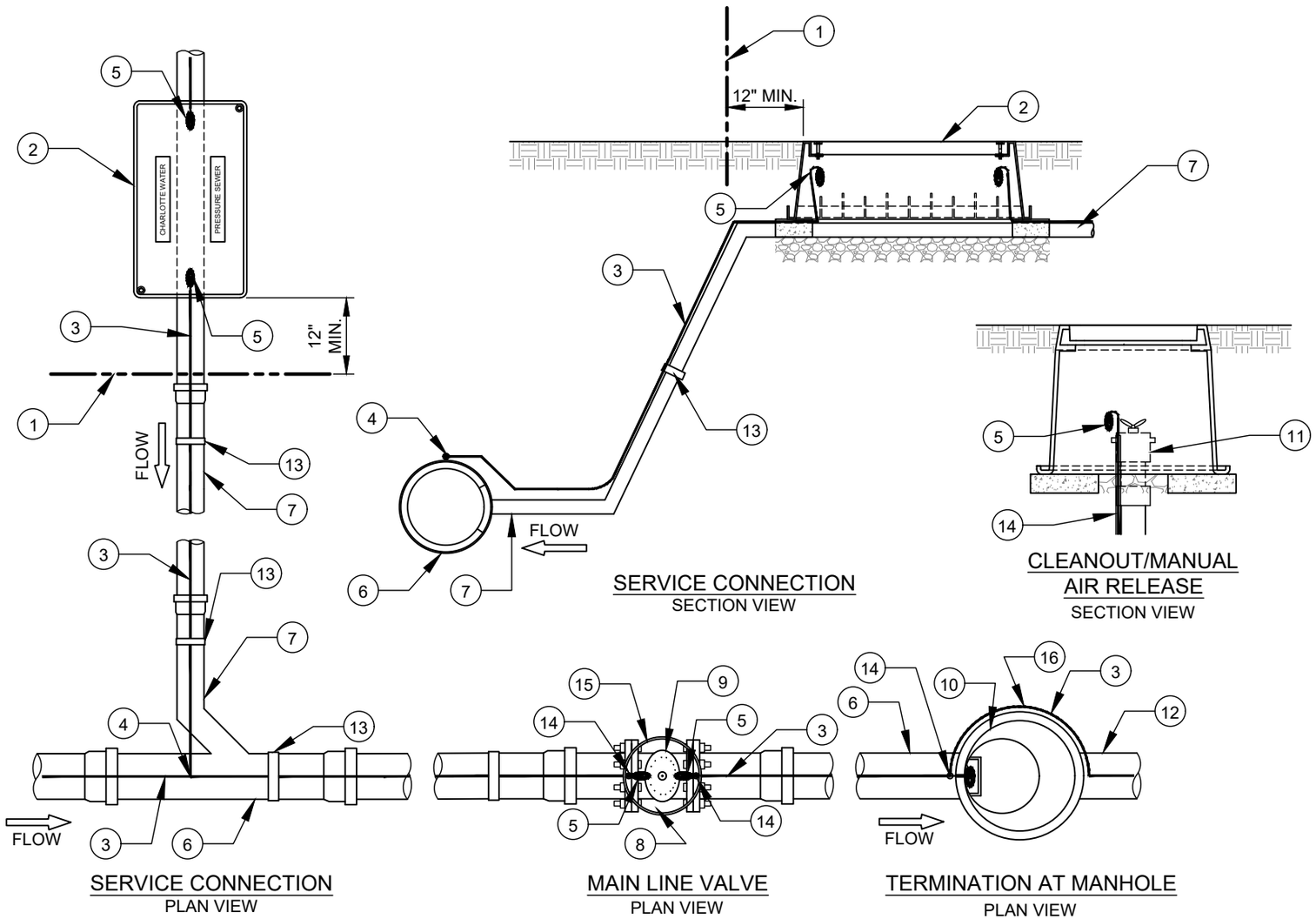
INDIVIDUAL GRINDER PUMP SYSTEM

NO SCALE

VERSION 1.0

DATE 04/2024

DETAIL 12.7



NO.	DESCRIPTION:
1.	PROPERTY/EASEMENT LINE/ROAD R/W.
2.	LOW PRESSURE SEWER SERVICE BOX .
3.	#12 GAUGE SOLID COPPER TRACER WIRES WITH 30 MILS GREEN HDPE INSULATION (TYP.).
4.	SPLICE.
5.	24" NEATLY COILED TRACER WIRE IN BOX.
6.	LOW PRESSURE SEWER FORCE MAIN.
7.	LOW PRESSURE SEWER SERVICE LATERAL.
8.	NO SPLICE.
9.	MAIN LINE VALVE WITH VALVE BOX ASSEMBLY.
10.	SANITARY SEWER MANHOLE.
11.	CLEANOUT/MANUAL AIR RELEASE.
12.	GRAVITY SEWER MAIN.
13.	FASTEN TRACER WIRE TO PIPE WITH ZIP TIES OR DUCT TAPE AROUND THE CIRCUMFERENCE OF PIPE AT 10' INTERVALS (TYP.).
14.	ALL VERTICAL WIRE SHALL BE PLACED IN 1/4" OR 3/8" I.D. CONDUIT SDR 9 PEX TUBING - ASTM F876 (TYP.).
15.	WHERE 2 OR MORE WIRES ENTER A VALVE BOX ASSEMBLY, (PROVIDE 24 INCHES OF NEATLY COILED WIRE) AFTER ACCEPTANCE TESTING, CONNECT ENDS OF ALL WIRES WITH WATER PROOF WIRE CONNECTOR NUT AND 3" BARE #12 COPPER WIRE PIGTAIL.
16.	FOR TRACER WIRE INSTALLATION AT A SEWER MANHOLE, REFER TO THE GRAVITY SEWER DETAILS.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

LOW PRESSURE SEWER

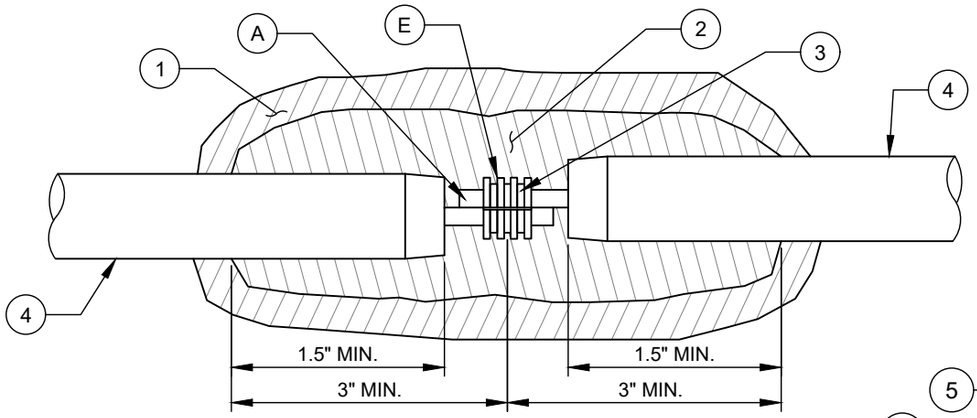
TRACER WIRE

NO SCALE

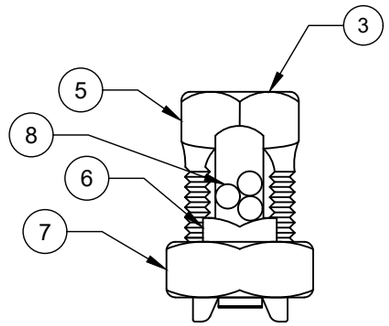
VERSION
1.0

DATE
04/2024

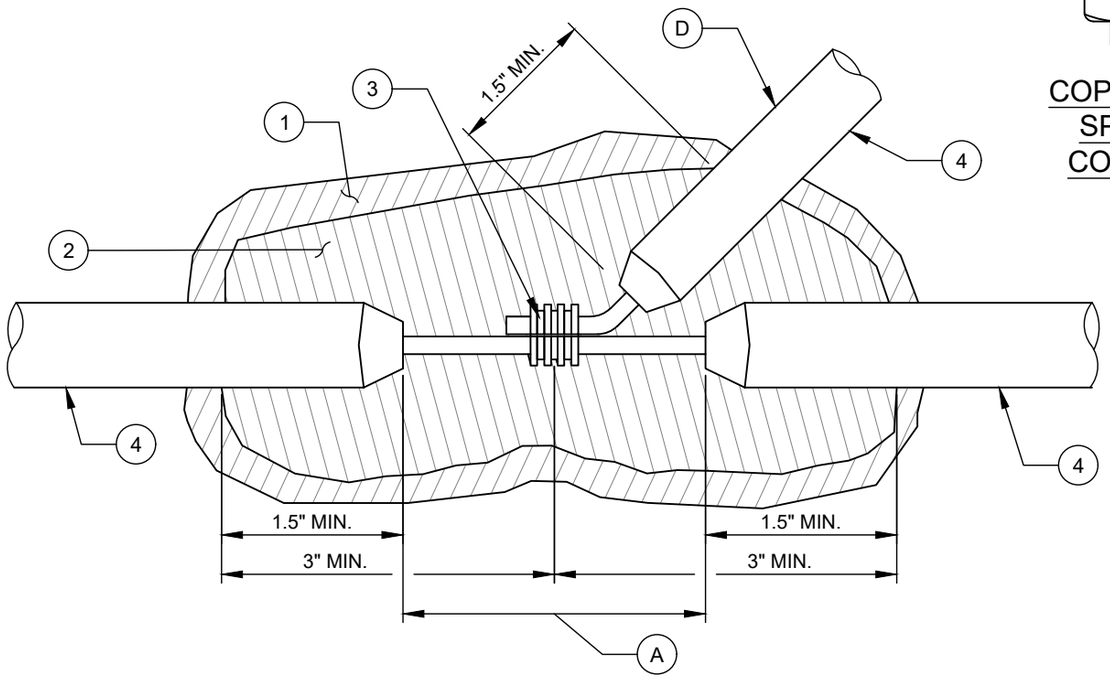
DETAIL
12.8



IN-LINE OR REPAIR SPLICE



COPPER ALLOY SPLIT BOLT CONNECTOR



BRANCH IN-LINE SPLICE FOR SERVICE LATERAL, WYE, OR CLEANOUT/AIR RELEASE

NO.	DESCRIPTION:
1.	3-LAYERS OF HALF LAPPED VINYL TAPE.
2.	3-LAYERS OF HALF LAPPED RUBBER TAPE.
3.	COPPER CRIMP CONNECTOR OR COPPER ALLOY SPLIT BOLT CONNECTOR.
4.	SOLID COPPER WITH 30 MILS GREEN HDPE INSULATION (AWG #12 TRACER WIRE).
5.	COPPER ALLOY SPLIT BOLT.
6.	COPPER ALLOY PRESSURE BAR.
7.	COPPER ALLOY HEX NUT.
8.	SOLID COPPER TRACER WIRES.

NOTES:

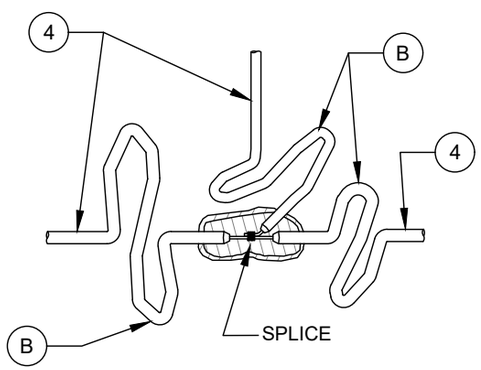
A. REMOVE MAINLINE (PRIMARY) TRACER WIRE INSULATION MATERIAL TO EXPOSE COPPER CORE WIRE.

B. IN LINE SPLICES SHALL BE LIMITED TO THE GREATEST EXTENT POSSIBLE. TRACER WIRE SHALL BE AS CONTINUOUS AS POSSIBLE WITHOUT SPLICES.

C. SPLICES SHALL INCLUDE 2' OF SLACK WIRE ON EACH SIDE OF EACH SPLICE (SEE DETAIL ON THIS SHEET).

D. 4-WAY WIRE SPLICES ARE ACCEPTABLE, WHERE NEEDED FOR 2 LATERALS CLOSELY SPACED, TO REDUCE THE NUMBER OF SPLICES.

E. THE CRIMPING TOOL USED TO COMPLETE THE CRIMP SHALL BE DESIGNED SPECIFICALLY FOR USE WITH THE CONNECTOR USED. GENERIC CRIMPING TOOLS ARE NOT ACCEPTABLE.



SPLICES WITH 2 FEET OF SLACK WIRE

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

LOW PRESSURE SEWER

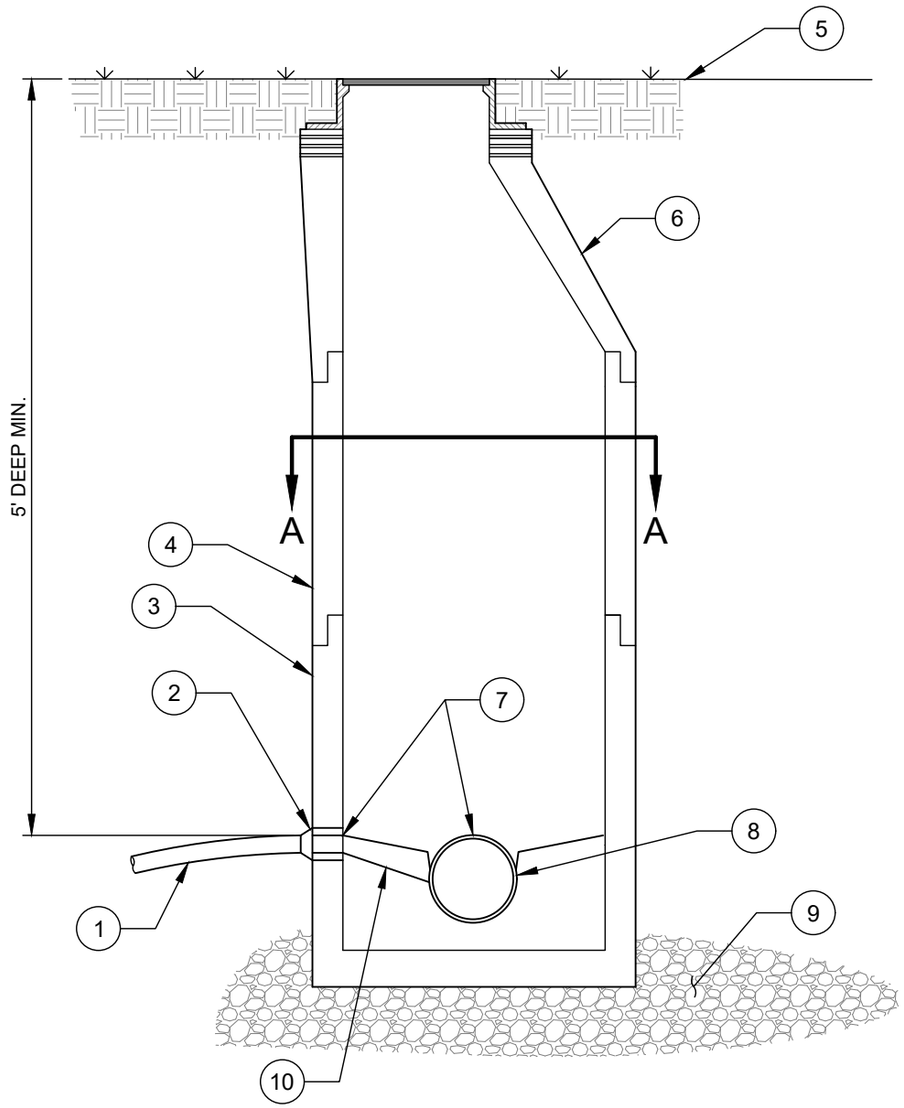
TRACER WIRE - SPLICE

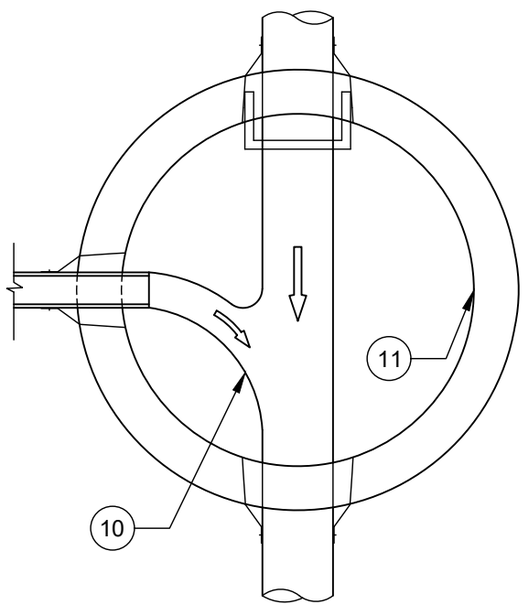
NO SCALE

VERSION 1.0

DATE 04/2024

DETAIL 12.9





SECTION A-A

NO.	DESCRIPTION:
1.	LOW PRESSURE SEWER MAIN.
2.	CORE HOLE AND INSTALL FLEXIBLE BOOT CONNECTOR.
3.	BASE SECTION.
4.	RISER.
5.	EXISTING OR FINISHED GRADE.
6.	CONE.
7.	CROWN OF LOW PRESSURE SEWER MAIN TO BE INSTALLED AT SAME ELEVATION AS THE CROWN OF THE GRAVITY SEWER LINE ENTERING THE MANHOLE.
8.	RECEIVING GRAVITY SEWER.
9.	#57 STONE BASE, SUITABLE BEARING CAPACITY AS APPROVED BY GEOTECHNICAL ENGINEER.
10.	RESHAPE INVERT.
11.	CORROSION PROTECTION REQUIRED - SEE GRAVITY SEWER MANHOLE SPECIFICATIONS.

NOTES:

A. INSIDE AND OUTSIDE DROPS SHALL NOT BE ALLOWED AT LOW PRESSURE SEWER CONNECTIONS TO MANHOLE.

B. TRACER WIRE NOT SHOWN FOR CLARITY. FOR TRACER WIRE INSTALLATION, REFER TO APPROPRIATE STANDARD DETAIL.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

LOW PRESSURE SEWER

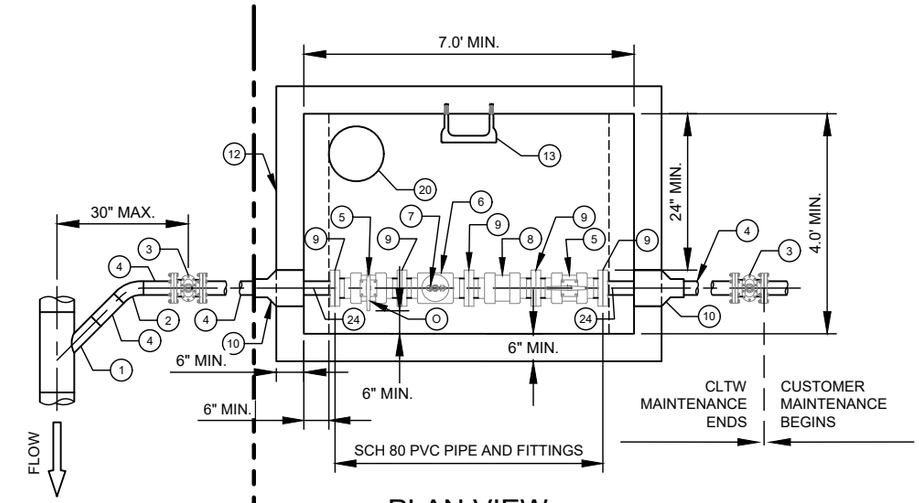
CONNECTION OF LOW PRESSURE SEWER MAIN TO MANHOLE

NO SCALE

VERSION
1.0

DATE
04/2024

DETAIL
12.10



PLAN VIEW

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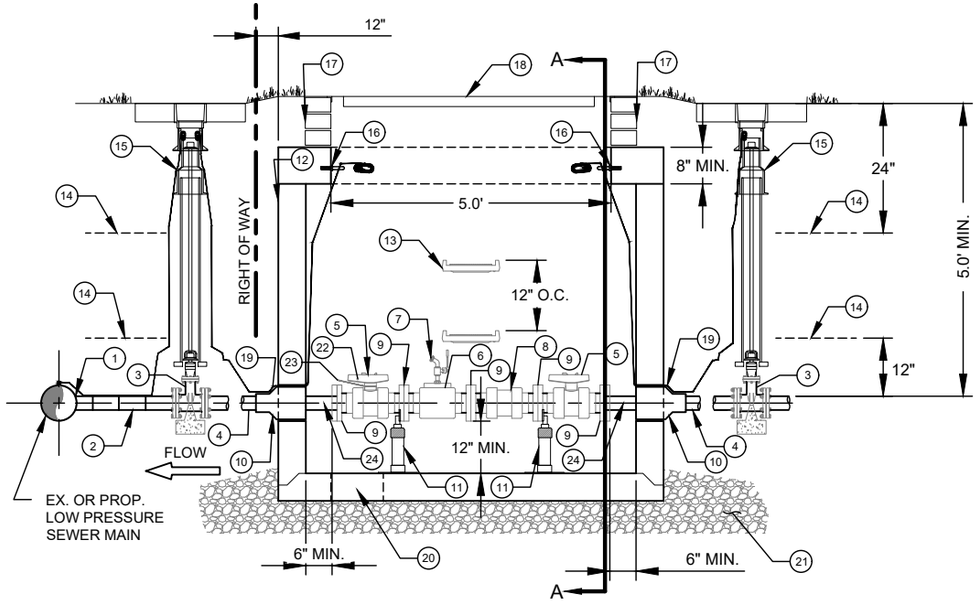
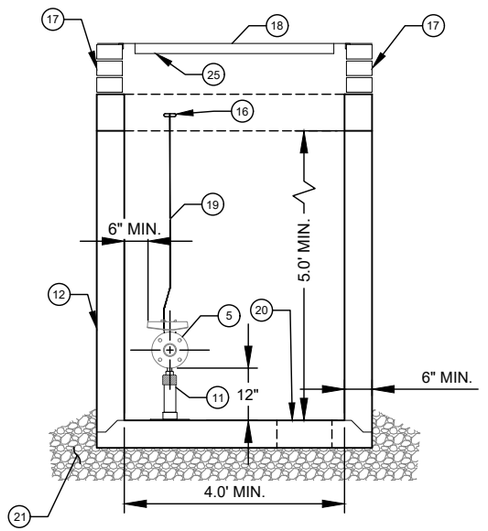
XXXXXXXXXXX AVE
APT/UNIT XX



SIDE VIEW



SECTION A-A VIEW

NO.	DESCRIPTION:
1.	4" OUTLET SDR 9 HDPE WYE, WITH CONCRETE THRUST BLOCKING.
2.	4" SDR 9 HDPE 45° BEND, WITH CONCRETE THRUST BLOCKING.
3.	4" MJ DI PLUG VALVE, WITH SDR 9 HDPE MJ ADAPTOR, EXTENSION STEM, 2" OPERATING NUT, AND CONCRETE THRUST BLOCKING/ SUPPORT.
4.	4" SDR 9 HDPE PIPE - BUTT FUSED.
5.	4" PVC HAYWARD TRUE UNION BALL VALVE WITH FLANGE ENDS, LOCKOUT HANDLE.
6.	4" X 4" X 2" SCH 80 PVC FLANGE TEE WITH 2" SOLVENT WELD OUTLET, 2" X 3/4" PVC REDUCING BUSHING, WITH FNPT OUTLET.
7.	3/4" BRASS BALL VALVE HOSE BIB, MNPT.
8.	4" PVC HAYWARD TRUE UNION BALL CHECK VALVE W/ FLANGE ENDS.
9.	4" SCH 80 PVC FLANGE SOLVENT WELD ADAPTORS, IF FLANGED MAJOR COMPONENTS ARE NOT AVAILABLE.
10.	RUBBER PIPE CONNECTOR BOOT (DO NOT GROUT AROUND PIPE).
11.	S.S. ADJUSTABLE FLANGE PIPE SUPPORTS W/ S.S EPOXY ADHESIVE ANCHORS (REQ'D - 2 EACH).
12.	PRECAST CONCRETE VAULT - MIN L,W,D = 7' X 4' X 5'.
13.	PLASTIC STEP - 12" O.C. VERTICAL SPACING.
14.	6" WIDE "PRESSURE SEWER" WARNING TAPE.
15.	STD SEWER VALVE BOX ASSEMBLY WITH CONCRETE PAD.
16.	3/8" S.S. EYE BOLT (TYP).
17.	MIN 3 COURSES CAP BLOCK WITH 3/8" MORTAR JOINTS, OR PRECAST RISER SECTION, MAX 2.5'.
18.	4' X 5' STEEL METER VAULT FRAME AND COVER, 1000 PSF MIN LOAD RATING, COVER SHALL SHALL BE "CLTW - L. P. SEWER", ERT HANGERS AND SLOTS NOT REQUIRED.
19.	SOLID COPPER AWG #12 GAUGE TRACER WIRE WITH 30 MILS GREEN HDPE INSULATION, TERMINATE WITH 24" AT EYE BOLT.
20.	12" DIAMETER SUMP HOLE.
21.	12" COMPACTED #57 WASHED STONE.
22.	BARREL LOCK - FURNISHED BY CLTW.
23.	PUMP STATION INSPECTION LOCKOUT WARNING TAG - FURNISHED BY CLTW.
24.	SDR 9 HDPE FLANGE ADAPTOR.
25.	ATTACH GREEN ENGRAVED LABEL, WITH PREMISE NUMBER AND ADDRESS, TO UNDERSIDE OF DOOR, NEAR THE LIFTING HANDLE.

NOTES:

A. VAULT SHALL NOT BE LOCATED IN PAVEMENT, SIDEWALKS OR DRIVEWAYS.
B. VAULT SHALL BE 7' LONG, 4' WIDE, 5' DEEP MINIMUM.
C. ALL FLANGE HARDWARE SHALL BE 316 OR 304 STAINLESS STEEL WITH ANTI-SEIZE COMPOUND, FLAT WASHER REQUIRED BETWEEN BOLT HEAD AND FLANGE, FLAT WASHER AND LOCK WASHER REQUIRED BETWEEN NUT AND FLANGE. TORQUE TO 20-25 FT. LBS.
D. ALL PIPE AND FITTINGS SHALL BE SDR 9 HDPE, EXCEPT AS INDICATED INSIDE THE VAULT.
E. ASSEMBLY CONFIGURATION AND LENGTH MAY VARY DUE TO BRAND - VERIFY LENGTH TO DETERMINE MINIMUM VAULT LENGTH.
F. ALL CONCRETE SHALL BE MINIMUM 4000 PSI COMPRESSIVE STRENGTH.
G. DESIGN SHALL CONFORM TO ASTM C858 - SPECIFICATIONS FOR "UNDERGROUND PRECAST CONCRETE UTILITY STRUCTURE".
H. STEEL REINFORCING DESIGN SHALL CONFORM TO ASTM C857.
I. REBARS SHALL BE GRADE 60 PER ASTM A615.
J. WELDED WIRE FABRIC SHALL CONFORM TO ASTM A185.
K. DIAGONAL REINFORCING SHALL BE ADDED AT ALL OPENINGS.
L. PIPE PENETRATION SHALL BE SEALED WITH FLEXIBLE CONNECTORS (MANHOLE BOOTS).
M. FRAME TO BE FLUSH WITH GROUND OR CONCRETE SIDEWALK, GROUND SHALL SLOPE AWAY FROM VAULT.
N. ALL JOINTS SHALL BE MADE WATERTIGHT USING 2 RINGS OF BUTYL RUBBER JOINT MASTIC.
O. BARREL LOCK AND LOCKOUT TAG TO BE INSTALLED AFTER PRESSURE TEST, AND WILL BE REMOVED AFTER CLTW INSPECTION OF PRIVATE LOW PRESSURE PUMP STATION - (CERTIFICATE OF OCCUPANCY HOLD WILL ALSO BE REMOVED).
P. WHEN CONNECTING TO A PVC LOW PRESSURE MAIN, NO. 1, NO. 2, NO. 3, NO. 4, AND NO. 24 SHALL BE SCH 80 PVC PIPE AND FITTINGS WITH SOLVENT WELD JOINTS.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

LOW PRESSURE SEWER

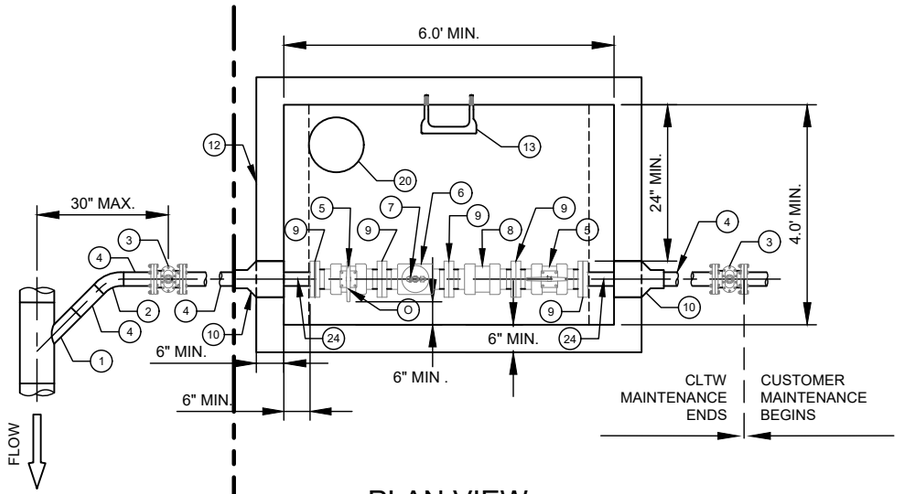
HDPE 4-INCH LOW PRESSURE SEWER SERVICE

NO SCALE

VERSION 1.0

DATE 04/2024

DETAIL 12.11



PLAN VIEW

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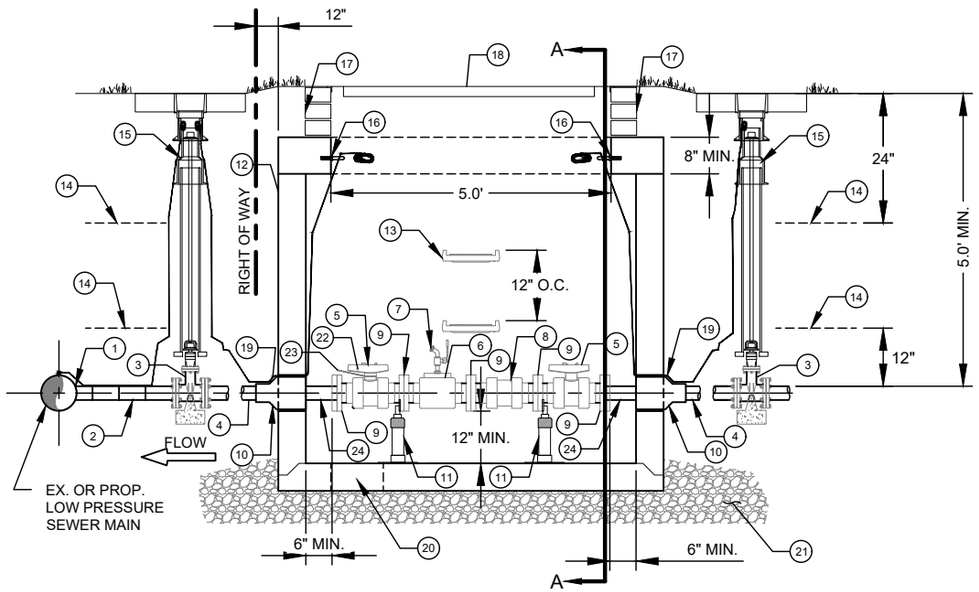
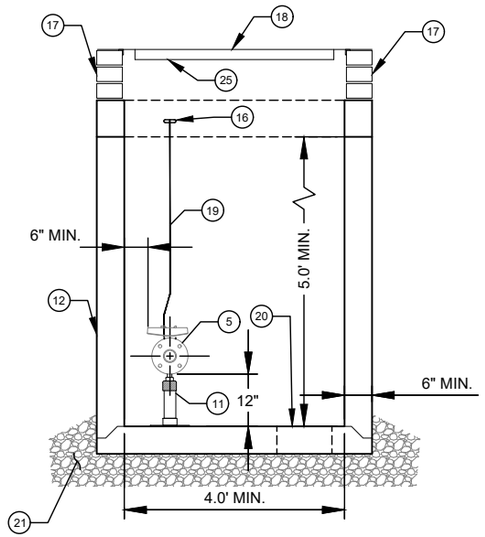
XXXXXXXXXXX AVE
APT/UNIT XX



SIDE VIEW



SECTION A-A VIEW

NO.	DESCRIPTION:
1.	3" OUTLET SDR9 HDPE WYE, WITH CONCRETE THRUST BLOCKING.
2.	3" SDR9 HDPE 45° BEND, WITH CONCRETE THRUST BLOCKING.
3.	3" MJ DI PLUG VALVE, W/ SDR9 HDPE MJ ADAPTOR, EXTENSION STEM, 2" OPERATING NUT, AND CONCRETE THRUST BLOCKING/SUPPORT.
4.	3" SDR9 HDPE PIPE - BUTT FUSED.
5.	3" PVC HAYWARD TRUE UNION BALL VALVE WITH FLANGE ENDS, LOCKOUT HANDLE.
6.	3" X 3" X 2" SCH 80 PVC FLANGE TEE WITH 2" SOLVENT WELD OUTLET, 2"X3/4" PVC REDUCING BUSHING, WITH FNPT OUTLET.
7.	3/4" BRASS BALL VALVE HOSE BIB, MNPT.
8.	3" PVC HAYWARD TRUE UNION BALL CHECK VALVE WITH FLANGE ENDS.
9.	3" SCH 80 PVC FLANGE SOLVENT WELD ADAPTORS, IF FLANGED MAJOR COMPONENTS ARE NOT AVAILABLE.
10.	RUBBER PIPE CONNECTOR BOOT (DO NOT GROUT AROUND PIPE).
11.	S.S. ADJUSTABLE FLANGE PIPE SUPPORTS W/ S.S EPOXY ADHESIVE ANCHORS (REQ'D - 2 EACH).
12.	PRECAST CONCRETE VAULT - MIN L,W,D = 6' X 4' X 5'.
13.	PLASTIC STEP - 12" O.C. VERTICAL SPACING.
14.	6" WIDE "PRESSURE SEWER" WARNING TAPE.
15.	STD SEWER VALVE BOX ASSEMBLY WITH CONCRETE PAD.
16.	3/8" S.S. EYE BOLT (TYP).
17.	MIN 3 COURSES CAP BLOCK WITH 3/8" MORTAR JOINTS, OR PRECAST RISER SECTION, MAX 2.5'.
18.	4' X 5' STEEL METER VAULT FRAME AND COVER, 1000 PSF MIN LOAD RATING, COVER SHALL SHALL BE "CLT WATER - L. P. SEWER", ERT HANGERS AND SLOTS NOT REQUIRED.
19.	SOLID COPPER AWG #12 GAUGE TRACER WIRE WITH 30 MILS GREEN HDPE INSULATION, TERMINATE WITH 24" AT EYE BOLT.
20.	12" DIA SUMP HOLE.
21.	12" COMPACTED #57 WASHED STONE.
22.	BARREL LOCK - FURNISHED BY CLTW.
23.	PUMP STATION INSPECTION LOCKOUT WARNING TAG - FURNISHED BY CLTW.
24.	SDR9 HDPE FLANGE ADAPTOR.
25.	ATTACH GREEN ENGRAVED LABEL, WITH PREMISE NUMBER, AND ADDRESS TO UNDERSIDE OF DOOR, NEAR THE LIFTING HANDLE.

NOTES:

A. VAULT SHALL NOT BE LOCATED IN PAVEMENT, SIDEWALKS OR DRIVEWAYS.
B. VAULT SHALL BE 6' LONG, 4' WIDE, 5' DEEP MINIMUM.
C. ALL FLANGE HARDWARE SHALL BE 316 OR 304 STAINLESS STEEL WITH ANTI-SEIZE COMPOUND, FLAT WASHER REQUIRED BETWEEN BOLT HEAD AND FLANGE, FLAT WASHER AND LOCK WASHER REQUIRED BETWEEN NUT AND FLANGE. TORQUE TO 20-25 FT. LBS.
D. ALL PIPE AND FITTINGS SHALL BE SDR 9 HDPE, EXCEPT AS INDICATED INSIDE THE VAULT.
E. ASSEMBLY CONFIGURATION AND LENGTH MAY VARY DUE TO BRAND - VERIFY LENGTH TO DETERMINE MINIMUM VAULT LENGTH.
F. ALL CONCRETE SHALL BE MINIMUM 4000 PSI COMPRESSIVE STRENGTH.
G. DESIGN SHALL CONFORM TO ASTM C858 - SPECIFICATIONS FOR "UNDERGROUND PRECAST CONCRETE UTILITY STRUCTURE".
H. STEEL REINFORCING DESIGN SHALL CONFORM TO ASTM C857.
I. REBARS SHALL BE GRADE 60 PER ASTM A615.
J. WELDED WIRE FABRIC SHALL CONFORM TO ASTM A185.
K. DIAGONAL REINFORCING SHALL BE ADDED AT ALL OPENINGS.
L. PIPE PENETRATION SHALL BE SEALED WITH FLEXIBLE CONNECTORS (MANHOLE BOOTS).
M. FRAME TO BE FLUSH WITH GROUND OR CONCRETE SIDEWALK, GROUND SHALL SLOPE AWAY FROM VAULT.
N. ALL JOINTS SHALL BE MADE WATERTIGHT USING 2 RINGS OF BUTYL RUBBER JOINT MASTIC.
O. BARREL LOCK AND LOCKOUT TAG TO BE INSTALLED AFTER PRESSURE TEST, AND WILL BE REMOVED AFTER CLTW INSPECTION OF PRICATE LOW PRESSURE PUMP STATION - (CERTIFICATION OF OCCUPANCY HOLD WILL ALSO BE REMOVED).
P. WHEN CONNECTING TO A PVC LOW PRESSURE MAIN, NO. 1, NO. 2, NO. 3, NO. 4, AND NO. 24 SHALL BE SCH 80 PVC PIPE AND FITTINGS WITH SOLVENT WELD JOINTS.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

LOW PRESSURE SEWER

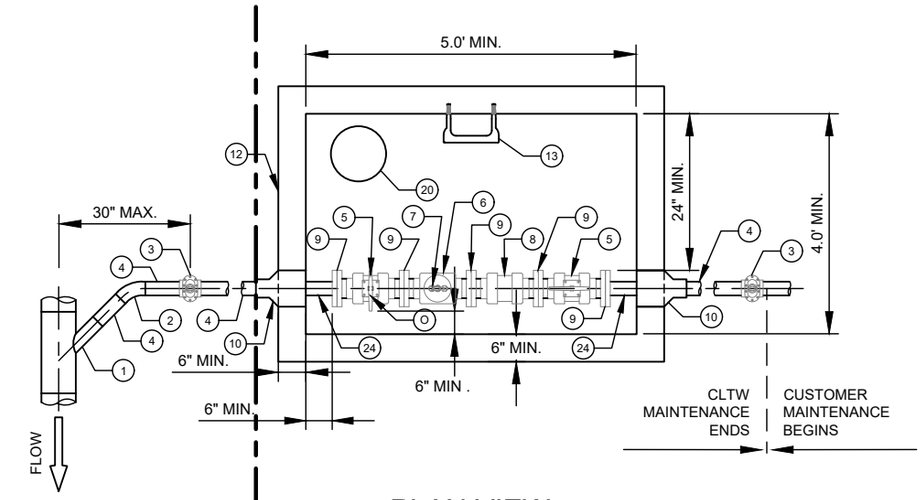
HDPE 3-INCH LOW PRESSURE SEWER SERVICE

NO SCALE

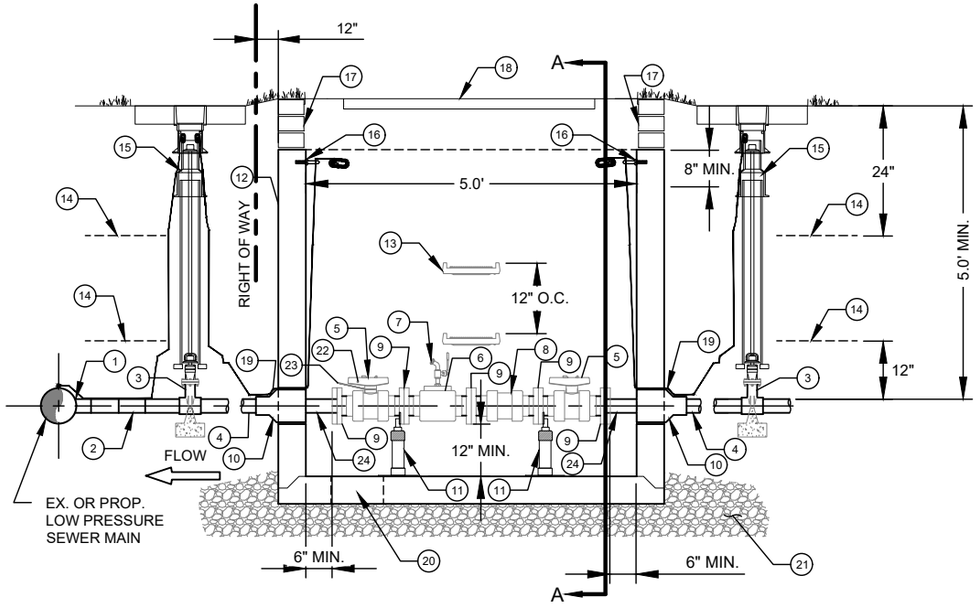
VERSION 1.0

DATE 04/2024

DETAIL 12.12



PLAN VIEW



SIDE VIEW

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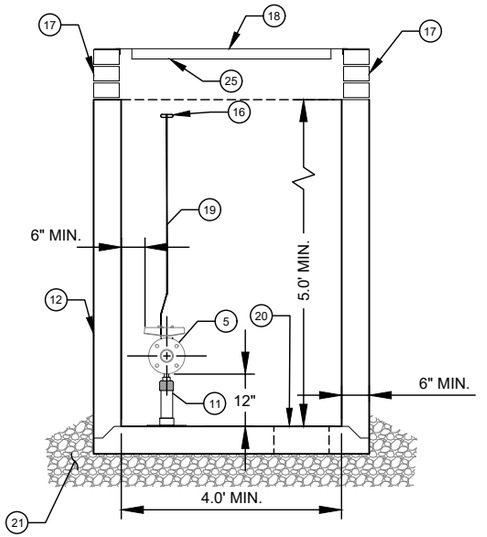
XXXXXXXXXXX AVE
APT/UNIT XX



SECTION A-A VIEW

NO.	DESCRIPTION:
1.	2" OUTLET SDR9 HDPE WYE, WITH CONCRETE THRUST BLOCKING.
2.	2" SDR9 HDPE 45° BEND, WITH CONCRETE THRUST BLOCKING.
3.	2" DI PLUG VALVE, FNPT, EXTENSION STEM, 2" OPERATING NUT, AND CONCRETE THRUST BLOCKING/SUPPORT.
4.	2" SDR9 HDPE PIPE - BUTT FUSED.
5.	2" PVC HAYWARD TRUE UNION BALL VALVE WITH FLANGE ENDS, LOCKOUT HANDLE.
6.	2" X 2" X 2" SCH 80 PVC FLANGE TEE WITH 2" SOLVENT WELD OUTLET, 2" X 3/4" PVC REDUCING BUSHING, WITH FNPT OUTLET.
7.	3/4" BRASS BALL VALVE HOSE BIB, MNPT.
8.	2" PVC HAYWARD TRUE UNION BALL CHECK VALVE WITH FLANGE ENDS.
9.	2" SCH 80 PVC FLANGE SOLVENT WELD ADAPTORS, IF FLANGED MAJOR COMPONENTS ARE NOT AVAILABLE.
10.	RUBBER PIPE CONNECTOR BOOT (DO NOT GROUT AROUND PIPE).
11.	S.S. ADJUSTABLE FLANGE PIPE SUPPORTS WITH S.S. EPOXY ADHESIVE ANCHORS (REQ'D - 2 EACH).
12.	PRECAST CONCRETE VAULT - MIN L,W,D = 5' X 4' X 5'.
13.	PLASTIC STEP - 12" O.C. VERTICAL SPACING.
14.	6" WIDE "PRESSURE SEWER" WARNING TAPE.
15.	STD SEWER VALVE BOX ASSEMBLY WITH CONCRETE PAD.
16.	3/8" S.S. EYE BOLT (TYP).
17.	MIN 3 COURSES CAP BLOCK WITH 3/8" MORTAR JOINTS, OR PRECAST RISER SECTION, MAX 2.5'.
18.	4' X 5' STEEL METER VAULT FRAME AND COVER, 1000 PSF MIN LOAD RATING, COVER SHALL SHALL BE "CLT WATER - L. P. SEWER", ERT HANGERS AND SLOTS NOT REQUIRED.
19.	SOLID COPPER AWG #12 GAUGE TRACER WIRE WITH 30 MILS GREEN HDPE INSULATION, TERMINATE WITH 24" AT EYE BOLT.
20.	12" DIAMETER SUMP HOLE.
21.	12" COMPACTED #57 WASHED STONE.
22.	BARREL LOCK - FURNISHED BY CLTW.
23.	PUMP STATION INSPECTION LOCKOUT WARNING TAG - FURNISHED BY CLTW.
24.	SDR9 HDPE FLANGE ADAPTOR.
25.	ATTACH GREEN ENGRAVED LABEL, WITH PREMISE NUMBER, AND ADDRESS TO UNDERSIDE OF DOOR, NEAR THE LIFTING HANDLE.

NOTES:

A. VAULT SHALL NOT BE LOCATED IN PAVEMENT, SIDEWALKS OR DRIVEWAYS.
B. VAULT SHALL BE 5' LONG, 4' WIDE, 5' DEEP MINIMUM.
C. ALL FLANGE HARDWARE SHALL BE 316 OR 304 STAINLESS STEEL WITH ANTI-SEIZE COMPOUND, FLAT WASHER REQUIRED BETWEEN BOLT HEAD AND FLANGE, FLAT WASHER AND LOCK WASHER REQUIRED BETWEEN NUT AND FLANGE. TORQUE TO 20-25 FT. LBS.
D. ALL PIPE AND FITTINGS SHALL BE SDR 9 HDPE, EXCEPT AS INDICATED INSIDE THE VAULT.
E. ASSEMBLY CONFIGURATION AND LENGTH MAY VARY DUE TO BRAND - VERIFY LENGTH TO DETERMINE MINIMUM VAULT LENGTH.
F. ALL CONCRETE SHALL BE MINIMUM 4000 PSI COMPRESSIVE STRENGTH.
G. DESIGN SHALL CONFORM TO ASTM C858 - SPECIFICATIONS FOR "UNDERGROUND PRECAST CONCRETE UTILITY STRUCTURE".
H. STEEL REINFORCING DESIGN SHALL CONFORM TO ASTM C857.
I. REBARS SHALL BE GRADE 60 PER ASTM A615.
J. WELDED WIRE FABRIC SHALL CONFORM TO ASTM A185.
K. DIAGONAL REINFORCING SHALL BE ADDED AT ALL OPENINGS.
L. PIPE PENETRATION SHALL BE SEALED WITH FLEXIBLE CONNECTORS (MANHOLE BOOTS).
M. FRAME TO BE FLUSH WITH GROUND OR CONCRETE SIDEWALK, GROUND SHALL SLOPE AWAY FROM VAULT.
N. ALL JOINTS SHALL BE MADE WATERTIGHT USING 2 RINGS OF BUTYL RUBBER JOINT MASTIC.
O. BARREL LOCK AND LOCKOUT TAG TO BE INSTALLED AFTER PRESSURE TEST, AND WILL BE REMOVED AFTER CLTW INSPECTION OF PRIVATE LOW PRESSURE PUMP STATION - (CERTIFICATE OF OCCUPANCY HOLD WILL ALSO BE REMOVED).
P. WHEN CONNECTING TO A PVC LOW PRESSURE MAIN, NO. 1, NO. 2, NO. 3, NO. 4, AND NO. 24 SHALL BE SCH 80 PVC PIPE AND FITTINGS WITH SOLVENT WELD JOINTS.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

LOW PRESSURE SEWER

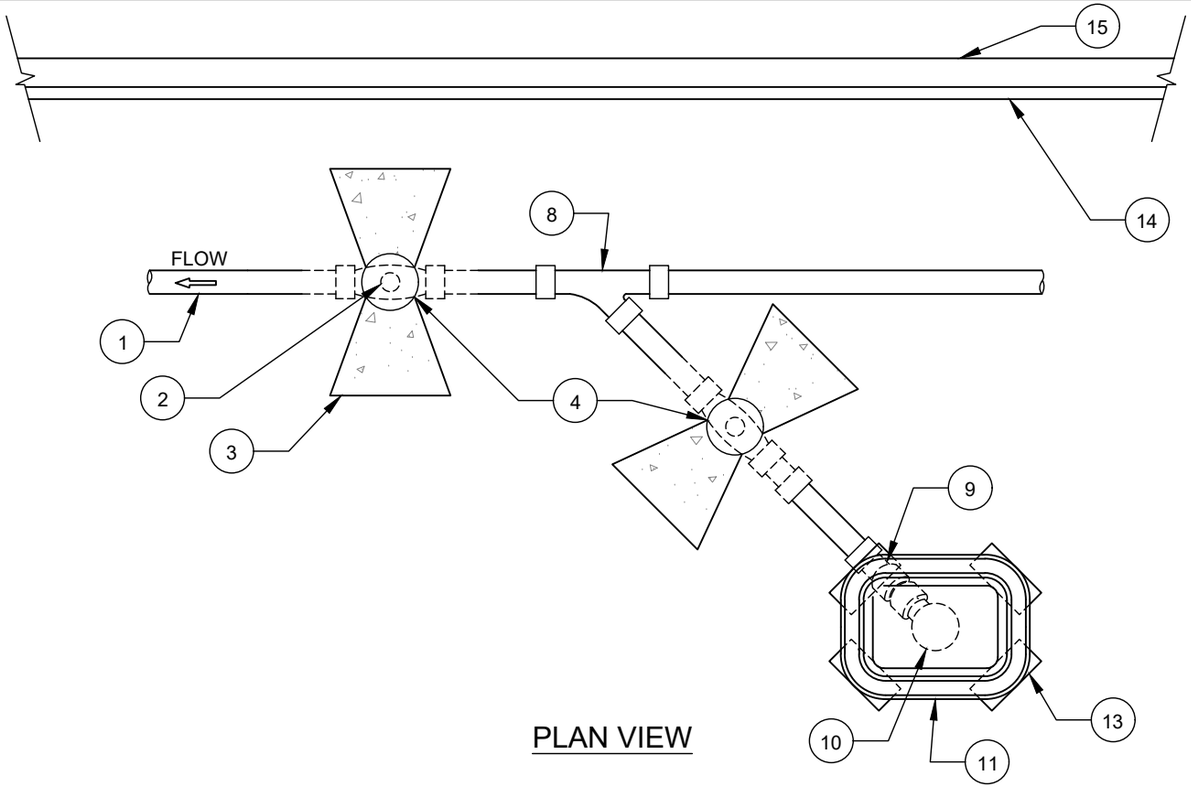
HDPE 2-INCH LOW PRESSURE SEWER SERVICE

NO SCALE

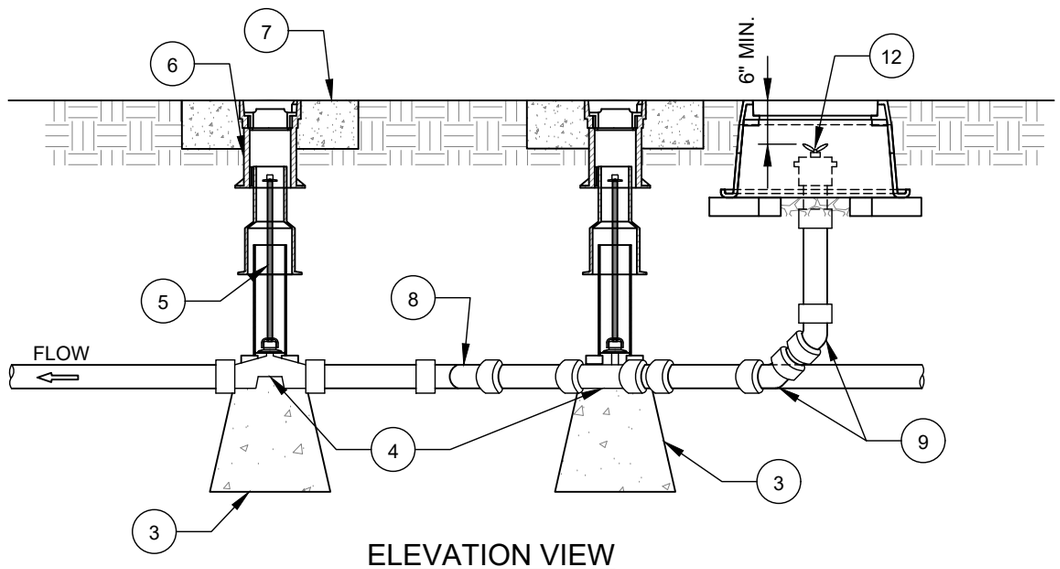
VERSION 1.0

DATE 04/2024

DETAIL 12.13



PLAN VIEW



ELEVATION VIEW

NO. DESCRIPTION:

1. LOW PRESSURE SEWER PIPE (SDR 21 PVC).
2. IRON BODY PLUG VALVE (2" - WITH THREADED BY SLIP JOINT DI ADAPTOR AND KNUCKLE JOINT RESTRAINT) (3 & 4" - MJ ENDS WITH WEDGE ACTION THRUST RESTRAINT GLAND AND IPS TRANSITION GASKETS).
3. CAST IN PLACE CONC. SUPPORT/THRUST BLOCK (TYP. ALL VALVES).
4. POLYETHYLENE WRAP, 4 MILS. EACH, 2 LAYERS, 12" EACH SIDE OF VALVE BODY.
5. EXTENSION STEM W/ 2" SQUARE OPERATING NUT, 10" BELOW GRADE (TYP. ALL VALVES).
6. VALVE BOX ASSEMBLY, PER CLTW STANDARD DETAIL (TYP. ALL VALVES).
7. 24" PRECAST CONCRETE DONUT.
8. WYE (SCH 80 PVC) WITH REDUCING BUSHING AS REQUIRED.
9. 45° BEND (SCH 80 PVC).
10. 2" CLEANOUT/MANUAL AIR RELEASE (SCH 80 PVC).
11. 2" CLEANOUT/MANUAL AIR RELEASE BOX (PLASTIC).
12. 1" GALVANIZED QUICK CONNECT WITH GALVANIZED PLUG AND 2 S.S. COTTER PINS.
13. SOLID STANDARD CONCRETE BRICK DIAGONAL AT CORNER.
14. BACK OF CURB.
15. EDGE OF PAVEMENT.

NOTE:

A. TRACER WIRE NOT SHOWN FOR CLARITY. FOR TRACER WIRE INSTALLATION, REFER TO APPROPRIATE STANDARD DETAIL.

B. 2" DUCTILE IRON PIPE ADAPTOR AND KNUCKLE JOINT RESTRAINT SHALL BE FUSION BONDED EPOXY COATED AND LINED BY HARRINGTON CORPORATION (HARCO) OR APPROVED EQUAL.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

LOW PRESSURE SEWER

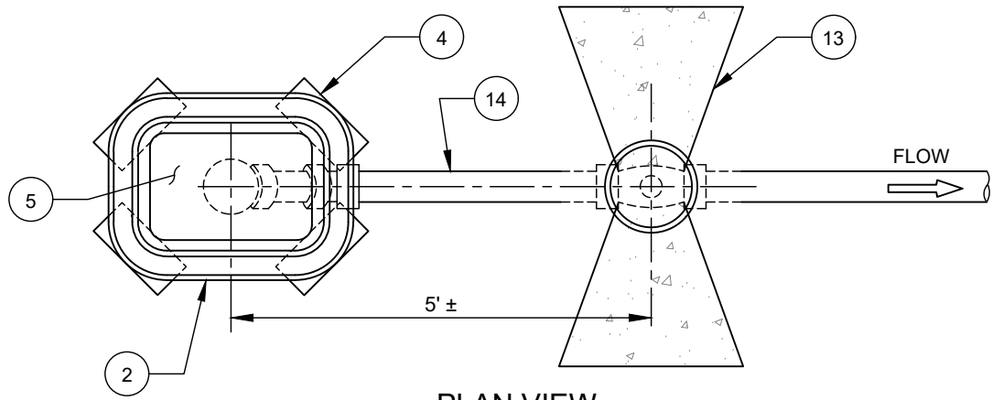
VALVE ASSEMBLY WITH CLEANOUT/ MANUAL AIR RELEASE - PVC PIPE

NO SCALE

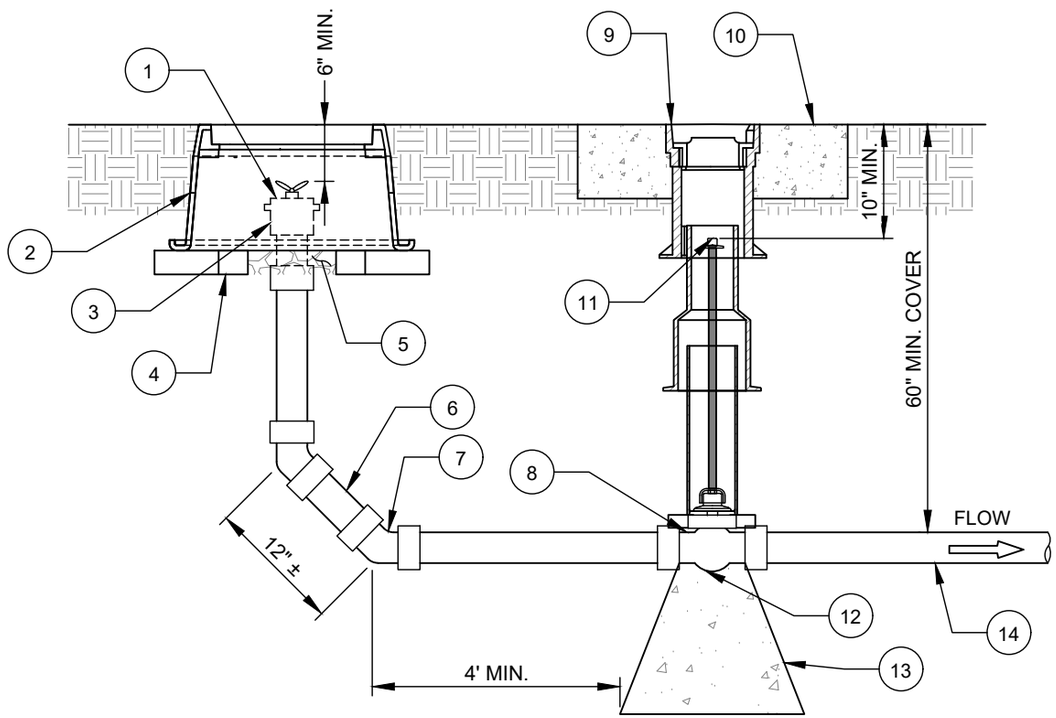
VERSION 1.0

DATE 04/2024

DETAIL 12.14



PLAN VIEW



ELEVATION VIEW

NO.	DESCRIPTION:
1.	1" QUICK CONNECT WITH PLUG AND 2 S.S. COTTER PINS.
2.	CLEANOUT BOX (PLASTIC).
3.	2" X 1" REDUCING BUSHING (SCH 80 PVC) WITH THREADED OUTLET.
4.	SOLID STANDARD CONCRETE BRICK DIAGONAL AT CORNER.
5.	6" MIN. OF #57 STONE BASE, SUITABLE BEARING CAPACITY AS APPROVED BY GEOTECHNICAL ENGINEER.
6.	2" CLEANOUT PIPE (SCH 80 PVC).
7.	45° BEND (SCH 80 PVC) WITH REDUCING BUSHING AS REQUIRED.
8.	POLYETHYLENE WRAP, 4 MILS EACH, TWO LAYERS, 12" EACH SIDE OF VALVE BODY.
9.	VALVE BOX ASSEMBLY, PER CLTW STANDARD DETAIL (TYP. ALL VALVES).
10.	24" PRECAST CONCRETE DONUT.
11.	EXTENSION STEM WITH 2" SQUARE OPERATING NUT, 10" BELOW GRADE (TYP. ALL VALVES).
12.	IRON BODY PLUG VALVE (2" - WITH THREADED BY SLIP JOINT DI ADAPTOR AND KNUCKLE JOINT RESTRAINT) (3 & 4" - MJ ENDS WITH WEDGE ACTION THRUST RESTRAINT GLAND AND IPS TRANSITION GASKETS).
13.	CAST IN PLACE CONCRETE SUPPORT/THRUST BLOCK.
14.	LOW PRESSURE SEWER PIPE (SDR 21 PVC).

NOTE:

A. TRACER WIRE NOT SHOWN FOR CLARITY. FOR TRACER WIRE INSTALLATION, REFER TO APPROPRIATE STANDARD DETAIL.

B. 2" DUCTILE IRON PIPE ADAPTOR AND KNUCKLE JOINT RESTRAINT SHALL BE FUSION BONDED EPOXY COATED AND LINED, BY HARRINGTON CORPORATION (HARCO) OR APPROVED EQUAL.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

LOW PRESSURE SEWER

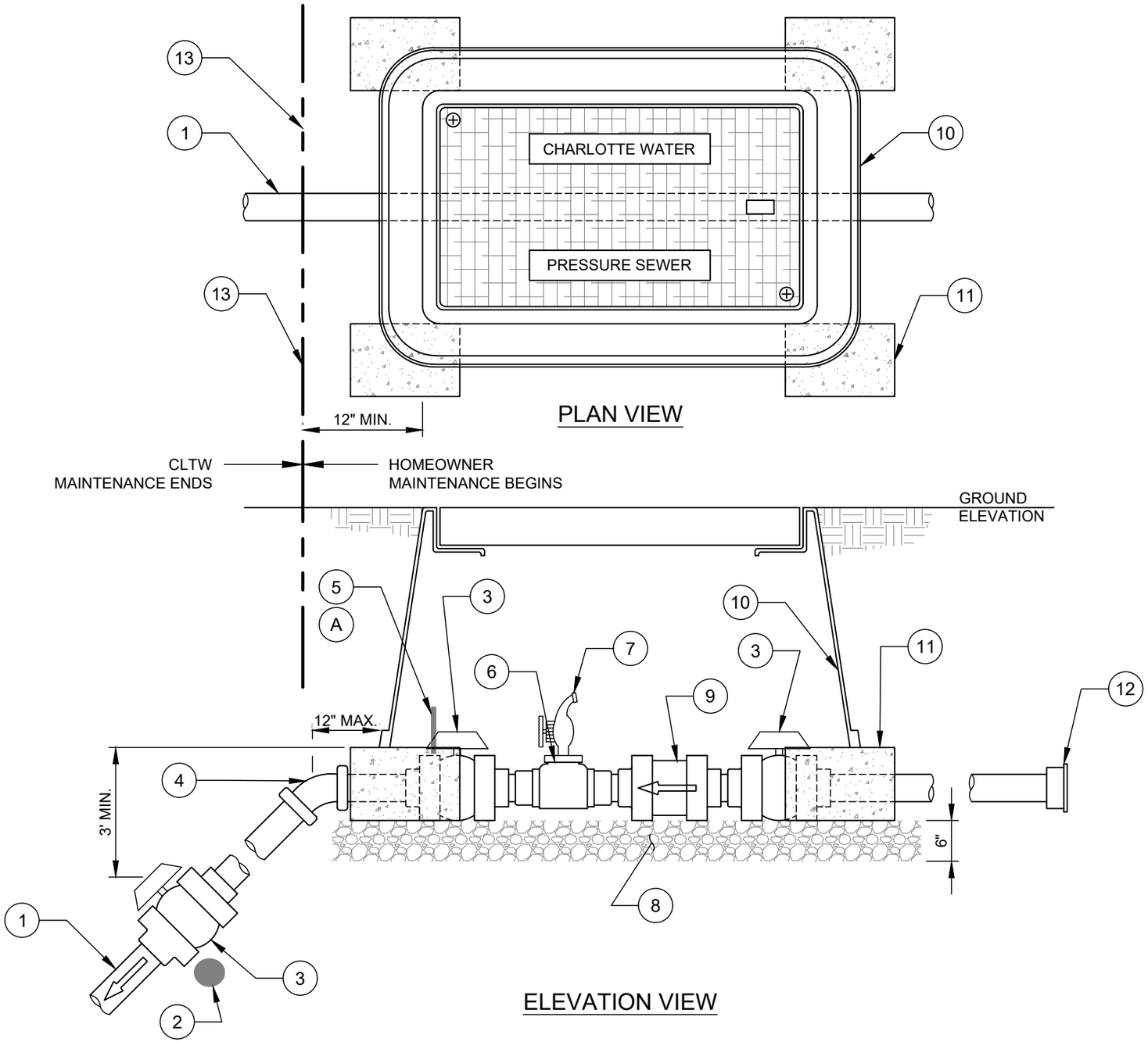
PVC 2" CLEANOUT/MANUAL AIR RELEASE AT END OF MAIN

NO SCALE

VERSION 1.0

DATE 04/2024

DETAIL 12.15



NO.	DESCRIPTION:
1.	1.5" SERVICE PIPE - SCH 80 PVC.
2.	PVC ENCAPSULATED MAGNET.
3.	1 1/2" TRUE UNION PVC BALL VALVE.
4.	45° SCH 80 PVC BEND.
5.	BARREL LOCK WITH RED CAP AND LOCKOUT TAG (FURNISHED BY CHARLOTTE WATER) - LOCK BALL VALVE CLOSED.
6.	1 1/2" THREADED OUTLET P.V.C. TEE W/1 1/2"x3/4" THREADED REDUCING BUSHING (SCH 80 PVC).
7.	3/4" BALL VALVE HOSE BIB (BRASS).
8.	6" #57 STONE BASE.
9.	1 1/2" TRUE UNION PVC BALL CHECK VALVE.
10.	SERVICE BOX.
11.	NCDOT SOLID CONCRETE CAPBLOCK (4"x4"x8").
12.	BUSHING TO REDUCE SERVICE SIZE AND CAP.
13.	PROPERTY LINE, ROAD RIGHT-OF-WAY OR CHARLOTTE WATER EASEMENT LINE.

NOTES:

A. BARREL LOCK AND LOCKOUT TAG TO BE INSTALLED AFTER PRESSURE TEST, AND WILL BE REMOVED AFTER CHARLOTTE WATER INSPECTION OF PRIVATE LOW PRESSURE PUMP STATION - (CERTIFICATE OF OCCUPANCY HOLD WILL ALSO BE REMOVED).

B. SERVICE BOX SHALL NOT BE IN SIDEWALKS OR DRIVEWAYS.

C. TOP OF BOX SHALL BE FLUSH WITH FINISHED GRADE OF LOT.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

LOW PRESSURE SEWER

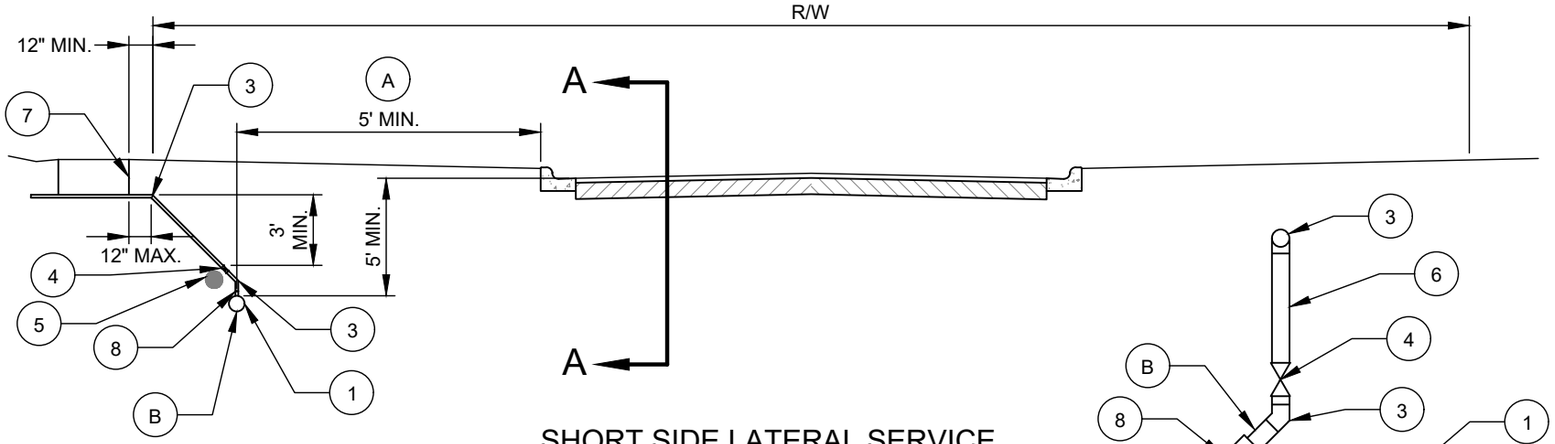
SERVICE CONNECTION - PVC

NO SCALE

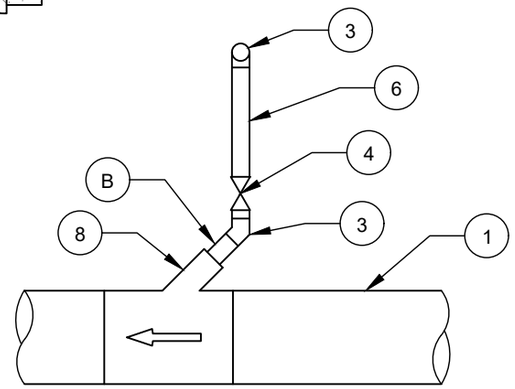
VERSION
1.0

DATE
04/2024

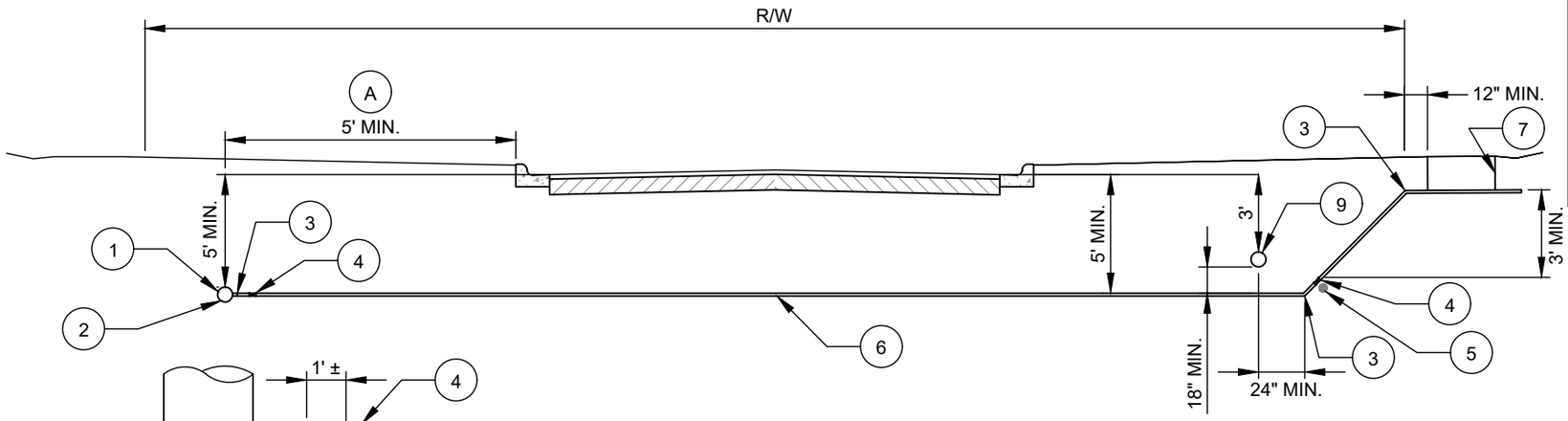
DETAIL
12.16



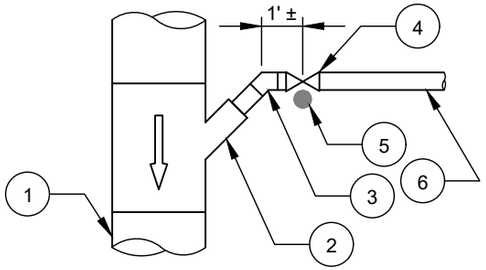
SHORT SIDE LATERAL SERVICE



SECTION A-A



LONG SIDE LATERAL SERVICE



PLAN VIEW

NO. DESCRIPTION:

1. LOW PRESSURE SEWER MAIN (SDR 21 PVC).
2. HORIZONTAL SERVICE WYE WITH REDUCING BUSHING (SCH 80 PVC).
3. 45° BEND (SCH 80 PVC).
4. 1.5" TRUE UNION PVC BALL VALVE (NO VALVE BOX ASSEMBLY).
5. PVC ENCAPSULATED MAGNET.
6. 1 1/2" SERVICE PIPE (SCH 80 PVC).
7. SERVICE CONNECTION BOX.
8. VERTICAL SERVICE WYE WITH REDUCING BUSHING (SCH 80 PVC).
9. WATER MAIN.

NOTES:

A. MINIMUM 5' FROM BOC AND OUTSIDE PLANTING STRIP. MUST MEET THE MOST STRINGENT GOVERNING AUTHORITY CRITERIA FOR MINIMUM SEPARATION FROM ALL OTHER UTILITIES.

B. ROTATE VERTICAL WYE AND 45° BEND FOR HORIZONTAL AND VERTICAL ALIGNMENT.

C. TRACER WIRE NOT SHOWN FOR CLARITY. FOR TRACER WIRE INSTALLATION, REFER TO APPROPRIATE STANDARD DETAIL.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

LOW PRESSURE SEWER

PVC SERVICE LATERAL

NO SCALE

VERSION 1.0

DATE 04/2024

DETAIL 12.17

CHAPTER 13
SEWER LIFT STATIONS AND FORCE MAINS

CHAPTER 13
SEWER LIFT STATION AND FORCE MAIN DESIGN

1. GENERAL

A. This chapter covers the minimum design criteria to be used for designing sewer lift stations and force main pipelines and appurtenances including those portions that lie in public rights-of-way and in easements granted to Charlotte Water. All other systems are the responsibility of the respective property owner unless otherwise documented via agreement with Charlotte Water.

B. All engineering plans for sewer lift stations and force mains must meet the Charlotte Water design standards as presented, the State standards as indicated in the most recent amended *Administrative Code, Title 15A, Subchapter 2T Waste Not Discharged to Surface Waters* by the North Carolina Department of Environmental Quality (NCDEQ), and the Division of Water Resources' *Minimum Design Criteria*. In general, the Charlotte Water standards should be the primary source for design guidance with the State standards as a supplement. In some cases, the Charlotte Water standard is more stringent than the State standard.

C. All projects must be sealed by a North Carolina professional engineer.

2. PLANNING POLICY

A. In general, the need for wastewater lift stations shall be limited and their construction and uses within the system shall be minimized. The basis for this policy is that pump stations cause disproportionate expense in order to provide service to a limited customer base and that failure of lift stations poses significant environmental risks.

B. Lift stations may be allowed where they are a feasible alternative to either a small, permanent treatment facility or a temporary solution for a new development.

C. Charlotte Water provides the large regional lift stations deemed necessary for orderly system development and operation under their Capital Investment Plan (CIP).

D. Charlotte Water may, on a case-by-case basis, consider requests to accept new Developer funded lift stations in the situations described below:

1) The lift station can be eliminated by a project or combination of projects, all of which are included for funding in the approved 5-year CIP. The lift station can be eliminated by a project being done under a reimbursable program, and the funds have been made available to Charlotte Water for construction.

2) The proposed lift station is at an appropriate location and has adequate capacity or expansion capacity to serve as a permanent or long-term facility, and gravity service is cost prohibitive or not possible due to other circumstances.

3) The construction of the proposed lift station would include elimination of one or more existing lift stations.

4) The construction of the proposed lift station would facilitate significant progress toward achievement of land use goals and strategies described by current, officially approved planning documents, and no other reasonable options are available for service.

E. In all cases, the receiving system must have available capacity to carry the proposed lift station discharge. Any upgrades required shall be the responsibility of the customer requesting the lift station.

3. SUBMITTAL REQUIREMENTS

A. All lift stations and force mains must be designed by a professional engineer licensed in the state of North Carolina and submitted for technical review and approval for conformance to the Charlotte Water design standards and the Division of Water Resources' *Minimum Design Criteria.*

B. Each lift station plan set shall contain engineering calculations that shall include:

1) Sewer basin map showing the project's total potential sewered area including any existing upstream sewered or unsewered areas, location of any contributing pumped sewer flow, and downstream connection to an existing sewer.

2) Average and peak flow calculations based on population and Future Land Use plans for the sewer basin.

3) Total dynamic head (TDH) calculations for all applicable pumping situations.

4) System curve/pump curve analysis used to determine pump selection and operational points and showing pump efficiency.

5) Net Positive Suction Head (NPSH) calculations.

6) Detailed surge analysis under all operating conditions.

7) Lift station cycle and pump run times, including an evaluation of any depressed sections of the force main to determine if the lift station is capable of completely flushing the force main section being evaluated in a single pumping cycle.

8) Lift station wet well, vaults, and adjacent gravity sewer manholes flotation/buoyancy calculations.

9) Available emergency storage capacities at average and peak wastewater flows for lift stations.

10) Overflow basin storage capacity.

11) Minimum and maximum velocities of the force main and individual pump piping.

12) Maximum detention times within the lift station and force main.

13) Downstream sewer evaluation demonstrating that the lift station discharge will not overload the receiving sewer line:

    a. In situations where the lift station discharges into a gravity sewer, the downstream gravity sewer shall be evaluated based on peak flow from the proposed project as well as peak flows already tributary or permitted to the downstream gravity sewer.

    b. In situations where the lift station discharges into another lift station, the downstream lift station shall be evaluated to verify its ability to convey peak flows from the proposed project as well as peak flows already tributary or permitted to the downstream lift station.

    c. In situations where the lift station discharges into a force main, the common force main shall be evaluated on peak flows from the proposed project as well as peak flows already tributary to the common force main. The ability of each lift station tributary to the common force main to pump against additional head created by greater flows through the force main shall also be evaluated. An evaluation of the discharge point of the downstream force main shall also be performed.

    d. The Flow Tracking/Acceptance for Sewer Extension Applications form (FTSE) meets this requirement.

4. GENERAL CONSIDERATIONS

A. Lift stations with peak, firm capacities of less than 2 million gallons per day (MGD) or pumps of 150 horsepower (HP) or less may be supplied with submersible type pumps depending on head conditions and availability of suitable pumps. Pumps used near these limits described will be approved by Charlotte Water on a case-by-case basis.

B. Lift stations with peak, firm capacities of 2 MGD or more or pumps larger than 150 HP shall be individually engineered and housed in a building appropriate for the specific application.

C. All lift stations shall be provided with an emergency power generator capable of operating the station and all its systems at full capacity with all pumps operating.

D. Lift stations shall be provided with a telemetry system to provide remote notification of problem conditions.

E. All lift stations shall be provided with emergency overflow containment basins or vaults capable of storing a minimum of 24 hours of average daily flow.

5. PUMP DESIGN

A. General

1) Pumps shall be non-clog, designed and manufactured for use in conveying raw, unscreened wastewater. Pumps shall be adequately protected from damage due to failure conditions specific to the selected pump type and lift station configuration.

2) Pump selection and construction shall consider the duty requirements as well as the physical and chemical characteristics of the wastewater.

3) Pumps shall be suitable for continuous duty in conveying raw, unscreened wastewater.

4) Pump suction and discharge openings shall be no less than 4 inches in diameter, unless the pump is capable of grinding, chopping, or cutting solids, or a mechanical means of reducing the size of a 3-inch solid and any trash or stringy material that can pass through a 4-inch hose is installed at the pump station.

5) Impellers shall have blades that are generally forward rounded or otherwise configured to avoid catching solids, trash, and stringy material.

6) Pump manufacturer shall be Xylem/Flygt, Sulzer/ABS, KSB, Grundfos, or approved equal as evaluated by Charlotte Water on a case-by-case basis.

7) For dry pit lift stations with a capacity of 3 MGD or greater or submersible lift stations with a capacity of 4 MGD or greater, comminutors shall be required for pretreatment.

8) Grinder pumps are not permitted.

B. Number and Capacity

1) Multiple pumps shall be used such that the lift station is capable of conveying the peak hourly wastewater flow to its desired outfall location with the largest single pump out of service.

   a. In duplex and triplex lift stations, the pumps shall be of the same capacity.

   b. If pumps in series are required to meet capacity or the TDH requirement, each set of pumps in series shall be viewed as a single pumping unit.

   c. Priming pumps, as well as any other auxiliary system that is necessary for pump functionality, shall also be provided in multiple numbers.

2) Determination of pump capacity shall be based on wastewater flows expected to become tributary to the lift station for the entire drainage area at build out including any existing upstream sewered or unsewered areas, location of any contributing pumped sewer flow, and downstream connection to an existing sewer. For regional lift stations, pump capacity shall be based on wastewater flows expected to become tributary from the entire service area over the life of the lift station.

3) Populations to be served shall be calculated from Future Land Use (FLU) plans for the sewer basin. Population may include residential, commercial, industrial, and institutional categories. Population should be estimated based on developable area.

4) All residential, commercial, industrial, and institutional unit wastewater design flow rates shall be as per 15A NCAC 02T .0114 unless that design flow has been adjusted as granted pursuant to paragraph (f) of that regulation.

5) The selected peak hourly wastewater flow to the lift station shall be appropriate for the service area as well as the associated wastewater generation patterns and population being served by the lift station. In small community type stations, this shall also include the discharge capacity of any public or community pool. The minimum peak hourly wastewater flow to the pump station shall be calculated using the design daily wastewater flow along with a peaking factor determined from the following equation:

$$PF = \frac{Q_{phf}}{Q_{ddf}} = \frac{18 + \sqrt{P}}{4 + \sqrt{P}}$$

Where:

PF = peaking factor, minimum of 3.0
Q_{phf} = peak hourly flow, gallons per day
Q_{ddf} = design daily flow, gallons per day
P = service population in thousands

Based on the complexity of the proposed project, Charlotte Water may request population projection calculations.

6) Pump capacity shall also take into consideration the need to maintain a minimum velocity of 2 fps and maximum velocity of 5 fps in the force main.

C. Selection Methodology

1) Pump selection shall be based on a hydraulic analysis of the system through which the wastewater is to be conveyed.

a. The design operating point(s) of the pump(s) shall be determined using a pump curve-system curve analysis. Pumps shall be selected such that the pumps shall be capable of pumping the required capacity for all TDH requirements developed by the system for the lifetime of the lift station. All pumps shall be designed in accordance with applicable portions *of ANSI / Hydraulics Institute 1.1- 1.6, 2.1-2.6 and 9.1-9.6.*

i. A system curve, plotting TDH versus capacity, shall be developed for all operating conditions that may be imposed on the system. TDH requirements for the system shall be calculated as the total of the following individual components:

(1) Static head requirements of the system, including that associated with both the suction and discharge sides of the pumps, shall be evaluated. In addition to calculating static head with the discharge elevation of the force

main, any intermediate high points in the force main that would have an effect on the TDH requirements of the pump shall be analyzed.

(2) Friction head requirements of the system, including that associated with both the suction and discharge sides of the pumps, shall be evaluated. The friction head shall be calculated using the Hazen-Williams formula:

$$h_f = L\left(\frac{10.44Q^{1.85}}{C^{1.85}D^{4.87}}\right)$$

Where:

h_f = friction head, ft
L = Length, ft
Q = Pumping rate, gpm
C = Hazen-Williams coefficient
D = Diameter, in

All operating conditions shall be evaluated including but not limited to multiple pump operation within the subject force main, simultaneous lift station operation for common force main situations, as well as the possibility for gravity flow conditions in force main segments with extreme negative slopes that may not flow full.

(3) Head derived from any minor losses of the system, including that associated with the both the suction side and discharge side of the pump, shall be evaluated. Such minor losses shall include head derived from valves and other fittings such as tees, bends, angles, etc.

(4) If applicable, the pressure head at the junction of the existing force main shall also be evaluated for its effect on the TDH requirements of the system. The evaluation shall consider the effects of simultaneous lift station operation as well as multiple pump operation in other lift stations.

ii. System curves shall be generated and evaluated not only for present day conditions, but also for those conditions that may exist over the expected lifetime of the lift station.

(1) The Hazen-Williams friction coefficient, C, appropriate for the force main pipe material and age of the force main shall be used.

(2) The maximum allowable values for C can be found in Table 13.1.

Table 13.1: Maximum Values for Hazen-Williams C for System Curve Generation		
Pipe Material	Initial Service C	End-of-Service C
DIP	125	100
PVC	140	120
HDPE	140	120

(3) Friction head and minor losses associated with the system shall be evaluated at both the initial service and the end-of-service condition.

iii. The design operation point(s) shall be defined as the intersection of the pump curve and the calculated system curve(s).

b. Pumps shall be selected such that all design operating points are on the pump curve as supplied by the pump manufacturer. In addition, pumps shall be selected such that the net positive suction head available (NPSHA) shall be greater than the net positive suction head required (NPSHR) for the pump at each of the design operating points.

c. Pumps shall be selected such that the pumps will not cavitate at any of the design operating points. Pumps that operate within the unstable portion of the pump curve under any of the expected design conditions shall not be allowed. Freewheeling (i.e., operating at pump run-out) or deadheading (i.e., operating at pump shut-off) of pumps shall not be allowed. All continuous duty operating conditions shall be within the manufacturer's Allowable Operating Region and the design operating points shall be within the manufacturers Preferred Operating Region, as defined in ANSI/Hydraulic Institute 9.6.3. Pump selections proposing maximum diameter impellers for the given pump model and casing size will not be accepted.

d. Pumps shall be selected such that their operating efficiency is maximized during all hydraulic conditions that may exist over the expected lifetime of the pump station. Pump efficiency shall be between 70% and 120% of the Best Efficiency Point (BEP).

2) Consideration shall be given to minimizing motor speeds during the pump selection process. The standard motor speed for submersible pumps shall be 1,800 RPM.

3) The motor horsepower shall be at least 1.15 times what is required to ensure that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.

D. Cycle and Pump Run Times

1) Constant speed pumps shall be cycled such that the number of starts is minimized and resting times are maximized to avoid overheating and overstressing of the pump motor.

a. Automatic pump alternation shall be provided.

b. Pumps shall be designed to operate between 2 to 8 times an hour at design daily flow with a strong preference for 4 to 5 cycles per hour.

i. The following equation shall be used to determine the active storage volume in the pump station (i.e., the volume between the pump-on and all pump-off elevations) required to elicit the required pump cycle time:

$$V = TQ_{ddf}(1 - \frac{Q_{ddf}}{Q})$$

Where:

V = Active volume within the pump station, gallons
T = Allowable cycle time between starts, minutes
Q_{ddf} = Design Daily Flow, gpm
Q = Pumping rate of single pump, gpm

ii. If the wastewater generation patterns are such that fewer than two pumping cycles per hour will occur at design daily flow, or if the lift station is intended to provide equalization of hydraulic surges, measures to control odor and corrosion shall be employed when resultant detention times cause septic conditions. These measures shall take into consideration protection of the lift station, the force main, the outfall sewer, any related appurtenances, as well as the surrounding area.

2) Consideration shall be given to using variable speed pumps for main lift stations or those lift stations that discharge directly into a wastewater treatment facility.

3) Pump run times shall be such that excessive wear of the pumps does not occur.

a. At design daily flow, adequate time shall be provided to allow a constant speed pump to “ramp up” to full speed before the pumping cycle ends.

b. Pump run times at design daily flow shall not be less than or greater than those recommended by the pump manufacturer.

4) Submersible pump/motor assemblies, including lifting brackets, are to remain completely submerged at all times.

6. LIFT STATIONS

A. Property

1) Lift station sites and access drives, including all appurtenances and vehicular turnaround areas, shall be located on fee simple owned property, with an assigned address, and owned by the City of Charlotte.

2) A minimum of 1/3 acre of usable land adjacent to the fenced lift station site shall be provided for future lift station replacement.

3) The lift station property shall include an area large enough to locate the lift station structures, odor control, an emergency generator, an overflow basin, replacement lift station, and have enough space to park and maneuver maintenance vehicles in a 20-foot wide by 25-foot-deep turnaround area located just before the lift station site.

4) The tract shall include any cut or fill areas adjacent to the fenced station site.

B. Location

1) Lift stations shall be located and designed to minimize the development of nuisance conditions (i.e., noise, odor, etc.) in the surrounding area.

2) The lift station shall be located at least 100 feet away from any occupied buildings or housing.

3) A grading plan shall be included in all lift station plans.

4) Landscaping with trees, shrubs, and/or bushes is not allowed unless dictated by governing jurisdiction and approved by Charlotte Water. Grass cover shall be established on the site outside of the fence by the final electrical inspection.

5) Lift stations design shall limit erosion and stormwater runoff shall be channeled away from the lift station area. The design shall allow for no deleterious effect for runoff on site.

C. Access

1) Lift station sites shall be accessible by an all-weather driveway, dedicated solely to station access, provided from a hard surface public road. The access driveway may be shared with the access driveway for storm control measures provided that the storm control measures are not located on top of the fee simple access driveway or lift station parcel. Storm drain piping may not be located parallel or within the access driveway.

2) The lift station driveway shall be at least 2 feet above the 100-year flood elevation as identified on the most recent FEMA Flood Insurance Rate map when available or as established through appropriate modeling techniques.

3) The roadway shall be designed to accommodate the largest vehicle expected to service the lift station. In no case shall the driveway be less than 14 feet in width or a curve radius of less than 90 feet.

4) At a minimum, the driveway shall be asphalt after the setback line. Driveways in existing or planned developments shall match adjacent driveway material unless otherwise approved by Charlotte Water for alternate material.

5) Maximum allowable slope for the driveway is 10%.

6) Within the fence, a minimum of 6 inches of washed #57 stone on top of a layer of weed guard shall cover all areas around permanent structures.

D. Security

1) All ports of entry into lift station structures, vaults, panels, etc. shall be lockable by padlock.

2) The lift station shall be provided with adequate lighting to facilitate normal and emergency operation and maintenance activities during daylight and non-daylight hours.

3) A light shall be provided under the weather canopy over the electrical panels.

4) Safety placards for all lift station structures and equipment, as required by federal, state, county, and city agencies shall be provided and be readily visible.

5) The lift station site, including all slabs, equipment, and utilities, shall be enclosed in an 8-foot tall, galvanized chain link security fence with 1-foot tall, barbed wire top around the entire perimeter. At Charlotte Water's discretion, black ornamental steel fencing may be required.

6) Open air overflow containment basins may be enclosed in a 4-foot tall, galvanized chain link security fence without a barbed wire top.

7) Double-swing gates at the pump station shall have a minimum clear opening of 16 feet. Larger gate openings may be required depending on the site.

8) Charlotte Water will provide surveillance cameras.

9) All items located within the fenced area shall be a minimum of 5 feet away from the fence.

E. Structural Design

1) Materials of Construction

a. Lift station structures shall be designed and built in complete compliance with all applicable state, local, and federal codes as well as any applicable Occupational Safety and Health Administration (OSHA) and National Fire Protection Association (NFPA) standards.

b. Material selections for lift station structures shall be based on installation and operating factors including, but not limited to, the following:

i. Physical, chemical, and biological wastewater characteristics

ii. Corrosive gas production

iii. Soil characteristics

iv. Groundwater presence

c. Lift station structures shall be completely separated unless made completely watertight and gas-tight.

d. Lift station structures shall be adequately protected to minimize damage from vehicular traffic.

e. Wet wells and valve vaults shall be concrete and sized with adequate clearances for equipment maintenance.

f. Polymer concrete, HDPE, or fiberglass material may be considered for wet wells, valve vaults, and air-release valve vaults to provide corrosion resistance.

g. Shop drawings for wet well, valve vault, and pump dimensions shall be submitted to Charlotte Water for approval.

h. Wet wells shall have a minimum diameter of 6 feet.

2) Buoyancy Protection

a. Below-ground lift station structures shall be protected from the buoyant forces of groundwater.

b. Buoyancy protection shall be demonstrated through the use of flotation calculations.

i. Flotation calculations shall be performed on below-ground lift station structures using the assumption that the elevation of the groundwater table is equivalent to the ground elevation.

ii. Flotation calculations shall not add the weight of the pumps, internal piping and appurtenances, or wastewater present in the lift station, including the wastewater below the all pumps-off activation level, into the downward forces used to counteract buoyancy.

iii. The saturated weight of any soil above the extended footing of the lift station structure shall be allowed in the flotation calculations.

c. Flotation calculations shall show that the design of the below-ground lift station structures will be protected from buoyancy with a factor of safety that is equal to or greater than 1.25.

3) Flood Resistance

a. Lift station structures, as well as all associated equipment and appurtenances, shall be protected in order to keep the lift station fully functional, operational, and free from physical damage during a 100-year flood.

b. The lift station shall be protected from inundation of floodwaters by elevating finished grade at least 3 feet above the 100-year flood elevation.

c. The 100-year flood elevation shall be that as identified on the most recent FEMA Flood Insurance Rate map as amended by local agencies when available, or as established through appropriate modeling techniques.

4) Solids Collection

a. Wet wells shall be designed to minimize pump suction piping operational problems resulting from the accumulation of solids and grit material within the wet well.

i. Acceptable designs include the use of fillets and sloped wet well floors. Charlotte Water's preference is for a self-cleaning design that employs a steeply sloped influent line entering near the bottom of the wet well.

ii. The design of fillets and slopes shall be such that solids are effectively moved toward the pump or pump suction piping.

b. No projections within the wet well or on the well wall that would allow for the deposition of solids under normal operations conditions shall be allowed.

5) Pump Submergence Depth

a. Sufficient submergence of the pump or pump suction piping shall be provided to prevent the occurrence of vortexing within the wet well.

b. In no case shall the all pumps-off activation level be less than the minimum level required for successful pump operation, as recommended by the pump manufacturer.

c. The wet well shall be provided with a depth as required to maintain the active storage volume.

F. Influent Pipe and Manhole

1) All influent sewers shall discharge into an influent manhole prior to the wet well and a single influent line shall be provided to the wet well. Inside drops shall be used in the influent manhole if required.

2) The wet well influent pipe shall be set at 2% slope with invert at the wet well at a minimum of 12 inches above the top of the pumps.

3) The influent line shall be orientated such that turbulence and air bubbles do not affect pump operation.

4) Influent piping shall be ceramic epoxy lined ductile iron within the station fence enclosure.

G. Suction and Discharge Piping Configurations

1) Each pump shall be provided with separate suction (when applicable) and discharge piping systems no less than 4 inches in diameter.

2) Pump suction and discharge piping shall be Pressure Class 350 ductile iron pipe no less than 4 inches in diameter, and the final pipe size shall be selected in order to achieve velocities between 2 to 8 fps.

3) All pipe and fittings shall have a minimum of 12 inches clearance from any wall or floor, and there shall be a minimum 30-inch clearance between the piping of each pump.

4) All piping inside the wet well through the emergency pump connection shall be flanged DIP with stainless steel nuts and bolts. Buried valves and fittings outside of structures shall be restrained mechanical joints.

5) The suction and discharge piping systems shall be provided with sufficient valves to facilitate proper operation and maintenance of the pump station during both normal and emergency conditions.

6) Valves shall be suitable for use with raw, unscreened wastewater and shall be of a design suitable for its function, its installation locations, as well as the normal and maximum operating pressures expected at the pump station.

   a. Pump isolation valves shall have the seat oriented toward the pump.

   b. All valves within the station enclosure shall be open left.

   c. A full-closing eccentric plug shut-off valve shall be provided on the discharge piping of each pump and on the suction piping of each dry well pump.

   d. A swing check valve with lever and weight assist shall be provided on the discharge piping of each pump between the pump and the shut-off valves, placed in the horizontal position and readily accessible.

   e. An emergency pump-out connection shall be provided at the lift station within the fenced station enclosure and upstream of the magmeter.

7) Flexible restrained pipe joints shall be used between the lift station structures to allow for and prevent damage from differential settlement.

8) Pipe inlets and outlets of lift station structures shall be made watertight with modular, elastomer pipe sealing system with 316 stainless steel hardware.

9) Buried plug valves shall be restrained mechanical joint.

H. Flow Meter

1) An electromagnetic flowmeter (magmeter) shall be installed on the discharge force main located downstream from the emergency pump-out connection and within the fenced enclosure.

2) The magmeter shall be installed within a precast concrete vault and bypass piping with valves shall be provided to isolate the magmeter for servicing.

I. Water Service

1) In areas where potable water is available, the lift station shall be furnished water service and a freeze-proof yard hydrant. A reduced pressure principle backflow prevention device is required per Charlotte Water specifications. Backflow prevention device shall be located within the fenced station enclosure and supplied with an integral screen, with a heating element, and an insulated cover anchored with stainless steel hardware.

2) If municipal water is not available, a groundwater well and yard hydrant shall be provided to meet the station's needs. The well shall have a minimum capacity of 8 gpm at 40 psi and be clearly labeled as non-potable.

3) Yard hydrants shall be mounted 30-inches high, frost-proof and equipped with stems and seat washers that are removable through the top of the hydrant. Operating rod shall be brass. The yard hydrant shall be installed complete with washed stone drain bed of at least 1 cubic foot and a 24-inch square concrete splash pad.

J. Pump Removal Methods/Equipment

1) Provisions shall be made so that the largest piece of equipment installed at the lift station may be removed, such as supplying a hoist or designing sufficient clearance for mobile hoisting equipment.

2) Lift station structures shall be provided with access of sufficient size such that the largest piece of equipment may be removed without damaging the integrity of the structural design.

3) Lift stations shall be provided with a system that allows for the removal and installation of the pumps without requiring entry into the wet well and with clear vertical access.

a. Each pump shall be provided with a 316 stainless steel guide rail and lift-out chain section with guide cable.

b. Both the guide rail and the lift-out chain shall be capable of withstanding the forces required to disengage the pump from the wet well.

c. Both the guide rail and the lift-out cable/chain shall be manufactured of stainless steel.

K. Access Equipment

1) Each structure shall be designed so that access to perform both routine and emergency operations is convenient, unobstructed, and safe.

2) Each structure shall have a separate means of access.

3) Steps, ladders, stairs, landings, hatches, and other means of access shall conform to OSHA standards, as well as all applicable local and state building codes regarding design characteristics.

4) Steps shall not be installed in the wet well.

5) Wall-mounted steps or an aluminum ladder shall be provided for all valve vaults.

L. Odor Control

1) Odor control may be required at Charlotte Water's discretion based on site location and site-specific conditions. Odor control may be required at the lift station site, at air release/air vacuum relief valves locations along the force main, or at the force main discharge manhole.

2) Lift stations accepting flow from low pressure sewer systems shall employ odor control measures during initial lift station construction.

3) If an odor control device is not part of the current lift station design, provide a 4 feet x 4 feet x 4-inch-deep concrete pad with a dedicated 2 ampere (amp) receptable for future use, if needed. All lift stations shall be built to allow for future odor control.

M. Ventilation

1) Lift stations shall be adequately vented in accordance with local and state building codes, as well as OSHA and NFPA standards.

2) The Class 1 explosion hazard zones, as defined in the *NFPA 820 Standard for Fire Protection in Wastewater Treatment and Collection Facilities, latest edition*, shall be identified on the plans.

3) Lift station temperature and humidity shall be controlled to a level appropriate for reliable operation of the electrical and instrumentation/control equipment.

   a. Lift station wet wells shall be provided with a 6-inch fusion bonded epoxy or ceramic epoxy lined ductile iron or 316 stainless steel gooseneck-type vent with a welded-on external flange ring with flanged stainless-steel insect/bird screen.

   b. Vent elevations shall be a minimum of 4 feet above the 100-year flood elevation as identified on the most recent FEMA map when available or as established through appropriate modeling techniques.

N. Overflow Containment Basin

1) An overflow containment basin shall be provided at all lift stations capable of holding 24 hours of average daily flow of the lift station.

2) Basin shall be constructed with a 1-foot-thick impermeable clay liner with the bottom a minimum of 1 foot above maximum groundwater elevation. A geological engineering report shall be used to establish the estimated seasonal high groundwater elevation.

3) The top of the containment basin shall be a minimum of 3 feet above the 100-year flood elevation as identified on the most recent FEMA map when available or as established through appropriate modeling techniques.

4) Basin embankments shall be structural fill placed in 6-inch loose lifts and compacted to a minimum 95% maximum dry density per standard proctor test.

5) Where groundwater elevation requires a large surface area or sufficient surface area is not available on the site, one of the following options should be provided:

   a. Additional manholes for overflow draining,

   b. A sump pump, or

   c. A sub-grade enclosed concrete vault per limitations described below.

6) A 4-foot security fence should be located around the basin a minimum of 6 feet from the top of the berm with a minimum 14-foot-wide double swing gate for truck access.

7) At Charlotte Water's discretion, based on site conditions and capacity lift stations may utilize a buried concrete vault to provide overflow storage. A 4-foot square hatch should be provided for access in the vault and the floor shall be sloped to allow drainage.

O. Sump and Sump Pump

1) Lift station structures, other than the wet well, shall be provided with a means to remove accumulated water and wastewater from the structure. All floor and walkway surfaces shall be sloped such that water and wastewater drains to the removal area under the influence of gravity. Acceptable removal means include the following:

   a. A sump for installing a portable pump (for Developer-donated projects only).

   b. A non-arcing sump pump system that is capable of automatic and manual operation with three automatic operating levels: all pumps-off, pump-on, and high-water alarm. It shall have a minimum ½ HP motor and a capacity of 1,000 gallons per hour at a TDH of 30 feet. The discharge piping of the sump pump shall be provided with an appropriate check valve and shut-off valve to prevent back flow of wastewater from the wet well into the structure and to facilitate removal of the sump pump. A dry pit/basement will require a larger sump pump. This shall be considered for larger/regional lift stations.

7. FORCE MAINS

A. Material

1) Force mains shall be either ceramic epoxy lined ductile iron pipe (DIP), Pressure Class 350, or AWWA C900 PVC SDR 14 or less. AWWA C906 HDPE SDR 9 may be allowed at Charlotte Water's discretion.

2) Pipe material shall be selected based on the installation and operating conditions of the force main following installation. Such factors include, but are not limited to:

   a. Installation depth and overburden pressure,

   b. Soil conditions and groundwater presence,

   c. Corrosion resistance from both external and internal sources, and

   d. Strength required to withstand internal pressures expected during normal operation as well as those resulting from hydraulic surges and water hammer.

3) PVC shall be used beginning at 5 feet outside of the lift station fence, except for railroad crossings and other locations as conditions dictate.

4) Any DIP used outside of the lift station fence shall be ceramic epoxy lined.

5) Force mains shall have an actual minimum internal diameter of 4 inches.

B. Velocity

1) Wastewater velocity occurring in a force main shall be calculated using the continuity equation.

2) A self-cleansing velocity of at least 2 fps shall be provided throughout the length of the force main.

3) The ability to provide velocities of between 3 to 8 fps is desirable to resuspend any solids that may have settled out.

4) Anchorage

   a. Force mains shall be adequately anchored/restrained to resist thrusts that may develop at bends, tees, plugs, end-of-line valves, and at any other location where a change in flow direction occurs.

   b. Anchoring shall be provided through the use of restrained joints integrally cast at the factory or wedge action thrust restrained mechanical joint fittings for DIP. PVC shall be restrained joint in bell.

   c. Field-installed restraining devices and thrust blocks are not permitted.

   d. Anchoring devices shall be designed to withstand force main pressures of at least 25 percent greater than the maximum pump shut-off head in addition to an allowance for water hammer and a safety factor of 2, to test pressure, or a minimum 200 psi, whichever is greater.

C. Surge Control

1) Force mains and their associated lift stations shall be analyzed with respect to the development of hydraulic transients and force main design shall be such that active devices for control of transient hydraulic conditions are minimized.

2) When necessary, the following shall be acceptable control strategies when approved by Charlotte Water:

a. Variable-speed pumps or constant-speed pumps in combination with soft start/stop motor starters

b. Pumps with augmented rotational inertia

c. Construction of the force main using a higher-strength pipe

d. Vacuum relief valves

e. Specialized control and/or release valves and other devices designed to prevent transient pressures from reaching levels that could damage the lift station and force main systems

D. Combination Air Release/Air Vacuum Relief Valves

1) Force mains shall be routed such that the number of combination air release/air vacuum relief valves is minimized.

2) An automatic combination air release/air vacuum relief valve shall be located at all high points, to prevent air locking of the force main, and when necessary for surge control where sub-atmospheric pressures or column separation may occur.

3) Air release/air vacuum relief valves are required when the difference between the low point and high point exceeds one pipe diameter.

4) These valves shall be of the quick-opening, slow-closing type and may be standard height or short body design with a minimum 2-inch diameter screw-threaded inlet.

5) The force main shall be ceramic epoxy lined DIP, PVC, or HDPE 40 feet on either side of air release/air vacuum relief valves.

E. Depth and Installation Considerations

1) A minimum depth of cover of 5 feet based on edge of pavement elevation or pipe centerline ground elevation, whichever requires the lower pipe elevation, and a maximum of 10 feet, as measured from the crown of the pipe to the ground surface/road edge of pavement elevation, shall be provided throughout the length of

the force main. If cover must be less than 5 feet, then the force main shall be ceramic epoxy lined DIP.

2) Ideally, the force main shall be designed without intermediate high points.

3) Force mains shall convert to gravity flow at a point where they can reasonably do so.

4) Isolation valves shall be considered when needed where force mains connect into a common force main.

5) Force mains shall be installed such that pipe and joint deflection is limited to no more than 50% of manufacture's recommendation in accordance with:

   a. AWWA C600 "Installation of Ductile Iron Water Mains and Their Appurtenances"

   b. AWWA C605 "Installation of Underground Installation of Polyvinyl Chloride (PVC) Pipe and Fittings for Water"

   c. AWWA M55 "PE Pipe-Design and Installation"

6) In general, force mains shall be located within the limits of public road rights-of-way (ROW). Where this is not achievable, any force main in a properly recorded public easement on private property outside of a public road ROW must be approved by Charlotte Water with minimum clear distance of 15 feet from force main centerline.

7) Force mains shall not be located in either public or private alleys.

8) Force mains shall be clearly identified with warning tape and copper tracer wire as shown in the standard details.

9) The force main location shall be provided with above-ground markers every 300' on straight runs, 100' on curves, and at every significant change in direction or otherwise limited sight distance.

10) Tracer wire terminal point valve box assemblies are required every 750'.

11) Pipe size and material shall be listed on the design drawings.

8. UTILITY SETBACKS AND SEPARATIONS

The minimum clearance requirements for conflicts with utilities and other features, in accordance with NCAC 02T.0305 and governing utility guidelines, is shown in Table 13.2. Depth of cover shall be defined from the top of the pipe. Charlotte Water reserves the right to require increased separations.

Table 13.2: Minimum Separations for Sewers per NCAC 02T.0305	
Setback Parameter	Separation Requirements*
Storm Sewers and other utilities not listed below (vertical) Where separation cannot be met, DIP or structural bridging to prevent crushing the underlying pipe shall be used.	2 feet
Water Lines Vertical, water over sewer including in shared, benched trenches Horizontal Where a water main crosses over a sewer, one full length of water pipe shall be located so that both joints will be as far from the sewer as possible.	 18 inches 10 feet
Reclaimed Water Lines Vertical, reclaimed over sewer Horizontal, reclaimed over sewer	 18 inches 2 feet
Any private or public water supply source, including any wells, WS-I waters of Class I or Class II impounded reservoirs used as a source of drinking water (stream classifications from Division's NC Surface Water Classifications webpage) For public or private wells where minimum separation cannot be met, piping materials, testing methods and acceptability standards meeting water main standards shall be used. All appurtenances shall be outside the 100' radius. The minimum separation shall however not be less than 25' from a private well or 50' from a public well.	100 feet
Waters classified WS (except WS-I or WS-V), B, SA, ORW, HQW, or SB from normal high water (or tide elevation) and wetlands (stream classifications from Division's NC Surface Water Classifications webpage)	50 feet
Any other stream, lake, impoundment, or ground water lowering and surface drainage ditches	10 feet
Any building foundation	10 feet
Any basement	10 feet
Top slope of embankment or cut of 2 feet or more vertical height	10 feet
Drainage systems and interceptor drains	5 feet

Swimming pools	10 feet
Final earth grade (vertical) Where minimum cover cannot be met, DIP shall be used. Where sewers are subject to traffic bearing loads, DIP or other pipe with proper bedding to develop design supporting strength shall be provided.	36 inches
For all other separations, materials, testing methods, and acceptability standards meeting water main standards (15A NCAC 18C) shall be required in any alternative.	

Table 13.3: Minimum Separations for Sewers to Other Features	
Stormwater BMP	Sewer easement remain outside 1:1 slope to the BMP easement
Retaining Wall	Sewer to remain outside of geogrid area/structural impact of retaining wall
Roadways and Driveways	2 feet from edge of pavement measured to center of pipe
Gas	3 feet from top of gas main to bottom of sewer
Existing Utilities (water, storm drain, etc.)	1 foot clearance from top of utility to bottom of sewer when sewer crosses over other utility lines, if clearance cannot be met, DIP shall be used from 5 feet outside the utility trench for a minimum length of 20 feet

9. STREAM CROSSINGS

Stream crossings shall be minimized, and the following design standards shall be followed:

A. Streambanks shall be protected from erosion at all times and shall comply with all requirements of the jurisdiction having authority.

B. Force mains shall cross stream channels at a near-perpendicular direction.

C. When possible, stream crossings shall be made with the top of pipe casing (or carrier pipe, if no casing) a minimum of 5 feet below the stream bed. Pipe shall be protected from flotation by the use of piers, piles, and/or concrete collars.

D. When necessary, as dictated by depth of cover, stream width, flow conditions, and soil conditions, concrete collars shall be required to prevent flotation and/or washout.

E. Pipe under streambed shall be factory installed restrained joint ductile with ceramic epoxy lining.

F. Aerial stream crossings are not recommended and shall only be reviewed by Charlotte Water in extreme circumstances.

G. Designers shall be responsible for compliance with floodplain regulations and any approval(s) required by appropriate jurisdiction having authority.

10. CORROSION PROTECTION

A. A corrosion resilient manhole shall be provided where the force main discharges into a downstream manhole, and a minimum of 100 feet downstream up to a maximum of three downstream manholes at Charlotte Water's direction. This may include protective coatings on exposed concrete surfaces, additives, or polymer concrete structures at Charlotte Water's discretion.

B. Where DIP may be installed in corrosive soils, polyethylene encasement of the ductile iron pipe and fittings is required. Soil testing shall be required to be conducted by an experienced technician as certified by the National Association of Corrosion Engineers (NACE) to determine if additional protective measures are required.

C. Where force mains are installed near impressed current utilities, such as gas pipelines, high voltage power transmission lines, light rail, street cars, and railroads, a stray current field analysis and soil testing shall be required to be conducted by an experienced technician as certified by the National Association of Corrosion Engineers (NACE) to determine if additional protective measures are required. External protective measures may include zinc coating, polyethylene encasement, or bonded joints and sacrificial anodes as approved by Charlotte Water. PVC or HDPE pipe is preferred However, if ductile iron pipe and fittings are used, they shall be double-wrapped in polyethylene encasement and lined with epoxy lining. Upon approval of controlling agency, restrained joint in bell (RJIB) C900 PVC carrier pipe inside a casing or open cut HDPE casing pipe may be allowed.

D. Reference Chapter 18 Corrosion Control for specific requirements and details for corrosion control and monitoring systems.

11. DESIGN OF EROSION AND SEDIMENT CONTROL MEASURES

Regardless of size, all sewer lift station and force main projects shall include measures and/or devices to prevent erosion and to contain sediment within the limits of the right-of-way and/or proposed easements. Design and permitting of erosion and sediment control devices shall be in accordance with Charlotte Land Development Standards including the City of Charlotte Soil Erosion and Sedimentation Control Ordinance for Developer-Donated projects. Charlotte Water designed projects shall meet NCDEQ requirements, as outlined in the North Carolina Erosion and Sediment Control Planning and Design Manual. Projects outside of City limits but within Mecklenburg County or outside of Mecklenburg County shall follow the appropriate county, town, and/or state requirements.

12. BORES AND TUNNELS

A. Force main crossings of railroads, major city streets, secondary roads, hydrocarbon transmission pipeline easements, and numbered highways must be encased in a steel pipe installed by either auger boring, boring and jacking, hand tunneling lined with prefabricated steel liner plates, or by another approved method by the controlling agency.

B. Minor city streets and secondary roads may be open cut with specific permission of the controlling agency, CDOT, NCDOT, or respective governing agency and if detailed on the construction drawings.

C. The carrier pipe shall be restrained ductile iron pipe, restrained joint in bell (RJIB) AWWA C900 DR 14 PVC pipe, ASTM F714 HDPE SDR 9 pipe, or other controlling agency approved pipe material.

D. Encasement pipe shall be new and manufactured of Grade “B” steel with minimum yield strength of 35,000 psi. Steel pipe shall have machine cut, bevel ends that are perpendicular to the longitudinal axis of the casing or permalock casing pipe. Pipe shall be designed in accordance with AWWA M11.

E. Casing spacers shall be used to prevent the carrier pipe from floating within a steel, or HDPE open cut casing pipe or tunnel or solid wall PVC open cut casing. A minimum of 3 casing spacers per joint shall be required. Casing spacers shall be evenly spaced to support the same weight of the carrier pipe. Casing spacer manufacturer shall provide the load carrying capacity of each spacer to determine when additional casing spacers are required.

F. Within NCDOT encroachments, the annular space between the carrier and casing pipe shall be filled if the casing pipe has a diameter of 24 inches or larger. Lightweight cellular concrete fill may be used to fill the annular space to allow future removal if necessary. The Engineer shall certify the casing pipe durability and design life of 100 years in lieu of filling the annular space when approved by NCDOT.

G. Bores and tunnels shall be designed to meet specific encroachment permit requirements, based on the governing agency (CDOT, NCDOT, CSX Corporation, Norfolk Southern Railway, NC Railroad, hydrocarbon transmission pipeline, etc.) based on loadings and depths. The minimum size and thickness standards for steel or HDPE casing pipe, carrier pipe, and tunnels for various sewer pipe sizes shall be in accordance with the governing agencies and meet the minimum requirements in Table 13.4.

H. The minimum thickness provided in Table 13.4 are provided by the controlling agencies. The actual thickness required must be calculated based on site conditions and actual depth of cover.

Table 13.4: Minimum Requirements for Casing Pipe and Tunnels				
DIP Carrier Pipe Size (inches)	Casing Pipe Minimum Thickness (inches)			Minimum Tunnel Size (inches)
	Casing Pipe Size (inches)	NCDOT	Railroads	
4	12	.250	.250	36
6	12	.250	.250	36
8	18	.250	.312	48
10	20	.250	.344	48
12	24	.250	.375	48
16	30	.312	.469	48
18	30	.312	.469	48
24	36	.375	.532	54

I. When HDPE SDR9 casing pipe is used for open cut casing installations, the minimum casing pipe size shall be as shown in Table 13.5. Bedding shall be Charlotte Water Type IV Granular Stone Bedding.

Table 13.5: Minimum Requirements for HDPE Open Cut Casing Pipe			
Carrier Pipe Size (inches)	Casing Pipe Size (OD, inches)	Casing Pipe Minimum Thickness (inches)	Casing Pipe Average ID (inches)
4	16	1.778	12.231
6	18	2.000	13.760
8	20	2.222	15.289
12	26	2.889	19.875
16	34	3.778	25.991

13. ABANDONMENT AND DISMANTLEMENT

A. Abandonment of existing pipes, structures, appurtenances, and limits of abandonment shall be clearly indicated on the project plans and shall meet the minimum requirements listed below. Abandonment procedures may be more stringent in accordance with the appropriate governing agency's standards.

1) All force mains to be abandoned shall be filled with excavatable flowable fill, lightweight cellular concrete, or removed. If abandoned force main is not removed or

filled, Contractor shall flush and pig the abandoned segment to remove accumulated sediments and properly dispose of contents.

2) Comply with current standards for force mains to be abandoned inside NCDOT rights-of-way.

3) All abandoned pipe ends shall be plugged watertight.

4) All abandoned force mains shall be removed from active discharge manholes and pipe and manhole walls plugged watertight. The manhole invert shall be rebuilt to conform with the standard details removing the abandoned trough.

5) All manholes, wet wells, and valve vaults shall be demolished to 3 feet below grade, removed from the site, and remaining structure filled with excavatable flowable fill or washed stone.

6) Charlotte Water will direct any equipment to be salvaged on a site-by-site basis.

7) Electrical, phone, and fiber service abandonment should be coordinated with the utility provider.

8) Water services shall be dismantled by applying for a dismantlement with the water supplier. Water meters shall be turned over to provider and service boxes removed and disposed offsite. Pipes shall be removed to below grade and pipe ends plugged watertight. Wells shall be dismantled and abandoned per 15A NCAC 2C for Well Construction Standards.

9) Overflow basins shall be backfilled with soil, graded and restored to match surrounding elevations. Fences shall be removed and disposed offsite.

10) Access roads shall be removed and graded to match surrounding elevations.

11) All disturbed areas shall be properly restored per Chapter 23 Restoration.

END OF SECTION

CHAPTER 13
SEWER LIFT STATIONS AND FORCE MAINS

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PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Ductile Iron Pipe and Fittings
2. PVC Pipe and Fittings
3. Valves
4. Open Channel Electric Grinders
5. Pumps
6. Pump Control System
7. Wetwells
8. Valve Vaults
9. Magnetic Flow Meters
10. Pump Station Security Fencing
11. Wiring
12. Conduit Raceways
13. Cable Tray
14. Electrical Service Entrance Equipment
15. Concrete Equipment Pads
16. Auxiliary Mounting Rack
17. Engine Generator Set
18. Engine
19. Alternator
20. Batteries & Charger
21. Sound Attenuated Housing
22. Automatic Transfer Switch (ATS)
23. Low-Profile Platform or Sub-Base Fuel Storage Tank
24. Geotextiles

1.2 RELATED DOCUMENTS

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

1.3 DEFINITIONS AND ABBREVIATIONS

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

1.4 SUBMITTALS

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

1. Product brochures
2. Catalog cut sheets
3. Shop drawings including dimensions and part/material lists
4. Certification of compliance
5. Prior product acceptance test reports
6. Reference contact data
7. Shipping tickets and purchase invoices

B. Provide product data for the following:

1. Ductile Iron Pipe and Fittings
2. PVC Pipe and Fittings
3. Valves
4. Open Channel Electric Grinders
5. Pumps
6. Pump Control System
7. Wetwells
8. Valve Vaults
9. Magnetic Flow Meters
10. Pump Station Security Fencing
11. Wiring
12. Conduit Raceways
13. Cable Tray
14. Electrical Service Entrance Equipment
15. Concrete Equipment Pads
16. Auxiliary Mounting Rack
17. Engine Generator Set
18. Engine
19. Alternator
20. Batteries & Charger
21. Sound Attenuated Housing

22. Automatic Transfer Switch (ATS)

23. Low-Profile Platform or Sub-Base Fuel Storage Tank

24. Geotextiles

C. Shop Drawings:

1. A bookmarked and indexed PDF file of shop drawings shall be submitted for review and approval prior to manufacture, fabrication, and construction.

2. The shop drawings shall include the following at a minimum:

a. Outline drawings showing product materials, equipment dimensions and weights, location of accessories, and clearances required.

b. Force main piping and appurtenances

c. Pumps

d. All electrical components

e. Control panel

f. Generator / transfer switch

g. Valve vault / Wetwell

h. Auxiliary equipment

i. Certified factory test and characteristic curves showing field performance for each pump and a pump curve / system curve with beginning and end of life operating points.

j. Wiring and schematic diagrams including accessories.

k. Spare parts list

D. Design:

1. Design calculations for pipe, fittings, and other accessories, reinforcement and/or test data.

2. Details of joint bonding and field welded joint restraint calculations when specified.

E. Pre-excavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth-moving operations. Submit before earth moving begins.

F. Product Certificates:

1. Required for all products furnished.

G. Qualification Data: For qualified testing agency.

H. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:

1. Classification according to ASTM D 2487.

2. Laboratory compaction curve according to ASTM D 698.

1.5 OPERATIONS AND MAINTENANCE (O&M) MANUALS

A. An O&M Manual shall be prepared for each pump station and a digital copy (bookmarked and indexed PDF file) shall be submitted to Charlotte Water for review within 14 days of startup date. After approval, a bookmarked and indexed PDF file that reflect any changes during construction shall be provided by the start-up date, along with the spare parts specified elsewhere. O&M Manuals shall contain the following information, at a minimum:

1. Approved shop drawings, including design data for all installed equipment and each major component.
2. Control panel wiring diagrams and a reduced set of station/force main plans.
3. Warranty information for all installed equipment and each major component.
4. Inventory, functional descriptions, and complete operating instructions for all installed equipment and each major component, including all valves.
5. Instructions for start-up/shut-down as well as for calibration and adjustment of all installed equipment and each major component.
6. Recommended maintenance plan, including preventative and predictive maintenance, for all installed equipment and each major component including odor control.
7. Contingency plan and analysis of critical safety issues.
8. Contact information for local parts suppliers and service companies as well as instructions for replacement of all installed equipment and each major component.
9. Contact information for local contractors capable of performing emergency repairs.
10. Factory start-up report.
11. Results of all witnessed testing and a digital video of said testing.

1.6 SERVICE MANUAL AND SPARE PARTS

A. Service Manuals shall be furnished for all mechanical and electrical equipment specified and shall be bound in a single book. The manual shall contain a description of the equipment, a complete accessory and parts list, and complete installation, operation, maintenance, troubleshooting, and repair instructions. A PDF shall be submitted for review within 30 days after approval of shop drawings. After approval of manual, a bookmarked and indexed PDF file of each manual shall be submitted by start-up date.

B. Equipment manufacturer shall furnish the proper lubricants for initial operation of each piece of equipment. Each type of lubricant shall be furnished in a separate sealed container, clearly labeled showing the type of lubricant, equipment for which it is intended, and instructions for use.

C. The manufacturer is to furnish a list of all recommended spare parts including, at a minimum, two sets of mechanical seals, o-rings, gaskets, wear plates, and wear

rings for each pump supplied. In addition to other spares recommended by the manufacturer, a spare pump shall be required, and each pump shall be provided with an extra full-size impeller. The spare parts shall be provided by start-up date. Spare parts shall be provided in original packaging in factory new condition.

D. The manufacturer is to furnish a list of all recommended spare parts including at a minimum two sets of all fuses and indicator lamps. The spare parts shall be provided, together with service manuals, prior to start-up date.

E. The contractor is to furnish a bookmarked and indexed PDF file, and electronic CADD files in .dwg format of record drawings by the start-up date. These drawings shall include any changes during construction with any such changes recorded on original design drawings by design engineer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Containers or skids shall be constructed for normal shipping, handling, and storage.

B. Containers shall provide adequate protecting for the equipment in a dry indoor environment between +40 ° F (+4.5 ° C) and +100 ° F (+37.8 ° C).

C. Do not store plastic pipe and fittings in direct sunlight. All pipe must be in brand new factory condition, and no more than one year old from manufacturer date to installation. Pipe manufacturer must provide letter regarding exposure requirements.

D. Protect pipe, pipe fittings, and seals from dirt and damage.

E. The Contractor shall be responsible for the safe storage of materials furnished by or to them, and accepted by them and intended for the work, until they have been incorporated in the completed project. Handling and storage of all project materials are to be in compliance with the manufacturer's recommendations for handling and storage. The interior of all pipe, fittings and other accessories shall be kept free from dirt and foreign materials at all times.

F. Transportation of Materials and Equipment: The Contractor and their Suppliers are directed to contact the North Carolina Department of Transportation to verify axle load limits on State maintained roads (and bridges) which would be used for hauling of equipment and materials for this project. The Contractor and their Suppliers shall do all that is necessary to satisfy the Department of Transportation requirements and will be responsible for any damage to said roads which may be attributed to this project. Unless otherwise specified, all materials required to construct this project shall be furnished by the Contractor and shall be delivered and distributed at the site by the Contractor or their material supplier.

G. Loading and Unloading Materials: Ductile iron pipe accessories shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Pipe, fittings, and other accessories will be unloaded with hoists and/or as recommended by the respective manufacturers. Under no circumstances shall such materials be dropped. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground.

H. Responsibility for Materials on Site: In distributing the material at the site of the work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench. Each piece shall be redundantly chocked at each end to prevent

movement or rolling. Pedestrian or vehicular traffic shall not be unduly inconvenienced in placing of material along the streets or right-of-way, as applicable.

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

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

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

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

J. Care of Coatings and Linings: Pipe, fittings, and other accessories including frames and covers, steps, straps, etc., shall be so handled such that the coating or lining will not be damaged. If, however, any part of the coating or lining is damaged, the repair shall be made by the Contractor at their expense in a manner satisfactory to the Engineer.

1.8 SUBMERSIBLE PUMPING STATION ELECTRICAL GENERAL PROVISIONS

A. The Contractor shall furnish all labor, materials, equipment and supplies and shall perform all work necessary for the complete construction of submersible pumping station as shown on the plans and specified herein. Items not specifically covered in this heading of the specifications are subject to requirements in other Charlotte Water “Standards and Specifications” and the direction and approval of the owner. The contractor shall coordinate power and phone service installation in their own name and arrange for the account to be transferred to the City of Charlotte at final acceptance of project. All bills shall be paid current prior to account transfer.

B. Applicable Standards, Codes & Design Criteria:

1. All equipment shall meet Standards of Underwriters Laboratories, Incorporated (U.L.) and the National Electrical Manufacturer’s Association (NEMA) in every case where they have established a standard for the particular type of material to be installed. All equipment shall be U.L. listed and labeled.

2. Installation shall meet or exceed the standards established by the National Fire Protection Association (NFPA) as currently referenced under the North Carolina State Building Code (NCSBC). Additionally, Charlotte Water facilities shall meet or exceed the requirements of NFPA-820, Standard for Fire Protection in Wastewater Treatment and Collection Facilities.

3. The pump station equipment and installation shall meet NC DEQ's Minimum Design Criteria for the Fast-Track Permitting of Pump Stations & Force Mains. Unless otherwise directed by Charlotte Water, and approved by NC DEQ, no variance to the Minimum Design Criteria is permitted.

C. Installation: Installation shall comply with the applicable rules of the National Electric Code (NFPA 70), rules/regulations of the SBC and local codes. In no case shall the materials or workmanship fail to meet the minimum requirements of the National Electric Code (NEC). All power and phone lines shall be located within Charlotte Water easement or property and shall be underground within the station enclosure.

1. The regulations of the local electric company shall govern the service connection and metering provisions. A pad mounted transformer located outside the fenced enclosure is required.

D. Materials: All materials used in this work shall be new and listed by Underwriters Laboratory (UL). All nuts, bolts, struts, supports, etc. shall be stainless steel (grade 316 or higher).

E. Grounding: The conduit and neutral conductors of the wiring systems and all electrical equipment shall be grounded. The ground connection of the wiring system neutral shall be made at the main service switch or circuit breaker.

1. Grounding electrodes, service ground conductor and equipment ground conductors shall be furnished and sized in accordance with NEC 250 requirements.

2. All ground conductors running outside of the electrical equipment enclosures, cable trays etc., shall be run in PVC-RGS (Rigid Galvanized Steel) conduit. All conduits shall be bonded at terminations to provide a continuous grounding path in accordance with NEC.

a. In addition, & supplementary to grounding inherent to continuous, bonded metallic conduit, a separate equipment-grounding conductor, sized per NEC, shall be installed in each conduit.

3. The grounding electrode connection shall be made below finished grade with provisions for periodic inspection and adjustment without need for excavation.

1.9 EMERGENCY AND STANDBY POWER SYSTEMS

A. The system shall be provided complete with all necessary automatic starting equipment, transfer switch, fuel tank, supply and return fuel oil piping, exhaust system/silencer, generator output circuit breaker, and all other necessary appurtenances for complete and operable system.

B. Guarantee: All equipment and wiring shall be guaranteed against defects in materials and workmanship for a two-year period from the activation of the system.

C. Service: Manufacturer's factory trained service representatives shall perform all service.

1. Routine warranty service for the equipment will be performed during normal working hours, (Monday thru Friday, 8:00 a.m. to 5:00 p.m., excluding City of Charlotte holidays). Emergency service provided at times other than stipulated above shall be provided from the same source at no additional cost to the Owner.

2. The Manufacturer shall have a service facility within 120 miles of the Charlotte CBD with effective dispatching to assure a maximum two-hour on-site response to the Owner's request for service. The Manufacturer shall demonstrate this capability to the Owner and shall provide this minimum response under all reasonable circumstances.

PART 2 - PRODUCTS

2.1 PIPE, GENERAL

A. All materials furnished in accordance with these specifications shall be new and unused, unless otherwise specified in the project Special Provisions. Unless superseded or modified by a Special Provision; all materials, apparatus, supplies, methods of manufacture, or construction shall conform to the specifications for same contained in this Section. National material standards (ASTM, ANSI, AWWA, NSF (NSF International), etc.) referred to herein shall be considered to be the latest revisions only.

B. Unless amended on the Construction Drawings, or approved by Charlotte Water, all piping shall be Ductile Iron, PVC, or HDPE as specified herein.

C. All pipe used for force main construction shall be labeled or otherwise identified as conveying wastewater.

1. All force mains shall be clearly identified with green plastic locator tape made specifically for that purpose. The tape shall be marked with black lettering clearly identifying the pipeline as sanitary sewer. The tape shall be 6-inches wide. The tape will be placed both approximately 1 foot above the pipe and also 2-feet below the ground surface.

2. A 12-gauge solid copper wire with 30 mil HDPE green insulation shall be laid on top of PVC force mains. This wire shall be secured to the pipe near every bell and at the center of each pipe joint. This wire shall be brought into air release valve vaults and secured to the stainless-steel hook along with the valve shutoff cable. Tracer wire terminal locator valve box stations shall be located a maximum of every 750 feet along the pipe alignment.

3. Aboveground markers shall be used every 300' on straight runs, 100' on curves, and at every significant change in direction or when otherwise limited by sight distance. Above-ground markers shall be 72"h x 3 ¾" w, and green in color as manufactured by Rhino Fiber3rail (product FR72-G) or approved equal. Markers shall be installed as recommended by the manufacturer.

D. All piping inside the pump station wetwell and through the mag meter vault shall be flanged Protecto 401 lined ductile iron pipe with 300 series stainless steel nuts and bolts. All buried valves and DIP pipe and fittings shall be restrained mechanical joints. All underground piping shall be inspected, prior to back filling, by the Charlotte Water Lift Station Manager.

E. Emergency Pump-Out Connection: An emergency pump-out connection shall be provided inside the pump station, upstream of the mag meter, per the Standard Details. The force main shall be fitted with an eccentric plug valve and downstream of this valve shall be a flanged tee with a riser pipe extending vertically to the surface. The riser pipe shall have an eccentric plug valve fitted on the end. This plug valve shall have a blind flange with a ¼" NPT ball valve. The buried plug valve shall operate with a two-inch square nut and the surface plug valve shall operate with a wrench. The Contractor shall furnish a valve key and a wrench as part of the permanent station equipment. The surface plug valve shall be set in a drain bed of washed #57 crushed stone at least six inches deep and shall be housed in a pre-cast concrete vault. Vault shall be sized so distance between valve/operator and wall shall have a minimum 12" clearance.

F. Water Service: In areas where potable water is available, the station shall be furnished with a ¾" water service and freeze-proof yard hydrant as manufactured by Simmons Manufacturing Co., Woodford Manufacturing, Everbilt, or approved equal. A reduced pressure principle backflow prevention device is required per Charlotte Water specifications. This shall be located within the fenced station enclosure and supplied with a strainer screen, heating element, and an insulated cover anchored with stainless steel hardware. If municipal water is not available, a groundwater well and yard hydrant shall be provided. The well shall have a minimum capacity of 8 gal./min at 40 psi and be clearly labeled as non-potable. Yard hydrants shall be mounted 30-inches high, frost-proof and equipped with stems and seat washers that are removable through the top of the hydrant. Operating rod shall be brass. The yard hydrant shall be installed complete with washed stone drain bed of at least 1 cubic foot and a 24-inch square concrete splash pad, per the Standard Details.

2.2 DUCTILE IRON PIPE AND FITTINGS

A. Pipe: At a minimum, buried ductile iron pipe shall conform to the requirements of AWWA Standard C-151, ANSI A21.51, pressure class 350. Flanged pipe inside the wetwell and vaults or otherwise exposed shall be thickness class 53. See project Special Provisions and Construction Drawings for additional design requirements, standards and details. A higher pipe class may be shown on the construction plans and/or elsewhere in Special Provisions.

1. Unless otherwise shown on the construction plans, all ductile iron pipe shall be furnished with a Protecto 401 lining.

2. The pipe shall contain all product markings required by ASTM A-746 and AWWA C-151. The minimum pipe markings shall include the weight, class or nominal thickness, casting date. The manufacturer's mark, the country where cast, the production year, and the letters "DI" or "DUCTILE" shall be cast or metal stamped on the pipe, and on pipe sizes 14-inch and larger shall not be less than ½-inch in height. All markings shall be clear and legible, and all cast or metal-stamped marks shall be on or near the bell.

3. DIP pipe shall be manufactured within the North American Continent by a pre-approved manufacturer.

4. Manufacturers:

   a. American Cast Iron Pipe Co

   b. U.S. Pipe Co

   c. McWane Cast Iron Pipe

B. Fittings: All fittings shall be cast from ductile iron, in accordance with AWWA C-110, ANSI A21.10 for full body fittings or AWWA C-153, ANSI A21.53 for compact fittings.

1. All cast fittings shall have a Protecto 401 lining.

2. The fittings shall contain all product markings required by AWWA C-110 or C-153 as applicable. The minimum markings on each fitting shall include the identity of the AWWA standard, the pressure rating, nominal diameters, manufacturer's identification, the county where cast, the letters "DI" or "DUCTILE", and the angle of all bends. The markings shall be distinctly cast raised or in relief on the outside of the fitting body.

3. All fittings, including gaskets, glands, and bolts, shall be furnished by one fittings manufacturer. DIP fittings shall be manufactured within the North American Continent or imported by an approved manufacturer.

4. Manufacturers:

   a. American Cast Iron Pipe Co

   b. U.S. Pipe Co

   c. McWane Cast Iron Pipe

   d. Tyler/Union Foundry

   e. Sigma Pipe

   f. SIP Industries

   g. Star Pipe

C. Force mains of DI pipe shall have mechanical or gasketed push-on type joints. Factory restrained joint DI pipe will be used for thrust restraint.

1. Mechanical Joint Accessories: Mechanical joint glands shall be ductile iron. Glands, bolts, nuts, and gaskets for mechanical joint pipe and fittings shall be furnished by the pipe/fitting manufacturer and shall conform to ANSI Specifications A21.11 (AWWA C-111). All mechanical joint fittings will be Bell and Bell unless otherwise indicated on the plans.

   a. Rubber gaskets shall be made of vulcanized natural or synthetic rubber in accordance with AWWA C-111, ANSI A21.11 unless otherwise shown on the plans or specified.

   b. The gaskets shall contain all product markings required by the appropriate AWWA Standard. The minimum gasket markings shall include size, manufacturer's mark, country where molded, year, mold number, and "MJ".

c. Bolts shall be Tee Head or Stud Bolts where required. Bolts shall be provided with standard hexagonal cold pressed nuts unless otherwise specified. Bolts and nuts shall be made of the best quality refined iron or mill steel and shall have sound, well-fitting threads. Bolts and nuts shall be threaded according to ASME B1.1 and B1.2, coarse-thread series unified coarse (UNC), Class 2A, External, and Class 2B, Internal. Bolts and nuts shall be of high-strength, low alloy steel conforming to the chemical and mechanical requirements of AWWA C-111, minimum 45,000 PSI tensile strength.

d. If the pipe manufacturer furnishes third party accessories, the pipe manufacturer shall provide a written and notarized statement signed by a current officer of the pipe manufacturer accepting unit responsibility for both the fitting, pipe, and accessories for 30-inch and larger products.

2. Push-On Joint Material: Gaskets for push-on pipe shall be furnished by the pipe manufacturer. Joint type shall be Tyton or Fastite only. Gaskets and gasket lubricant shall conform to ANSI Specifications A21.11 (AWWA C-111).

a. Rubber gaskets shall be made of vulcanized natural or synthetic rubber in accordance with AWWA C-111, ANSI A21.11 unless otherwise shown on the plans or specified.

b. If the pipe manufacturer furnishes third party accessories, the pipe manufacturer shall provide a written and notarized statement signed by a current officer of the pipe manufacturer accepting unit responsibility for both the fitting, pipe, and accessories for 30-inch and larger products.

3. Restrained Joint Pipe Systems:

a. 12-inch diameter and smaller pipe shall be Mechanical Joint, Tyton, or Fastite only. Field Lok gaskets are allowed for DI pipe only.

b. 16-inch diameter and larger pipe shall be factory restrained joint system.

D. Flange Joints and Accessories: All fittings inside pump station and through the mag meter vault shall be flange joint ductile iron fittings. Ductile iron flange joints shall be furnished in accordance with the requirements of ANSI A21.15/AWWA C-115. Flange joints shall be either Class 125 or Class 250, as required. Flanges, flange bolts and nuts, and gaskets shall conform to the dimensional requirements of ANSI B16.1 for Class 125 or ANSI B16.2 for Class 250. Bolts shall be ASTM F593 316 SS and have standard hexagonal heads and ASTM F 594 316 SS nuts. An anti-seize compound shall be used during assembly. No all-thread connections are allowed between valves or between valves and piping.

1. Rubber gaskets shall be made of vulcanized natural or synthetic rubber in accordance with AWWA C-111, ANSI A21.11 unless otherwise shown on the plans or specified. Gaskets shall be ring or full-faces, and 1/8-inch thick.

2. The flange shall contain all product markings required by the appropriate AWWA/ANSI/ASME Standard. The minimum markings shall include the

manufacturer's mark, size, and the letters "DI" cast or stamped on the back face of the flange.

3. Bolts shall have standard hexagonal heads and shall be provided with standard hexagonal cold pressed nuts unless otherwise specified. Bolts and nuts shall be made of the best quality refined iron or mill steel and shall have sound, well-fitting threads. Bolts shall conform to the requirements of ASME B18.2.2. Bolts and nuts shall be threaded according to ASME B1.1, Unified Inch Screw Threads, UN and UNR Thread Form, Class 2A, External, and Class 2B, Internal. Bolts and nuts shall be grade 316 stainless steel, minimum 60,000 PSI tensile strength. Anti-seize compound shall be used on bolts and nuts for pipe 30-inches and larger.

4. If the pipe manufacturer furnishes third party accessories, the pipe manufacturer shall provide a written and notarized statement signed by a current officer of the pipe manufacturer accepting unit responsibility for both the fitting, pipe, and accessories for 30-inch and larger products.

5. Restrained flange adapters shall be used in the valve vault as shown in Standard Details.

   a. The adapters shall be used in lieu of threaded, or welded, flanged spool pieces. Flange adapters shall be made of ductile iron conforming to ASTM A536 and have flange bolt circles that are compatible with ANSI / AWWA C110 / A21.10.

   b. Restraint for the flange adapter shall consist of a plurality of individual actuated gripping wedges to maximize restraint capability. Torque limiting actuating screws shall be used to insure proper initial set of gripping wedges.

   c. The flange adapter shall be capable of deflection during assembly, or permit lengths of pipe to be field cut, to allow a minimum of 0.6" gap between the end of the pipe and the mating flange without affecting the integrity of the seal.

   d. For ductile iron pipe, the flange adapter shall have a safety factor of 2:1 minimum.

   e. The flange adapter shall be MEGAFLANGE SERIES 2100 adapter, as produced by EBAA Iron, Inc., or an approved equal.

E. Ductile Iron Flexible Expansion Joints: There shall be two flexible restrained joints on each DI pipe between the wet well and valve vault to prevent damage from differential settlement. Piping shall be EBAA Iron - Flex 900 or approved equal.

1. Flexible expansion joints shall be manufactured of ductile iron conforming to the material requirements of ASTM A536 and ANSI/AWWA C153/A21.53. Foundry certification of material shall be readily available upon request.

2. Each flexible expansion joint shall be pressure tested prior to shipment against its own restraint to a minimum of 350 psi (250 psi for flexible expansion joints 2 inch and 30 inches diameter and larger.) A minimum 2:1 safety factor, determined from the published pressure rating, shall apply. Factory Mutual Approval for the 3-inch through 12-inch sizes is required.

3. Each flexible expansion joint shall consist of an expansion joint designed and cast as an integral part of a ball and socket type flexible joint, having a minimum per ball deflection of: 20º, 2”-12”; 15º, 14”-36”;12º,42”-48” and 4-inches minimum expansion. Flange end connections shall be required.

4. All internal surfaces (wetted parts) shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213. Sealing gaskets shall be constructed of EPDM. The coating shall meet ANSI/NSF-61.

5. Exterior surfaces shall be coated with a minimum of 6 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C116/A21.16.

6. Appropriately sized polyethylene sleeves, meeting ANSI/AWWA C105/A21.5, shall be included for direct buried applications.

F. Corrosion Protection: Consideration shall be given to the existence of or the potential for development of corrosive environments within and outside the force main. Sources of corrosion may include acidic soils, septic wastewater, and air entrainment within the force main. Where corrosion is deemed to be a serious problem, DI pipe shall be provided with an alternate coating appropriate for the pipe material and situation. Such coatings shall be manufactured or applied in accordance with the appropriate ANSI and AWWA standards. All force main DI piping shall be lined with Protecto 401.

G. The Engineer reserves the right to witness any or all acceptance tests. Prior notice of testing schedules will be provided by the manufacturer to the Engineer to accommodate travel or independent third-party witness arrangements.

H. Quality Control/Quality Assurance: The manufacturer shall perform the standard acceptance tests required by AWWA C-151, Section 5.1.1.2 and shall keep test records on file for inspection by the Engineer. The manufacturer shall furnish an affidavit that the materials used in the making of the pipe meet all provisions of the applicable AWWA and ASTM standards and that the pipe, fittings, accessories, and rubber gaskets meet all applicable provisions of AWWA C-104, C-110, C-111 C-115, C-150, and C-153 respectively.

2.3 PVC PIPE

A. Pipe: At a minimum, PVC pipe shall be green and conform to the requirements of AWWA Standard C900. The thickness and pressure class of PVC pipe required for the installation and operating conditions during the expected service life of the force main shall be determined in accordance with AWWA Standard C900 but shall be a minimum of Pressure Class 305 with an SDR of 14 or less. See project Special Provisions and Construction Drawings for additional design requirements, standards and details.

1. PVC material used in the manufacture of PVC pipe shall conform to ASTM D1784 “Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.”

2. All PVC pipe will be shipped, stored, and strung at the project in such a manner as to be protected from total accumulated exposure to sunlight and possible ultraviolet radiation of no more than four (4) weeks. Pipe shall be

installed within 12 months of the manufacturer date stamped on the pipe wall.

3. PVC pipe shall be manufactured within the North American Continent. An officer of the manufacturing company shall certify that all PVC pipe products were manufactured in North America.

4. Force mains of PVC pipe shall have elastomeric gasketed push-on type joints. Gaskets shall meet the requirements of ASTM F-477.

B. Restrained Joint Polyvinyl Chloride Pipe (PVC):

1. Restrained joint PVC pipe shall be restrained joint in bell (RJIB) PVC pipe and shall use the Bulldog Restraint System or the Spline/Groove Restraint System. Pipe shall be made from green (only) pigmented virgin materials and shall be furnished in lengths of 20, 30, or 40 feet. Lesser lengths will be accepted to allow the proper placement of fittings, valves, etc.

2. Rubber gaskets shall be as furnished by the pipe manufacturer and shall be made of vulcanized styrene butadiene rubber (SBR) or EPDM, unless otherwise approved or specified. Gaskets shall meet the requirements of ASTM F-477 for high head applications.

3. Gasket lubricant shall be recommended by the pipe manufacturer.

4. Manufacturers: Restrained joint PVC pipe restraining system shall be

a. Eagle Loc 900, with BullDog™ Restraint System (manufactured by JM Eagle)

b. Diamond Loc-21 (manufactured by Diamond Plastics Corporation)

c. Certa-Lok® (manufactured by Westlake Corp). ≤16 inches only

d. Approved equal

C. Fittings:

1. Mechanical joint DI fusion bonded epoxy lined pipe fittings conforming to ANSI/AWWA C110/A21.10 and C116/A21.16-98 shall be used for force mains four inches in diameter and larger.

D. Valve and Fitting Restraint Systems for PVC Pipe

1. Restraint at connection to mechanical joint valves and fittings shall be by the use of wedge action thrust restraint for mechanical joints as specified for use with restrained joint PVC pipe.

a. EBAA Iron – 2000PV MEGALUG – Series 2000

b. Star Pipe Products – PVC Stargrip – Series 4000

c. Romac Industries – GripRing

d. Tyler Union Corp – TufGrip – Series 2000

e. SIP Industries – EZ Grip Ultra Joint Restraint

2.4 HIGH DENSITY POLYETHYLENE (HDPE) PIPE (OD-BASED IRON PIPE SIZE – IPS) AND FITTINGS

A. The HDPE pipe shall be manufactured in accordance with AWWA C-901 or C-906 and ASTM D-3035, using PE 4710 resin (ASTM D-3350, Cell Classification PE 345464C). Polyethylene pipe shall be 200 PSI pressure class, OD based Iron Pipe Size – IPS pipe and must meet the dimension ratio (DR) below. Each pipe nipple shall contain no more than two (2) butt fusion joints. Due to the pipe wall thickness of HDPE pipe and due to IPS OD-based pipe, the HDPE pipe size shall be based on ID dimensions of the HDPE pipe (e.g. when 24-inch nominal pipe is called out on the plans, 32-inch HDPE is needed to provide the required 24-inch ID pipe).

Pipe Use	Outside Diameter (inch)	ASTM Test Method	AWWA Standard	Pressure Class (PSI)	Max Dimension Ratio
Sewer Mains	4 - 32	D2239, D2239, D2737, D3035, D3350, F714	C906	250	DR 9

B. The transition pieces at each end of the HDPE pipe shall be Series 710 Male NPT couplings as manufactured by Poly-Cam, Inc or approved equal, and shall be press fit onto the HDPE pipe. The HDPE shall extend through the full length of the transition piece with no metal exposed in the waterway. The transition piece shall be manufactured from 304 or 316 stainless steel.

C. The pipe shall be manufactured within the North American Continent. An officer of the manufacturing company shall certify that all HDPE was manufactured in North America.

D. Pipe shall be manufactured at a facility that has a Registered ISO 9001:2000 Quality Management System. Copy of current ISO 9001:2000 registration shall be submitted with product submittals.

E. Pipe markings shall be as required by AWWA C-906 and/or ASTM D-3035. Product markings shall be at intervals of not more than 5 feet. The minimum pipe markings shall be as follows:

1. Manufacturer’s Name or Trademark and product record.
2. Nominal pipe size.
3. IPS.
4. Dimension Ratio (“DR 11”).
5. AWWA C-906.
6. Seal of testing agency that verified the suitability of the pipe.
7. Resin type (PE345464C).
8. Color identification requirements:

a. Larger than 2-inch HDPE Pipe shall be identified by a green stripe on exterior. Striping material shall be the same as piping material.

9. Manufacturers: Performance Pipe, GF Piping Systems, JM Eagle, Driscoplex, WL Plastics or approved equal.

F. Fittings:

1. Butt Fusion Fittings:

a. Butt fusion fittings shall be made of HDPE material with a minimum material designation code of PE345464C and with a minimum Cell Classification as required for HDPE Pipe.

b. Butt fusion fittings shall meet the requirements of ASTM D3261. Molded and fabricated fittings shall have a pressure rating equal to or greater than the pipe unless otherwise specified on the plans.

1) Fabricated Fittings shall be Equivalent Dimension Ratio to DR11.

2) Pipe stock used to manufacture fabricated fittings shall meet requirements of AWWA C906 and meet the material designation code of PE345464C.

3) Fabricated Fittings typically require a lower DR rating than the pipe to meet or exceed the pipe pressure rating. Calculate the difference for a fabricated fitting based on a published rerating percentage.

4) Fabricated bend and tee fittings shall have a minimum of 3 segments.

5) Fabricated bend fittings over 45 degrees through 90 degrees shall have a minimum of four segments.

6) Field fabricated fittings are not allowed.

c. All fittings shall meet the requirements of AWWA C906.

d. Markings for molded fittings shall comply with the requirements of ASTM D3261.

1) Standard Designation (ASTM D 3261).

2) Manufacturer’s name or trademark.

3) Material designation (PE345464C).

4) Date of manufacture or manufacturing code.

5) Size.

6) Dimension Ratio (example: DR 11).

e. Fabricated fittings shall be marked in accordance with ASTM F 2206.

1) Standard Designation (ASTM F 2206).

2) Manufacturer’s name or trademark.

3) Material designation (PE345464C).

4) Date of manufacture or manufacturing code.

5) Size.

6) Equivalent Dimension Ratio.

7) Manufacturers: ISCO, IPEX, GF Piping Systems, or approved equal.

2. HDPE Electrofusion Fittings:

a. Electrofusion Fittings shall be made of HDPE material with a minimum material designation code of PE 4710 and with a minimum Cell Classification as noted for HDPE pipe.

b. Electrofusion Fittings shall have a manufacturing standard of ASTM F1055. Fittings shall have a pressure rating equal to the pipe unless otherwise specified on the plans.

c. All electrofusion fittings shall be suitable for use as pressure conduits and have nominal burst values of four times the Working Pressure Rating (WPR) of the fitting.

d. Markings shall be according to ASTM F 1055.

1) Standard Designation (ASTM F 2206).

2) Manufacturer's name or trademark.

3) Material designation (PE345464C).

4) Date of manufacture or manufacturing code.

5) Size.

6) Equivalent Dimension Ratio.

7) Manufacturers: Agru America, GF Piping Systems, Integrity Fusion Products, IPEX, MT Deason Company, NUPI Americas Inc, or approved equal.

3. Flanges and Mechanical Joint Adapters (MJ Adapters):

a. Flanges and Mechanical Joint Adapters shall have a material designation code of PE4710 or higher and a minimum Cell Classification as noted for HDPE pipe.

b. Flanged and Mechanical Joint Adapters can be made to ASTM D 3261 or if machined, must meet the requirements of ASTM F 2206.

c. The outside diameter of Flanges shall be based on Iron Pipe Size (IPS).

d. The MJ Adapters shall be based on Iron Pipe Size by Ductile Iron Pipe Size (IPS x DIPS).

e. Flanges and MJ Adapters shall have a pressure rating equal to the pipe unless otherwise specified on the plans.

f. Markings for molded or machined flange adapters or MJ Adapters shall be per ASTM D 3261.

1) Manufacturer's name or trademark

2) Material designation (PE345464C)

3) Date of manufacture or manufacturing code

4) Size

5) Where recessed marking is used, take care not to reduce the wall thickness below the minimum specified.

g. Fabricated (including machined) flange adapters shall be per ASTM F 2206.

h. Metal gland for MJ Adapter may be either AWWA C110 (full body) or AWWA C153 (compact).

i. Low alloy steel bolts shall comply with AWWA C 111.4. Bolts, rods, and hex nuts shall be manufactured from 304 stainless steel as per ANSI/ AWWA C111/A21.11.

j. Van-Stone style, metallic (including stainless steel), convoluted, or flat-plate back-up rings and bolt materials shall follow the guidelines of Plastic Pipe Institute Technical Note # 38, and shall have the bolt-holes and bolt-circles conforming to one of these standards: ASME B-16.5 Class 150, ASME B-16.47 Series A Class 150, ASME B-16.1 Class 125, or AWWA C 207 Class 150 Series B, D, or E.

k. The back-up ring shall provide a long-term pressure rating equal to or greater than the pressure-class of the pipe with which the flange adapter assembly will be used, and such pressure rating shall be marked on the back-up ring. The back-up ring, bolts, and nuts shall be protected from corrosion by a system such as coal-tar epoxy, galvanization, polyether, or polyester fusion bonded epoxy coatings, anodes, or cathodic protection, as specified by the Engineer.

l. Stiffening insert required shall comply to Part 2.7.G.4.

m. Manufacturers: Georg Fisher, DriscoPlex, IPP, or approved equal.

4. <u>Stiffening Insert (Stiffener):</u>

a. Provide stiffeners at each MJ adapter and coupling per Standard Details.

b. Stiffening inserts shall be specially designed for use on the inside of HDPE pipe in conjunction with AWWA C111 mechanical joints.

c. Provide stainless steel per ASTM 240, type 304 or 316.

d. Stiffener shall be manufactured within the pipe or MJ adapter by the factory.

e. Field installed stiffeners may be allowed upon approval of Charlotte Water inspector. Wedge style stiffeners are allowed.

f. Stiffener length must be sufficient to fully encompass the area of the pipe being restrained.

g. Inserts must be designed for underground pressurized fluid service and are pressure rated to match the pipe DR pressure rating, derated as appropriate for service temperature. Maximum test pressure limited to pipe rated pressure.

h. Stiffener design shall prevent movement causing fitting to slide or rotate on the pipe.

i. Manufacturers: Georg Fisher, ROMAC, or approved equal.

5. <u>Flex Coupling Restraint Device</u>:

a. HDPE flex coupling restraint devices will be rated for minimum of 8,000 pounds of force.

b. Resin used to manufacture device shall meet requirements of ASTM 3350 with minimum cell classification of 445474C.

c. Device will include bar code and product label tag.

d. Device will install by electrofusion.

6. Stainless Steel Threaded Fitting: Stainless steel fittings, including bends, street tees, and couplings, used with HDPE pipe shall be type 304 or type 316 stainless steel with NPT threads. The minimum wall thickness shall be 0.130-inches. Fittings shall be Standard Weight 150# Stainless Fittings as manufactured/supplied by Smith-Cooper International, or pre-approved equal. The fittings may be import or domestic production and shall be manufactured in as IS0 9001:2000 manufacturing facility.

2.5 VALVES

A. Valves and appurtenances shall be the type, size and class shown on the plans and as specified elsewhere in this document. Valves smaller than 4" on pump sewer discharge piping shall not be allowed.

B. Ball Valves: Ball valves shall be 316 stainless steel construction with iron pipe thread, screw ends, as required and having a working pressure of 200 PSI.

C. Swing Check Valves: Check valves 4-inches and larger shall be horizontal swing check valves for sewage service furnished with iron bodies, bronze mounted, single disc, swing type full opening, with lever and weight assist (compatible with the specified pumps and working pressure) and with flange ends conforming to ANSI Specification B16.1. Valves 8-inches and larger shall be cushioned. Valves shall be manufactured by APCO (Series 6000), Mueller/Milliken/Pratt (CCNE Series 9001), or Valmatic (Series 7800). All working parts shall be removable through the top of the valve unless otherwise required by the installation. When check valves are located in vaults or other areas with limited access, Mega-flange or equivalent fittings with stainless steel bolts will be located immediately upstream of each check valve to facilitate maintenance. Swing check valves for pump discharge shall include a ¼" NPT tap in the check valve cover with a ¼" full port ball valve and dust cover.

1. Shaft Seals: Shaft seals shall be designed for the use of standard O-ring seals.

2. Inspection: The manufacturer shall furnish to the Engineer written certification that all valves and material furnished under this specification have been tested and found to conform with the requirements of AWWA standards for valves C-508 and ASTM and ANSI requirements for materials as applicable.

3. Lining and Coatings: Check valves shall have factory applied fusion bonded epoxy lining and coatings.

4. Valve Body Types: Valve bodies shall be manufactured with flanged ends conforming in dimensions and drilling to ANSI B16.1 Class 125 cast iron

flanges. The short style valve body will be furnished as required to complete the installation as shown on the Plans.

5. Valve Drawings: Plans for valves and assemblies will be approved by the Engineer prior to construction.

D. Plug Valves: All valves for pressure sewers and force mains shall be eccentric plug valves as follows:

1. Plug valves shall be non-lubricated, with a plug facing of a material specifically recommended by the valve manufacturer for the indicated service and shall have stainless steel permanently lubricated upper and lower plug stem bearings. Valve seats shall be nickel. Valves shall be designed with adjustable seals that are replaceable without removing the bonnet. The bearing and seal area shall be protected with grit seals. Valves shall have factory applied fusion bonded epoxy linings and coatings. Area of port opening for all valves shall be full port only. Valves shall have working pressure of 175 psi for 12-inch and smaller valves and 150 psi for 14-inch and larger valves. Bi-directional shutoff is required. Plug valves shall be as manufactured by Dezurik, Milliken, Val-Matic, J & S Valve, or approved equal.

2. Valves with flange ends shall be provided where indicated. Flanges shall be in accordance with ANSI B16.1 including thickness, facing, and drilling except that the four holes straddling the principal axis of the valve may be tapped and connected to the adjacent piping with cap screws of adequate size as recommended by the valve manufacturer and approved by the Engineer.

3. Operation: Plug valve operation shall be as indicated on the Plans and as follows:

a. All valves shall open left or counterclockwise.

b. Buried valves shall have gear operators, 2-inch square operating nuts, and valve stem extensions as required.

c. Buried valves shall have buried service gears in enclosed gear cases. They shall meet AWWA C-517 for testing and shall be rated for full bi-directional pressure and have a maximum rim pull of 80 lbs. Hand wheels shall not exceed 16 inches in diameter.

4. Extension stems, stem guides, operating levers, and other miscellaneous items required for a complete installation shall be provided in accordance with the requirements and recommendations of the valve manufacturer. Operating nut shall be within 12” of grade.

5. Discharge valves in vault shall be installed with an aluminum pipe cradle and adjustable stainless-steel standpipe. Buried valves shall be provided with a valve box conforming to the Standard Details. The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the operating nut, with the box cover flush with the surface of the pavement or other existing surface. Where the box is not set in pavement, the top section shall be anchored by a concrete pad, or an approved precast concrete pad, set flush with the existing terrain. The top section will be encased into the concrete pad.

E. Combination Air Release Air Vacuum Relief Valves:

1. An automatic combination air release/air vacuum relief valve shall be located at all high points, to prevent air locking of the force main, and when necessary for surge control where sub-atmospheric pressures or column separation may occur. Air release/air vacuum relief valves are required when the difference between the low point and high point exceeds one pipe diameter. These valves shall be of the quick-opening, slow-closing type and may be standard height or short body design with a minimum 2-inch diameter screw-threaded inlet. Valve body shall have a removable bonnet secured with 316 stainless steel fasteners to facilitate maintenance of the internal working parts. Valve body and all internal components shall be 316 stainless-steel. Outlet is to be screw-threaded. Valves shall be mounted to force main through the use of a bronze corporation stop and stainless-steel tapping saddle followed by a stainless-steel ball valve. Shop drawings shall be submitted to the Engineer for approval prior to ordering materials. Air release valves shall be as manufactured by Vent Tech (Model SWG), Vent-O-Mat (Model RGX), ARI (Model D020), Valmatic (Series 7800) or approved equal.

F. Gate Valves for Overflow Basin Drain Line Piping:

1. General: Gate valves shall be furnished with non-rising stems only, and stem seals shall be of the "0" ring type only. Gate valves shall be furnished with two-inch square operating nuts and shall open by turning to the left or counterclockwise. Valve ends shall normally be mechanical restrained joint with necessary glands, gaskets and bolts furnished with the valve. Flange ends shall be furnished for special installations as shown on the construction plans.

2. Gate valves shall be direct bury gate valves and shall be furnished with Charlotte Water Standard valve boxes set in concrete pads as specified and shown on the Standard Details. Only valves which have been specifically approved by Charlotte Water and listed in the Water and Sewer Design and Construction Standards may be furnished.

3. Gate valves shall be of the resilient wedge seat type in accordance with AWWA C-509 or AWWA C-515 with a minimum working pressure of 250 PSI. Resilient seated gate valves must be furnished with durable opaque end shields to prevent ultraviolet damage to the rubber discs.

4. The body and gate shall have guide surfaces to minimize wear of the gate seats during operation of the valve, to accurately position the gate throughout the travel distance to its seat, and to ensure the alignment of the gate and steam in all orientations without gate binding or galling. As a minimum, wedge guides and body guides shall be hard-faced and machined with appropriate tolerances and clearances to allow for proper valve operation in any orientation, including the effects of wear or galling.

5. Gate valves shall contain all product markings required by AWWA C-509, AWWA C-515, UL 262, and FM 1120/1130 as applicable. The minimum cast in markings on each C509 valve shall include the manufacturer’s name or trademark, valve size, working pressure, and year of manufacture. The markings shall also include the UL Listed mark, FM Approved mark, when

applicable. The markings shall be distinctly cast raised or in relief on the outside of the casting. C515 valves shall also include the letters “C515”. C515 valve markings may be cast in as indicated above or may be stamped on a permanently affixed corrosion-resistant tag.

6. Valves shall be manufactured within the North American Continent. An officer of the manufacturing company shall certify that all valves were manufactured in North America.

2.6 OPEN CHANNEL-ELECTRIC GRINDER WITH ROTATING SCREEN DRUM

A. General: Grinder shall reduce or shred influent solids for protection of downstream equipment. Grinder shall be two shafted design consisting of individual cutters and spacers, with cutters on drive and driven shafts of equal diameter. The grinder shall have two rotating screen drums that shall collect solids too large to pass through the screen drum and direct them to the cutters for solids reduction. Grinder shall have a single motor and speed reducer to drive both the cutters and the screen drum.

B. Cutters and Spacers:

1. Cutting stack shall be a nominal height of 40-inches (1016.0 mm).
2. Cutter shall be an individual disk constructed of AISI 4130 alloy steel surface ground to thickness of .438-inches +.000/-.001 (11.1 mm +.000/-.003).
3. Cutters shall be heat treated to produce a hardness of 45-53 Rockwell C.
4. Cutters shall have 7 cam shaped teeth. Tooth height shall not be greater than ½-inch (13 mm) above the root diameter of the cutter. OD shall be 4.71-inches (120 mm).
5. Spacers shall be an individual disk constructed of AISI 4130 alloy steel surface ground to a thickness of .446-inches +.001/-.000 (11.3mm +.003/-.000).
6. Spacers shall have a hardness of 34-38 Rockwell C.
7. Spacers shall have a smooth outside diameter with no tooth profiles.

C. Shafts:

1. Shafts shall be constructed from AISI 4140 alloy steel with a minimum tensile strength of 170,000 PSI (1,172 kPa).
2. Shafts shall measure a nominal 2-inches (51 mm) across flats of hex.
3. Shafts shall be hardened to 38-42 Rockwell C.

D. Intermediate Shaft Collars with Vertical Support Structure:

1. Intermediate shaft collars shall be constructed of ASTM A743 stainless steel, AISI 17-4 stainless steel and SAE 660 bearing bronze.
2. Shaft collars shall be lubricated with high temperature marine grade grease at the factory.
3. Grease fittings on the shaft collars shall be provided for periodic maintenance.

4. Intermediate shaft collars shall provide radial support to the shafts during severe grinding demands.

5. Vertical support structure shall be constructed of stainless steel.

6. Vertical support structure shall have brackets to locate and secure intermediate shaft collars within the cutter stack.

7. Vertical support structure shall have a shape that coincides with the radial profile of the cutters to allow for a close interface.

8. Vertical support structure shall have adjustable brackets for mounting to the top and bottom end housings.

9. Intermediate shaft collars and vertical support structures shall only be supplied on cutter stacks of 32-inches (813mm) and taller.

E. Seal Cartridges:

1. Seal cartridges shall be rated to a maximum of 90 PSI (620 kPa).

2. Seal cartridges shall not require flushing.

3. Dynamic and rotating seal faces shall be constructed of tungsten carbide with 6% nickel binder.

4. O-rings shall be constructed of Buna-N (Nitrile).

5. Radial and axial loads shall be borne by sealed, oversized, deep-groove ball bearings.

F. Housings and Covers:

1. End housings and top cover shall be constructed of ASTM A536-84 ductile iron.

2. End housings shall have integral bushing deflector to guide solids from seal cartridges.

3. Bottom cover shall be constructed of ASTM A-36 rolled steel.

G. Side Rails:

1. Side rails shall be constructed of ASTM A536-84 ductile iron.

2. Drum side rail shall have a Brush type sealing strip for creating an adjustable interface between the side rail and the rotating drum.

3. Cutter side rail shall have evenly spaced horizontal slots to increase flow and decrease water head loss through the grinder. Slots shall only be located on the upstream or influent side of the rail and the effluent side of the rail shall be void of slots to allow for unobstructed flow.

4. Inside profile of the cutter side rail shall be concave and follow the radial arc of the cutters.

5. Clearance between the outside diameter of cutters and concave arc of the cutter side rail shall not exceed 5/16-inch (7.9 mm).

6. Side rails shall have integral guide slot for installing into framework.

H. Perforated Screen Drum:

1. Perforated screen drum shall be constructed of 11-gauge (120") AISI 316 stainless steel with ½-inch (12.7 mm) diameter holes.

2. Perforated screen drum shall have center ring supports, end flanges, and stub shafts to properly support the perforated screen.

3. Perforated screen drum shall have no shaft in center of drum.

4. Perforated screen drum shall be electropolished.

I. Speed Reducer:

1. Reducer shall be manufactured by Sumitomo Machinery Corporation of America.

2. Reducer shall be internal planetary mechanism with trochoidal curved tooth profile.

3. Reducer shall be a vertically mounted with 29:1 single reduction.

4. Reducer shall be grease lubricated.

J. Motor:

1. Motor shall be immersible 5 hp (3.7 kW), XPNV, 1770 rpm, 460 volt, 3 phase, 60 Hz and be supplied with a 40' integral cable.

2. Motor shall be U.L. rated NEMA 6P, Class I, Div. I Groups C&D, Class II Div. II, Groups F&G, Class III Div. I

3. Motor shall have additional rating of 7 consecutive days of submergence at a maximum depth of 30 feet (9 m).

4. Motor shall not utilize fan cooling at any time during operation.

5. Motor shall utilize ceramic shaft seal requiring no oil lubrication.

6. Motor shall have a minimum service factor of 1.15, 91% minimum efficiency factor at full load, minimum 76% power factor at full load.

K. Capacity:

1. Grinder shall be capable of processing the peak design flow of the lift station.

L. Frame and Supports:

1. Frame and/or supports shall provide a method for properly securing the grinder in an open channel or wet well. The frame shall allow installation or removal without any disassembly of the frame or grinder.

2. Frame and/or supports shall be constructed of AISI 304 stainless steel.

3. Frame shall provide proper support and interface to prevent unwanted bypass.

4. Frame shall utilize guides that insert into the grinders side rail slots to properly position and locate the grinder.

M. Controller:

1. Controller shall provide control of the grinder and screen drum and be designed for 460 volts, 3 phase, 60 Hz. The controller shall have indicator

lights, switches and other control devices, and shall be equipped with an integral disconnect switch.

2. Enclosures:

   a. Enclosure shall be stainless steel NEMA 4X.

   b. Enclosure shall house the control devices, motor starter, and PLC.

3. Grinder ON-OFF/RESET-REMOTE three-position 22mm type, NEMA 4X selector switch:

   a. In the OFF/RESET position, the grinder shall not run.

   b. In the ON position, the grinder shall run continuously.

   c. In the REMOTE position, the grinder shall start and stop as controlled by an external device.

   d. Selector switch shall be the only method for resetting the controller after a failure.

4. Pilot Lights:

   a. Lights shall be LED type 22 mm, rated NEMA 4X.

   b. Lights shall indicate POWER ON, RUN, and FAIL.

5. Programmable Logic Controller (PLC):

   a. PLC shall be manufactured by Panasonic.

   b. PLC shall have a minimum of 16K of memory.

6. Motor Starter:

   a. Starter shall be a full-voltage reversing type with 120-volt operating coil.

   b. Overload relays shall be adjustable and sized to full load amperes (FLA) of the motor.

7. Control Transformer:

   a. Control transformer shall be minimum 130 VA.

   b. Control transformer primary and secondary shall be fused for over current protection.

8. Current Transducer:

   a. Current transducer shall be manufactured by Veris Industries.

   b. Current transducer shall have adjustable set point from 1-135A with 200ms or less response time.

9. Performance:

   a. When a grinder jam condition occurs, the controller shall stop the grinder and reverse the grinder rotation to clear the obstruction. If the jam is cleared, the controller shall return the grinder to normal operation. If three (3) reverses occur within a 30 second interval, the controller shall stop the grinder motor and activate the grinder FAIL indicator and relay.

b. When a power failure occurs while the grinder is operating, the grinder will resume operation once power is restored.

c. When a power failure occurs while the grinder is in a fail condition, once power is restored the fail indicator shall reactivate and remain until reset.

d. Reset of the grinder and shall be accomplished from the controller only.

N. Manufacturers:

1. Grinder(s) and controller(s) shall be in accordance with these specifications and plans and shall be supplied by one of the following manufacturers:

a. JWC Environmental, 290 Paularino Ave, Costa Mesa, CA 92626

Tel: 800-331-2277

www.jwce.com

JWC Environmental Model CMD4010-XDS-2.0 Channel Monster

JWC Environmental Model PC2200 Controller

b. Franklin Miller

Tel: 973-535-9200

www.franklinmiller.com

c. Vogelsang

d. Approved equal

2. Manufacturers requesting to be selected as an approved equal shall submit certified documentation including installation lists with phone numbers, equipment drawings, flow performance curves, electrical schematics and cut sheets, O&M draft showing compliance with these specifications a minimum of ten (10) days prior to bid opening. Selected equipment manufacturers shall be added to the list of approved manufacturers.

a. Supplier shall have a minimum 10 years experience as a manufacturer of municipal wastewater equipment and a minimum 500 prior installations of similar equipment.

b. Supplier shall provide a list of reference sites for similar equipment for verification by the Engineer or Owner's Representative.

c. Supplier shall conduct factory testing and verification of equipment prior to shipment.

d. Supplier shall have factory owned bi-coastal service centers.

3. Selected approved equal manufacturers shall conduct an onsite test within ten (10) days of installation demonstrating compliance with all areas of this specification.

2.7 PUMPS

A. All pumps for the pumping stations shall be new and shall be furnished by the Contractor in accordance with the following requirements:

1. Pump shall be capable of delivering the specified GPM at the specified total dynamic head as shown on the plans. Pumps shall be as manufactured by Xylem/Flygt, Sulzer/ABS, KSB, Grundfos, or approved equal. Pump data plate shall be mounted on inside of control panel door and identify the pump manufacturer, voltage, full load amperes, impeller size, pump model, pump serial number, and pump rating (GPM @ TDH). Fasteners shall be of, at minimum, ASTM A276 Type 316 stainless steel.

2. The pump volute, motor and seal housing shall be high quality gray cast iron, ASTM A-48, Class 35 minimum. The pump discharge shall be fitted with standard ANSI 125 lb. flanges. All external-mating parts shall be machined, and Buna N Rubber O-ring sealed on a beveled edge. Gaskets shall not be acceptable.

3. Bearings and shaft: The pump shaft shall rotate on two (2) permanently lubricated bearings. These shall be heavy duty single or double row ball bearings as needed to provide an American Bearing Manufacturers Association(ABMA) L10 bearing life of a minimum of 50,000 hours at the anticipated axial and radial loadings. Double row sealed grease pack bearings are not acceptable.

    a. The pump shaft shall be solid ASTM A276 Type 400 series stainless. The shaft shall be of a sufficient diameter with minimum overhang to reduce shaft deflection and bearing wear. Shaft stiffness factor shall not exceed 60.

4. Seals: Each pump shall have a tandem mechanical shaft seal system. The upper set of tandem seals shall operate in an oil chamber located below the stator housing. The set shall contain one stationary tungsten or silicon carbide ring and one positively driven rotating carbon ring, functioning as an independent secondary barrier between the pumped liquid and the stator housing. The lower tandem set shall function as the primary barrier between the pumped liquid and the stator housing. This set shall consist of a stationary ring and a positively driven rotating ring both being tungsten carbide or silicon carbide.

    a. Each seal interface shall be held in contact by its own spring system. The seals shall not require maintenance or adjustment but shall be easily replaceable.

    b. The pump shall be equipped with a seal leak detection device and warning system. This shall be designed to alert maintenance personnel of lower seal failure without having to take the unit out of service for inspection or requiring access for checking seal chamber oil level and consistency.

    c. There shall be a seal failure sensor installed in the seal chamber between the two tandem mechanical seals or in the stator housing. If the lower seal fails, contaminants which enter the seal chamber, or the stator housing shall be detected by the sensor and send a signal to operate the specified warning device.

    d. Units equipped with opposed mechanical seals shall not be acceptable.

5. Impeller: The impeller shall be enclosed, non-clogging, and have pump out vanes to prevent grit and other materials from collecting in the seal area. Pumps shall be capable of handling a three-inch solid and any trash or stringy material that can pass through a four-inch hose unless a mechanical means of solids reduction is installed at the pump station. Impellers shall have replaceable wear rings.

   a. Impellers must be dynamically balanced and shall be slip fit to a tapered shaft and key driven. The impeller shall be fastened to the shaft with a 400 stainless steel washer and bolt.

   b. A volute case wear ring or wear plate shall be provided to minimize impeller wear. The wear ring/plate shall be field replaceable.

6. Motors: The pumps shall have a UL or FM listed, hermetically sealed, air-filled submersible type, electric motor for operation at 460 Volt, 3 phase, 60 hertz power. Standard motor speed is 1800 RPM. Horsepower shall be as specified on the plans. They shall be designed for use in electrically hazardous locations (Class 1, Division 1, Group D) and for general use in pumping sewage. The motor shaft shall be stainless steel. The motor shall be provided with thermal overload protection and a moisture detection system. The motor shall be designed for continuous duty, capable of sustaining a minimum of 10 starts per hour. The combined service factor (combined effect of voltage, frequency and specific gravity) shall be a minimum of 1.15.

   a. The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.

7. Motor & Float Cable: Assemblies shall be UL approved for extra-hard usage and shall be of sufficient length to reach the control panel without the need of any splices. Where required by local authorities, each cable shall contain a grounding conductor in addition to any circuit conductors. Outer covering shall be oil resistant, thermoplastic. Conductor size shall be per NEC standard requirements.

8. Rail Assembly: The pumps shall be mounted on a 316 stainless steel schedule 40 rail assembly with at least two rails and stainless-steel brackets. Pump removal shall not require personnel entering the wetwell. A machined metal-to-metal contact shall accomplish sealing of the pump to the discharge connection. The rails shall be plumb and the distance between rail supports shall not exceed 15 feet. The rail/pump interface shall be non-sparking through the use of bronze bushings or other method.

2.8 PUMP CONTROL SYSTEM

A. General: It is the intention that this specification shall cover a complete Electrical Pump Control System as hereinafter described and all necessary appurtenances that might normally be considered a part of the complete electrical system of this installation. All the automatic control equipment is to be furnished by one manufacturer and supplied by the pump manufacturer. Approved pump control panel manufacturers are RSI, CITI, and CAROTEK. It shall be factory assembled,

wired, and tested. Complete electrical drawings and instructions shall be submitted for approval.

B. Required Submittal Information

1. For a system to be considered, it will be necessary for the contractor to provide three sets of written information completely describing the system. Should the system or the information describing it fail to describe its capability in meeting the job requirements or if the contractor fails to furnish complete information, the engineer shall regard the submittal as an inferior system and disregard the submittal.

2. Electrical Contractor shall submit product information for all materials that will be used in the installation and interconnection of pumping system equipment. Such items shall include, but are not necessarily limited to electrical wiring, conduits, fittings, cable tray, mounting struts, etc.

3. This information shall include complete mechanical dimensions, electrical details and specifications of every electrical device, valve, meter, and instruments to be provided by this section. If a microprocessor or any other similar programmable system is being provided, manufacturer's literature shall be provided.

4. System sketches shall be provided of the hydraulic processes identifying the locations schematically of all process equipment being provided by this contract and the schematic location of the devices being provided in relation to the process equipment.

5. A written system description of how the control system interacts with the process equipment shall be provided. A system schematic shall be provided indicating the relationship of telemetry equipment to the system. A sketch shall be provided of the main control panel indicating enclosure size and relative location of panel mounted equipment. All panel-mounted equipment is to be identified on this panel sketch so that their existence can be checked, and functional relationships determined, and wire routing can be verified.

C. Field Supervision: The services of a factory trained, qualified representative shall be provided to inspect the completed installation, make all adjustments necessary to place the system in trouble free operation and instruct the operating personnel in the proper care and operation of the equipment.

D. Guarantee: All equipment shall be guaranteed against defects in material and workmanship for a period of one year from date of owner's final inspection and acceptance to the effect that any defective equipment shall be repaired or replaced without cost or obligation to the owner.

E. Panel Wiring and Accessories: All wiring shall be of a single manufacturer. It shall be stranded, minimum 600-volt (UL) type MTW or AWM and have a current carrying capacity of not less than 125% of the full load current. The conductors shall be in complete conformity with the National Electric Code, state, local and NEMA electrical standards.

1. Power and Control Wiring: shall be single conductor stranded copper NFPA No. 70 Type MTW No.16 AWG minimum. Wiring for signal shall be No.16 AWG stranded copper NFPA. 70 Type MTW.

2. Terminal blocks: shall be tubular clamp type with closed cable funnels rated for 300 volts. Each terminal strip shall have unique identifying alphanumeric code at one end and a vinyl marking strip running the entire length of the terminal strip with a unique number for each terminal. Number shall be machine printed and 1/8 inch high. Connections between adjacent terminals, if require, shall be made by means of prefabricated metal comb type jumpers. Terminal blocks shall be Phoenix Contact UK 2,5N, or equal.

3. Surge Protectors: shall be provided at panel external terminal blocks for signal circuits which extend outdoors. Surge Protectors shall be multi-stage plug-in type and shall be selected in accordance with the requirements of equipment to be protected. Surge Protector shall be removable without changing the impedance of the circuit. Surge Protectors shall be Phoenix Contact MCR-PLUGTRAB UFBK 2-PE, or equal.

   Surge Protectors shall be provided at panel incoming power supply. Surge Protectors for three phase power shall be as specified or as shown on the drawings. Surge protection for 120 VAC shall be EDCO model HSP-121 or equal.

4. Wire ID Labeling: To ensure the safety of personnel and aid circuit tracing or troubleshooting efforts, all wiring shall be affixed with permanent ID labels at every termination. Application of ID labels shall be in strict accordance with the manufacturers wiring diagram. ID labels shall be pre-printed, heat-shrink sleeves (closed tube type). Wrapped tape or tag type labeling is not acceptable.

5. Cable Identification

   a. MCC-1- Cable: Brady Permasleeve PSPT heat shrink type labels (*printed on a Brady BMP61 label machine*), or Panduit equivalent, or an approved equal, shall be used for conductors up to 500mcm.

   b. For instrumentation and control circuits, labels shall include three lines of text, and shall be the same on both ends of the conductor:

      1) Line one: shall indicate the origination of circuit.

      2) Line two: shall indicate the destination of the circuit.

      3) Line three: brief description of circuit function.

   c. Examples:

1)	PLC-1-TB2-5	PLC-1-TB2-7
2)	MCC-1-Pump 1-TB-6	Pump 1-TB-7
3)	Run Status	Stop Status

6. Color Codes: All control/signal wiring shall be color coded as follows:

   a. “Normal” powered (hot) conductors, red; neutral (common) conductors, white.

   b. “Emergency/UPS connected” powered (hot) conductors, blue; neutral (common) conductors, white.

   c. Dialer alarm conductors shall be blue.

d. All 480v conductors shall have insulation that is continuously color coded.

e. 120/208 V, 3Ph/4W – Black, Red, Blue. Neutral – White.

f. 120/240V – 1Ph/3W – Black, Red. Neutral – White.

g. 480V – Brown, Orange, Yellow. Neutral (277v) – Gray

h. The following color code shall be used for conductor identification in all enclosed industrial control panels:

Item Code	**120 VAC Wire**	**Color**
L	Power	Black
C	Control	Red
N	Neutral	White
PG	Equipment Ground	Green

Item Code	**24 VDC Wire**	**Color**
SP	Power Supply	Blue
S	Signal (+)	Black
SG	Signal Ground	White
PG	Equipment Ground	Green

7. Conductors and Cable Assemblies

a. 600 Volt Lighting/Power/Control

1) Conductors #6 and smaller shall be type THHN/THHW, and ***continuously colored*** for desired phase identification.

b. 600 Volt Power Conductors

1) Conductors #4 and larger shall be type XHHW-2, and ***continuously colored*** for desired phase identification.

8. Conductor/Cable Installation

a. NO splices shall be permitted in any manhole/handholes, or in any feeder installation without express approval of Charlotte Water Electrical personnel. All conductors shall be installed complete from point of origin to point of termination.

b. Termination lugs shall be 2-hole, tin plated copper, long barrel compression for all bus terminations unless equipment requires a single hole lug.

c. Aluminum or dual rated Aluminum/Copper lugs **will not** be permitted for use.

d. Stranded conductors shall be used for all installations, including lighting and receptacle circuits.

e. No Aluminum conductors shall be permitted.

f. An individual neutral shall be pulled per branch circuit.

g. Excessive slack left in conductors at the point of termination **will not** be permitted.

h. When conductors/cables cannot be terminated immediately and are potentially exposed to moisture, in manholes/handholes for example, the ends of the conductors/cables shall be sealed with heat shrinkable end caps not less than 3"- 4" in length to prevent moisture/water from "wicking" into the end of the conductor/cable.

i. No more than two wires shall be connected to a terminal.

j. Where feeder conductors, for MCC's or for motors, rated 600V or less are installed in cable tray, there shall be a maintained space separation between conductors.

1) Where feeder conductors are installed in a single layer, the space shall be not less than one cable diameter between individual conductors.

2) Where feeder conductors are installed in a triangular or square configuration, the space between conductors shall have a minimum of 2.15" x the diameter of the largest conductor within the configuration and adjacent conductor or cable.

NOTE: All conductor and or cable installations installed in cable tray systems shall comply with NEC Article 392 – Cable Trays.

3) Where conductors transition from the cable tray to a switchboard, MCC, PLC enclosure, etc., a "waterfall" or "drop out" with minimum 4" radius shall be installed to protect cable as it exits from cable tray.

k. Where conductors/cables are installed in vertical runs of cable tray exceeding 24', the conductors/cables shall be supported at the top of the vertical run using cable grips and shall also be ty-wrapped approximately every 18" for the length of vertical run.

l. All conductors of a 3 phases circuit, whether installed as a single set or one set of a parallel, shall be of the same size, same conductor type, and insulation type.

m. All conductors shall be properly racked and supported to the wall of handhole/manhole using fiberglass reinforced polyester saddles.

n. Cable Pulling Lube shall be Polywater "Type J" (or equal) high performance cable lube.

o. Conductors shall be terminated using an oxide inhibiting compound recommended for copper-to-copper connections. The compound shall be Penetrox E manufactured by Burndy Electrical or an approved equal.

p. All spares shall be terminated on terminal blocks and identified by labels indicating origination and destination of spare conductor.

q. Control panels, disconnects, Low Voltage and Power panels, MCC's, etc., shall not be used as a raceway for conductors that are not specifically associated with the intended equipment.

r. Where neutral conductors of different systems are installed in same raceway, wire trough, j-box, etc., the jacket shall be identified by the system associated with, by means of tracer stripe, other than green, on outer jacket.

s. Neutrals shall be Primary insulation color for 120v neutrals shall be white; 277v gray.

9. Control Panel Enclosure

a. The described equipment shall be housed in individual NEMA 4X/3R stainless steel enclosures arranged for integral pedestal mounting where shown on the drawings. The enclosure shall be approximately 74.0" (H)x 72.0" (W) x24.0" (D) 304 Stainless NEMA 4X Enclosure with 12"H Mounting Feet and sufficiently wide to house control panel components & accessories. Enclosure shall have no pumping eyes or other nonessential penetrations.

b. The enclosure shall be constructed of not less than 14-gauge stainless steel and suitable for installation in an unprotected outdoor location. It shall have a gasketed, hinged front weather door with three-point latching mechanism and pad lockable handle.

c. Data pockets shall be mounted to interior panel doors with bolts on welded steel anchors as follows:

d. One 6" wide X 6" high X 1" deep data pocket shall be installed on front side of the inside door. Locate data pocket below elapsed time meters.

e. One 12" wide X 12" high X 1" deep data pocket (for O & M manuals) shall be installed on the backside of the inside door.

F. U.L. Approval, Listing & Labeling

1. The control panels shall be constructed in compliance with Underwriter's Laboratories "Enclosed Industrial Control Panels Relating to Hazardous Locations with Intrinsically Safe Circuit Extensions" (UL 698) listing and follow-up service, utilizing UL listed and recognized components where applicable. The control panels shall bear the Underwriter's Laboratory listed & serialized label.

2. Control enclosure shall incorporate a hinged, dead front panel, behind the weather door such that all controls and meters necessary for routine operation are accessible without exposing the internal components and circuitry.

3. All major components and sub-assemblies shall be identified as to function with laminated, engraved phenolic nameplates or similar approved means. A 12" X 18" laminated control panel print shall be permanently bonded to the backside of the exterior door. Pump data plate shall be mounted on inside of panel door identifying the pump manufacturer, voltage, full load

amperes, impeller size, pump model, pump serial number, and pump rating (GPM @ TDH).

4. Enclosure with 208 or 480 VAC motor circuits shall include a safety barrier to separate 120V or less control circuits from the motor control circuits.

5. Enclosure subpanel shall include a minimum of 20 percent space for future use. Din rails for terminal blocks and relays shall include space for future addition.

6. Equipment control panels shall be sheltered by a white aluminum awning structure extending one foot beyond the back and sides and three feet to the front of the control panel. In no case shall the awning be smaller than the concrete slab for the equipment rack. A 4' high output fluorescent or LED light fixture, at minimum depending on awning length, shall be installed underneath awning centered in front of the control panel. Fixture shall be controlled by a switch mounted on electrical rack. See standard details.

G. Power Supply and Metering

1. Electrical Power Wiring and equipment shall be in compliance with specifications. Power disconnect switches shall be provided within sight of equipment and shall be labeled to indicate opened and closed positions and specific equipment served. "Within sight of" is defined as having a clear unobstructed view from the equipment served and within 50 feet of the equipment served. Disconnect switches shall be mounted between 36 to 72 inches above requirements cannot be met by a single disconnect switch, two switches, one at the equipment and one at the work platform, shall be provided.

2. Each disconnect switch serving equipment located outdoors shall be provided with a surge arrestor, General Electric 9L15CCB001, or equal. The surge arrestor shall be bonded to plant ground grid with a No. 8 AWG bare copper conductor.

3. Noise-Suppression Isolation Transformers shall be provided for AC powered instrument loads containing solid state circuitry where such is not included within the instrument. Isolation transformers supplying power to a solid-state system shall be provided with surge arrestors and capacitors on the primary winding. Transformers shall be Topaz Series or equal.

4. Direct Current Power Supplies Provide redundant DC power supply and provide alarm input to the PLC when in the fault condition. Direct-Current supplies for bulk 24-volt nominal instrumentation power shall be convection-cooled switching type. Line regulation shall be 0.4 percent for line variations from 105 to 132 volts, and load regulation shall be 0.4 percent for load variations from 0 to full load. Ripple and noise shall not exceed 100 mV peak-to-peak. Hold-up time at maximum load shall be not less than 15 milliseconds. Efficiency shall be a better than 70 percent. Power supply shall be rated for continuous duty from 0 to 50 degrees C at rated load. Output shall be electronically current limited, and over voltage crowbar shutdown shall be provided. Power supply output voltage shall be rated 28 VDC, adjustable plus or minus 5 percent, and shall be set to

provide 26.4 volts on the panel direct current bus. Power supply shall be Power One, Phoenix Contact Quint Series or equal.

5. The incoming service shall be as noted on the drawings. All metering shall be done ahead of the main disconnect and control panel.

6. Control panel shall have an emergency battery backup system (UPS) to operate the local alarm light and horn for at least 120 minutes. Additionally, this backup power source shall power the intrinsically safe relay module monitoring the high wet well float such that a high-level condition will be recognized and reported by the telephone dialer during losses of power and/or failure of on-site power back-up systems.

7. UPS power output shall be isolated during normal operation such that UPS failure cannot affect the normal operation of the pump station. UPS output shall be connected via a maintenance by-pass switch to allow easy maintenance, removal, or replacement of the UPS.

8. Battery: battery shall be maintenance-free, seal type, installed in cabinet. Provide 30 minutes of battery backup at full load.

9. Battery Charger: the battery charger shall be constant voltage type and shall provide equalization capability with a manually initiated timer.

10. Transfer Switch: No-break transfer line in inverter and return. UPS shall be able to be switched to the utility source bypassing the UPS should service be required.

11. Inverter: the inverter system shall be low frequency pulse width modulated type using power MOSFETS.

12. Process Switches

    a. Process Switches shall comply with the following requirement unless otherwise specified:

    b. Contact outputs used for alarm actuation shall be ordinary closed and shall close to initiate the alarm.

    c. Contact outputs used to control equipment shall be ordinary open and shall open to start the equipment.

    d. Contact monitored by solid state equipment such as programable controllers or annunciators shall be hermetically sealed and designed for switching currents from 20 to 100 mA at 24 VDC.

    e. Contacts monitored by electro-magnetic devices such as mechanicals relays shall be rated NEMA ICS 3, designation B300.

    f. Double barriers shall be provided between switch elements and process fluids into electrical enclosures.

    g. Switch electrical enclosures shall be rated NEMA 250, Type 4 minimum.

    h. Contacts located in Class 1, Division 1 and 2 areas shall be made safe by suitable intrinsic safety barriers or relays as specified.

13. Control Relays

a. Load-Switching Control Relays:

1) Control Relays used for switching loads such as solenoids, actuators, contactors, motor starter coils, remote interlocking, etc. shall be heavy duty machine tool type.

2) Contacts shall be 4-pole and be field interchangeable to either normally-open or normally-closed. Relay shall be capable of accepting a 4-pole adder.

3) AC relays shall have NEMA A600 contact rating and electrical clearances for 600 volts. DC relays shall have NEMA P300 contact rating and electrical clearance for 250 volts.

4) Manufacturer: Allen Bradley bulletin-700, Square D class 8501, or equal.

b. Logic Level Switching Control Relays:

1) Control Relays for signal circuit shall have a minimum of three SPDT, gold-flashed, fine silver contacts rated 10-ampere resistive at 120 VAC or 28 VDC.

2) Control relays shall be plug-in type with heavy duty, barrier-protected screw terminal sockets and clear polycarbonate dust cover with clip fastener.

3) AC models shall have neon lamp indicator wired in parallel with coil. DC models shall have LED lamp indicator wire in parallel with coil.

14. Intrinsic Safety Barriers and Relays

a. Intrinsic Safety Barriers for two-wire transmitters shall be of the active, isolating, loop power type; MTL type MT3042, Stahl 9005/01-252/100/00, P+F ZG series or equal. Intrinsic safety barriers for process dual type; MTL 787, Panalarm 201-BR2, or equal. Intrinsic safety relays shall be Gems, Square D, Warrick, or equal.

15. Signal Condition Modules: Signal Conditioning modules shall comply with the following requirement:

a. Analog signal inputs shall be 1 to 5 VDC into 20 megaohms.

b. Analog signal output shall be 1 to 5 VDC into 20kohms.

c. Discrete output contacts shall be SPDT rated 5 amps at 117 VAC and 28 VDC.

d. Power supply shall be 24 VDC, plus or minus 10 percent. Power supply effect shall not exceed 0.005 percent per 1.0 percent change.

e. Electronic trips shall be arranged so that output contact opens in case of loss of signal or loss of power supply.

f. Modules shall be rated for continuous operation in an ambient temperature of 0 to 80 degree C within that range.

g. Span and zero adjustments shall be made by front accessible multi-turn potentiometers.

h. Electronic trip modules shall be provided with LED indicators for relay status.

i. Modules shall withstand 30 volts per meter radio frequency radiation between 200 and 500 MHz with not more than 0.25 percent calibration effect. Modules shall also be provided with traps on the terminals to shunt conducted radio frequency interference to ground.

j. Signal and power supply terminals shall be galvanically isolated from the case.

k. All modules specified in this section shall be the product of a single manufacturer and shall be of matching construction.

16. Pump Circuit Breaker & Branch Circuit Breakers

a. Symmetrical RMS fault current ratings for all circuit breakers (operating at service voltage) shall be coordinated to no less than maximum fault current availability from electric utility. Breakers serving pumps/motors shall be equipped with padlock hasp for lockout capability.

b. All circuit breakers shall be heavy-duty type with handles operable through the inner door. Circuit breakers shall be properly sized to protect equipment and wiring from overcurrent conditions.

c. Sufficient 120-volt, branch circuit breakers & transformer capacity shall be provided to serve all pump station appurtenances. Branch circuit breakers shall have fault current ratings of 10,000 amps symmetrical or greater. Branch circuit loads include, but are not necessarily limited to, the following:

1) Generator Block Heater
2) Generator Battery Charger
3) Panel Space Heater
4) Future Sump Pump
5) Future SCADA
6) Area Light
7) Convenience Receptacle (20 Amp)
8) Pump Control System, Alarm Dialer, and UPS
9) Spare/Odor Control System
10) Spare
11) Spare
12) Spare

H. Three Phase Voltage Monitor: A Three Phase Voltage Monitor shall be provided in control panel. Unit shall protect against phase loss, phase reversal and under voltage. Unit shall be fully adjustable and wired for offsite monitoring capability.

I. Motor Starters: A motor starter shall be provided for each submersible pump motor. Overload devices shall be selected (or adjusted) based on nameplate data of installed pump. Coil voltage and pump controls shall be 120-volt. Depending on pump size, starters will be Full Voltage, Non-Reversing (FVNR) magnetic type or solid state, “Soft-Start” units as indicated:

J. FVNR motor starters shall be furnished for pump motors up to 20hp (unless otherwise directed by Charlotte Water or required by local electric utility). Starters shall have ambient insensitive, thermal overload relays with manual reset.

K. Soft-Start starters shall be provided for all pump motors exceeding 20hp. Starters shall be optimized for centrifugal pumping loads and equipped with integral shorting contactors (to by-pass Silicon Control Rectifier (SCR) circuit after start-up for increased efficiency & reduced heat build-up). Schneider Electric ATS 48 Heavy Duty Rating is the only approved manufacturer for the soft-start unit. Starter shall have adjustable, electronic motor protection/overload relay with auxiliary contacts for telemetry annunciation of pump failure.

1. Motor Starters
2. Laminated one line control drawings shall be included on the inside of each starter bucket door.
3. Motor Name plate information shall be included on the front of each starter bucket.
4. Status Lights – All shall be Push to Test:
    a. Red – indicates Run
    b. Green – indicates Stop
    c. Amber – indicates Alarm/Trip
5. Motors terminations #6 AWG and larger, shall be terminated using crimp type lugs and taped using “*Tommy Tape*” or T&B “*Self-Fusing Insulation Tape*” with an outer cover of Scotch 33+.
6. Motors terminations #8 AWG and smaller, shall be terminated using appropriately sized wire nuts, rated for correct size and number of conductors, and left un-taped.
7. Motors over 125hp shall have oversized motor conduit box (termination enclosure).
8. NO split bolt terminations shall be permitted.

L. Pump Data: The motor HP, full load amps, circuit breaker size, and motor starter size shall be shown on the vendor’s shop drawings.

M. Control System: A packaged digital control system shall be furnished to monitor wet well levels and generate outputs for stop/run operation of two or more submersible pumps. System shall be able to provide analog or digital outputs (for SCADA) and programmable start/stop/alarm indications & outputs for integration into the motor control circuits and/or local alarm/telemetry equipment. System shall

be designed for independent control with two (or more) backup floats to operate pumps. If level controller system should fail, pumping operations will continue automatically via float level sensing. The electronic level control system shall be Automation Direct PLC Model P2-550 Productivity Series and a Primary and Backup Level Transmitters to operate the system at the correct set points. Automation Direct CMORE HMI – EA9-10T-CL Touch Screen shall be mounted in the inner door of the Control Panel.

N. PLC IO Modules: PLC Control shall be list as:

1. Discrete Inputs 16 -24 VDC Model P2-16NE3 (3)
2. Discrete Outputs 8 24VDC & 120VAC Model P2-08TRS (2)
3. Analog Input 4 Input 24VDC Model: P2-04AD (2)

O. Level Transmitters: A Transducer which derives operating Power Supply from signal transmission circuit and therefore require no separate power supply connections. Two-wire transmitter refer to a transmitter which produces a 4 to 20 milliampere current regulated signal in a series circuit with 24 VDC current driving potential and a maximum circuit resistance of 600 ohms. Submersible Level Transmitter shall be Dwyer Series PBLT2 or Prosense SLT Series Submersible Level Transmitters Model SLT2-010/015-XXX is UL approved intrinsically safe.

P. Magnetic Flow Meter: Magnetic Flow meter Manufacturers shall be ABB, Rosemount, Siemen provided as a system consisting of a flow tube with separate remote mounted converter/indicating transmitter, as shown on the contract drawings, complete with interconnecting cable.

Remote mounted indicating transmitter for full-scale flow rate 1.0 to 30 feet per second. System error shall not exceed the greater of 0.5 percent of flow rate or 0.1 foot per second from 3 to 30 feet per second.

The transmitter shall provide pulse DC coil drive current to the flow tube and shall convert the returning signal to a linear, isolated 4-20 mA DC signal.

Q. Level Float Switches: High- and Low-Level float switches shall be installed to provide redundant level sensing to the control system for backup operation when level control system is off-line. Floats shall be wired via U.L. 913 listed, intrinsically safe control relays. All intrinsically safe wiring, terminals, and components shall be installed in accordance with the requirements of U.L. 698.

Float Switch shall be free floating type, suspended from an oil resistant waterproof cable, minimum 40-feet in length. The cable shall be designed to support the weight of the float without additional strain relief and shall be permanently sealed where it enters the float body. The conductors shall be a minimum size 18 AWG. The switch shall be a single pole double throw dry contact type and shall be rated at not less than 10 Amps at 120 VAC. Mercury switches are not acceptable. The float shall have a PVC or ABS corrosion and impact resistant shell. Approved Manufacturers: Anchor Scientific Roto-Float Type S, Flygt ENM-10 Standard Level Switch or equal.

R. Running Time Meter: A running time meter measuring hours and tenths of hours of operation up to 99999.9 hours shall be furnished for each pump motor indicated. This shall be a 120 VAC device operating from the control voltage by an auxiliary contact of the motor starter or other run contact.

S. Selector Switches: A heavy-duty, three-position, hand-off-automatic selector switch shall be flush-mounted on the inner door of the Control Panel for the operation of each motor magnetic starter. This selector switch shall operate the starter when it is in either the “HAND” position, the “AUTOMATIC” position and the automatic control system is calling for the operation of the equipment in the manner as herein described. The “HAND” circuit shall have no other control logic except for pump protection. The “OFF” position is the equipment is NOT able to run by either PLC Logic or Float Switch Relay Circuit.

T. Status Indicators: All status indicator lights shall be LED Push-to-Test type, furnished, and mounted on the inner door as follows:

1. Amber pilot light indicating wet well “HIGH LEVEL”.
2. Amber pilot light indicating wet well “LOW LEVEL”.
3. Red “PUMP RUNNING” indicator lamps.
4. Green “PUMP STOP” indicator lamps.
5. Amber “PUMP OVER TEMP” indicator lamps.
6. Amber “PUMP SEAL FAILURE indicator lamps.
7. Amber “PUMP FAULT” Indicator lamps.
8. White Shall Indicate Power ON.

U. Enclosure Heaters: 120-volt protective heaters (for condensation prevention) with high temperature safety switch shall be supplied in the control panel. Heater wattage, quantity and placement shall be determined by panel manufacturer to suit panel volume and anticipated site conditions.

V. Weatherproof Alarm Light: A weatherproof, high water alarm light assembly including a high impact resistant Lexan Red Lens shall be included. The alarm light bulb shall be LED and Replaceable from inside the control panel without having to remove the weatherproof red lens from the panel. A solid-state flasher shall be included to strobe the alarm light for any of the specified alarm conditions.

Weatherproof Alarm Horn: A weatherproof audible alarm horn shall be provided. The horn will be side mounted to the control center and operate on 115 VAC with a typical 95 dB output. An alarm silence push button shall be included, mounted on the inner door.

W. Ignition SCADA

1. Automation Direct PLC Model P2-550 Productivity Series will connect thru Ethernet to SEL-3061 Schweitzer Cellular Router to communicate to Lift Station Ignition SCADA Server to send SMS message describing the alarm condition(s). The SEL-3061 shall connect with 2 Radio Surge Protector with N Type Connectors and 2 Low Profile Omnidirection Antennas mount on the top of the Control Panel.
2. Lift Station Ignition SCADA Server shall have data logging capability, showing alarm conditions along with time/date stamp.

X. Spare Parts

1. Furnish a spare power supply of each type provided.

2. Furnish a spare communications card of each type provided.
3. Furnish a spare ethernet switch of each type provided.
4. Furnish a spare PLC CPU of each type provided.
5. Furnish a spare IO card of each type provided.
6. Furnish a spare surge protector of each type provided.
7. Furnish 5 spare fuses of each type provided.
8. Furnish 5 spare relays of each type provided.

Y. Lift Station Control Panel Bill of Material: Current BOM of upgrading Lift Station

30-50HP @480 BILL OF MATERIAL				
ITEM	QTY	DESCRIPTION	PART No.	Manufacturer
1	3	POWERPACT B 480Y/240 V - 65kA 3P- 20A	BJL36020	SQUARE D
2	20	Ground modular terminal block - UKK 5-PE	2774211	PHOENIX
3	1	POWERPACT B #12 Control Power Terminals	LV426974	SQUARE D
4	2	PANELBOARD GROUNDING BAR KIT	PK32DGTA	SQUARE D
5	1	400 WATT SPACE HEATER	DAH4001B	HOFFMAN
6	1	PowerPact J Circuit Breaker AUXILIARY SWITCH	S29452	SQUARE D
7	2	POWERPACT H Circuit Breaker,ThermMagn,110A,3P,600V,50kA	HLL36110	SQUARE D
8	1	FOLDING SHELF FOR ENCLOSURE, (PAINTED)	AA61SHLF2424	HOFFMAN
9	3	POWERPACT B 480Y/240 V - 65kA 2P-20A	BJL26020	SQUARE D
10	1	POWERPACT B 480Y/240 V - 65kA 2P-40A	BJL26040	SQUARE D
11	1	TERMINAL 6@ #4-#14AWG FOR POWERPACT JLL36225	PDC6JD4	SQUARE D
12	1	PowerPact J Circuit Breaker,ThermMagn,200A,3P,600V,50kA	JLL36200	SQUARE D
13	14	Multi 9 UL489 1P-20 A - tunnel term	60113	SQUARE D
14	7	Multi 9 UL489 1P-10 A - tunnel term	60110	SQUARE D
15	3	Multi 9 UL489 1P-3A - tunnel term	60104	SQUARE D
16	3	Multi 9 UL489 1P-6 A - tunnel term	60107	SQUARE D
17	2	ALTISTART 48 480VAC 50HP 37.5KW	ATS48D75Y	SQUARE D
18	1	7.5KVA 480/240 - 120/240 NEMA 3R CONTROL TRANSFORMER	7S1FSS	SQUARE D
19	1	RED LED ALARM LIGHT 24VDC (FLASHING)	125LEDFR24DB	EDWARDS
20	1	Panel Mount Sounder, 65mm, 12-24VAC/DC	AB 855P-B30LE22	A-B
21	3	3" x 4" WIREDUCT COVER GRAY x 6'	C3LG6	PANDUIT
22	3	3" X 4" WIREDUCT GRAY x 6'	G3X4LG6	PANDUIT
23	4	Productivity2000 PLC FILLER MODULE	P2-FILL	AUTO DIRECT
24	1	Distribution block - CU lug, line 1, load 1, 600V 200A CU	NSYEBCD12611	SQUARE D
25	1	Industrial Ethernet Switch - FL SWITCH SFNT 5TX	2891003	PHOENIX
26	3	Fixed Padlock Attachment Kit (OFF ONLY)	S37422	SQUARE D
27	1	SOCKET STRIP - EM-DUO 120/20/GFI	5602519	PHOENIX
28	2	ANEROID BELLOWS FOR LEVEL SENSOR	SLT-AB1	AUTO DIRECT
29	2	LED enclosure light - PLD E 400 W 500	2702223	PHOENIX
30	1	LOAD CENTER SURGE ARRESTER MTG KIT	QOSAMK	SQUARE D
31	1	POWERPACT AUX SWITCH (SD) WIRING HARNESS	S434501	SQUARE D
32	1	PHASE LOSS & UNDERVOLTAGE RELAY	460-14	SYMCOM
33	2	PILOT PTT LED Panel Mount Indicator, GREEN, 28 V, 30 mm	9001KT35LGG31	SQUARE D
34	2	ELAPSED TIME METER RND W/3 MNT HOLES 24VDC	731-0046	REDDINGTON
35	2	3 POS MAINTAINED SELECTOR SWITCH METAL	9001KS43FBH13	SQUARE D
36	3	PILOT PTT LED Panel Mount Indicator, YELLOW, 28 V, 30 mm	9001KT35LYA31	SQUARE D
37	1	PUSHBUTTON PANEL MOUNT, WHITE	9001KR2UH5	SQUARE D
38	4	PILOT PTT LED Panel Mount Indicator, Red, 28 V, 30 mm	9001KT35LRR31	SQUARE D
39	8	DIN RAIL STEEL GALV 35MM X 15MM X 1 METER W/0.25 SLOTS	8961K19	MCMASTER-CARR
40	8	PUSH BUTTON Contact Block, 10 A, 600 V, Screw, SPST-NO	9001KA2	SQUARE D
41	1	Uninterruptible power supply - QUINT-UPS/ 24DC/ 24DC/20	2320238	PHOENIX
42	1	Energy storage - UPS-BAT/VRLA/24DC/7.2AH	2320319	PHOENIX
43	1	POWER SUPPLY - QUINT-PS/3AC/24DC/20	2866792	PHOENIX
44	2	HOFFMAN DOOR GROUNDING STRAPS	DBGRDK	HOFFMAN
45	2	Productivity2000 PLC DISCRETE OUT 8 24VDC & 120VAC	P2-08TRS	AUTO DIRECT
46	3	Productivity2000 PLC DISCRETE INPUT 16 24VDC	P2-16NE3	AUTO DIRECT
47	1	Productivity2000 PLC CPU	P2-550	AUTO DIRECT
48	1	Productivity2000 PLC POWER SUPPLY 24VDC	P2-01DCAC	AUTO DIRECT
49	2	Productivity2000 PLC ANALOG 4 INPUT 24VDC	P2-04AD	AUTO DIRECT
50	2	Repeater power supply - MACX PL-EX-RPSS-2I-2I	2904963	PHOENIX
51	1	C-MORE HMI, 10IN COLOR, SVGA, LED 3 SERIAL,1 ENET,2 USB	EA9-T10CL	AUTO DIRECT
52	1	Productivity2000 I/O base, 11-slot flush mount	P2-11B	AUTO DIRECT
53	11	Productivity2000 I/O 18 TERMINAL PLUG IN CONNECTOR	P2-RTB	AUTO DIRECT
54	13	RELAY 2POLE SCREW TERMINALS - PLC-RSC- 24DC/21-21	2967060	PHOENIX
55	2	Isolation amplifier - MACX MCR-EX-SL-2NAM-RO	2865476	PHOENIX
56	1	Timer relay - ETD-BL-1T-ON-300S - 2917382	2917382	PHOENIX
57	10	POWER RELAY PLUG IN - Zelio RXM 4 24DC 6 A with LED	RXM4AB2BD	SQUARE D
58	10	FUSE SI FORM C 3AMP DIN 72581	0913773	PHOENIX
59	10	FUSE SI FORM C 5AMP DIN 72582	0913692	PHOENIX
60	1	TELCOM ZONEBARRIER	ZB24501	TELECOM
61	10	POWER RELAY DIODE - ZELIO- FOR RXM4	RXM040W	SQUARE D
62	7	FUSED TERMINAL BLOCK UK 6-FSI/C-LED24 BLK	3001938	PHOENIX
63	30	TERMINAL BLOCK,26 - 12 AWG, GRAY, 20A	3044131	PHOENIX
64	10	POWER RELAY BASE RXZ 4 POLE - 10A -FOR RXM4	RXZE2S114M	SQUARE D
65	70	TERMINAL BLOCK,26 - 12 AWG, BLUE, 20A	3044144	PHOENIX
66	4	TESYS D CONTACTOR SIZE 3 3POLE 24VDC COIL 480VAC BOX TERM	LC1D65ABD	SQUARE D

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67	1	1" X 2" WIREDUCT BLUE X 6'	G1X2IB6	PANDUIT
68	1	1" X 4" WIREDUCT BLUE X 6'	G1X4IB6	PANDUIT
69	3	3" X 4" WIREDUCT BLUE X 6'	G3X4IB6	PANDUIT
70	2	1" WIREDUCT COVER BLUE X 6'	C1IB6N	PANDUIT
71	3	3" WIREDUCT COVER BLUE X 6'	C3IB6N	PANDUIT
72	1	HOFFMAN MOUNTING PANEL 72 X 72 GROUNDING (NO PAINT)	A72P72F1G	HOFFMAN
73	1	HOFFMAN ENCLOSURE, NEMA 4X/3R	A727218SSFSDN4	HOFFMAN
74	1	HOFFMAN HEAVY DUTY PANEL SUPPORT	A72FSCPS	HOFFMAN
75	1	HOFFMAN FLOOR STAND KIT, STAINLESS STEEL	AFK1218SS	HOFFMAN
76	2	SWING-OUT FULL PANEL 60.00 x 30.81	A72SP36F3	HOFFMAN
77	2	Keypad, Remote Mount, Altistart 48	VW3G48101	SQUARE D
78	2	T-Slotted Framing, Single Rail, Silver, 1" x 1" X 6 FT	47065T85 X 6'	MCMASTER-CARR
79	30	T-Slotted Framing Spring Tab End-Feed Fastener	47065T383	MCMASTER-CARR
80	2	T-Slotted Framing, Double Rail, 2" High x 1" Wide, HOLLOW	47065T107 X 6'	MCMASTER-CARR
81	1	16 CHANNEL ANTX ELITE TELEPHONE DIALER	END16D	ANTX
82	1	16 CHANNEL ANTX ELITE MODBUS SLAVE OPTION	EMBUSSLV	ANTX
83	1	16 CHANNEL ANTX ELITE INTEGRATED MODEM OPTION	EMOD001	ANTX
84	1	16 CHANNEL ANTX ELITE ANALOG INPUT CARD (V and ma)	EA8CH001	ANTX
85	1	16 CHANNEL ANTX ELITE EXTERNAL OMNI DIRECTION ANTENNA	ANTKIT8	ANTX
86	3	16 CHANNEL ANTX ELITE DIGITAL INPUT CARD	ED8CH001	ANTX
87	1	SOCKET HEAD Zinc- 1/4"-20 Thread Size, 3/4" Long- Box of 50	91274A164	MCMASTER-CARR
88	3	MULTI 9 INSULATED COMB BUSBAR 6 POINT	10170	SQUARE D
89	3	MULTI 9 INSULATED POWER CONNECTOR COMB BUSBAR	10175	SQUARE D
90	6	MULTI 9 INSULATED TOOTH COVER END CAP	10190	SQUARE D
91	1	30MM KEYED SWITCH 2 POSITION MANU RETURN	9001KS11K1H13	SQUARE D
92	2	HOFFMAN LIGHT DOOR SWITCH	ALFSWD	HOFFMAN
93	2	Heavy Duty Non-Contact Magnetic Switches	CPR-113013	AUTO DIRECT
94	1	CIRCUIT BREAKER MX WIRE HARNESS	S434504	SQUARE D
95	1	SHUNT TRIP J FRAME CIRCUIT BREAKER 24VDC	S29390	SQUARE D
96	3	POWER DISTRIBUTION BLOCK	NSYEBCD13618	SQUARE D
97	10	TERMINAL BLOCK BLUE End cover - D-UT 2,5/10 BU	3047235	PHOENIX
98	10	TERMINAL BLOCK GRAY End cover - D-UT 2,5/10	3047028	PHOENIX
99	10	TERMINAL BLOCK Plug-in (4)Bridge - FSB 4-8	3030307	PHOENIX
100	10	TERMINAL BLOCK Plug-in (2)Bridge - FBS 2-8	3030284	PHOENIX
101	50	TERMINAL BLOCK End clamp - E/NS 35 N	0800886	PHOENIX
102	2	TERMINAL BLOCK Marker card - SBS 8:UNBEDRUCKT	1007235	PHOENIX
103	26	ANGLE BRACKET SUPPORT	E19	
104	1	CABLE FOR LED enclosure light - SAC-3P- 3,0-PUR/M 8SIFS AE	1417698	PHOENIX
105	1	CABLE FOR LED enclosure light - AC-3P-M 8MS/ 0,6-PUR/M 8SIFS	1417699	PHOENIX
106	1	Aluminum Sign, (Danger-Do Not Enter Authorized...), 7"x 10"	7592T21	MCMASTER-CARR
107	1	Aluminum Sign(Arc Flash and Shock Hazard...), 7" x 10"	76445T111	MCMASTER-CARR
108	20	PUSH BUTTON LEGEND PLATE 30MM T-K	9001KN100BP	SQUARE D
109		POWERPACT B 480Y/240 V - 65kA 2P-50A		SQUARE D
110		TeSys LRD THERMAL OL CLASS 10 -12-18A		SQUARE D
111		TeSys LRD THERMAL OL CLASS 10 - 23-32A		SQUARE D
112		TeSys LRD THERMAL OL CLASS 10 - 37-50A		SQUARE D
113		TeSys LRD THERMAL OL CLASS 10 - 48-68A		SQUARE D
114	3	Relay Module - PLC-RSC-120UC/21-21	2967086	PHOENIX
115		Power supply unit - QUINT-PS/1AC/24DC/20		PHOENIX
116		PowerPact J Circuit Breaker,ThermMagn,150A,3P,600V,50kA		SQUARE D
117	1	AUX SWITCH Multi 9	MG26925	SQUARE D
118	2	Patch cable - FL CAT6 PATCH 2,0	2891589	PHOENIX
119	1	Patch cable - FL CAT6 PATCH 1,0	2891385	PHOENIX
120	2	ENCLOSURE PARTITION	E20	
121	1	TERMINAL SHIELD & PHASE BARRIER FOR J FRAME BREAKER	S37450	SQUARE D
122		SURGE PROTECTIVE DEVICE 40KA 208Y/120V 3P 4WIRE		SQUARE D
123		SURGE PROTECTIVE DEVICE 40KA 240V DELTA 3P 3WIRE		SQUARE D
124	1	SURGE PROTECTIVE DEVICE 40KA 480Y/277V 3P 4WIRE	SDSA4040	SQUARE D
125	1	SURGE PROTECTIVE DEVICE 40KA 480V DELTA 3P 3WIRE	SDSA4040D	SQUARE D
126	1	HOFFMAN DATA POCKET SMALL 6 X 6	ADP1	HOFFMAN
127	4	PUSH BUTTON Contact Block, 10 A, 600 V, Screw, SPST-NC	9001KA1	SQUARE D
128	2	Aluminum 3/4 LB	LB-42	Bridgeport
129	1	RIGID Aluminum 3/4 Conduit	34A	PLATT
130	1	3/4 ALUM HUB WATER TIGHT	DC-52	Bridgeport
131	2	LED enclosure light Accessories	651-2702313	PHOENIX
132	1	2-level knife disonnnect End Cap	2775197	PHOENIX
133	1	2-level knife disonnnect	2775223	PHOENIX
134	2	Multi 9 UL489 1P-30A - tunnel term	60115	SQUARE D
135	2	Aluminum raised rail 2 Meter length	5604188	PHOENIX
136	2	Rubber Bumper with Steel Washer, 3/4" OD, 1" High, 5/32" Hole	9540K49	MCMASTER-CARR

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2.9 WETWELLS

A. All wetwells for the pumping stations shall be new and shall be furnished by the Contractor in accordance with the following requirements:

1. Cementitious Wetwells:

a. Precast wetwells shall be 6 feet to 12 feet in diameter constructed conforming to ASTM C-478. Joints shall be made to receive butyl mastic rope sealer and a non-shrink type grout especially made for this purpose. Additionally, all joints shall be coated inside and out with Flex-Seal Utility Sealant by Sealing Systems, Inc, Loretto MN, or approved equal. The sealant coverage shall be 18-inches wide with a minimum dry thickness of 80 mils. Wetwell bottom shall be integrally cast with extended base and walls shall conform to ASTM C-478 or to minimum dimensions shown on the drawings. Wetwell top shall be casted with access doors and pipe penetrations. All exposed concrete finishes for the valve vault and wetwell shall be uniform and finished to a light brush finish after all patchwork is completed. The wetwell shall be installed plumb.

1) Wetwell supplier shall design manhole sections to resist earth loads and to resist uplift resulting from buoyant forces calculated with groundwater table at finished grades. Wall and/or base dimension shall be increased accordingly.

2) Manhole sections shall be designed for H-20 loadings and a minimum manhole height of 40 feet. Earth loading shall be 120 pounds per cubic foot.

3) Access Door: Shall be constructed of aluminum with ¼" thick one-piece aluminum extruded frame, having a continuous concrete anchor as part of the frame. Door panels shall be ¼" thick aluminum diamond plate capable of withstanding 300 pounds per square foot. All hardware detail and hinges shall be 316 stainless steel with tamper-proof fasteners. Doors shall open 90 degrees and be locked in this position with a stainless-steel positive locking arm and aluminum release handle. Doors shall close flush with the top of the frame and be fully supported around the perimeter on a ½" wide lip. Doors shall be lockable with a built-in locking point, welded to the frame and have lift assist if weight is over 50 pounds. A fall protection grating system shall be provided. Doors shall be as manufactured by Bilco, Halliday (S Series), EJ Corp or USF Fabrication.

4) Corrosion Protection: Interior of cementitious wetwell shall have a coating lining system applied to manufacturers specifications with manufacturer certified application contractor. Contractor to submit product specifications and qualifications for approval prior to installation. Approved coating systems are PPG Ravens 405; Tnemec Epoxytec CPP Sprayliner; OBIC 1000 sprayliner or Approved Equal.

2. Polymer Concrete Wetwells:

a. The polymer concrete wetwell shall be as manufactured by Armorock, Boulder City, Nevada; US Composite Pipe Inc., Alvarado, TX; or pre-approved equal.

b. Reference to a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.

c. Like items of materials/equipment shall be the end products of one manufacturer in order to provide standardization for appearance, operation, maintenance, spare parts and manufacturer's service.

d. Provide engineered non-penetrating lifting devices in each precast section for proper handling.

e. Cement for base slabs and anti-flotation slabs/collars shall conform to ASTM C150, Type II cement or equal.

f. Mark date of manufacture, name and trademark of manufacturer on each precast section.

g. Brick masonry shall not be utilized for any part of the polymer concrete wetwell.

h. Polymer Concrete Structure Sections: Precast concrete base sections, riser sections, transition top sections, flat slab tops and grade rings shall conform to ASTM C478 and meet the following requirements:

1) Structures shall be designed for all live and dead loads in accordance with ASTM C890 including a live load equal to AASHTO H-20 truck loading applied at finished grade.

2) Base, riser and top sections shall have bell and spigot/ship-lap design so that, on assembly, the manhole base, riser and top section make a continuous uniform manhole.

3) Top section shall be a flat slab.

i. Design:

1) Structure walls, transition slabs, tops, and base slab shall be designed according to the requirements of ASTM C478, and C890. FRP reinforced products shall be designed according to ACI 440.1R.

2) Design loading requirements:

a) AASHTO M-306 H-20/HS-20 design live loading loads as referred to in AASHTO M-305 applied to manhole cover or structure top slab and transmitted down to transition and base slabs.

b) Unit weight of soil of 120 pcf located above portions of structure, including base slab projections.

c) Lateral soil pressure based on saturated soil conditions producing an at rest equivalent fluid pressure of 100 psf.

d) Internal liquid pressure based on unit weight of 63 pcf.

e) Dead load of manhole sections fully supported by transition and base slabs.

3) Structure wall thickness shall be designed to resist hydrostatic pressures with a minimum factor of safety of 2.0 for full depth conditions from grade to invert. The CONTRACTOR shall assume the design groundwater level is at finished grade. Wall thickness shall be a minimum of 3" for 48" and 60" manholes and 4" for 72" and larger".

4) Structure shall be designed with sufficient bottom anchorage and side friction to resist buoyancy with a minimum factor of safety of 2.0. Field cast floatation collars are acceptable. The CONTRACTOR shall assume the design groundwater level is at finished grade and the structure is empty.

5) The minimum clear distance between openings shall be 12" or half the diameter of the smaller opening, whichever is greater.

6) The minimum clear distance between an opening and a joint shall be 6".

7) Structure shall have a monolithic base slab unless otherwise approved. Monolithic base sections shall have vertical reinforcing extend into the base slab section.

8) Structures shall be designed with the reinforcement carrying all of the tensile stress. The tensile property of the polymer concrete shall not be used in the design calculations.

j. Polymer Concrete:

1) Resin:

a) The resin shall be polyester, or vinyl ester resin systems designed for use with this particular application.

b) The resin content shall be a minimum of 7% by weight.

c) The resin shall have a minimum deflection temperature of 158 F when tested at 264 psi following test method in accordance with ASTM D648.

d) The resin selection shall be suitable for application in the corrosive conditions in a wastewater wetwell.

2) Filler: All aggregate, sand and quartz powder shall meet the requirements of ASTM C33.

3) Additives: Resin additives such as curing agents, pigments, dyes, fillers and thixotropic agents, when used, shall not be detrimental to the manhole.

4) Polymer concrete compressive strength shall be a minimum of 9000 psi per ASTM C497.

5) No Portland cement shall be permitted in the polymer concrete mix and all aggregates shall have a minimum acid insoluble content of 95%.

k. Reinforcement:

1) Deformed Concrete Reinforcing Bars: ASTM A615, Grade 60 deformed bars.

2) Fiberglass Reinforced Polymer Bars (FRP): ACI 440.1R-06, "Guide for Design & Construction of Structural Concrete Reinforced with FRP Bars."

3) Reinforcing shall be in accordance with ASTM C478. If FRP reinforcement is used, reinforcement shall be placed according to ASTM C478 for barrel sections and slabs. Required ASTM C478 steel area shall be converted to equivalent FRP design per ACI 440.1R. Hoop reinforcement shall only be permitted per ASTM C478.

4) Steel Welded Wire Reinforcement: ASTM A497.

l. Joints:

1) Structure components shall be connected with an elastomeric sealing gasket as the sole means to maintain joint water tightness and both the gasket material and the manhole joint shall meet the requirements of ASTM C443.

2) Structure shall utilize spigot and bell type joints incorporating either a confined O-ring or single step profile joint.

m. Pipe Connections:

1) Provide resilient connectors conforming to the requirements of ASTM C923. Certification from connector manufacturer shall be provided if requested. Resilient connectors shall be installed directly to the monolithic structure wall or cast in during the initial pour. Cold joint pipe stub grouting shall not be allowed to facilitate connectors unless specifically indicated on the plans. Use the following materials for metallic mechanical devices as defined in ASTM C923:

a) External clamps: Type 304 Stainless steel

b) Internal, expandable clamps: Type 304 stainless steel, 11gauge minimum.

2) All connectors are to be watertight.

3) Where penetrations of pre-fabricated polymer concrete structures are required for piping, conduit, or ducts, such penetrations shall be through precast openings. All openings shall be smooth and free of surface irregularities and with exposed steel reinforcing. A separate opening shall be provided for each pipe or conduit entering the structure.

n. Vent Pipe: Vent pipes shall be constructed of stainless steel or fusion bonded epoxy DIP as shown on the Standard Details.

o. Access Door: Shall be constructed of aluminum with ¼" thick one-piece aluminum extruded frame, having a continuous concrete anchor as part of the frame. Door panels shall be ¼" thick aluminum diamond plate capable of withstanding 300 pounds per square foot. All hardware detail and hinges shall be 316 stainless steel with tamper-proof fasteners. Doors shall open 90 degrees and be locked in this position with a stainless-steel positive locking arm and aluminum release handle. Doors shall close flush with the top of the frame and be fully supported around the perimeter on a ½" wide lip. Doors shall be lockable with a built-in locking point, welded to the frame and have lift assist if weight is over 50 pounds. A fall protection grating system shall be provided. Doors shall be as manufactured by Bilco, Halliday (S Series) or USF Fabrication.

3. Fiberglass Wetwells: Wetwells shall be 6 feet to 12 feet in diameter constructed conforming to ASTM D-3753. Wetwells shall be commercial grade unsaturated polyester resin with fiberglass reinforcements and Vinyl Ester liner. The fiberglass reinforcement materials shall be Grade E glass in mat, continuous roving, chopped roving, roving fabric, or a combination of the above forms. Coupling agent shall provide a suitable bond between the glass reinforcements and the resin. Fiberglass reinforcement materials on surfaces exposed to the contained substance shall be chemical-resistant glass with a C-Veil liner that will provide a suitable bond with the resin. The laminate layer of the tank shall have a minimum thickness of 10 mils, consisting of reinforcing materials, C-Veil, and Vinyl Ester resin. The interior and exterior surfaces of the wetwell shall be smooth with no blisters larger than ½" and no exposed fibers. Wetwell top shall be concrete with a the bottom lined in fiberglass meeting the specification of the wetwell and designed for H-20 traffic loading.

a. Brackets: Brackets, discharge piping brackets, and fasteners shall be stainless steel.

b. Flange: The outside diameter of the wetwell flange shall be 6" greater than the diameter of the wetwell.

c. Access Door: Shall be constructed of aluminum with ¼" thick one-piece aluminum extruded frame, having a continuous concrete anchor as part of the frame. Door panels shall be ¼" thick aluminum diamond plate capable of withstanding 300 pounds per square foot or H-20 traffic loading. All hardware detail and hinges shall be 316 stainless steel with tamper-proof fasteners. Doors shall open 90 degrees and be locked in this position with a stainless-steel positive

locking arm and aluminum release handle. Doors shall close flush with the top of the frame and be fully supported around the perimeter on a ½" wide lip. Doors shall be lockable with a built-in locking point, welded to the frame and have lift assist if weight is over 50 pounds. A fall protection grating system shall be provided. Doors shall be as manufactured by Bilco, Halliday (S Series), EJ Corp, or USF Fabrication.

4. High Density Polyethene (HDPE) Wetwells: Wetwells shall be 6 feet to 12 feet in diameter and constructed conforming to ASTM F-1759. HDPE wetwells shall be constructed with high density polyethylene meeting cell classification PE 335444E and ASTM D-3350. The wetwell risers shall be constructed from solid wall profile pipe.

   a. Access Door: Shall be constructed of aluminum with ¼" thick one-piece aluminum extruded frame, having a continuous concrete anchor as part of the frame. Door panels shall be ¼" thick aluminum diamond plate capable of withstanding 300 pounds per square foot or H-20 traffic loading. All hardware detail and hinges shall be 316 stainless steel with tamper-proof fasteners. Doors shall open 90 degrees and be locked in this position with a stainless-steel positive locking arm and aluminum release handle. Doors shall close flush with the top of the frame and be fully supported around the perimeter on a ½" wide lip. Doors shall be lockable with a built-in locking point, welded to the frame and have lift assist if weight is over 50 pounds. A fall protection grating system shall be provided. Doors shall be as manufactured by Bilco, Halliday (S Series), EJ Corp or USF Fabrication.

2.10 VALVE VAULTS

A. All valve vaults for the pumping stations shall be new and shall be furnished by the Contractor in accordance with the following requirements:

   1. Vaults shall have an 18"x18"x12" deep sump pit along wall nearest the wet well with a 2" sch. 40 316 stainless steel sleeve pipe with no bends between the vault and the wet well. This sleeve shall be plugged at the valve vault side with common expansion plugs.

B. Access Door: Shall be constructed of aluminum with ¼" thick one-piece aluminum extruded frame, having a continuous concrete anchor as part of the frame. Door panels shall be ¼" thick aluminum diamond plate capable of withstanding 300 pounds per square foot. All hardware detail and hinges shall be 316 stainless steel with tamper-proof fasteners. Doors shall open 90 degrees and be locked in this position with a stainless-steel positive locking arm and aluminum release handle. Doors shall close flush with the top of the frame and be fully supported around the perimeter on a ½" wide lip. Doors shall be lockable with a built-in locking point, welded to the frame and have lift assist if weight is over 50 pounds. Doors shall be as manufactured by Bilco, Halliday, EJ Corp, or USF Fabrication.

2.11 MAGNETIC FLOW METERS

A. Magnetic flow meter systems shall include a magnetic flow tube and a microprocessor-based "smart" transmitter that is capable of converting and

transmitting a signal from the flow tube. Magnetic flow meters shall utilize the characterized field principle of electromagnetic induction and shall produce DC signals directly proportional to the liquid flow rate.

B. Magnetic flow meter systems shall be manufactured by ABB, Siemens, or Rosemount, and shall meet the following minimum requirements:

1. Carbon steel flow tube
2. Class 150 carbon steel flanges with raised face
3. IP 68 (NEMA 6P) Flow tube and cable assembly rated for continuous submergence
4. Minimum of 200 feet of cable, factory assembled to flow tube and potted
5. Stainless steel bullet nose electrodes
6. PTFE (Teflon) liner
7. Two (2) Stainless steel grounding rings
8. FM Class I Div. 2 Rated
9. Temperature range -20 to 50 degrees C
10. 0.5 % Accuracy
11. Remote transmitter, wall mounted:
    a. 24 VDC powered
    b. 4-20mA flow signal output
    c. HART communications
    d. ½-14 NPT conduit entry
    e. Operator interface and display
    f. IP 67 (NEMA 4X)

C. Manufacturers

1. Rosemount

Rosemount Magnetic Flow Meters	
Size (Inches)	**Model Number**
3	8750WDEW2A1FTSB030CA1Z5DA1DA2M4G1R200Q4
4	8750WDEW2A1FTSB040CA1Z5DA1DA2M4G1R200Q4
6	8750WDEW2A1FTSB060CA1Z5DA1DA2M4G1R200Q4
8	8750WDEW2A1FTSB080CA1Z5DA1DA2M4G1R200Q4
10	8750WDEW2A1FTSB100CA1Z5DA1DA2M4G1R200Q4
12	8750WDEW2A1FTSB120CA1Z5DA1DA2M4G1R200Q4
14	8750WDEW2A1FTSB140CA1Z5DA1DA2M4G1R200Q4

16	8750WDEW2A1FTSB160CA1Z5DA1DA2M4G1R200Q4
18	8750WDEW2A1FTSB180CA1Z5DA1DA2M4G1R200Q4
20	8750WDEW2A1FTSB200CA1Z5DA1DA2M4G1R200Q4
24	8750WDEW2A1FTSB240CA1Z5DA1DA2M4G1R200Q4

2. ABB

ABB Magnetic Flow Meters	
Size (Inches)	**Model Number**
3	FEW325080A1S4A1B1A1A6P3B4A1M5V3CWY
4	FEW325100A1S4A1B1A1A6P3B4A1M5V3CWY
6	FEW325150A1S4A1B1A1A6P3B4A1M5V3CWY
8	FEW325200A1S4A1B1A1A6P3B4A1M5V3CWY
10	FEW325250A1S4A1B1A1A6P3B4A1M5V3CWY
12	FEW325300A1S4A1B1A1A6P3B4A1M5V3CWY
14	FEW325350A1S4A1B1A1A6P3B4A1M5V3CWY
16	FEW325400A1S4A1B1A1A6P3B4A1M5V3CWY
18	FEW325450A1S4A1B1A1A6P3B4A1M5V3CWY
20	FEW325500A1S4A1B1A1A6P3B4A1M5V3CWY
24	FEW325600A1S4A1B1A1A6P3B4A1M5V3CWY

3. Siemens

a. For a complete Siemens system, you must purchase a flow tube, two grounding rings, a transmitter, a wall bracket and a special cable kit.

b. Transmitter Part Number: 7ME6910-1AA30-1AA0

c. Wall Bracket Part Number: FDK:085U1053

d. Special Cable Kit Part Number: A5E01181689

Siemens Magnetic Flow Meters		
Size (Inches)	**Flow Tube Part Number**	**Grounding Ring Part Number**
3	7ME6310-3MJ13-1AA2-Z+Y41	FDK:083N8291
4	7ME6310-3TJ13-1AA2-Z+Y41	FDK:083N8118
6	7ME6310-4HJ13-1AA2-Z+Y41	FDK:083N8126

8	7ME6310-4PJ13-1AA2-Z+Y41	FDK:083N8370
10	7ME6310-4VJ13-1AA2-Z+Y41	FDK:083N8140
12	7ME6310-5DJ13-1AA2-Z+Y41	FDK:083N8148
14	7ME6310-5KJ13-1AA2-Z+Y41	FDK:083N8157
16	7ME6310-5RJ13-1AA2-Z+Y41	FDK:083N8165
18	7ME6310-5YJ13-1AA2-Z+Y41	FDK:083N8173
20	7ME6310-6FJ13-1AA2-Z+Y41	FDK:083N8182
24	7ME6310-6PJ13-1AA2-Z+Y41	FDK:083N8190

2.12 PUMP STATION SECURITY FENCING

A. Fence shall be 8'-0" high (main fence height, excluding barbed wire) around the entire perimeter of the station site. Overflow basin shall have a 4’-0” high fence around perimeter. Double-swing gates shall have a minimum clear opening of 14 feet. Larger gate opening may be required, depending on station layout, to allow for large sewer cleaning equipment. Fencing shall be colored and supplied with matching privacy slats of brown, black, or green. Provide black slats for overflow basin fence.

B. Fabric: The fabric shall be composed of 9-gauge steel wire helically wound to form a continuous chain link fabric having a 2-inch mesh. Top and bottom edges shall have a twisted and barbed finish. The fabric shall be manufactured in accordance with ASTM A-392 Class 2 and in accordance with the Chain Link Fence Manufacturers Institute.

1. Fabric shall be hot dip galvanized after weaving to produce a zinc coating not less in weight than 2.0 ounces per square foot of uncoated wire surface.

2. Wire in the fabric shall meet minimum breaking strength of 1,290 pounds after galvanizing.

C. Line Posts: Line posts shall be 2.375-inch O.D. galvanized pipe, schedule 40, 3.65 lbs./ft. Line posts shall be spaced no more than 10 feet on center and set 28-inches deep in full 3 foot deep, 8-inch diameter bell-shaped concrete footings, crowned to shed water.

D. Top Rail: Top rail shall be 1 5/8" O.D. sch. 40 pipe hot galvanized and shall be furnished in random lengths averaging not less than 20 feet, jointed with extra-long pressed steel sleeves, hot galvanized, making a rigid connection but allowing for expansion and contraction. Top rail shall pass through base of line post tops or barbed wire arms and form a continuous brace from end of each stretch of fence. Rail to be securely fastened to terminal posts by beveled edge bands and rail end fittings.

E. Fabric Ties: Fabric ties for attaching fabric to line posts, top rail or top wire, shall be aluminum strip or 9-gauge wire. Fabric ties shall be used on top rail every 24-inches and for line posts every 14-inches.

F. Barbed Wire: On the perimeter fence, the fabric shall be surmounted with 3 strands of barbed wire. Each strand shall consist of two no. 12-1/2 twisted copper-bearing

steel line wires hot galvanized, with no. 14 gauge aluminum 4-point barbs spaced not more than 5-inches apart. The barbed wire shall be manufactured in accordance with ASTM A-121.

G. Barbed Wire Support Arms: Pressed steel or cast iron and hot dip galvanized 18-inch arms with provisions for attaching three rows of barbed wire at a 45-degree angle. Arms must provide a minimum of an additional 12-inches to the fence height. Capable of withstanding 250 pounds downward pull at outermost end of arm without failure. Arms designed to fit securely over line posts with provisions for passage of top rail. Provide tamper-proof hardware for attaching arms to end and corner posts with screws or by spot welding.

H. Fasteners: Galvanized carriage bolts with nuts.

I. Extension Arms: All intermediate, gate, and corner posts shall be equipped with extension arms for supporting barbed wire with gate and end post arms vertical. Line post arms shall be galvanized pressed steel with self-locking slot and provision for passing top rail. The corner arm base shall be malleable iron and the extension pressed steel with set screw.

J. End, Corner, and Gate Posts: End and corner posts shall be 2.875-inch O.D. galvanized pipe weighing 5.79 lbs./LF. Gate posts shall be 4-inch O.D. copper bearing galvanized pipe weighing 9.11lbs./ft. All to be set in full 3 feet deep 10-inch diameter bell-shaped concrete footings crowned to shed water.

1. End and gate posts tops shall be galvanized malleable iron, drive fitting outside of post to exclude moisture.

K. Brace and Tension Bands: Brace and tension bands shall be unclimbable beveled edge type with 5/16-inch diameter square shouldered galvanized steel carriage bolts, non-removable from outside fence. Tension bands shall be spaced no more then 14-inches apart.

L. Bracing: All corner, gate, and terminal posts shall be braced by means of 1-5/8-inch O.D. horizontal compression member, securely attached to terminal and first line posts with malleable iron fittings, beveled edge bands, and truss braced from first line post to bottom of terminal by 3/8-inch rod and turnbuckle. Corner posts to be so braced in each direction.

M. Tension Bars: Tension bars for attaching fabric to terminal posts shall be 3/16" x 3/4" high carbon steel attached to terminal posts by means of beveled edge bands, spaced not over 15-inches on center. Provide one tension bar for each gate and end post, and 2 for each corner and pull post, except where fabric is integrally woven into post.

N. Bottom Tension Wire: Bottom tension wire shall be 7 gauge marcelled galvanized high carbon coiled steel wire in accordance with ASTM A824 Type I aluminum-coated or Type II zinc-coated.

O. Post Caps: Pressed steel or cast iron, hot dip galvanized; designed to fit snugly over post and exclude moisture from inside; furnish caps with openings to permit passage of top rail.

P. Gates: Gates shall be double-swing and frames shall be 2-inch O.D. with 1 5/8 – inch internal bracing welded at all joints to provide rigid watertight construction. Filler fabric shall be same as used in line of fence with barbed wire at top. Hinges shall be pivot type malleable iron or pressed steel. Latch shall be drop bar type

securely fastened to gate frame and to engage a 2-inch I.D. pipe sleeve driven 18-inches minimum into earth.

2.13 WIRING

A. All power & control wiring shall be individual conductors installed in conduit unless otherwise required by Charlotte Water or application.

B. 600 Volt Lighting/Power/Control

1. Conductors #6 and smaller shall be type THWN/THHW, and continuously colored for desired phase identification.

C. 600 Volt Power Conductors

1. Conductors #4 and larger shall be type XHHW-2, and continuously colored for phase identification.

D. Minimum conductor size shall be #12 AWG for 120-volt (or greater) branch circuits. #14 AWG may be used for control circuits provided it is adequately protected from overcurrent in accordance with NEC requirements. All conductors shall be rated 600 VAC and 75-90°C terminations.

1. Motor connections shall be made using insulated multi-cable connector block (NSI type) connections. Wire shall be covered with proper sleeve to prevent damage when tightening connector.

E. Conductors shall run continuous between termination points, and wire-to-wire splicing is prohibited.

F. Termination lugs shall be 2-hole, tin plated copper, long barrel compression for all bus terminations unless equipment requires a single hole lug.

G. Aluminum or dual rated Aluminum/Copper lugs will not be permitted for use.

H. Stranded conductors shall be used for all installations, including lighting and receptacle circuits.

I. No Aluminum conductors shall be permitted.

J. Cable Pulling Lube shall be Polywater “Type J” (or equal) high performance cable lube.

K. Contractor installed service, distribution and branch circuit wiring shall be color coded as follows:

1. 120/240-volt, 1-phase, 3-wire systems (Serving 120-volt branch circuits): Phase “A”, black; Phase “B”, red, Grounded neutral, white, ground conductor, green.

2. 240-volt, 3-phase, 3-wire systems: Phase “A”, black; Phase “B”, red; Phase “C” blue; ground conductor, green.

3. 240-volt, 3-phase, 4-wire systems: Phase “A”, black; Phase “B” (high-leg), orange; Phase “C” blue; Grounded neutral, white, ground conductor, green.

4. 277/480-volt, 3-phase, 4-wire systems: Phase A, brown; Phase B orange, Phase C; yellow; Grounded neutral, white with stripe, ground conductor, green.

2.14 CONDUIT RACEWAYS

A. All wiring, other than those in cable trays, shall be in PVC- coated Rigid Galvanized Steel (RGS) conduit manufactured by Robroy or Ocal. All underground conduit shall be inspected and approved, prior to backfilling, by the Charlotte Water Lift Station Manager.

1. Conduit size shall accommodate the installed, and/or the anticipated future conductors in accordance with NEC. Minimum size is ¾-inch.

2. All conduit connections at enclosures shall be made using Myers STG type, PVC-coated hubs that accommodate bonding. All interconnections between adjacent enclosures shall utilize Myers STG type, PVC-coated hubs; chase nipple connections are not permitted. Only Form 8 style fittings shall be used.

3. PVC-RGS conduit shall be installed using specific tools and techniques that do not damage the PVC coating.

   a. Conduits with damaged coatings shall be replaced as judged by Charlotte Water solely. Contractor applied coatings or patching compounds (repairs) are not permitted.

   b. Personnel installing PVC-Coated conduit shall be trained and certified for installation by the manufacturer.

   c. Strap wrenches or other approved tools for use on PVC-Coated Conduit shall be used for conduit installation. Pipe wrenches, channel locks, chain wrenches, etc. shall not be used.

   d. Total bends in PVC-Coated RGC shall not exceed 270° between pull points.

   e. Conduit damaged during installation shall be replaced at contractors' expense.

   f. Conduit damage shall be determined by Charlotte Water Electrical personnel.

   g. All threaded conduit ends shall be degreased, using a good quality degreaser, then coated with an electrically conductive, corrosion resistant compound during installation of conduit such as T&B "Kopr-Shield" or equal.

   h. The use of a Tinker & Rasor holiday detector may be used at the discretion of Charlotte Water Electrical personnel.

   i. NO PATCHING of damaged PVC-Coated Conduit will be allowed.

2.15 CABLE TRAY

A. A cable tray system shall be furnished for routing wet well power and control cables to control enclosure. Material and installation requirements are as follows:

1. Cable tray system shall consist of a heavy-duty trough type tray with ventilated bottom, louver-ventilated flange type cover and full height barrier strip. Tray, cover & barrier strip shall be constructed of 6063-T6 aluminum alloys.

2. Tray system shall meet all state and local building codes requirements and be UL listed/labeled for outdoor applications as manufactured by B-line, Chalfant, MP Husky, Thomas & Betts, or approved other.

3. Cable tray shall be sized in accordance with NEC requirements but shall be no smaller than 12” wide & 4” high.

4. Load rating requirements shall be based on support spans and the anticipated loading (cable weight plus 250 lbs). Load capacity shall be no less than 400 lbs. at a span of 6’. Vertical deflection between span supports shall not exceed 1/200th of the span length (>3/8” for a 6’ span). Maximum distance between supports is 6 feet.

5. A full height barrier strip shall be installed over full length of tray system to provide an isolated 2” wide raceway for the intrinsically safe circuit extension cables. Said cables shall be installed, secured and guarded from contact from all other wiring per NEC 504 requirements.

6. Unless indicated otherwise, tray system shall be routed along fence line in areas that will not hinder station access or maintenance operations. Tray system shall be installed no closer than 12” to permit reasonable access for installation/removal of cables, covers & cover clamps.

7. Cable tray shall be installed level (for level lots) or be run parallel to the finished grade (for sloping lots). Where practical, vertical offsets should be made using standard, factory assembled inside & outside vertical bends. Offsets that do not correspond to those possible with factory-assembled fittings may be achieved using hinged splice plates.

8. Horizontal bends shall be factory assembled; no field modifications will be allowed.

9. Covers shall be segmented in 3’ sections (where possible) and cover clamps installed at intervals not exceeding 3’. No less than two clamps shall secure a cover segment.

10. Tray system shall be elevated 8” above finished grade on cylindrical or rectangular reinforced concrete piers with 1-5/8”, 316 stainless steel channel grouted into support pier. Tray shall be attached using resilient mounts (guide clamps), and expansion type fittings shall be installed at section joints, as necessary to alleviate stresses due to thermal expansion intermittent loading. There shall be a solid type nonmetallic barrier installed between the cable tray and concrete pier to prevent corrosion.

11. Tray system shall have adequate provisions for cable drop-in (at panel) and dropout (at wet well). Cable shall be adequately protected & supported. Contractor shall maintain adequate separation for intrinsically safe cables in accordance with NEC 504.

    a. Control Panel: Tray section below control panel shall be terminated using blind end plate with 3-sided bushed opening in cover to permit cable drop-in from control panel. Cables entering control enclosure shall be terminated using cable seal fittings in accordance with NEC 501-5(d)(1).

    b. Wet Well: Tray system shall be extended over wet well opening and be terminated with a blind end plate. Provide 4” diameter

Schedule 40 PVC pipe (length to match wet well thickness) with end bells and socket connect adapter on top of wet well. Required materials:

1) Kraloy Conduit End Bells, 4" diameter, Model Part MEB40
2) 4" diameter Schedule 40 PVC, length to fit well well thickness
3) McMaster-Carr Socket-Connect Adapter, 4 flange pipe, Model Part 4881K219

2.16 ELECTRICAL SERVICE ENTRANCE EQUIPMENT

A. A U.L. Service Entrance listed disconnecting means shall be provided as follows:

1. Disconnect enclosure shall be NEMA 4X, heavy-duty type constructed of stainless steel. Contractor shall clearly label disconnect enclosure with the Service Voltage & Phase. Label plate shall be engraved phenolic permanently cemented, using 2-part, marine epoxy, to the front surface of the enclosure.
2. Disconnect shall be furnished with lightning arrestor, surge arrestor, and all necessary grounding and neutral connection kits required for installation and/or service entrance listing. Where terminations of multiple phase, neutral or ground conductors is necessary, equipment shall have the proper multi-barrel lugs to accommodate them.
3. Disconnect shall have overcurrent protection provided integral (breaker type) or located within disconnect enclosure (fusible) as indicated below:
    a. Where approved by NC DEQ (on a case-by-case basis) a thermal magnetic type of circuit breaker shall be used for the service disconnect.
    b. For installations fully compliant with NC DEQ Minimum Design Criteria for the Fast-Track Permitting of Pump Stations & Force Mains, a fusible switch shall be used for the service disconnect.

2.17 CONCRETE EQUIPMENT PADS

A. Concrete Pads shall be furnished below all electrical equipment racks or as mounting surfaces for freestanding enclosures or generators. Pad shall be located and oriented such that all electrical enclosures will remain outside any NFPA 820 designated hazardous area. Hazardous areas for all Charlotte Water wastewater-pumping facilities shall be based on a non-ventilated "combined" or "sanitary" sewer (NFPA 820, Table 2, Row 16a); "Residential" wastewater classification (Row 11a) shall not be used.

1. Pads shall be furnished to accommodate equipment load without cracking or settling, but in no cases shall they be less than 3600 psi concrete; 8" minimum thick with 6x6/W1.4xW1.4 welded wire mesh reinforcement. Final elevation shall be 8" above grade. Pads at electrical racks or enclosures shall fully accommodate full width of enclosure & rack installation with 12" additional space on each side, and a minimum 3' in front of deepest cabinet and shall extend at least 12" behind enclosures.

2. Pads shall be formed with two or more access windows to permit stub-ups for electrical/communications connections in control panel, generator/transfer switch or service equipment.

3. Equipment pads shall have light brush (non-skid) finish and all edges, including those for wiring access, shall be chamfered.

2.18 AUXILIARY MOUNTING RACK

A. A steel mounting rack shall be provided at all facilities equipped with permanent generators for mounting of service disconnect, automatic transfer switch, telephone service terminal & other appurtenances not integral or attached to a freestanding enclosure. Rack & enclosures shall be located outside all hazardous areas (see mounting pad requirements). Rack components and installation shall comply with the following:

1. Horizontal support members shall be constructed of 1-5/8" stainless steel, channel (Unistrut #P1100 or approved equal). Structure width shall be sufficient to accommodate mounting of designated equipment.

   a. Enclosures shall be mounted using stainless steel spring nuts & bolt connections at the enclosure's mounting bushings or brackets.

   b. Supports shall be mounted level and square to vertical posts using 3/8" stainless steel U-bolts, nuts & washers. The open side of the Unistrut channel shall face away from posts.

   c. Install protective end caps on all channels.

2. Vertical posts shall be furnished and installed as follows:

   a. Posts shall be constructed of 3" ID rigid galvanized steel conduit and shall extend from 6'6" (max) above finished grade and 2'6" minimum below finished grade. Tops shall be sealed using threaded sleeves and insert plugs.

   b. Post shall be embedded in ground and ballasted with concrete (minimum 60lbs per post) to provide a rigid and plumb support for electrical equipment. Additional supports, embedding depth or ballast material shall be provided as necessary to maintain a plumb & square installation.

2.19 ENGINE GENERATOR SET

A. The Generator, consisting of a performance matched diesel engine and electrical alternator, (see engine & alternator) shall be the product of Caterpillar, Kohler, Detroit Diesel, or Cummins.

1. The distributor must be authorized to perform warranty work on both the engine and generator. The distributor shall have factory-trained service personnel under their direct employ.

2. Supplier must have no less than sixty percent of all generator replacement parts in their stock at all times. Certified proof of this requirement shall be available from the distributor.

3. Generator capacity shall be sufficient to power all connected loads. Size shall be based on a 2-step generator loading sequence; Step #1 = “lead” pump & all appurtenances, Step #2 = “lag” pump. Acceptable performance under installed conditions shall be as follows:

   a. Starting voltage dip shall not exceed 30%.

   b. Steady state voltage shall be maintained within +/-0.25% from no load to full load.

   c. Steady state frequency regulation shall be +/-0.33% with a frequency dip of less than 5% from no load to full load.

4. The generator set shall be adequately sized to support a fully loaded pump station facility. The generator sizing calculation shall consider loading during typical operations to mitigate the risk of wet stacking.

5. The complete operating system, including engine generator set, accessories, and transfer switch, shall be furnished to the Contractor by one vendor as a single, complete package to assure system responsibility and that vendor shall be the local factory authorized distributor of the engine company.

6. Generator shall be furnished in weatherproof enclosure. Batteries shall be located inside a weatherproof enclosure separate from main enclosure.

7. Generator shall be equipped with an NFPA 110, 12-light monitor and meter package as indicated below:

   a. AC volt/ammeters w/phase selector switch.

   b. Dual scale frequency/tachometer

   c. A/C rheostat with ±5% output voltage adjustment.

   d. Light indicators w/alarm contacts as follows:

      1) Generator run (green)

      2) Low oil pressure alert (yellow)

      3) High coolant temp alert (yellow)

      4) Low oil pressure alarm (red)

      5) High coolant temp alarm (red)

      6) Overcrank shutdown (red)

      7) Overspeed shutdown (red)

      8) Switch Off, Auto-start mode off (flashing red)

      9) Low coolant temp (yellow)

      10) Low fuel (yellow)

      11) Two (2) Auxiliary fault indicators (red lights)

         a) Fuel leak detection

         b) Unused spare indication

e. Alarms 2 through 11 shall be tied to a common failure alarm and routed to the control panel dialer as a “generator failure” - channel 25.

2.20 ENGINE

A. The engine shall be the product of Caterpillar, Kohler, Detroit Diesel, or Cummins and shall be a model that has been manufactured and successfully operated for a period of one year.

1. The engine shall be of the four-cycle type, multi-cylinder, and capable of starting solely on No. 2 diesel fuel. The engine shall develop its respective rated horsepower at 1800 rpm. Rating shall be in accordance with the requirements of the Diesel Engine Manufacturer's Association of 85-degrees and elevation of 1500-feet.

2. Maximum or gross engine horsepower to produce standby generator KW ratings is unacceptable. Minimum engine horsepower at 1800 rpm will be determined by the formula below:

$$HP = \left[KW \div \left(EFF \times 0.746\right)\right] + RF + ACC + MF$$

Where,

HP = Minimum Engine Horsepower

KW = Generator Rating in Kilowatts

EFF = Gen-Set Efficiency

RF = Radiator Fan Horsepower

ACC = Accessory Horsepower

MF = Manufacturing Tolerance

3. The engine shall be equipped with a 12 or 24-volt electrical starting system capable of starting cold on No. 2 diesel fuel. Engine shall automatically start on power failure and transfer to standby power and retransfer to normal power upon restoration. Engine shall be equipped with all auxiliaries recommended by the Manufacturer for proper, sure, quick starting of the engine including coolant heater as a cold weather starting aid. The heater shall be powered from a separate power circuit feed from the pump control panel. It shall be plug and cord connected and be isolated by ball valves on both the inlet and discharge sides.

4. Engine shall be liquid cooled via fin-tube radiator and engine driven blower fan. Radiator shall dissipate full load engine heat at a 110-degree F ambient temperature using a 50% ethylene glycol solution. Radiator top tank temperature shall not exceed 205°F.

5. Engine shall be equipped with an adjustable isochronous type electronic governor with stalled work capacity 50% greater than required. Governor shall be Woodward 2301 or equal by Barber Coleman.

6. Combustion exhaust shall be routed via a critical or hospital grade silencer and terminated with a hinged rain cap. Silencers furnished integrally with the sound attenuating weather housing are equally acceptable.

2.21 ALTERNATOR

A. Alternator shall be the product of an established generator manufacturer and shall be a model that has been manufactured and successfully operated for a period to sufficiently establish its reliability.

1. Design shall be revolving field, single bearing, 4-pole, brushless, drip-proof construction. Temperature rise shall be no greater than 130°C at rated output.

2. Output shall be reconnectable, 12-lead type.

3. Excitation system shall employ a Permanent Magnet Generator (PMG) and shall provide 300% short circuit capacity for a 10 second duration to provide a reliable source of excitation power for optimum motor starting and short circuit performance.

2.22 BATTERIES & CHARGER

A. Heavy-Duty lead-acid batteries and charger shall be provided with generator unit. Batteries shall be located inside a weatherproof enclosure separate from generator enclosure and battery charger shall be located either in the generator enclosure or the automatic transfer switch.

1. 12 or 24-volt battery system shall be provided to match engine cranking system. Capacity shall be for at least three cranking cycles (each cycle consisting of three 10-second cranks with five-second rest period between each crank), total cranking time of 160 seconds.

2. An automatic "float" type battery charger shall be provided to maintain the batteries at normal capacity and to recharge batteries after cranking. Unit shall be cord connected to a receptacle if located inside generator enclosure.

a. The charger shall have fused 120-volt input with fused 12 or 24-volt output with ammeter/voltmeter displays.

b. Regulated DC output with complete isolation from A.C. input to prevent battery in event of failure.

c. Unit shall be capable of recharging a completely discharged battery in eight hours or less.

d. The charger shall be U.L. listed and labeled.

2.23 SOUND ATTENUATED HOUSING

A. An all-weather enclosure with noise attenuation features shall be furnished to limit the combined engine & exhaust noises produced by the generator. All generator installations shall limit noise to 75 dBA (average readings taken at 8 positions, measured 23’ (7m) from unit centerline in a free field environment) or 60 dBA minimum at the property line per City of Charlotte ordinance, whichever is strictest.

2.24 AUTOMATIC TRANSFER SWITCH (ATS)

A. ATS shall be enclosed contactor type unit. Unit shall be continuous rated for all load types and furnished with all necessary contacts, relays and accessories

required for proper operation. Transfer switches utilizing molded case or insulated case circuit breakers shall not be acceptable.

1. ATS enclosure shall be weather/corrosion resistant stainless steel with UL/NEMA 3R or 4X listing with three-point latching mechanism and pad-lockable handle.

2. ATS control shall be such that the engine shall continue to run for five minutes after retransfer to normal power and then shut down.

3. ATS shall be furnished with 7-day exerciser clock for unattended exercising of engine.

4. Auxiliary control and status contacts shall be furnished for generator starting, shutdown & off-site monitoring.

2.25 LOW-PROFILE PLATFORM OR SUB-BASE FUEL STORAGE TANK

A. Fuel storage tank of capacity indicated on drawings shall be of double-wall construction to provide secondary containment of fuel in the event of a weld, seam or other failure in the storage sections of the tank. The secondary containment shall provide at least 10% of the storage tank capacity. Tank capacity shall be of sufficient to provide no less than 24 hours of operation at the generator's full rated load. All materials shall be new and rust free and shall meet ASTM A36 Standards. On smaller units, sub-base type tanks are permitted if no generator controls, meters or breaker handles will be more than 6' above finished grade. For larger generators, a platform type tank shall be furnished providing a non-skid standing surface (18" minimum width) around the perimeter of the generator's weather housing. The overall enclosure should not be more than 8 feet in height.

1. Tank design shall incorporate structural steel channels or I-beam side rails common to both the fuel tank and the secondary confinement. Top and bottom of both the fuel tank and secondary confinement sections shall be 10-gauge minimum sheet steel. Secondary confinement section of tank shall have a minimum depth of three inches.

    a. All internal cross members shall be sized to support the specified generator and all necessary appurtenances. Cross members shall be designed to allow free and equal flow of fuel through the storage tank and the secondary confinement section.

    b. A "stub-up" sleeve shall be provided through both the main fuel tank and secondary confinement section. Sleeve shall be 12-inches square and shall not compromise the secondary containment criteria. Sleeve shall be located below the output circuit breaker and generator control panel.

2. Construction of the tank shall be in two steps. The fuel tank section shall be constructed, deburred and pressure tested. The secondary containment section then shall be constructed, deburred and pressure tested.

    a. Pressure tests shall be at 10 PSI minimum. Any defects shall be repaired and retested.

    b. All welds shall be continuous MIG or dual shield type.

3. The tank shall be equipped with the following fittings and appurtenances:

a. 2-inch N.P.T. manual fill pipe with cap located outside of enclosure.

b. Mechanical fuel level sight located to allow monitoring during filling and to prevent over filling.

c. Fuel supply and return fittings. Flexible fuel lines shall be provided between tank and engine.

d. 3/4-inch N.P.T. vents with screened mushroom caps shall be provided for fuel storage and secondary containment sections of the tank.

e. A leak detection device mounted in the secondary containment section of the tank with dry contacts for annunciation at the engine panel shall be provided.

f. Provide low fuel alarm contacts to indicate at the engine panel when there is only three hours fuel remaining in the tank.

4. Spill Prevention: A Spill Prevention Control and Countermeasure Plan, and recommended supplies, will be re-quired at any site that stores petroleum products in aboveground storage tanks and containers that are 55 gallons and greater in capacity and where the combined storage capacity is greater than 1,320 gallons.

2.26 GRATE INLETS FOR OVERFLOW BASIN INLET MANHOLES

A. Basin overflow inlet manholes shall be installed with a beehive style inlet frame, manufactured in accordance with ASTM A-48, AASHTO M-105, and ASSHTO M-306-05.

B. Manufacturers include US Foundry, EJ Corp or approved equal.

2.27 GEOTEXTILES FOR LIFT STATION ACCESS ROAD

A. Geotextile fabric shall be as specified in Section 1056 “Geosynthetics” of NCDOT’s 2024 Standard Specifications for Roads and Structures

PART 3 - EXECUTION

3.1 CONSTRUCTION LAYOUT

A. Construction Staking: Contractor is responsible for staking force main alignments, appurtenance structures, easements, rights-of-way, limits of disturbance, tree protection fence line, wetland boundaries, buffers, Project Control Points and other horizontal control reference points and benchmarks for the work shown on the Drawings. Charlotte Water or the developer’s consulting engineer will provide a drawing and/or staking plan files in electronic format to Contractor. Contractor shall confirm all drawing dimensions and elevations and establish elevations, lines, and levels from reference points, utilizing recognized engineering survey practices. During construction, Contractor shall provide competent helpers for checking elevations, lines, and levels deemed necessary by Charlotte Water. Contractor to establish horizontal and vertical control benchmarks and reference points on the

site located in prominent and protected places as agreed upon by Contractor and Charlotte Water

1. Prior to construction, the Engineer will provide the following construction layout for each pipeline project:
    a. Centerline of proposed force main, appurtenance structures will be established and offset referenced.
    b. Begin and end point of proposed mainline dry bore with steel encasement or tunnel will be established and offset referenced centerline.
2. Permanent or temporary benchmarks will be established at or near:
    a. Connection to existing force mains,
    b. Proposed end of force mains,
    c. Approximate 1000-foot station,
    d. Proposed appurtenance structures
    e. Proposed piers
    f. Mainline bore with encasement or tunnel
3. The Contractor is responsible for protecting these control points until construction is complete. All other construction layout and surveying, which may be required for construction, shall be provided by the Contractor. The Contractor is responsible for determining the amount of additional construction layout and surveying that may be required to complete construction.
4. On developer projects, the force main shall only be installed after road right-of-way grading is complete, and the curb and gutter has been installed.

3.2 CONNECTION TO EXISTING SYSTEM

A. Connections to the existing system shall be made in the presence of Charlotte Water Inspection personnel. Valves, air and vacuum valves, etc. will be operated by Charlotte Water personnel and/or the Contractor if specifically directed by Charlotte Water to do so. The Contractor shall provide all labor, materials, and equipment required for connection to the existing system.

B. The Contractor shall verify blocking at existing valves prior to making connections and will be required to block, rod, or restrain existing and new pipe, fittings and valves as necessary.

C. Existing pump station structures shall be core drilled or saw-cut when connections are made through the structure wall. In no case shall penetrations into pump station structures be made by hammering.

3.3 PIPING INSTALLATION GENERAL

A. General Locations and Arrangements: Drawing plans and details to indicate general location and arrangement of underground sanitary sewer piping. Location and arrangement of piping layout consider design considerations. Install piping as

indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

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

C. Install proper size increasers and tees where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

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

E. Force mains shall be installed such that pipe and joint deflection is minimized and does not exceed deflection values identified below. Charlotte Water installation methods will be followed and will require no less than the following:

1. Force mains of DI pipe shall be installed in accordance with AWWA C600 “Installation of Ductile Iron Water Mains and Their Appurtenances.”

2. Force mains of PVC pipe shall be installed in accordance with AWWA C605 “Installation of Underground Installation of Polyvinyl Chloride (PVC) Pipe and Fittings for Water.”

F. Pipe Bedding: Continuous and uniform bedding and backfill that is appropriate for the soil type and pipe material shall be provided in the force main trench. Unless otherwise specified or noted on the Plans the following bedding classes are as commonly required by Charlotte Water. When filter fabric is required to be placed over the granular bedding and pipe, the fabric shall be Mirafi 140N or approved equal. When granular material embedment is required, the Contractor will backfill above the granular bedding as specified for Type I bedding to an elevation one (1) foot above the top of the pipe bell.

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

2. Type IA – Granular Shaped Bottom Bedding: The trench bottom shall be shaped so the pipe bears uniformly upon undisturbed native earth. The pipe haunches shall be filled with an approved stone to a vertical height of one-fourth the outside diameter of the pipe bell for the pipe's entire length and for the entire width of the ditch. Type IA granular shaped bottom bedding may be used in lieu of Type I shaped bottom bedding. Soil shall then be placed by around the pipe and completely in uniform layers not exceeding six (6) inches in depth up to an elevation one (1) foot above the

top of the pipe bell. Each layer shall be placed and then carefully and uniformly compacted, so that the pipe is not damaged, nor the alignment disturbed.

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

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

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

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

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

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

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

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

G. Depth of Pipe Installation: Unless otherwise indicated on Plans, or required by existing utility location, all pipe will be installed with the top of the pipe at least 5.0' and a maximum of 10.0’ below the edge of adjacent roadway pavement or below the ground at the pipe, whichever is greatest. If cover must be less than 5 feet, the force main shall be ductile iron pipe. The Contractor is instructed to check the construction plans and blow-up views for additional requirements.

1. The Contractor may be required to vary the depth of pipe to achieve minimum clearance from existing utilities while maintaining the minimum cover specified whether or not the existing pipelines, conduits, cables, mains, etc. are shown on the Plans.

3.4 INSTALLATION AND ASSEMBLY, GENERAL

A. Proper implements, tools, and facilities satisfactory to the Engineer shall be provided and used by the Contractor for the safe and convenient prosecution of the work. All pipe, fittings, valves and hydrants shall be carefully lowered into the trench piece by piece by means of a backhoe or other suitable means, in such a manner as to prevent damage to protective coatings and linings. Under no circumstances shall pipeline materials be dropped or dumped into the trench. A

tracer wire system shall be installed for all piping based on the standard details and specifications.

1. Inspection of Material: The pipe and fittings shall be inspected for defects.

2. Cleaning Pipe and Fittings: All lumps, blisters and excess coatings shall be removed from the bell and spigot ends of each pipe, and the outside of the spigot and the inside of the bell shall be clean and dry and free from oil and grease before the pipe is laid. Cleaning shall be per the pipe manufacturer's instructions.

3.5 INSTALLATION AND ASSEMBLY OF DUCTILE IRON PIPE

A. Laying Pipe: Pipe shall be laid with bell ends facing in the direction of laying, unless otherwise approved by the Engineer. Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed.

1. If the pipe laying crew cannot put the pipe into the trench and in place without getting earth into it, the Engineer may require that before lowering the pipe into the trench, a heavy, tightly woven canvas bag of suitable size shall be placed over each end and left there until the connection is to be made to the adjacent pipe. During laying operations, no debris, tools, clothing or other materials shall be placed in the pipe.

2. After placing a length of pipe in the trench, the spigot end shall be centered in the bell and the pipe forced home and brought to correct line and grade. The pipe shall be secured in place with approved backfill material tamped under it except at the bells. Precautions shall be taken to prevent dirt from entering the joint space.

3. At times when pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug or other means approved by the Engineer. This provision shall apply during the noon hours as well as overnight. If water is in the trench, the seal shall remain in place until the trench is pumped completely dry.

B. Permissible Deflection of Joints: Wherever it is necessary to deflect pressure pipe from a straight line, either in the vertical or horizontal plane, to avoid obstruction or plumb valve stems, or where long radius curves are permitted, the amount of deflection allowed shall not exceed 50% of that which is required for satisfactory sealing of the joint as recommended by the manufacturer and shall be approved by the Engineer.

C. Installation of Push-On Joint Pipe: The gasket groove and bell socket shall be cleaned and lubricated, and the gasket inserted as specified by the pipe manufacturer. Sterile lubricant, as furnished or specified by the manufacturer shall be applied to the gasket and beveled spigot end of the pipe. The beveled spigot end of pipe shall be pushed straight into bell using either a bar, jack, lever puller, or backhoe. A timber header will be placed between the jack or backhoe bucket and the pipe to prevent damage to the pipe. At no time will the joint be made by swinging the pipe. The pipe will be deflected, if required, after the joint is made.

D. Installing Mechanical Joint Pipe and Fittings: All spigots shall be centrally located in the bell and adequate anchorage shall be provided where abrupt change in direction and dead ends occur. All pipe surfaces with which the rubber gasket seals

come into contact will be brushed with a wire brush just prior to assembly in order to remove all loose rust or foreign material and to provide a clean surface for the installation of the gasket. The pipe surface with which the gasket comes into contact and the gasket will be brushed with soapy water just prior to the installation of the gasket and the making up of the joint. Torque loads shall be applied to the standard cast iron bolts used in making the joint as follows:

BOLT SIZE, INCHES	RANGE OF TORQUE, FT. POUNDS
5/8	40-60
¾	60-90
1	70-100
1-1/4	90-120

1. The above torque loads may be applied with torque measuring or indicating wrenches. Torque wrenches may be used to check the application of approximate torque loads applied by people trained to give an average pull on a definite length of regular socket wrench. The following lengths of wrenches should satisfactorily produce the above ranges of torques when used by the average person:

BOLT SIZE, INCHES	LENGTH OF WRENCH, INCHES
5/8	8
¾	10
1	12
1-1/4	14

2. When tightening bolts, the gland will be brought up toward the pipe flange evenly, maintaining approximately the same distance between the gland and the face of the flange at all points around the socket.

E. Bend and Fitting Location: The Contractor is advised that the bends and fittings indicated on the plans are for a guide only. The Contractor will be required to furnish additional bends and fittings as needed to complete all installations.

F. Cutting Pipe: The cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or cement lining and so as to leave a smooth end at right angles to the axis of the pipe. Cut ends of a pipe shall be beveled before installation in a push-on joint bell.

G. Ductile Iron Pipe shall be installed when the minimum cover is less than 5.0 feet and in all crossings of other pipelines (storm drainage, gas, etc.) when the vertical distance between the force main and the other pipeline is less than 12-inches.

H. Tracer wire and warning tape shall be installed in accordance with the Standard Details and as specified in these specifications.

3.6 INSTALLATION AND ASSEMBLY OF PVC PIPE

A. Laying Pipe: Pipe shall be laid with bell ends facing in the direction of laying, unless otherwise approved by the Engineer. Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed.

1. If the pipe laying crew cannot put the pipe into the trench and in place without getting earth into it, the Engineer may require that before lowering the pipe into the trench, a heavy, tightly woven canvas bag of suitable size

shall be placed over each end and left there until the connection is to be made to the adjacent pipe. During laying operations, no debris, tools, clothing or other materials shall be placed in the pipe.

2. After placing a length of pipe in the trench, the spigot end shall be centered in the bell and the pipe forced home and brought to correct line and grade. The pipe shall be secured in place with approved backfill material tamped under it except at the bells. Precautions shall be taken to prevent dirt from entering the joint space.

3. At times when pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug or other means approved by the Engineer. This provision shall apply during the noon hours as well as overnight. If water is in the trench, the seal shall remain in place until the trench is pumped completely dry.

B. Permissible Bending Radius: Wherever it is necessary to deflect pressure pipe from a straight line, either in the vertical or horizontal plane, to avoid obstruction or plumb valve stems, or where long radius curves are permitted, the longitudinal bending radius shall not exceed 300 times the outside diameter of the pipe or as recommended by the manufacturer and shall be approved by the Engineer. The minimum bending radius shall not exceed the radius created by the joint deflection allowed in part C below.

C. Permissible Deflection of Joints: [If allowed by the manufacturer] Wherever it is necessary to deflect pressure pipe from a straight line, either in the vertical or horizontal plane, to avoid obstruction or plumb valve stems, or where long radius curves are permitted, the amount of deflection allowed shall not exceed 50% of that which required for satisfactory sealing of the joint as recommended by the manufacturer and shall be approved by the Engineer. Not all manufacturers allow joint deflection. Contractor to confirm if manufacturer allows for joint deflection.

D. Installation of Push-On Joint Pipe: The gasket groove and bell socket shall be cleaned and lubricated, and the gasket inserted as specified by the pipe manufacturer. Sterile lubricant, as furnished or specified by the manufacturer shall be applied to the gasket and beveled spigot end of the pipe. The beveled spigot end of pipe shall be pushed straight into bell using either a bar, jack, lever puller, or backhoe. A timber header will be placed between the jack or backhoe bucket and the pipe to prevent damage to the pipe. At no time will the joint be made by swinging the pipe. The pipe will be deflected, if required, after the joint is made.

E. Installing Restrained Joint Pipe: The exposed gasket surface and pipe spigot shall be cleaned and lubricated, and the spigot end inserted into the coupling as specified by the pipe manufacturer. When the pipe end seats against the stop in the coupling, spline grooves are automatically aligned for spline insertion. The spline shall then be inserted through the insertion hole in the coupling and into the aligned grooves until it is fully seated around the circumference of the pipe. A timber header will be placed between the jack or backhoe bucket and the pipe to prevent damage to the pipe.

F. Bend and Fitting Location: The Contractor is advised that the bends and fittings indicated on the plans are for a guide only. The Contractor will be required to furnish additional bends and fittings as needed to complete all installations.

G. Cutting Pipe: The cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe so as to leave a smooth end at right angles to the axis of the pipe. Cut ends of a pipe shall be beveled before installation in a push-on joint bell.

H. Unless otherwise indicated on the Plans, or required by existing utility locations, all PVC pipe will be installed with a minimum cover of 5.0 feet. The maximum cover shall be as previously specified.

I. Tracer wire and warning tape shall be installed in accordance with the Standard Details and as specified in these specifications.

3.7 INSTALLATION AND ASSEMBLY OF HDPE PIPE

A. HDPE water main shall be installed in accordance with AWWA M55 and ASTM D2774 and with the pipe manufacturer's recommendations. Backfill shall be as specified elsewhere in these specifications.

B. Joining Methods:

1. Butt Fusion: The pipe may be joined by the butt fusion procedure outlined in ASTM F2620 or PPI TR-33. All fusion joints shall be made in compliance with the pipe or fitting manufacturer's recommendations. Fusion joints shall be made by qualified fusion technicians per PPI TN-42. Butt fusion shall not be allowed on 1-inch and smaller HDPE pipe.

2. Saddle Fusion: Saddle fusion shall be done in accordance with ASTM F 2620 or TR-41 or the fitting manufacturer's recommendations and PPI TR-41.

3. Electrofusion: Electrofusion joining shall be done in accordance with the manufacturers recommended procedure. Other sources of electrofusion joining information are ASTM F 1290 and PPI TN 34. The process of electrofusion requires an electric source, a transformer, commonly called an electrofusion box that has wire leads, a method to read electronically (by laser) or otherwise input the barcode of the fitting, and a fitting that is compatible with the type of electrofusion box used. The electrofusion box must be capable of reading and storing the input parameters and the fusion results for later download to a record file.

4. Mechanical: Mechanical connection of HDPE pipe to auxiliary equipment such as valves shall use male HDPE mechanical joint adapters on 3-inch and larger HDPE water mains and other devices in conformance with the PPI Handbook of Polyethylene Pipe, Chapter 9 and AWWA Manual of Practice M55, Chapter 6.

C. Minimum Bending Radius: Wherever it is necessary to deflect pressure pipe from a straight line, either in the vertical or horizontal plane, to avoid obstruction or plumb valve stems, or where long radius curves are permitted, the bending radius shall not be less than 31 times the pipe diameter (in feet) or as recommended by the manufacturer and shall be approved by Charlotte Water.

Pipe Dia. (in)	SF	Minimum Bending Radius (ft)	Pipe Dia. (in)	SF	Minimum Bending Radius (ft)	Pipe Dia. (in)	SF	Minimum Bending Radius (ft)
2	31	6	12	31	32	24	31	62
3	31	8	14	31	38	26	31	68
4	31	12	16	31	42	28	31	74
6	31	16	18	31	48	30	31	78
8	31	22	20	31	52	32	31	84
10	31	26	22	31	58			

D. Ductile Iron Pipe shall be installed when the minimum cover is less than 3.0 feet and in all crossings of other pipelines (storm drainage, gas, etc.) when the vertical distance between the water main and the other pipeline is less than 12-inches.

E. Tracer wire and warning tape shall be installed in accordance with the Standard Details and as specified in these specifications.

3.8 INSTALLING VALVES AND FITTINGS

A. Valves and fittings shall be installed in the manner specified for installation and assembly of pipe. Valves and hydrants shall be installed at locations shown on the plans and/or as directed by the Engineer.

1. Valve Boxes: Valve boxes shall conform to the Standard Details. The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the operating nut, with the box cover flush with the surface of the pavement or other existing surface.

    a. Where the box is not set in pavement, the top section shall be anchored by an 18" x 18" x 6" concrete pad, or an approved pre-cast concrete pad, set flush with the existing terrain. The top section will be grouted into the pre-cast concrete pad, the full depth of the concrete pad. The location of valves will be identified by the letter "V" cut/imprinted into the curb adjacent to mainline or valve. The ”V” shall point directly toward the valve/box.

2. Valve Blocking: All end of line valves 12-inch and smaller installed on PVC or DIP force mains and all 12-inch valves installed along PVC force mains shall be securely wedge blocked with concrete bearing against and cut into the excavated sides of the trench. Care shall be taken in forming and pouring the "wedge" blocking so the fitting joints will be accessible for repair and/or valve extraction.

3. Blocking Fittings: All plugs, caps, tees, and bends deflecting 11-1/4 degree or more on pressure mains 6" in diameter or larger shall be provided with thrust blocking, placed as shown on the Plans and/or as directed by the Engineer. Thrust blocking shall consist of ready-mix concrete having a compressive strength of not less than 3,600 lbs. per square inch at 28 days.

a. Bagged mix concrete may be used for blocking, anchorage, concrete valve pads, etc. on water mains and valves 12-inches and smaller, when less than 1/2 yard is required.

b. Blocking shall be placed between solid ground and the fittings to be anchored. The area of bearing on the pipe and on the ground in each instance shall be that shown or directed by the Engineer. The blocking shall be so placed that the pipe and fittings will be accessible for repair.

4. Restrained Joints: Restrained joints shall be installed where shown on the plans, standard details or when directed by the Engineer, and may be installed in lieu of blocking. Installation shall be per manufacturer's recommendations, as shown on the plans, special provisions, and/or as directed by the Engineer.

5. Gasket Joint Restraint: Gasket joint restraint may be used on ductile iron pipe 12-inch and smaller only. Gasket joint restraint shall be installed where shown on the plans, standard details or when approved by the Engineer. Restrained lengths on each side of the fittings shall be as shown on the plans, or as approved by the Engineer. Installation shall be as per the gasket and pipe manufacturer's recommendations. Gasket joint restraint is prohibited for use in above ground applications, such as bridge crossings. Gasket joint restraint is prohibited for use in directional drilling applications. When used in conventional straight casings, gasket joint restraint shall be installed per the manufacturer's recommendations by pulling, not pushing, the pipe through the casing. Gasket joint restraint is prohibited for use at end of line plugs. Gasket joint restraint will not be allowed on PVC pipe.

3.9 INSTALLATION OF MAGNETIC FLOW METERS

A. The Contractor shall furnish, test, install and place in satisfactory operation the magnetic flow meters, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

B. Install magnetic flow meter in location as indicated on Construction Drawings per the standard details and in accordance with manufacturer's installation guidelines.

C. Ground magnetic flow meter flow tubes and grounding rings in strict accordance with the manufacturer's recommendations.

D. Magnetic flow meter to be calibrated with written report documenting calibration procedure.

E. Witness Testing: Witness testing will be required by Charlotte Water for the magnetic flow meter. All costs associated with witness testing shall be borne by the bidding contractor, except Charlotte Water will cover travel expenses for its own personnel. The results of all witness testing shall be maintained as part of the construction record documentation.

3.10 INSTALLATION OF TRACER WIRE, PIPE MARKING, AND IDENTIFICATION

A. Tracer Wire System: A single conductor 12-gauge solid copper wire with 30 mil HDPE green insulation shall be laid on top of the pipe to aid in locating the pipe for maintenance purposes. The copper conductor wire shall conform to ASTM B-3.

1. This wire shall be secured to the pipe with duct tape (2-inches in width) near every bell and at 10-foot intervals of each pipe joint. The wire shall NOT be fastened to valves. The wire shall be a single continuous conductor structure to structure. When the distance between structures exceeds 500 feet, splices will be permitted at 500 feet (or greater) intervals. The splice shall be made watertight as approved by the Engineer, per the standard details. Splices shall be isolated from direct tension on the wires by knotting the wires together, using a two-wire overhand knot, approximately 6 to 12 inches from the splice. The maximum distance between tracer wire terminal points or structures shall be 750 linear feet.

2. When wire splices are required, the splices shall be securely bonded together with an approved industrial connector to provide electrical continuity. Connector shall be copper, and insulation shall be repaired as detailed to seal out moisture and corrosion and shall be installed so as to prevent any uninsulated wire exposure. See Standard Details.

3. Valve boxes, for the purposes of this section, shall be defined as mainline valves, which require a standard valve box. At valve boxes, the wire shall be installed along the outside of the valve box assembly from the pipe to the top section of the valve box. The vertical wire shall be installed in an HDPE conduit as shown on the standard detail. The wire shall enter the valve box assembly, directly below the top section of the valve box. The wire shall extend through the top section and shall terminate 24 inches above the top section. This excess wire shall be coiled and stored in the top section, directly below the valve box cover. At air release vaults, the wire shall be installed per the standard detail. Tracer wire terminal point requirements are shown on the standard details.

4. Contractor shall perform post installation testing of the tracer wire system to confirm conductivity from structure to structure on a daily basis during construction. Immediately prior to, or during the final inspection, the Contractor shall perform post installation testing of the tracer wire system to confirm conductivity from structure to structure. The test shall consist of applying an alternating High/Low tone voltage to the conductor at one structure and testing the conductor at the next structure with a Fluke Networks PRO3000 Tone Generator and Probe Kit or approved equal. The testing shall be witnessed by the Engineer. The repair or replacement of any defective or improperly installed systems shall be the responsibility of the Contractor. Any and all repairs or replacement of defective or improperly installed tracer wire systems shall be performed by the Contractor and at no cost to the Engineer. Method of repairs or replacement shall be subject to approval of the Engineer. Upon acceptance by the Engineer, the wires in each valve box shall be connected together with a wire-nut wire connector, coiled and stored in the top section, directly below the valve box cover.

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

3.11 INSTALLATION OF SUBMERSIBLE PUMPING STATION EQUIPMENT

A. All equipment shall be carefully handled and protected from damage while in storage and during installation. Equipment shall be protected from the weather at all times. Equipment damaged by the weather, handling or construction shall be immediately repaired or replaced to the Engineer's satisfaction.

B. Equipment shall be installed in strict accordance with the manufacturer's instructions and approved shop drawings, and in accordance with all OSHA, local, state, and federal codes and regulations.

C. Equipment manufacturer shall furnish all instruction and assistance necessary for proper installation of all equipment specified herein. After installation, a qualified service representative of the equipment manufacturer shall inspect the complete installation and adjust as needed prior to scheduling a Charlotte Water representative to witness performance testing and place the equipment in permanent operation after Charlotte Water approval.

D. Suitable backfill around the wetwell and valve vault shall be compacted to 95% of max. dry density as determined by the standard Proctor curve (ASTM D-698). Foundation subgrade for these structures shall be compacted to 100% of Max. dry density. All fill material shall be non-plastic in nature and free of roots, vegetative mater, waste, construction material, rocks, or other objectionable matter. Materials deemed unsuitable by the inspector shall be removed and replaced with suitable fill. Density testing requirements and test reports to be furnished by the engineer.

3.12 INSTALLATION OF PUMPING STATION SECURITY FENCING

A. Fencing shall be installed true to the line and grade indicated or directed. Fabric shall be pulled tight and shall maintain an even clearance above grade. Unless otherwise specified, fencing shall be installed in strict accordance with the manufacturer's instructions. At ditches and low points, rods, bars, or extra fabric shall be used to close the area. All fittings necessary to make a complete installation are to be malleable iron, pressed steel, or aluminum. All ferrous material shall be hot dip galvanized to insure uniform heavy zinc coating. Concrete shall be 3600 pounds per square inch (psi) minimum strength.

3.13 INSTALLATION OF EMERGENCY AND STANDBY POWER SYSTEMS

A. Shop Drawings, Manuals & Submittals: Drawings with dimensions, details, and instructions necessary for installation of the generating unit and accessories shall be submitted prior to the purchase of any equipment. Such documents shall indicate compliance with performance specifications for loads served. The Contractor shall furnish 2 sets of hard copy and 1 set of electronic, in PDF format, of dimensional drawings along with installation, operation, maintenance, troubleshooting, and repair instructions at start-up.

B. Personnel Instructions: Provisions shall be made for instruction of Owner's operating personnel during the construction period, and a concentrated instruction course during the final check and acceptance test stages. Charlotte Water reserves the right to require up to 8 hours of field training. All costs shall be covered by the contractor.

C. Field Tests: The engine generator sets shall first be broken in, in accordance with the recommendations of the Engine Manufacturer, and all safeties checked. After

this the set shall be run two hours at 75% rated load, and then immediately after by two hours at 100% rated load. Voltage performance shall be verified. Any problems or deficiencies found shall be corrected and test repeated until satisfactory. All required instrumentation for testing shall be provided.

D. Fuel: Upon installation of the tank, the Electrical Contractor shall fill the tank with No. 2 diesel fuel and refill the tank at completion of testing and operation just prior to acceptance of the Project.

3.14 TESTING AND INSPECTION

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

B. Force Main Testing:

1. Prior to testing any segment of force main, care shall be taken to prevent the pipe from moving while under pressure.

2. All testing shall be performed in the presence of an authorized Charlotte Water representative.

3. The results of all testing shall be maintained as part of the construction record documentation.

4. A hydrostatic pressure test shall be performed on each segment of installed force main after the force main has been backfilled.

5. The following procedures shall be followed in performing hydrostatic pressure tests on force mains:

   a. The force main segment shall be carefully filled with water so that air is eliminated from the system. Once full of water, the force main segment shall be pressurized and allowed to stabilize at a minimum test pressure of 200psi or 1.5 times the maximum design pressure of the force main pipe material, whichever is greater. This pressure shall be maintained within 5 psi for a minimum of two hours per AWWA C600 and C605 testing procedures for water mains.

6. Testing allowance (makeup water) shall be measured with a calibrated ultrasonic test meter furnished by Charlotte Water and shall not exceed the amount given by the following formula:

$$L = \frac{SD\sqrt{P}}{148{,}000}$$

L = testing allowable makeup water (gallons per hour)

S = length of pipe under test (feet)

D = nominal diameter of pipe segment tested (inches)

P = test pressure (pounds per square inch)

a. All visible leaks shall be repaired regardless of the amount of make up water. If make up water leakage exceeds this rate, the contractor is responsible for assuring that the cause of test failure is determined, all necessary repairs are made, and repeating the test until the force main segment passes. The repair method is to be submitted to and approved by the Engineer.

C. Pump Testing:

1. Factory Testing: All pumps shall be tested by the manufacturer in accordance with the appropriate Hydraulics Institute standard prior to shipment for installation and the results of all factory testing shall be reviewed by Charlotte Water for compliance with specified requirements and maintained as part of the construction record documentation.

2. Drawdown Testing: Following installation, each pump in the pump station shall be subjected to drawdown and "shut-off" head tests to verify that pump performance meets the design criteria with a full, operational force main. Surge pressure will also be measured.

3. These tests shall be performed in the presence of an authorized Charlotte Water representative and in conjunction with other instrumentation and control testing.

4. The results shall be maintained as part of the construction record documentation.

5. Witnessed Testing: Witnessed testing may be required by Charlotte Water for large pumps (greater than 2 MGD or 100 HP) or critical installations. Witnessed testing, if required, shall be fully detailed on the bid documents and shall require all costs for such testing be borne by the bidding contractor The results of all witnessed testing and a video of said testing shall be maintained as part of the construction record documentation.

a. Charlotte Water reserves the right to witness test on donated projects at the direction of the Engineer. Charlotte Water will be responsible for the cost of travel.

D. Pump Station Watertightness Testing:

1. Wet wells and all other wastewater containment structures at the pump station shall be inspected and tested for watertightness. The watertightness test shall be performed in the presence of a Charlotte Water authorized representative.

2. The watertightness test shall be performed in accordance with ACI (American Concrete Institute) 350.1R "Testing Reinforced Concrete Structures for Watertightness" for cast-in-place wetwells.

3. After backfilling, wetwells shall be filled with water and allowed to saturate over 24 hours. Then the level will be noted at two places 180 degrees apart at the edge of the access hatch opening. Over the next 24 hours no visible leakage is permitted. A vacuum test method, prior to backfilling, in accordance with ASTM C1244 "Standard Test Method for Concrete Sewer Manholes by Negative Test Pressure (Vacuum) Test" must be passed in conjunction with a hydraulic test.

a. Testing shall not commence until the structure being tested has been fully assembled and backfilling is complete unless the pump station wet well is constructed of cast-in-place concrete.

b. All inlets and outlets in the structure shall be temporarily plugged and braced or otherwise sealed prior to initiating the test.

c. Pump station wet wells that fail to meet the watertightness test requirements shall be inspected, made watertight, and retested until the test passage is assured. Proposed repair methods shall be submitted to the engineer for review and approval. Repairs shall be witnessed by the inspector unless otherwise approved by the engineer.

4. The results of all watertightness testing shall be maintained as part of the construction record documentation.

E. Electrical and Instrumentation/Control System Testing:

1. All start-up sessions shall be scheduled at least 72 hours in advance with the Pump Station Supervisor. The design engineer, pump and control panel representative(s), Electrical, and General contractors shall be present with the Charlotte Water representative. A preliminary test prior to the “official” test is required. Testing shall commence within one hour of appointed time or be rescheduled.

2. The Contractor is responsible for testing the pump as follows:

a. Check incoming voltage prior to energizing panel or pumps.

b. Place the operating mode switch in the off position.

c. Check motor resistance readings.

d. Fill wet well with water.

e. Manually start and stop each pump sequentially and then both pumps together.

f. With water level lower than pump’s “shut-off” point, place selector switches in “auto” position.

g. Fill wet well slowly and observe lead pump start, pump down, and shut off at proper level.

h. Check lead pump motor current.

i. Increase water level so that lag pump starts, pumps, and shuts off at proper level.

j. Check lag pump motor current.

k. Level control points for lead / lag on and lead/ lag off should be at least 6-inches apart.

l. Disconnect power to pumps and fill well to alarm level to verify operation of visual, audible, and telemetry alarms. Verify that “alarm on” level is at least 6-inches above the “lag on” level.

m. Disconnect level controller and verify that pumps are turned on and off at proper levels by the float switches.

n. Verify that lead and lag pumps alternate.

o. Measure pump operating head and “shut-off’ head and perform a timed drawdown test to verify that actual performance of each pump meets the design criteria.

p. Verify that emergency back-up power systems function and will operate both all pumps simultaneously.

q. Verify that the UPS system operates the alarm and telemetry systems.

r. Verify that submersible pumps are properly seated.

s. Verify the proper time delays between pump starts and adjust, if applicable.

t. Check other controls as necessary by design.

u. Test phone and alarm dialer / telemetry alarms and other alarms as required by design.

3. The results of all testing shall be made part of the construction record documentation. Any changes or modifications will be updated in the O&M manual.

3.15 REPAIRS

A. The Contractor shall make any needed repairs to newly installed unactivated mains and shall notify the Owner and Engineer of the repairs. A representative of the Owner shall be on site during repairs. Repairs to existing and/or activated mains will be made by Charlotte Water unless the Contractor is otherwise directed by the Engineer.

1. Repairs to New mains: Repairs shall be made by cutting out and removing the damaged/defective section and replacing those with new pipe using long pattern solid sleeves to connect plain ends. Bell clamps will not be allowed to repair newly installed.

2. Repairs to Existing Mains: The Contractor will not be required to repair existing mains unless specifically directed by the Engineer or specified elsewhere in these specifications. Repair methods will be considered on a case-by-case basis by the engineer.

3. Repairs to Wetwells: Repairs shall be made in accordance with repairs to “Wetwells” as indicated in Part 3 of the Chapter 11 Gravity Sewer Specifications.

3.16 CONTRACTOR RECORD DRAWINGS

A. The Engineer shall provide the Contractor PDFs to use as the Contractor Record Drawings. Record Drawings shall be maintained rolled or flat and shall not be folded. Defaced or damaged sheets shall not be accepted. The Record Drawings shall be annotated using Bluebeam, by the Contractor, to show all changes encountered or made during the construction of proposed facilities. Record Drawings should be submitted to the Engineer upon completion of construction of facilities required by each sheet, but no less often than once a month. Record

Drawings shall be subject to approval pending review by the Engineer and Charlotte Water Inspector. Review and approval shall consist of a review for accuracy and completeness, based on the Inspector's knowledge of the project, and based on the minimum requirements indicated below. Record Drawings which are not approved by the Engineer shall be returned to the Contractor for explanation, revision, or correction as deemed necessary by the Engineer.

B. Record Drawings shall meet the following minimum requirements and standards:

1. General to all projects:

a. Annotations shall be in red ink or red pencil only.

b. Annotations shall be neatly printed and legible.

c. Add existing facilities encountered but not shown on plans.

d. Revise existing facilities encountered differently from plans.

e. Traffic control, erosion control and other temporary facilities shall not be recorded.

f. Mark through changed stations, bearings, distances, slopes, etc., and print actual station, bearing, distance, slopes, etc.

g. Mark through "proposed" for items that were actually installed.

h. Mark completely through items that were proposed but were not installed.

i. Correct notes, sizes, diameters, dimensions, classes, types, etc. to actual as installed.

j. Revise profile of proposed facilities to within 0.1 feet of actual vertical and within 1.0 feet of actual horizontal, based on contractor field survey of each pipe joint.

k. Revise plan view of proposed facilities to within 1.0 feet of actual.

l. The following sheets are excluded, and do not require updating by the Contractor:

m. Cover Sheet, Permit Sheet. Vicinity/Location Map Sheets

n. Traffic Control Sheets, Erosion Control Sheets

o. Standard Detail Sheets

2. General to all new force main projects:

a. Indicate pipe manufacturer, type and class of pipe.

b. Indicate station for transition in pipe materials.

c. Indicate restraint type, manufacturer, and beginning and ending stations in profile, or on plan views without profiles.

d. Indicate bedding type and location in profile, or on plan views without profiles.

e. Indicate solid ledge rock in profile to within 0.1 feet of actual vertical and within 1.0 feet of actual horizontal, or on plan views without profiles.

f. All fittings, valves, air releases, casings, tunnels, etc. shall be stationed.

g. Indicate survey grade northing and easting coordinates for all appurtenances and provide GPS locations along the main.

h. At air releases, indicate station for tee or plug, control valve and standpipe. Detail required, if not directly adjacent to the main.

i. At ALL valves, indicate valve manufacturer, model, and actual number of turns to operate.

j. At ALL valves, indicate if valve extension stem was installed, and actual height of extension stem (valve nut to operating nut length, measured to closest 0.1 feet).

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

3.17 FINAL INSPECTION

A. A final inspection will be held for each assigned project once construction and complete restoration has been completed. The Contractor SHALL ATTEND the final inspection. During the final inspection, all structures shall be opened and inspected, all valves and air releases shall be inspected and operated. On pressure sewer projects, the Contractor will provide a means and method to capture all sewer water discharged from the main and shall dispose into a manhole under the direct supervision of the Inspector. All other features of the project, either constructed or reconstructed, shall also be inspected. The Contractor shall be responsible for providing equipment and labor, as may be necessary, to conduct the final inspection and to provide a safe worksite. Deficiencies, if any, shall be noted for correction by the Contractor. The Contractor will schedule the work with the Inspector. Any and all corrective actions necessary to correct a deficiency noted at the final inspection shall be completed prior to acceptance of the work.

END OF SECTION

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SEWER LIFT STATION AND FORCE MAIN DETAILS
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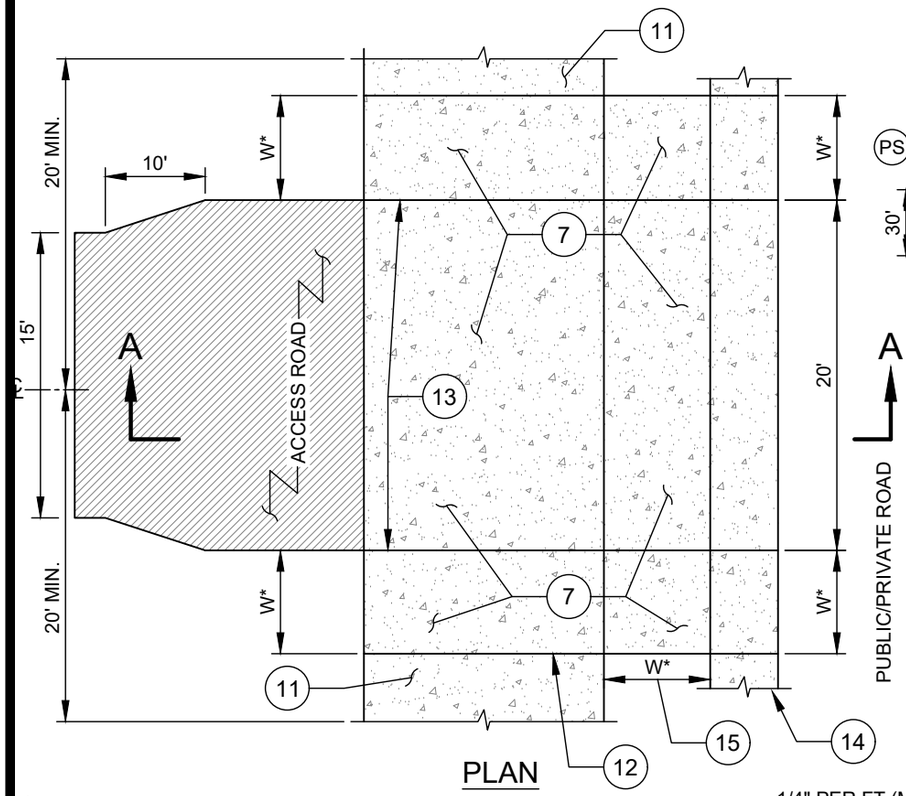
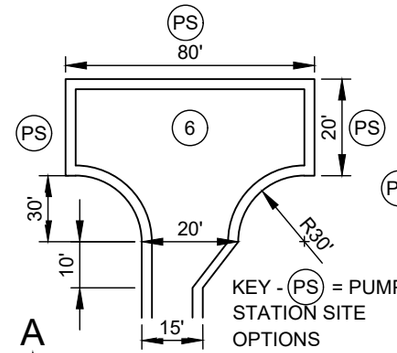


PLAN



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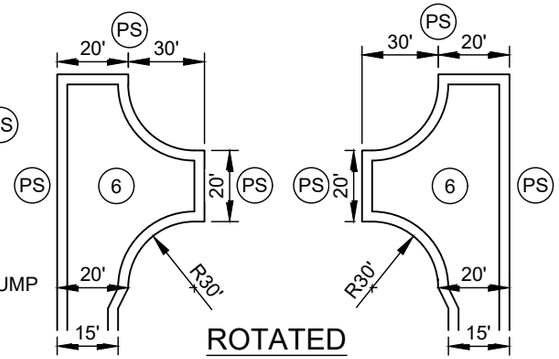
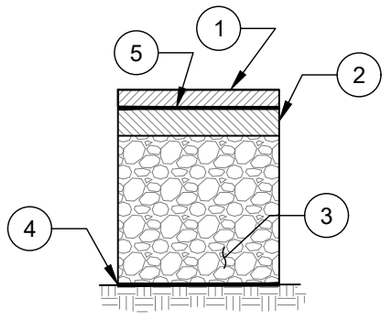
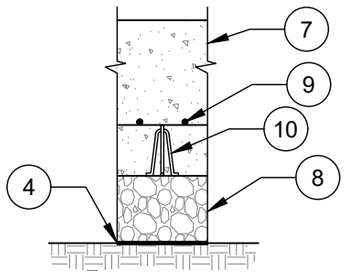


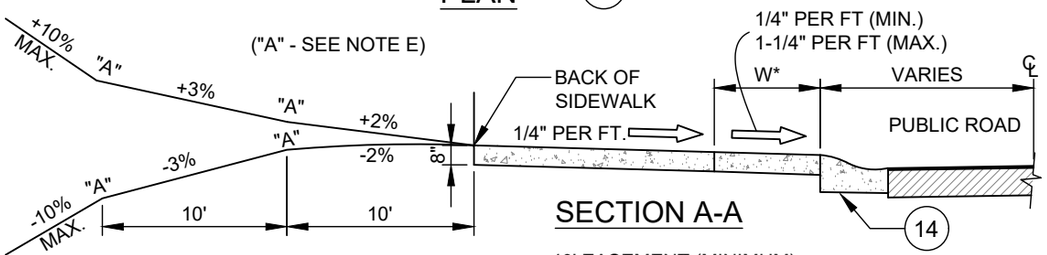
ROTATED HAMMERHEAD



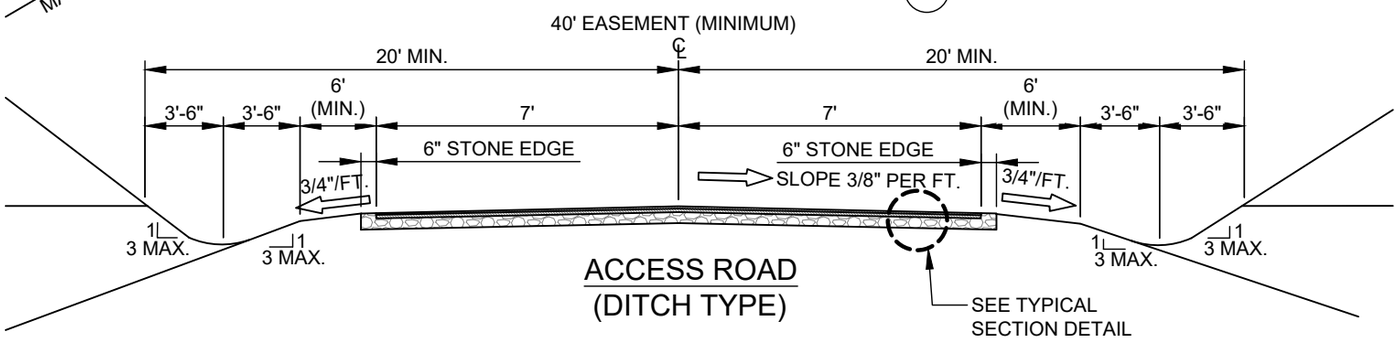
TYPICAL PAVEMENT SECTION TYPE I



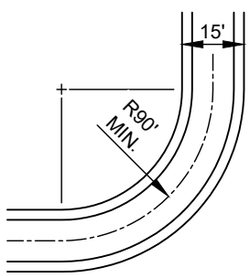
TYPICAL CONCRETE SECTION TYPE II



SECTION A-A



ACCESS ROAD (DITCH TYPE)



ACCESS ROAD CURVE RADIUS REQUIREMENT

NO.	DESCRIPTION:
1.	SURFACE COURSE 1" SF9.5B : FINAL LIFT TO BE APPLIED AFTER INITIAL PUMP START UP.
2.	INTERMEDIATE COURSE: 1 1/2" S9.5B INSTALL PRIOR TO INITIAL PUMP START UP.
3.	BASE COURSE: 8" COMPACTED AGGREGATE BASE COURSE (CABC), OR 4" BITUMINOUS CONCRETE BASE COURSE (BCBC) TYPE B25.0C.
4.	GEOTEXTILE FABRIC UNDER STONE.
5.	TACK COAT.
6.	HAMMERHEAD - 0" - 1/4" PER FT. SLOPE AWAY FROM P.S. SITE.
7.	SURFACE COURSE - 8" CONCRETE - f 'c = 3,600 PSI MINIMUM.
8.	BASE COURSE - 4" COMPACTED AGGREGATE BASE COURSE (CABC).
9.	WELDED WIRE FABRIC (WWF) - 6 X 6, W2.9 X W2.9.
10.	2" CHAIR, PLASTIC OR STEEL, SPACING PER MANUFACTURER'S REQUIREMENTS, OR AS NEEDED.
11.	CONCRETE SIDEWALK.
12.	GROOVE JOINT (TYP).
13.	1/2" EXPANSION JOINT (TYP).
14.	STANDARD 2' VALLEY GUTTER.
15.	*W = WIDTH OF PLANTING STRIP (VARIES).

NOTES:

A. SEE PUMP STATION SPECIFICATIONS FOR ADDITIONAL ACCESS ROAD DESIGN STANDARDS/REQUIREMENTS.

B. TYPE I PAVEMENT SECTION REQUIRED WHEN ACCESS ROAD SLOPE IS BETWEEN 0% AND 10%.

C. TYPE II CONCRETE SECTION REQUIRED WHEN EXISTING OR PLANNED ADJACENT DRIVEWAYS ARE CONCRETE.

D. STORM WATER MAY NOT CROSS OVER ROADWAY - PROVIDE DRAINAGE FACILITIES AS NECESSARY.

E. "A" BREAKOVER SHALL BE 7% OR LESS (A = ALGEBRAIC DIFFERENCE).

F. CENTERLINE ROAD PROFILE REQUIRED WITH RECORD DRAWINGS.

G. HAMMERHEAD AREA SHALL BE FLAT UNLESS UNLESS A MAX SLOPE OF 2 PERCENT IS APPROVED.

H. CONCRETE ACCESS ROAD EXTENDS ALL THE WAY TO THE PUMP STATION OR MAY BE APPROVED ONLY TO THE REAR LOT BUILDING SETBACK, AND THEN

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SEWER LIFT STATION

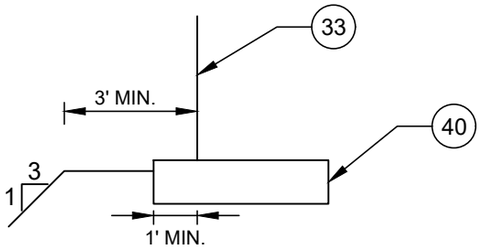
ACCESS ROAD STANDARDS AND DETAILS

NO SCALE

VERSION 3.0

DATE 01/2026

DETAIL 13.1



SECTION A-A

NO. DESCRIPTION:

1. ELECTRIC SERVICE.
2. MAIN DISCONNECT TO BE CIRCUIT BREAKER.
3. OPENINGS IN PAD BELOW EQUIPMENT. CUT OUT OPENING NEEDED FOR CONDUITS UNDER PCP.
4. AUTOMATIC TRANSFER SWITCH.
5. TRANSFORMER.
6. CABLE TRAY SYSTEM PER CLTW REQUIREMENTS (SEE TRAY REQUIREMENTS IN ELEC. SPECIFICATIONS).
7. 3" OR 4" X 3/4 OR 1" HDPE SERVICE SADDLE WITH BRASS CC OR IPS OUTLET, CORP STOP, 3/4" OR 1" TYPE K COPPER WATER SERVICE LINE, OR SDR 9 HDPE WHEN APPROVED BY CLTW.
8. FREESTANDING PUMP CONTROL PANEL.
9. UNDER CANOPY AND STATION AREA LIGHT.
10. EXPLOSIVE HAZARD BOUNDARY WITHIN A 5' SPHERICAL RADIUS FROM VENT OPENINGS PER NFPA 820.
11. PRECAST CONCRETE, POLYMER CONCRETE, HDPE OR FIBERGLASS WET WELL.
12. 3 - 3/4" CONDUITS FOR FUTURE SUMP PUMP, ODOR CONTROL, AND SCADA WIRING.
13. EXPLOSIVE HAZARD EXTENDING FROM ACCESS HATCH 18" UP AND 3' OUT FROM ALL EDGES PER NFPA 820.
14. UNCLASSIFIED ZONE.
15. HAZARDOUS ZONE.
16. WET WELL ACCESS HATCH-ALUMINUM.
17. VENT OPENINGS.
18. PRECAST CONCRETE VALVE VAULT. EXPLOSIVE HAZARD WITHIN VALVE VAULT PER NFPA 820.
19. PRECAST CONCRETE EMERGENCY PUMP CONNECTION VAULT.
20. PRECAST CONCRETE MAGMETER VAULT.
21. YARD HYDRANT. SEE DETAIL.
22. MUELLER 2.5" SINGLE OR DOUBLE OUTLET POST YARD HYDRANT, 3' BURY, WITH 3" OR 4" FLANGE SHOE, 3" OR 4" FL X RMJ OPEN RIGHT GV, 3" OR 4" HDPE MJ X BUTT FUSION ADAPTOR.
23. MIN 2 PERCENT INFLUENT DIP PIPE SLOPE. INVERT SET 24" ABOVE HIGH WATER ALARM ELEVATION.
24. INFLUENT MANHOLE WITH INSIDE DROPS AS NEEDED.
25. ELECTRICAL POWER METER.
26. DIESEL GENERATOR SET.
27. START SIGNAL GOES FROM GENERATOR TO AUTOMATIC TRANSFER SWITCH.
28. GENERATOR FAULT AND RUN SIGNALS GO FROM GENERATOR TO PUMP CONTROL PANEL.
29. UTILITY AND EMERGENCY SIGNALS GO FROM AUTOMATIC TRANSFER SWITCH TO PUMP CONTROL PANEL.
30. RADIATOR EXHAUST.
31. GENERATOR BATTERY CHARGER AND JACKET HEATER CIRCUITS GO FROM GENERATOR TO PUMP CONTROL PANEL.
32. 16' MIN. GATE OPENING.
33. FENCE (8' TALL CHAIN LINK FENCE WITH 1 FOOT TALL BARBED WIRE TOP).
34. RMJ X RMJ PLUG VALVE WITH VALVE BOX ASSEMBLY (TYP.) FLUSH WITH EXISTING GRADE.
35. GENERATOR BATTERY(S) TO BE INSTALLED OUTSIDE GENERATOR ENCLOSURE IN A WEATHERPROOF BOX TO FACILITATE REPLACEMENT.
36. 3" OR 4" SDR 9 HDPE PRIVATE WATER LINE.
37. ELECTRICAL CONDUIT FROM CONTROL PANEL TO THE BACKFLOW ASSEMBLY, MIN DEPTH 2', WITH WARNING TAPE 12" DEEP, MIN 1" DIA CONDUIT, MIN #10/2 AWG. ELECTRICAL ENGINEER MUST CERTIFY THE REQUIRED WIRE GAUGE BASED ON WATTAGE LOADING AND LENGTH OF THE WIRING TO THE BACLFLOW ASSEMBLY.
38. 5' X 5' X 6" REINFORCED CONCRETE PAD FOR FUTURE ODOR CONTROL.
39. 2" RPZ BACKFLOW ASSEMBLY AT ROAD ROW, AND 2" WATER METER AT PUBLIC WATER MAIN.
40. 6" ABC W/ STABILIZATION WEED BLOCK FABRIC, TOPPED WITH 2" #57 WASHED STONE.

NOTES:

A. ALL COMPONENTS WITHIN FENCING SHALL BE 5' MINIMUM FROM FENCE. TRANSFORMER MUST ALSO BE 5' FROM FENCE.

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SEWER LIFT STATION

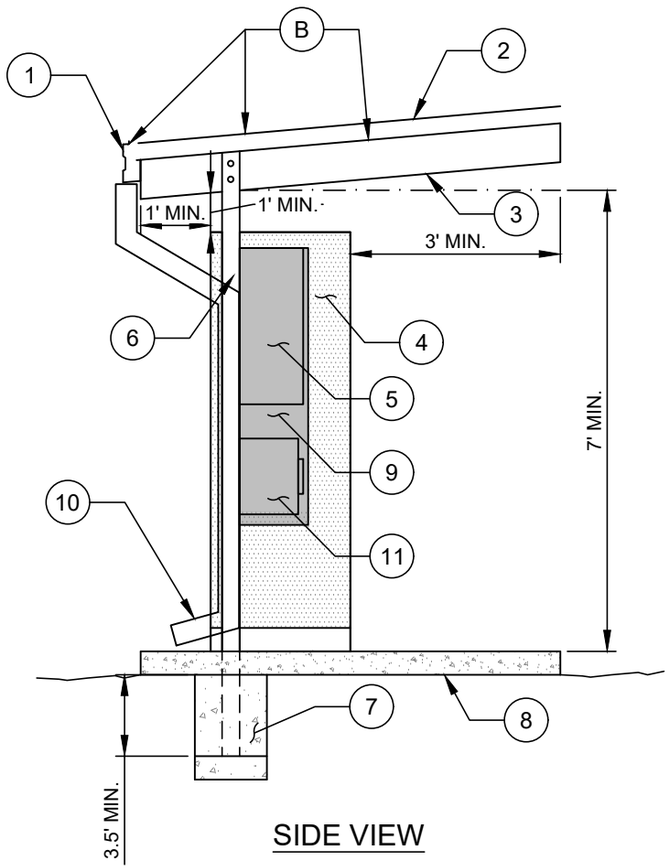
SUBMERSIBLE STATION SAMPLE LAYOUT

NO SCALE

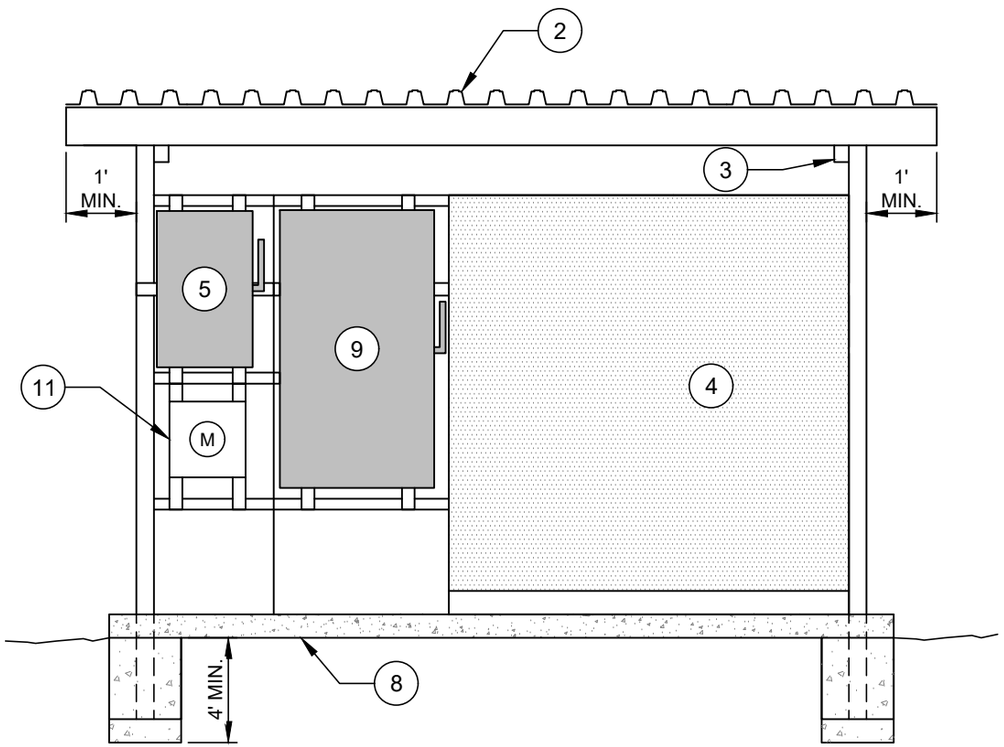
VERSION 2.0

DATE 01/2025

DETAIL 13.2



SIDE VIEW



FRONT VIEW

NO. DESCRIPTION:

1. GUTTER, ALONG LENGTH OF BACK OF ROOF.
2. ROOF PANEL, 15 DEGREE SLOPE.
3. CHANNEL BEAM.
4. PUMP CONTROL PANEL.
5. MAIN DISCONNECT SWITCH.
6. 3" (MIN.) SQUARE STEEL POST 14 GA (MIN.) POWDER COAT FINISH. COLOR SHALL BE GRAY, GALVANIZED, OR WHITE.
7. 3600 PSI REINFORCED CONCRETE FOOTING.
8. 3600 PSI REINFORCED CONCRETE PAD - MIN. 8" THICK.
9. AUTOMATIC TRANSFER SWITCH.
10. GUTTER DOWNSPOUT. DIRECT AWAY FROM ENCLOSURE AND SHELTER PAD.
11. POWER METER.

NOTES:

A. STRUCTURE INCLUDING ALL PANEL AREAS AND FOOTING SHALL BE DESIGNED TO WITHSTAND 100 MPH WIND LOAD.

B. ROOF PANEL, CHANNEL BEAM AND GUTTERS SHALL ALL BE ALUMINIUM.

C. ADDITIONAL CONTROL PANELS NOT SHOWN MAY BE REQUIRED.

D. ROOF DECK STRUCTURE AND FOOTING SHALL BE DESIGNED TO WITHSTAND 100 MPH WIND LOAD.

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SEWER LIFT STATION

CONTROL PANEL SHELTER

NO SCALE

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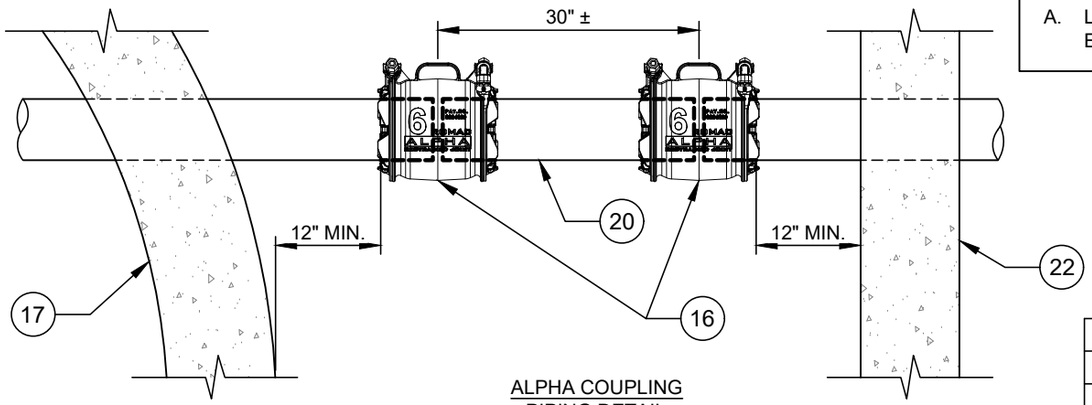
DETAIL
13.3

NOTES:

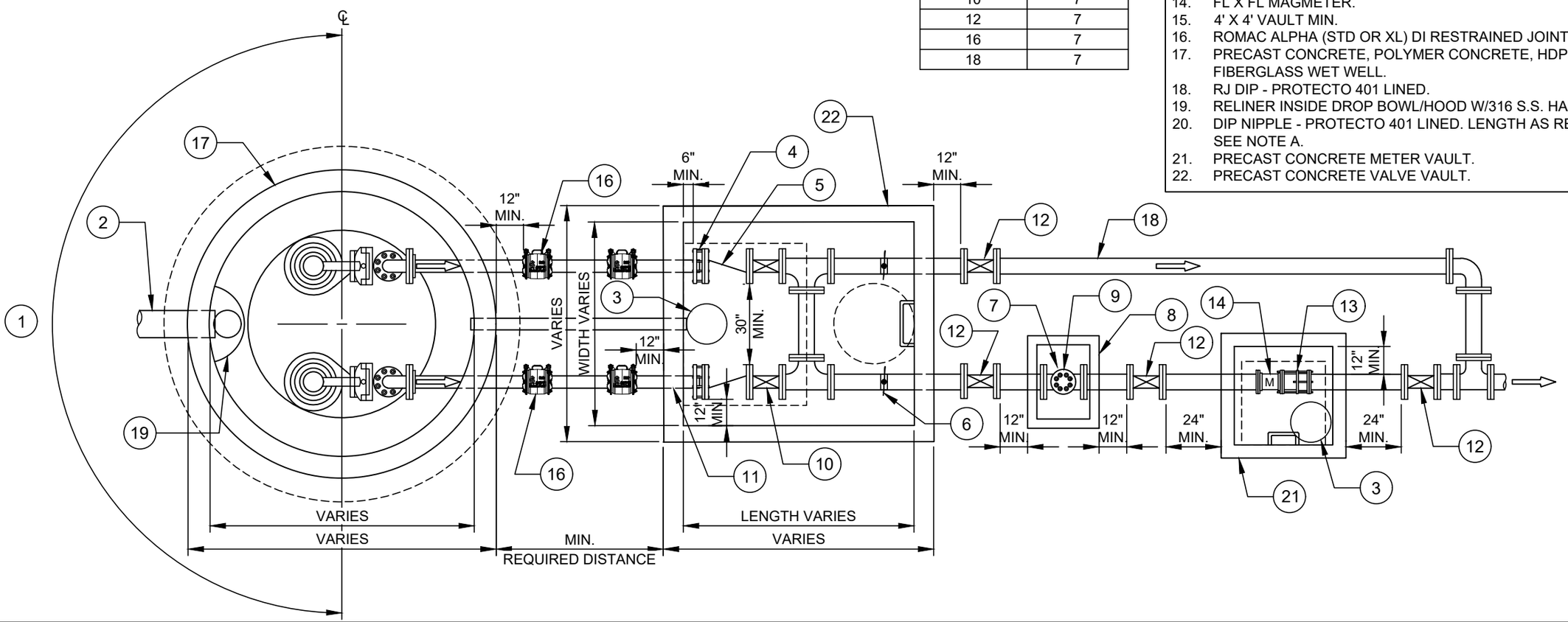
A. LEAVE 1" - 2" GAP BETWEEN PIPE ENDS IN COUPLING CENTER.



ALPHA COUPLING
PIPING DETAIL

REQUIRED DISTANCE	
PIPE DIA. (IN.)	FT
4	6
6	6
8	6
10	7
12	7
16	7
18	7

NO.	DESCRIPTION:
1.	ALLOWABLE INFLUENT ENTRY AREA.
2.	INFLUENT DIP SANITARY SEWER MIN. 2% SLOPE.
3.	18" DIAMETER SUMP - PVC OR DIP PIPE, GROUTED INTO BASE FLOOR.
4.	MEGA FLANGE.
5.	SWING CHECK VALVE WITH EXTERNAL LEVEL AND WEIGHT FOR SEWAGE SERVICE TAP C/V LIDS 1/4" NPT WITH 1/4" BALL VALVE.
6.	1" BRONZE CORPORATION STOP AND S.S. SERVICE SADDLE.
7.	EMERGENCY PUMP CONNECTION. SEE APPROPRIATE DETAIL.
8.	2' X 3' PRECAST CONCRETE VAULT.
9.	RMJ X RMJ X FL TEE WITH RISER AND FL X FL PLUG VALVE (IN BOX) WITH BLIND FLANGE AND 1/4" BALL VALVE ON TOP OF PLUG VALVE.
10.	FL X FL PLUG VALVE.
11.	BOOT (TYP).
12.	RMJ X RMJ PLUG VALVE WITH VALVE BOX ASSEMBLY (TYP.) FLUSH WITH EXISTING GRADE.
13.	FL X FL DISMANTLING JOINT.
14.	FL X FL MAGMETER.
15.	4' X 4' VAULT MIN.
16.	ROMAC ALPHA (STD OR XL) DI RESTRAINED JOINT COUPLING.
17.	PRECAST CONCRETE, POLYMER CONCRETE, HDPE OR FIBERGLASS WET WELL.
18.	RJ DIP - PROTECTO 401 LINED.
19.	RELINER INSIDE DROP BOWL/HOOD W/316 S.S. HARDWARE.
20.	DIP NIPPLE - PROTECTO 401 LINED. LENGTH AS REQUIRED. SEE NOTE A.
21.	PRECAST CONCRETE METER VAULT.
22.	PRECAST CONCRETE VALVE VAULT.



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SEWER LIFT STATION

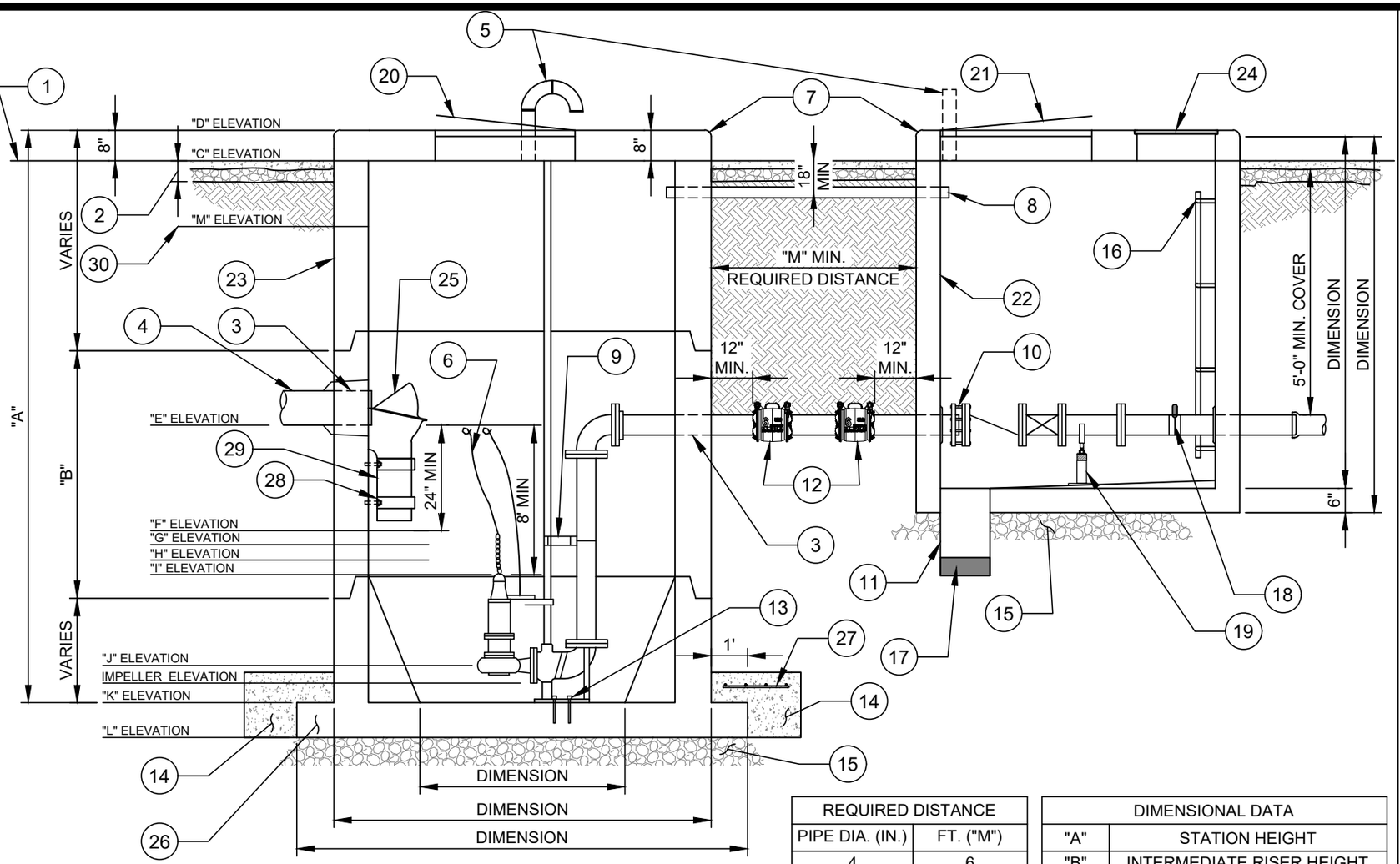
SUBMERSIBLE STATION PLAN VIEW

NO SCALE

VERSION 3.0

DATE 01/2026

DETAIL 13.4



REQUIRED DISTANCE	
PIPE DIA. (IN.)	FT. ("M")
4	6
6	6
8	6
10	7
12	7
16	7
18	7

DIMENSIONAL DATA	
"A"	STATION HEIGHT
"B"	INTERMEDIATE RISER HEIGHT
"C"	FINISHED GRADE ELEVATION
"D"	TOP OF WET WELL ELEVATION
"E"	INVERT OF INFLUENT ELEVATION
"F"	HIGH WATER ALARM ELEVATION
"G"	LAG PUMP ON ELEVATION
"H"	LEAD PUMP ON ELEVATION
"I"	PUMPS OFF ELEVATION MUST BE ABOVE THE TOP OF THE PUMP
"J"	LOW LEVEL ALARM ELEVATION
"K"	WET WELL FLOOR ELEVATION
"L"	BOTTOM ELEVATION
"M"	FULL POND ELEVATION

NO. DESCRIPTION:

1. FINISH GRADE MINIMUM OF 3' ABOVE 100 YEAR FLOOD ELEVATION.
2. 6" ABC W/ STABILIZATION WEED BLOCK FABRIC TOPPED WITH 2" #57 STONE FINISH 8" BELOW TOP OF STATION.
3. LINK SEAL PIPE CONNECTOR W/ 316SS HARDWARE.
4. INFLUENT SEWER DIP - MIN 2% SLOPE (SHOWN OUT OF POSITION).
5. 6" VENT PIPE - FLANGED DIP WITH FBE (FUSION BONDED EPOXY) OR PROTECTO 401 LINED OR 316SS VENT PIPE AND STAINLESS STEEL INSECT SCREEN.
6. STAINLESS STEEL HOIST CABLE W/ 1 FOOT STAINLESS STEEL CHAIN.
7. 1" CHAMFER (TYP).
8. SCHEDULE 40 2" STAINLESS STEEL PIPE BETWEEN WET WELL AND VALVE VAULT. PIPE IS TO BE LEVEL AND STUBBED OUT 2" ON EACH END WITH EXPANSION PLUG ONLY ON VALVE VAULT SIDE.
9. S.S. INTERMEDIATE GUIDE RAIL SUPPORT.
10. MEGA FLANGE.
11. 18" DIA SUMP - PVC OR DIP PIPE, GROUTED INTO BASE FLOOR.
12. ROMAC ALPHA (STD OR XL) DI RESTRAINED JOINT COUPLING.
13. STAINLESS STEEL ANCHORS PER PUMP MANUFACTURER.
14. REINFORCED CONCRETE BALLAST (IF REQUIRED) ENCIRCLING BASE.
15. MINIMUM 6" LEVEL COMPACTED STONE (#57).
16. ALUMINUM LADDER - STEPS AT 12" O.C..
17. 6" THICK REINFORCED CONCRETE PLUG.
18. 1" CORPORATION STOP WITH S.S. SERVICE SADDLE.
19. ADJUSTABLE S.S. ALUMINUM PIPE CRADLE W/ 2" SS STANDPIPE.
20. ALUMINUM PUMP ACCESS HATCH AND FALL PROTECTION GRATE.
21. ALUMINUM ACCESS HATCH.
22. PRECAST CONCRETE VAULT.
23. PRECAST CONCRETE, POLYMER CONCRETE, HDPE OR FIBERGLASS WET WELL, DIAMETER + 6' MIN., OR 7,8,10 OR 12' DIAMETER.
24. 30" DIA CLEAR OPENING FIBERGLASS COMPOSITE COVER AND TYPE E CAST IRON FRAME.
25. INSIDE DROP BOWL/HOOD W/ 316 SS HARDWARE. MODEL SIZE BASED ON INLET PIPE NO. 4 DIA.
26. MONOLITHIC CONCRETE BASE.
27. #5 REBARS AT 6" ON CENTER, EACH WAY.
28. RELINER 316 SS PIPE SUPPORT BRACKETS - 2 EA.
29. PVC DROP PIPE, MAX. 3' LENGTH. SAME PIPE DIA. AS INLET PIPE NO. 4.
30. "M" ELEVATION SHALL BE MINIMUM 3' BELOW "D" ELEVATION.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

SEWER LIFT STATION

SUBMERSIBLE STATION ELEVATION VIEW

NO SCALE

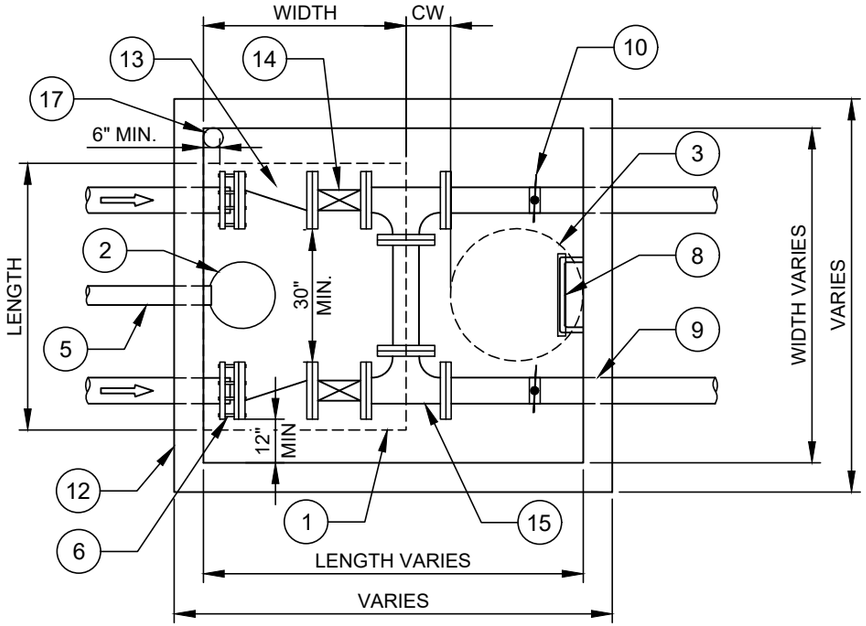
VERSION 3.0

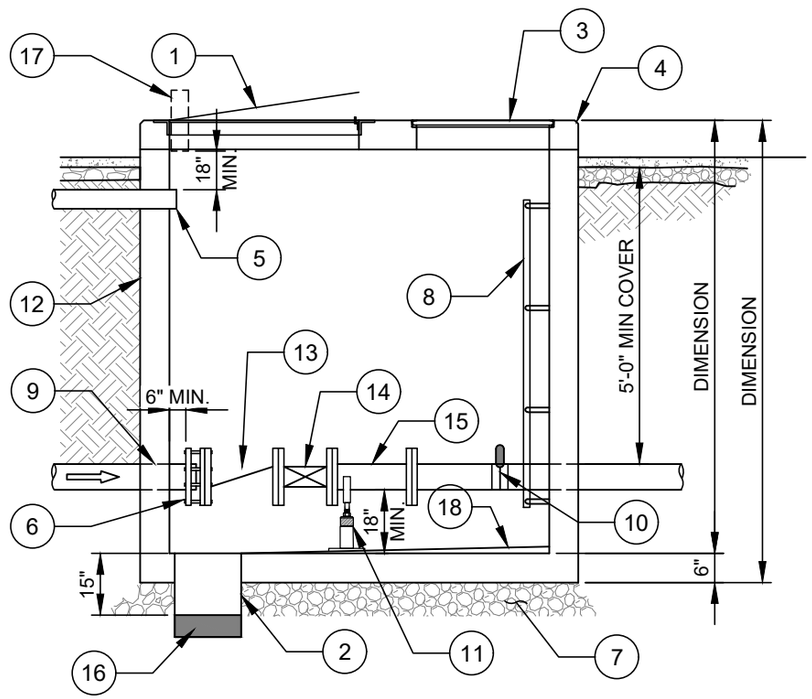
DATE 01/2026

DETAIL 13.5

MIN VAULT DIMENSIONS (FEET)		
PIPE DIA. (IN.)	"L"	"W"
4	6.5	6.0
6	7.0	7.0
8	7.5	7.0
10	8.5	7.0
12	9.0	8.0
16	10.0	9.0
18	10.5	9.0

CW - MIN CONCRETE WIDTH (FEET)	
PIPE DIA. (IN.)	W
4	1
6	1
8	1
10	1
12	1.5
16	2
18	2





ACCESS HATCH DIMENSIONS (FEET)	
PIPE DIA. (IN.)	L X W
4	4X3
6	4.5 X 3.5
8	5X4
10	5.5X5
12	6X5
16	6.5X5.5
18	7X6

NO. DESCRIPTION:

1. ALUMINUM ACCESS HATCH - SINGLE OR DOUBLE LEAF, DEPENDING ON SIZE. LOCK PIN FOR PADLOCK.
2. 18" DIA SUMP - PVC OR DIP PIPE, GROUTED INTO BASE FLOOR.
3. 30" DIA CLEAR OPENING FIBERGLASS COMPOSITE COVER AND TYPE E CAST IRON FRAME.
4. 1" CHAMFER (TYP).
5. SCHEDULE 40 2" STAINLESS STEEL PIPE BETWEEN WET WELL AND VALVE VAULT. PIPE IS TO BE LEVEL AND STUBBED OUT 2" ON EACH END WITH EXPANSION PLUG ONLY ON VALVE VAULT SIDE.
6. MEGA FLANGE OR APPROVED EQUAL.
7. MINIMUM 6" LEVEL COMPACTED STONE (#57).
8. ALUMINUM LADDER STEPS AT 12" O.C.
9. RUBBER BOOT (TYP) ALL PIPE PENETRATIONS.
10. 1" CORPORATION STOP WITH S.S. TAPPING SLEEVE.
11. ADJUSTABLE S.S. ALUMINUM PIPE CRADLE W/ 2" SS STANDPIPE.
12. PRECAST CONCRETE VAULT.
13. SWING CHECK VALVE WITH EXTERNAL LEVEL AND WEIGHT FOR SEWAGE SERVICE TAP C/V LIDS 1/4" NPT WITH 1/4" BALL VALVE.
14. FL X FL PLUG VALVE.
15. FL X FL TEE.
16. 6" THICK WIRE MESH REINFORCED CONCRETE PLUG AS FLOOR OF SUMP.
17. 6" VENT PIPE - FLANGED DIP WITH FBE (FUSION BONDED EPOXY) OR PROTECTO 401 LINED OR 316 SS VENT PIPE AND STAINLESS STEEL INSECT SCREEN.
18. SLOPE 1/4" PER FOOT TO SUMP.

NOTE:

A. MEGA FLANGES SHALL ONLY BE USED WHERE SHOWN IN THE STANDARD DETAILS.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

SEWER LIFT STATION

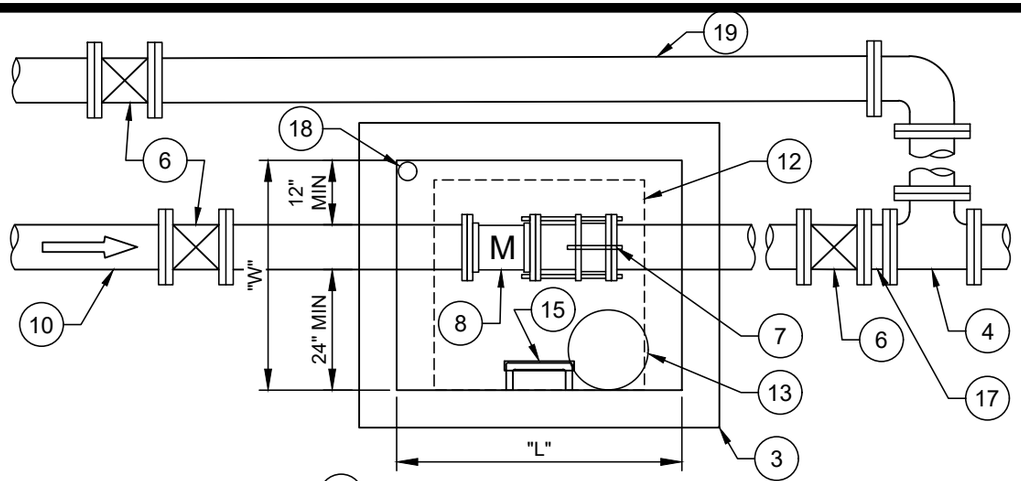
PRECAST CONCRETE VALVE VAULT

NO SCALE

VERSION 3.0

DATE 01/2026

DETAIL 13.6



PLAN VIEW

MIN. VAULT DIMENSIONS (FEET)		
PIPE DIA. (IN.)	"L"	"W"
4	4.0	4.0
6	4.0	4.0
8	4.0	4.0
10	5.0	5.0
12	5.0	5.0
16	5.0	5.0
18	5.0	5.0

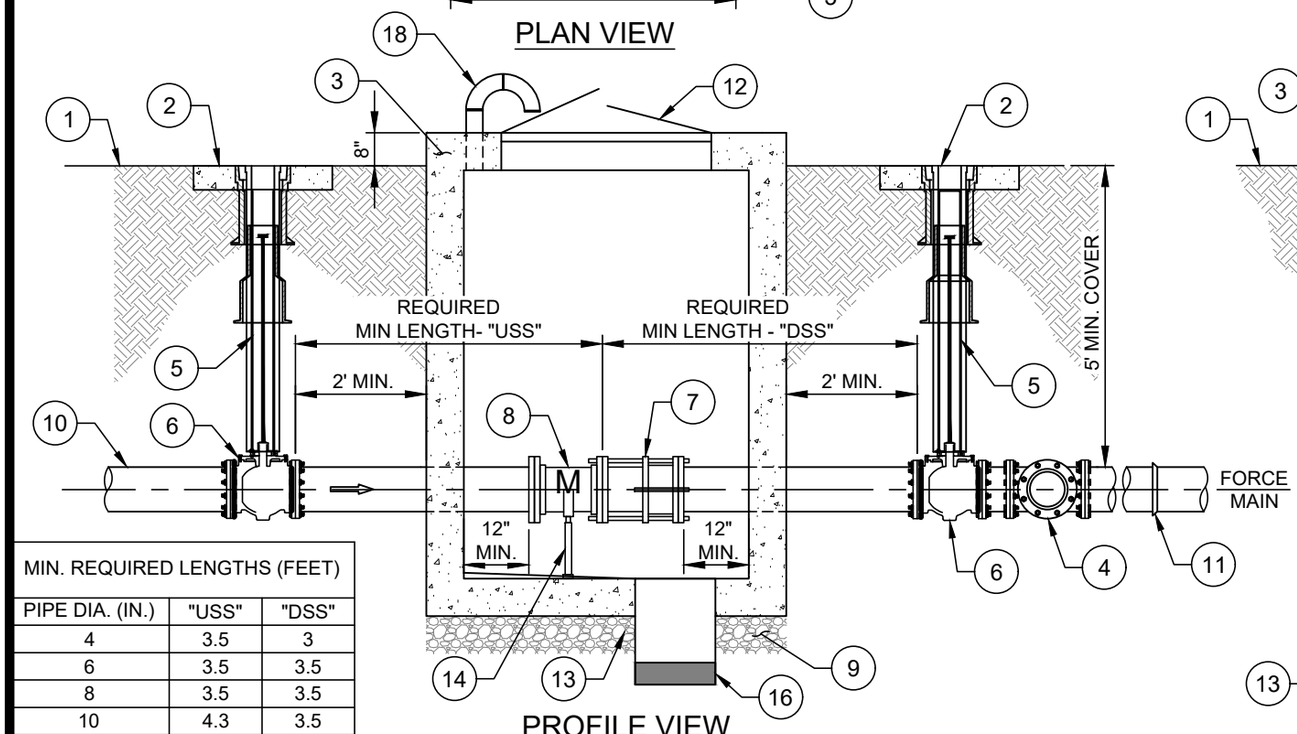
ACCESS HATCH DIMENSIONS (FEET)	
PIPE DIA. (IN.)	LxW
4	4X4
6	4X4
8	4X4
10	5X5
12	5X5
16	5X5
18	5X5

NO. DESCRIPTION:

1. FINISHED GRADE.
2. 24" X 24" X 4" CONCRETE PAD.
3. CONCRETE VAULT.
4. RMJ TEE FOR BYPASS PIPING.
5. CLTW VALVE BOX (TYP. PER CLTW STD. DETAIL) TO BE LOCATED OUTSIDE OF MAGMETER VAULT AND FLUSH WITH EXISTING GRADE. VALVE STEM WITHIN 12" OF SURFACE.
6. RMJ PLUG VALVE.
7. FL X FL W/ SS HARDWARE DISMANTLING JOINT = SMITH BLAIR #975 OR ROMAC #DJ400 BOLTED DIRECTLY TO THE METER FLANGE.
8. FL X FL ELECTROMAGNETIC FLOW METER (MAGMETER). ROSEMONT #8750W, ABB #FEW325 OR SIEMENS #7ME6310.
9. 6" #57 WASHED STONE.
10. PROTECTO 401 LINED DI PIPE AND FITTINGS.
11. MAY TRANSITION DIP TO PVC OUTSIDE THE FENCE AREA, IF APPROPRIATE.
12. ALUMINUM ACCESS HATCH.
13. 18" DIAMETER SUMP - PVC OR DIP PIPE, GROUTED INTO BASE FLOOR.
14. S.S. PIPE JACK WITH SADDLE.
15. ALUMINUM LADDER STEPS 12" O.C.
16. 6" THICK REINFORCED CONCRETE PLUG.
17. DIP SHORT, OR FOSTER ADAPTOR.
18. 6" VENT PIPE, FLANGED DIP WITH FBE (FUSION BONDED EPOXY) OR PROTECTO 401 LINED, OR 316 SS VENT PIPE AND STAINLESS STEEL INSECT SCREEN.
19. RJ DI PIPE AND FITTINGS - PROTECTO 401 LINED.
20. SLOPE 1/4" PER FOOT TO SUMP.

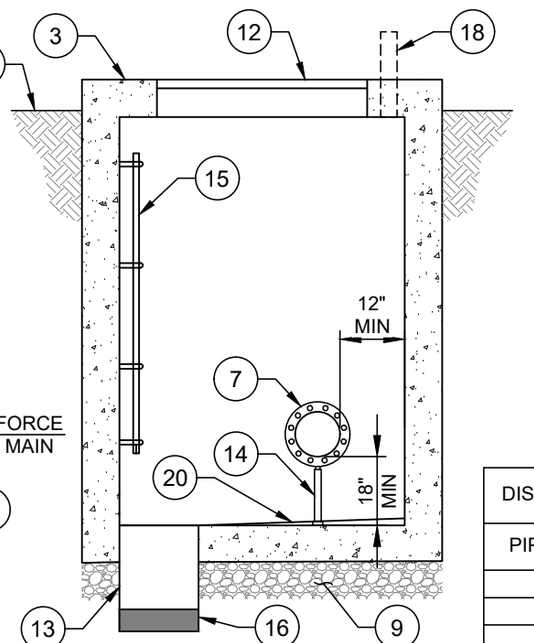
NOTES:

A. THIS DETAIL IS A SAMPLE LAYOUT AS MAGMETER DESIGN, SIZING, AND THE BYPASS CONNECTION LOCATION ARE PROJECT DEPENDENT.
B. ALL VALVES OPEN LEFT.



PROFILE VIEW

MIN. REQUIRED LENGTHS (FEET)		
PIPE DIA. (IN.)	"USS"	"DSS"
4	3.5	3
6	3.5	3.5
8	3.5	3.5
10	4.3	3.5
12	5.0	3.5
16	6.8	4.0
18	7.5	4.5



SECTION VIEW

DISMANTLING JOINT REQUIRED LAY LENGTH (INCHES)		
PIPE DIA. (IN.)	SMITH BLAIR #975	ROMAC #DJ400
4	9	8.00
6	9	8.38
8	9	8.38
10	10	10.50
12	10	10.50
16	12	13.50
18	12	13.75

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

SEWER LIFT STATION

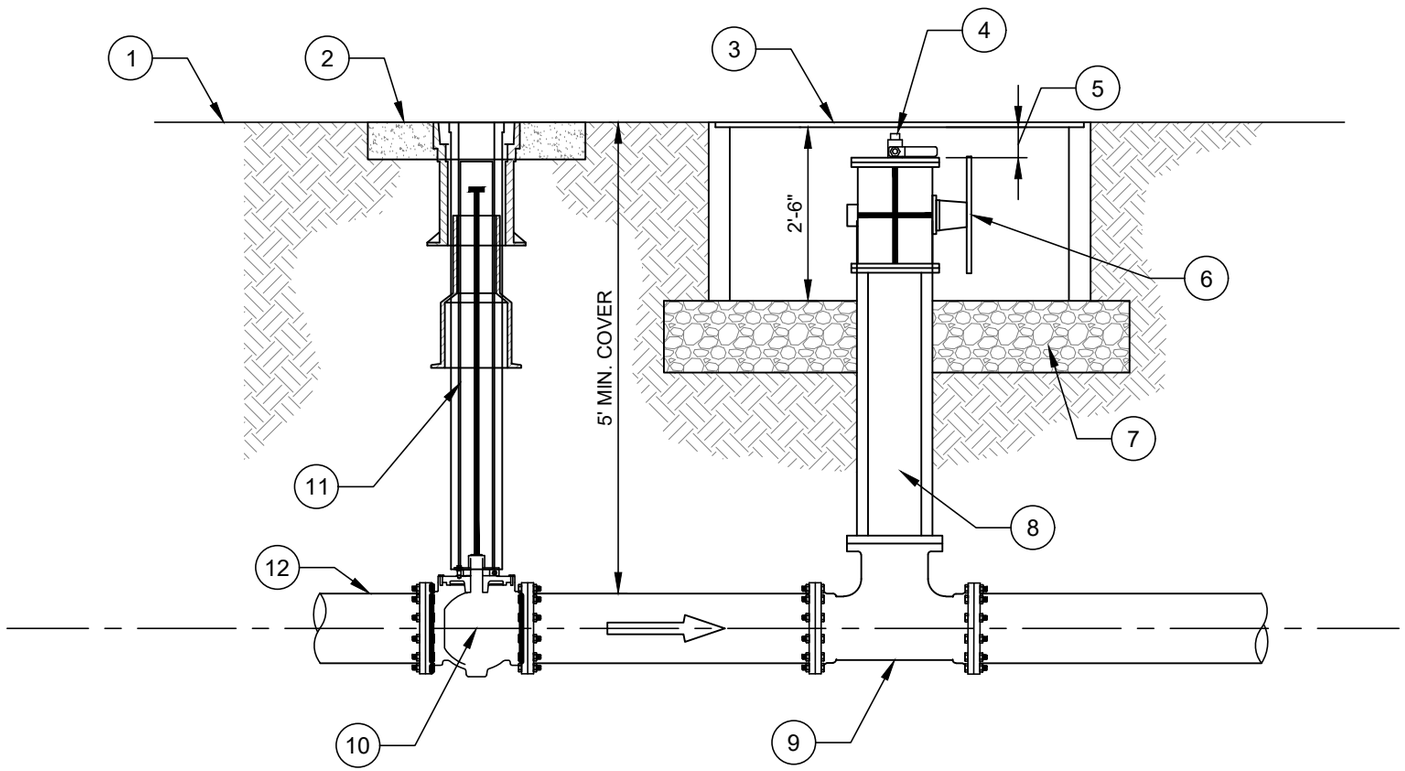
MAGMETER VAULT DETAIL

NO SCALE

VERSION
3.0

DATE
01/2026

DETAIL
13.7



NO.	DESCRIPTION:
1.	FINISHED GRADE.
2.	24" X 24" X 4" CONCRETE PAD OR APPROVED 24" DIAMETER PRECAST PAD (GROUT IN UPPER SECTION).
3.	CLTW STD. 2' X 3' CONCRETE VAULT STEEL COVER.
4.	BLIND FLANGE (PROTECTO 401 LINED) WITH 1/4" BRASS OR SS BALL VALVE.
5.	4" CLEARANCE BETWEEN FLANGE AND COVER.
6.	PLUG VALVE WITH FLANGED ENDS AND HANDWHEEL GEAR REDUCED OPERATOR POSITIONED TO ALLOW REMOTE OPERATION W/ HANDWHEEL.
7.	SET BOX IN 0.5 C.Y. OF GRAVEL (#57).
8.	FLANGE BY FLANGE DIP SPOOL (PROTECTO 401 LINED)
9.	RMJ X RMJ X FLANGE TEE - PROTECTO 401 LINED
10.	RMJ PLUG VALVE.
11.	CLTW VALVE BOX (TYP. PER CLTW STD. DETAIL) TO BE LOCATED OUTSIDE OF VALVE VAULT. VALVE STEM WITHIN 12" OF SURFACE.
12.	RJ DIP (PROTECTED 401 LINED) FROM PUMP STATION

NOTES:

A. CONTRACTOR TO FURNISH "T" - HANDLE VALVE KEY AND WRENCH FOR 2" NUT AS PERMANENT STATION EQUIPMENT.
B. PUMP CONNECTIONS LARGER THAN 8" SHALL BE HOUSED IN VAULT SIZED AS REQUIRED FOR APPLICATION AS DETERMINED BY CLTW.
C. ALL VALVES OPEN LEFT.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

SEWER LIFT STATION

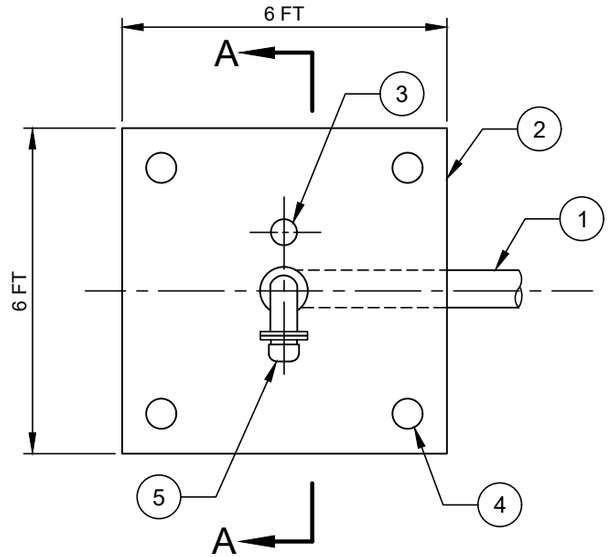
EMERGENCY PUMP CONNECTION DETAIL UP TO 8-INCH

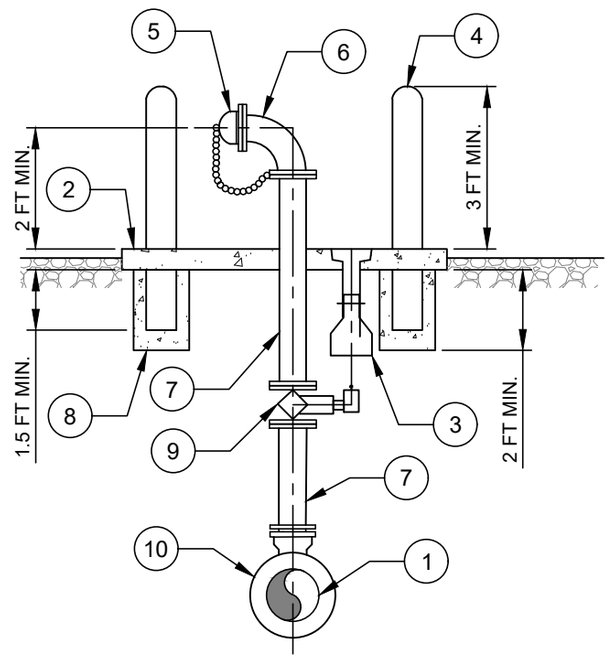
NO SCALE

VERSION
2.0

DATE
01/2025

DETAIL
13.8





SECTION A-A
PROFILE VIEW

NO.	DESCRIPTION:
1.	RMJ FORCE MAIN - DIP PROTECTO 401 LINED.
2.	6" REINFORCED CONCRETE PAD.
3.	STANDARD VALVE BOX ASSEMBLY.
4.	4" DIA BOLLARD WITH YELLOW PLASTIC SLEEVE.
5.	BLIND FLANGE WITH 1/4" BRASS OR SS BALL VALVE.
6.	FL X FL LONG PATTERN 90 BEND.
7.	FL X FL DIP SPOOL.
8.	CONCRETE FOOTING.
9.	FL X FL PLUG VALVE WITH 90 DEGREE BEVEL GEAR ACTUATOR.
10.	RMJ X RMJ X FL TEE OR 90 DEGREE BEND.

NOTE:
PUMP CONNECTION SHALL BE LOCATED INSIDE THE PUMP STATION FENCE IF SPACE ALLOWS (SEE EMERGENCY PUMP CONNECTION DETAIL UP TO 8-INCH). ALTERNATIVELY, IT CAN BE LOCATED OUTSIDE THE SITE FENCE DIRECTLY ACCESSIBLE TO THE ACCESS ROAD.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

SEWER LIFT STATION

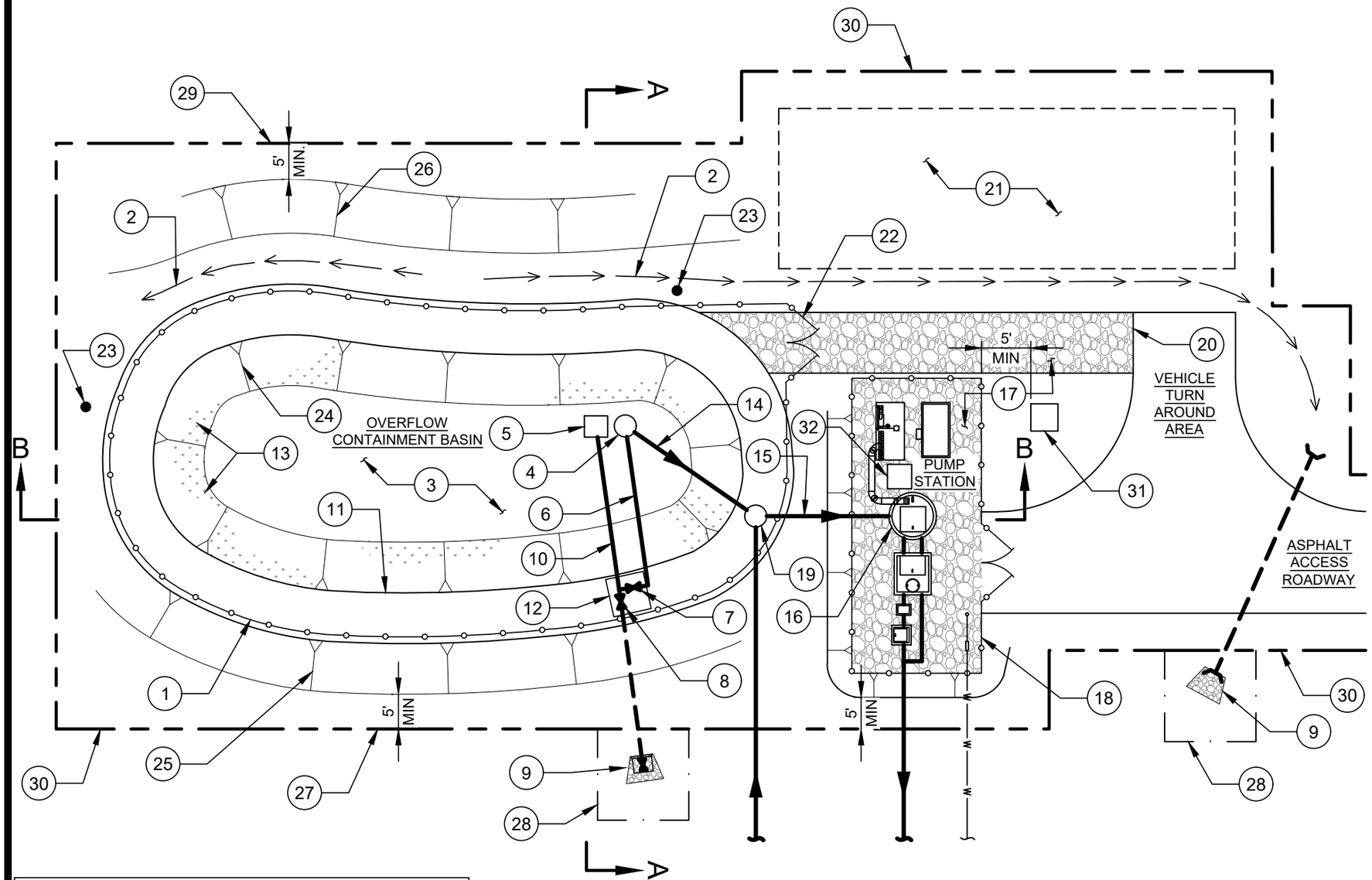
ALTERNATE STANDPIPE EMERGENCY PUMP CONNECTION

NO SCALE

VERSION
2.0

DATE
01/2025

DETAIL
13.9



NO. DESCRIPTION:

1. 4' SECURITY FENCE.
2. SURFACE DRAIN DITCH.
3. REINFORCED CONCRETE FLOOR - MIN. 4" THICK - FIBER REINFORCED.
4. SEWER OVERFLOW DISCHARGE MANHOLE WITH BEEHIVE GRATE.
5. 4' X 4' OVERFLOW BASIN RAINWATER DRAINAGE BOX.
6. 8" RJ DIP SEWER DRAIN PIPE - 1.0 PERCENT MIN. SLOPE.
7. 12" X 12" X 8" RMJ TEE, 8" OPEN LEFT GATE VALVE, (VALVE TO REMAIN CLOSED, AND IS ONLY TO BE OPENED TO DRAIN SEWER WATER BACK TO THE PUMP STATION, AFTER AN OVERFLOW EVENT), 8" RMJ 90 DEG BEND, 8" RJ DIP SEWER DRAIN PIPE.
8. 12" OPEN LEFT GATE VALVE AND EXTENSION STEM (VALVE REMAINS CLOSED DURING NORMAL OPERATIONS AND IS ONLY OPENED TO DRAIN RAINWATER FROM THE OVERFLOW BASIN.)
9. RIP RAP APRON - 25 SQ FT MINIMUM.
10. 12" RJ DIP RAINWATER DRAIN PIPE - 1.0 PERCENT MINIMUM SLOPE.
11. STRUCTURAL FILL CONTAINMENT BERM.
12. REINFORCED CONCRETE PAD - 6' X 6' X 6".
13. BERMUDA SOD OR ESTABLISHED TURF - BARE SPOTS ARE PROHIBITED.
14. MINIMUM 0.60% SLOPE - DIP.
15. MINIMUM 2.0% SLOPE - DIP.
16. PUMP STATION WET WELL.
17. GRAVEL.
18. 8' SECURITY FENCE.
19. COLLECTION SYSTEM MANHOLE.
20. 12' WIDE 8" CABC GRAVEL ACCESS DRIVE TO OVERFLOW CONTAINMENT BASIN.
21. REPLACEMENT PUMP STATION SITE/STAGING AREA - MINIMUM 0.35 ACRE. GRADE TO SAME ELEVATION AS PROPOSED PUMP STATION SITE.
22. 14' SECURITY GATE.
23. 2 EACH - GROUND WATER MONITORING WELL, OPTIONAL.
24. BASIN SLOPE - MINIMUM 3:1 SLOPE
25. FILL SLOPES - MINIMUM 3:1 SLOPE
26. CUT SECTIONS - MINIMUM 3:1 SLOPE
27. EXTEND PROPERTY A MINIMUM OF 5' OUTSIDE TOE OF SLOPE IN FILL AREAS.
28. 20' CHARLOTTE WATER STORM EASEMENT OR CLTW PROPERTY.
29. EXTEND PROPERTY A MINIMUM OF 5' OUTSIDE DRAINAGE DITCH OR BERM FILL SLOPES.
30. PROPERTY LINE - (CLTW PROPERTY - NOT AN EASEMENT).
31. POWER TRANSFORMER REINFORCED CONCRETE PAD.
32. 5' X 5' X 6" REINFORCED CONCRETE PAD FOR FUTURE ODOR CONTROL SYSTEM.

NOTE:
IF THE OVERFLOW BASIN FLOOR ELEVATION IS BELOW THE 100 YEAR FLOOD ELEV. PLUS 2 FT, THEN THE RAINWATER DRAIN PIPE ENDS WITH A FL RUBBER DUCK BILL CHECK VALVE AFTER A REINFORCED CONC. END WALL AND SPLASH PAD/RIP RAP.

SEE DETAIL 13.10.2 FOR CROSS SECTIONS A-A AND B-B.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

SEWER LIFT STATION

OPEN EARTH SEWER OVERFLOW CONTAINMENT BASIN SITE LAYOUT

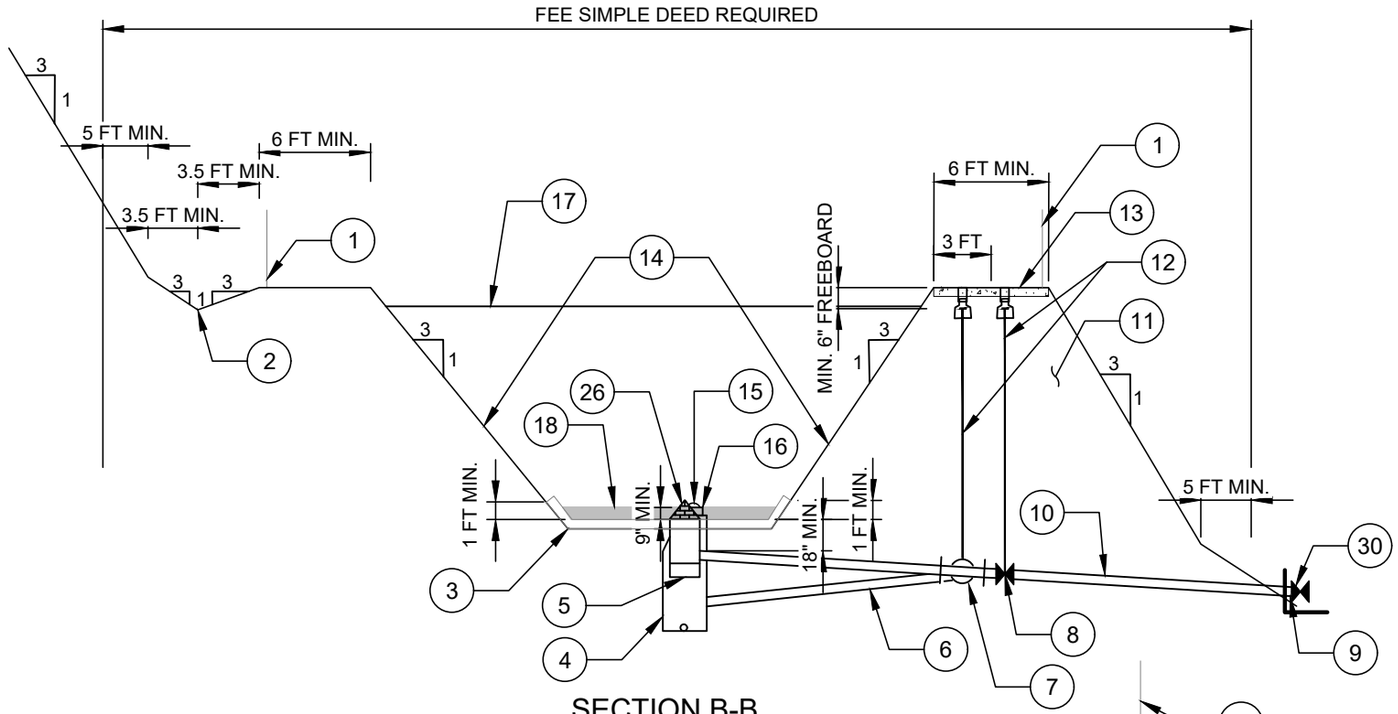
NO SCALE

VERSION 2.0

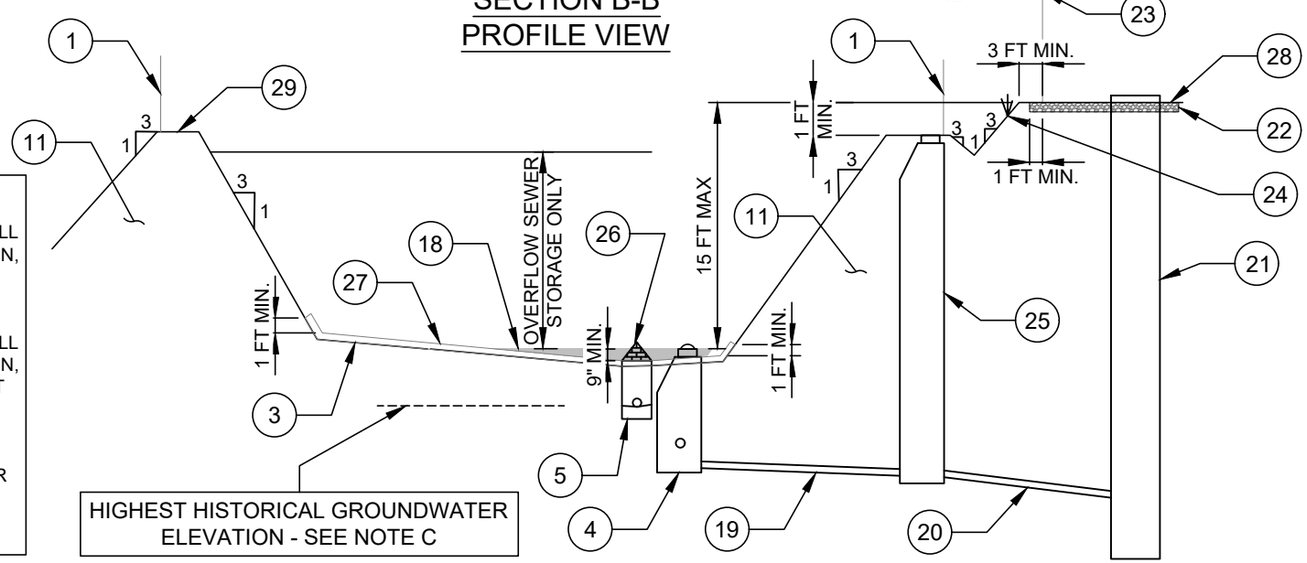
DATE 01/2025

DETAIL 13.10.1

SECTION A-A
PROFILE VIEW



SECTION B-B
PROFILE VIEW



NOTES:

A. ALL GRAVITY SEWER MANHOLES IN ALL DIRECTIONS FROM THE PUMP STATION, WITH AN INVERT LOWER THAN THE FULL POND ELEVATION, SHALL BE HYDRAULIC LEAK TESTED.
B. ALL GRAVITY SEWER MANHOLES IN ALL DIRECTIONS FROM THE PUMP STATION, SHALL HAVE MIN. RIM ELEVATION 1 FT HIGHER THAN THE OVERFLOW BERM ELEVATION, REGARDLESS OF THE ADJACENT GROUND ELEVATION.
C. HIGHEST HISTORICAL GROUNDWATER ELEVATION MUST BE AT LEAST 2 FT BELOW THE LOWEST ELEVATION OF THE CONCRETE FLOOR.

NO. DESCRIPTION:

1. 4' SECURITY FENCE.
2. SURFACE DRAIN DITCH.
3. REINFORCED CONCRETE FLOOR - MIN. 4" THICK - FIBER REINFORCED. MIN 1' UP BERM SLOPE AND MIN 6" ABOVE #16 - SEWER OVERFLOW RIM.
4. SEWER OVERFLOW DISCHARGE MANHOLE.
5. 4' X 4' OVERFLOW BASIN RAINWATER DRAINAGE BOX (OR 4' DIA MANHOLE) - MATCH RIM ELEVATION 9" BELOW TOP OF DISCHARGE MANHOLE FRAME.
6. 8" RJ DIP SEWER DRAIN PIPE - 1.0 PERCENT MIN. SLOPE.
7. 12" X 12" X 8" RMJ TEE, 8" OPEN LEFT SEWER GATE VALVE, (VALVE TO REMAIN CLOSED, AND IS ONLY TO OPENED TO DRAIN SEWER WATER BACK TO THE PUMP STATION, AFTER AN OVERFLOW EVENT), 8" RMJ 90° BEND, 8" RJ DIP SEWER DRAIN PIPE.
8. 12" OPEN LEFT RAINWATER GATE VALVE.
9. FLARED END SECTION AND RIP RAP APRON - 25 SQ FT MIN. IF ABOVE 100 YEAR FLOOD ELEV. PLUS 2'.
10. 12" RJ DIP RAINWATER DRAIN PIPE - 1.0 PERCENT MIN SLOPE.
11. STRUCTURAL FILL CONTAINMENT BERM.
12. VALVE BOX ASSEMBLY AND VALVE EXTENSION STEM.
13. REINFORCED CONCRETE PAD - 6' X 6' X 6".
14. BERMUDA SOD OR ESTABLISHED TURF - BARE SPOTS ARE PROHIBITED.
15. BEEHIVE SEWER OVERFLOW GRATE.
16. SEWER OVERFLOW RIM ELEVATION SHALL NOT BE MORE THAN 15' BELOW THE PUMP STATION FENCED SITE ELEVATION.
17. SEWER OVERFLOW CONTAINMENT BASIN FULL POND ELEVATION - EXCLUDE THE RAINWATER STORAGE CAPACITY FROM THE CONTAINMENT BASIN VOLUME CALCULATIONS.
18. RAINWATER STORAGE CAPACITY (SHADED AREA ONLY) - MUST BE GREATER THAN 1.5" OF RAIN OVER THE AREA INSIDE OF THE SECURITY FENCE.
19. SEWER MIN. 0.60% SLOPE - DIP.
20. SEWER MIN. 2.0% SLOPE - DIP.
21. PUMP STATION WET WELL.
22. GRAVEL.
23. 8' SECURITY FENCE.
24. OPTIONAL SHRUBBERY.
25. SEWER COLLECTION SYSTEM MANHOLE.
26. ALUMINUM OR GALVANIZED STEEL RAINWATER TRASH RACK.
27. FLOOR SLOPE - 0.25 INCH PER FOOT.
28. PUMP STATION FINISH GRADE MIN. ELEV. IS 100 YEAR FLOOD ELEV. PLUS 3'.
29. MIN. BERM ELEV. IS 100 YEAR FLOOD ELEV. PLUS 2'.
30. IF THE OVERFLOW BASIN FLOOR ELEVATION IS BELOW THE 100 YEAR FLOOD ELEV. PLUS 2', THEN THE RAINWATER DRAIN PIPE ENDS WITH A FL RUBBER DUCK BILL CHECK VALVE (e.g. REDVALVE TIDEFLEX) AFTER A REINFORCED CON. END WALL AND SPLASH PAD/RIP RAP.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

SEWER LIFT STATION

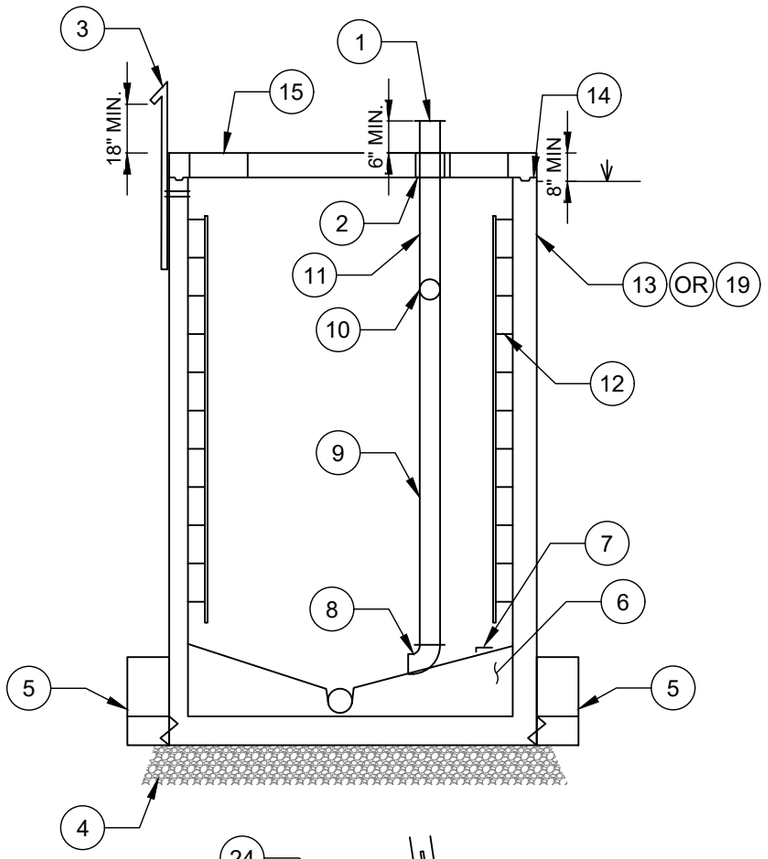
OPEN EARTH SEWER OVERFLOW CONTAINMENT BASIN DESIGN

NO SCALE

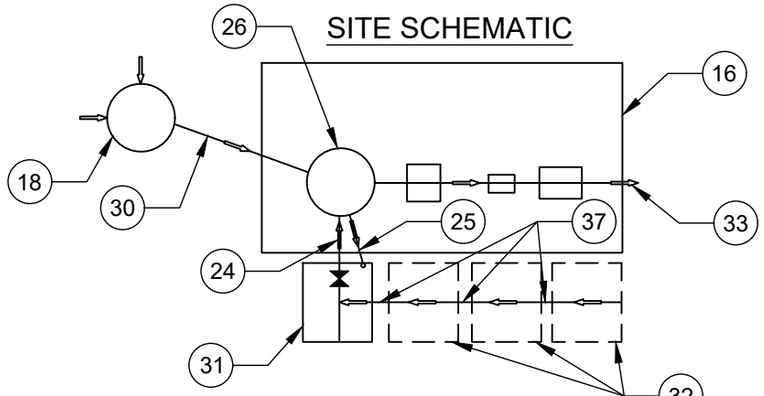
VERSION 2.0

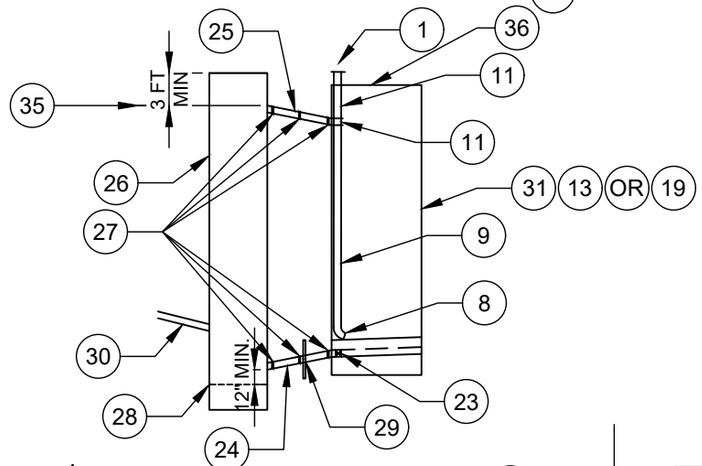
DATE 01/2025

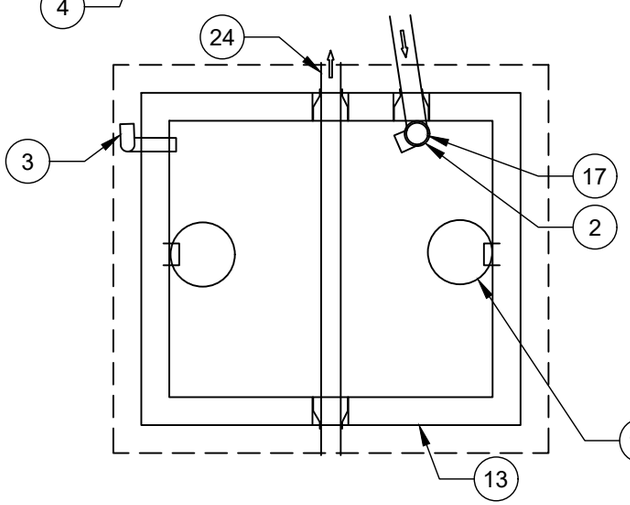
DETAIL 13.10.2

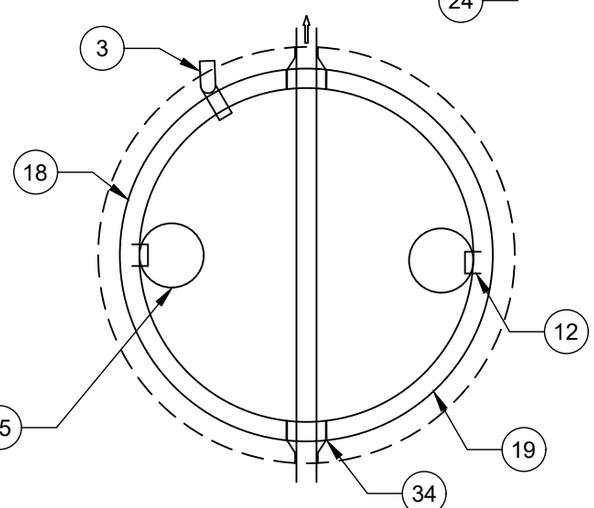


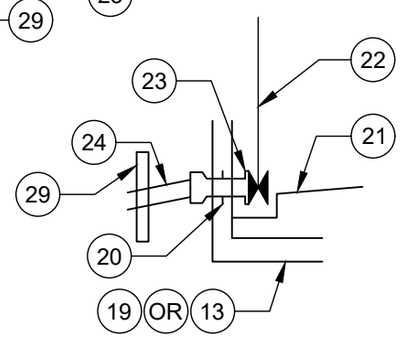
SITE SCHEMATIC











NOTES:

A. ALL DI PIPE AND FITTINGS SHALL BE PROTECTO 401 LINED.
B. ALL PIPE AND FITTINGS IN THE INSIDE DROP SHALL BE ONE PIPE SIZE LARGER THAN THE INLET PIPE #25 DIAMETER.

NO.	DESCRIPTION:
1.	DI BLIND FLANGE CLEANOUT.
2.	FILL ANNULAR SPACE WITH NON SHRINK GROUT.
3.	6" VENT PIPE.
4.	MIN. 8" WASHED STONE BEDDING.
5.	ADD ANTI FLOTATION REQUIREMENTS.
6.	CONCRETE INVERT / SHELF.
7.	2":12" SLOPE.
8.	RMJ DI 90° BEND.
9.	RJ DIP INSIDE DROP ONE PIPE DIAMETER LARGER THAN THE INLET PIPE #25.
10.	RMJ DI CROSS, OPEN OUTLET.
11.	FL X PE DIP SPOOL.
12.	ALUMINUM LADDER - STEPS 12" O.C. - AT ALL ACCESS POINTS.
13.	6' X 6', 8' X 8', 10' X 10' OR 12' X 12' PRECAST CONCRETE CONTAINMENT BASIN VAULT.
14.	REQUIRED JOINT.
15.	2 EA. - 30", CLEAR OPENING, CAST IN FRAME AND COVER.
16.	PUMP STATION SITE.
17.	RJ DIP INSIDE DROP.
18.	OVERSIZED MANHOLES MAY BE USED IN PLACE OF UPSTREAM MANHOLES TO PROVIDE OVERFLOW CONTAINMENT BASIN VOLUME REQUIREMENTS.
19.	6', 7', 8', 10' OR 12' DIAMETER OVERFLOW CONTAINMENT BASIN MANHOLE.
20.	THRUST COLLAR.
21.	INVERT.
22.	WALL MOUNTED VALVE EXTENSION STEM.
23.	FL X FL GATE VALVE WITH EXTENSION STEM TO VAULT TOP, FL X THRUST COLLAR X FASTITE BELL WALL PIPE 24" LL - CAST INTO VAULT WALL. (VALVE TO REMAIN CLOSED DURING NORMAL OPERATIONS, AND IS ONLY OPENED TO DRAIN THE OVERFLOW BASIN.)
24.	RJ DIP OVERFLOW BASIN DRAIN PIPE, MIN. 2% SLOPE.
25.	RJ DIP OVERFLOW BASIN INLET PIPE, MIN. 2% SLOPE.
26.	WET WELL/PUMP STATION.
27.	MIN. 3 FLEXIBLE RDI JOINTS.
28.	PUMP OFF ELEVATION.
29.	WALL THRUST RESTRAINT REQUIRED.
30.	DIP - 2% SLOPE, PER DESIGN SPECS.
31.	DEDICATED OVERFLOW CONTAINMENT VAULT OR MANHOLE.
32.	ADDITIONAL OVERFLOW CONTAINMENT VAULTS / MANHOLES AS NEEDED.
33.	FORCE MAIN.
34.	LINK SEAL PIPE CONNECTOR W/ 316SS HARDWARE - TYP. ALL PIPE CONNECTIONS.
35.	OVERFLOW BASIN FULL POND ELEVATION.
36.	OVERFLOW BASIN RIM SHALL BE A MINIMUM 1' BELOW THE WETWELL RIM ELEVATION.
37.	FLEXIBLE RJ DI JOINT REQUIRED BETWEEN EACH VAULT/MANHOLE.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

SEWER LIFT STATION

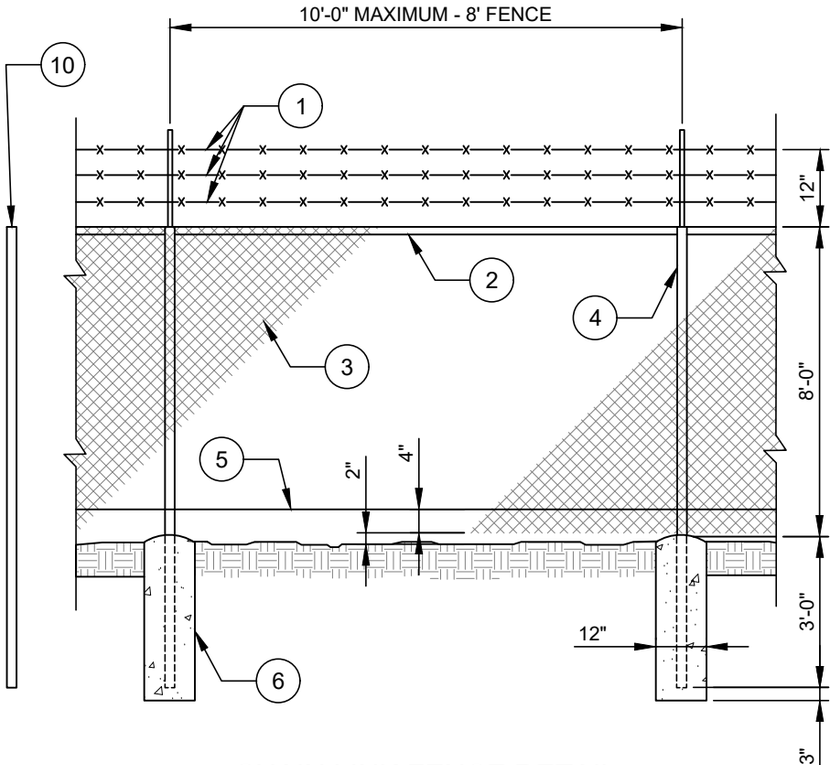
PRECAST VAULT SEWER OVERFLOW CONTAINMENT BASIN DESIGN

NO SCALE

VERSION 3.0

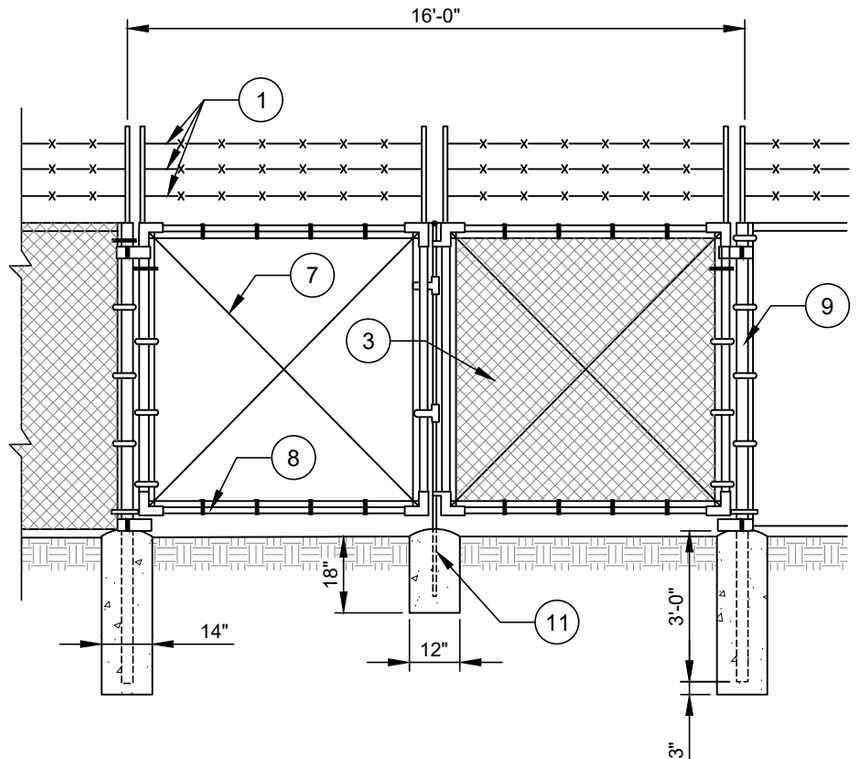
DATE 01/2026

DETAIL 13.10.3



CHAIN LINK FENCE DETAIL

NOT TO SCALE



DOUBLE CHAIN LINK SWING GATE

NOT TO SCALE

NO.	DESCRIPTION:
1.	3 STRANDS BARBED WIRE @ 4" O.C. VERTICAL.
2.	TOP RAIL - SCH. 40 1-5/8" O.D. GALVANIZED STEEL PIPE.
3.	CHAIN LINK - 9-GAUGE GALVANIZED STEEL WIRE, 2" MESH.
4.	LINE POST - SCH. 40 2.375" O.D. GALVANIZED STEEL PIPE.
5.	TENSION WIRE - 7-GAUGE GALVANIZED STEEL WIRE.
6.	3600 PSI CONCRETE FOOTING, TYPICAL.
7.	TRUSS ROD - 3/16" X 3/4" GALVANIZED STEEL.
8.	GATE FRAME - SCH. 40 2" O.D. GALVANIZED STEEL PIPE W/ 1-5/8" INTERNAL BRACING WELDED AT ALL JOINTS.
9.	GATE POST - SCH. 40 4" O.D. GALVANIZED STEEL PIPE.
10.	CORNER/END POST - SCH. 40 2.875" GALVANIZED STEEL PIPE.
11.	DROP ROD WITH SCH. 40 2" I.D. GALVANIZED STEEL PIPE SLEEVE.

NOTES:

A. FENCE SHALL BE GALVANIZED BLACK VINYL COATED. CLTW REQUIRE BLACK COLOR PLASTIC PRIVACY SLATS.

B. FENCE HEIGHT AT PUMP STATION SITE IS 8 FEET. FENCE HEIGHT AT CONTAINMENT BASIN SITE IS 4 FEET.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

SEWER LIFT STATION

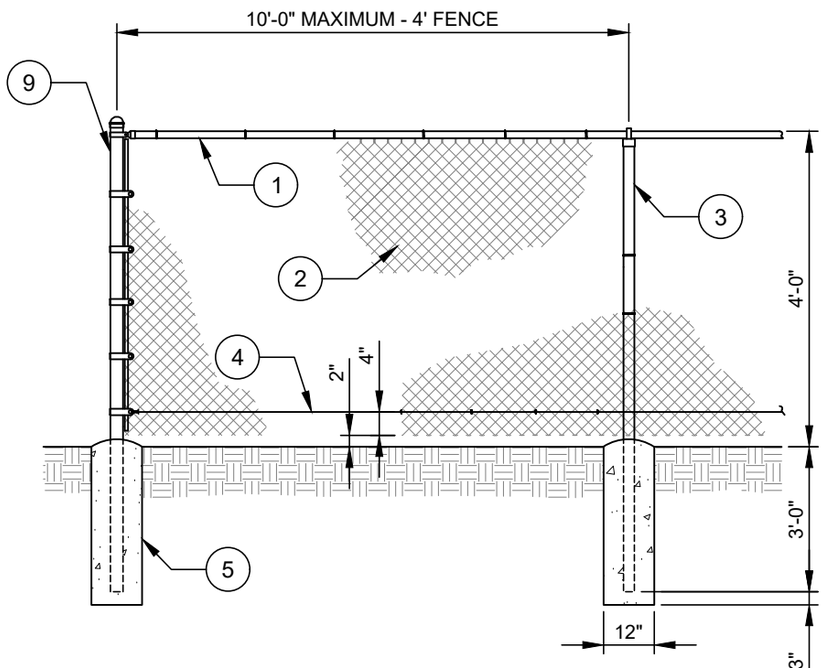
PUMP STATION - 8 FOOT SECURITY FENCE DETAIL

NO SCALE

VERSION 2.0

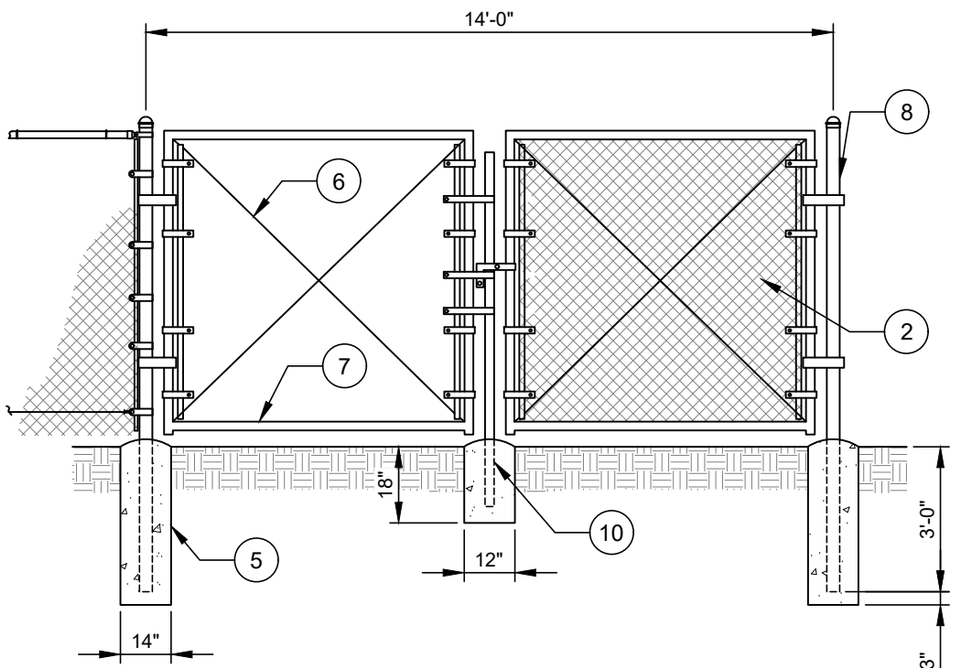
DATE 01/2025

DETAIL 13.11.1



CHAIN LINK FENCE DETAIL

NOT TO SCALE



CHAIN LINK SWING GATE

NOT TO SCALE

NO.	DESCRIPTION:
1.	TOP RAIL - SCH. 40 1-5/8" O.D. GALVANIZED STEEL PIPE.
2.	CHAIN LINK. - 9-GAUGE GALVANIZED STEEL WIRE, 2" MESH.
3.	LINE POST - SCH. 40 2-3/8" O.D. GALVANIZED STEEL PIPE.
4.	TENSION WIRE - 7-GAUGE GALVANIZED STEEL WIRE.
5.	3,600 PSI CONCRETE FOOTING, TYPICAL.
6.	TRUSS ROD - 3/16" X 3/4" GALVANIZED STEEL.
7.	GATE FRAME - SCH. 40 2" O.D. GALVANIZED STEEL PIPE W/ 1-5/8" INTERNAL BRACING WELDED AT ALL JOINTS.
8.	GATE POST - SCH. 40 4" O.D. GALVANIZED STEEL PIPE.
9.	CORNER/END POST - SCH. 40 2-7/8" GALVANIZED STEEL PIPE.
10.	DROP ROD W/ SCH. 40 2" I.D. GALVANIZED STEEL PIPE SLEEVE.

NOTES:

A. FENCE SHALL BE GALVANIZED BLACK VINYL COATED W/ BLACK COLOR PLASTIC PRIVACY SLATS.

B. BARBED WIRE IS NOT REQUIRED AT CONTAINMENT BASIN SITE.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

SEWER LIFT STATION

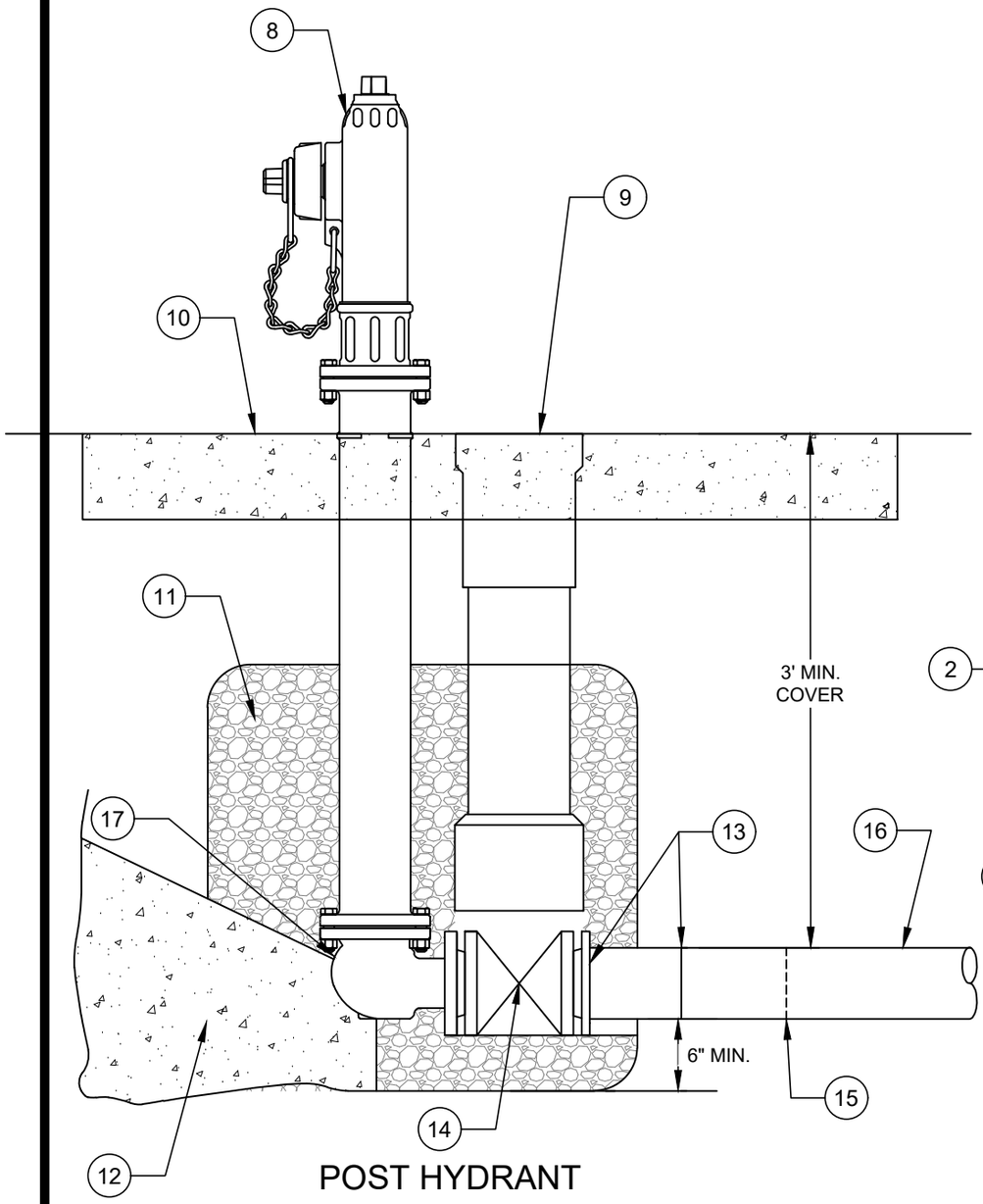
CONTAINMENT BASIN - 4 FOOT FENCE DETAIL

NO SCALE

VERSION
2.0

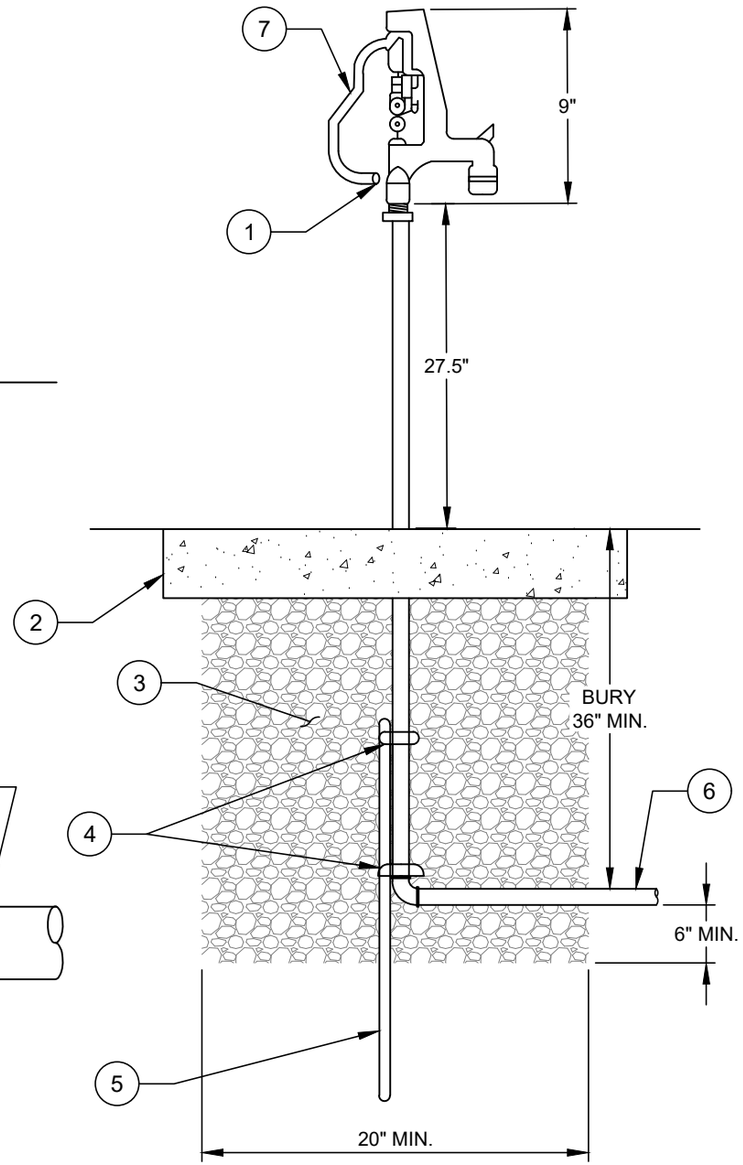
DATE
01/2025

DETAIL
13.11.2



POST HYDRANT

NOT TO SCALE



YARD HYDRANT

NOT TO SCALE

NO.	DESCRIPTION:
1.	LOCKING HOLE.
2.	24" X 24" X 6" REINFORCED CONCRETE SPLASH PAD.
3.	MIN. 20" DIA. OF WASHED STONE.
4.	S.S. HOSE CLAMPS (4 EACH).
5.	2" X 10' SCH 80 GALV. STEEL PIPE DRIVEN IN GROUND.
6.	3/4" TYPE K COPPER TUBING
7.	NON-FREEZE YARD HYDRANT WOODFORD MODEL Y34 (RATED AT 125 PSI), CLAYTON MARK INC. #5451NL SERIES MODEL (RATED AT 80 PSI), ZURN Z1396XL VERSION (RATED AT 90 PSI), SIMMONS DELUXE YARD HYDRANT #H803NL (RATED AT 120 PSI), OR APPROVED EQUAL
8.	2-1/2" NOZZLE POST HYDRANT - MUELLER OPEN RIGHT SINGLE OR DOUBLE 2.5" NOZZLE POST HYDRANT #A-411, W/3" FL SHOE. CLTW STD YELLOW PAINT.
9.	WATER VALVE BOX ASSEMBLY
10.	5' X 5' REINFORCED CONCRETE PAD
11.	1/4 CY WASHED STONE FOR DRAINAGE. WRAP IN FILTER FABRIC. FILTER FABRIC SHALL BE PLACED AFTER THRUST BLOCK HAS CURED
12.	THRUST BLOCKING 3,600 PSI. SEE DETAIL
13.	3" HDPE MJ ADAPTER BUTT-FUSED JOINT
14.	3" MJ X FL OPEN RIGHT GATE VALVE. VALVE CONNECTS TO HYDRANT SHOE WITH FLANGE
15.	4" X 3" HDPE REDUCER - BUTT FUSION. WHEN 4" SERVICE PIPE IS REQUIRED
16.	3" OR 4" SDR 9 HDPE
17.	3" FL SHOE

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

SEWER LIFT STATION

2-1/2" NOZZLE POST HYDRANT AND 3/4 INCH HOSE CONNECTOR NON-FREEZE YARD HYDRANT DETAIL

NO SCALE

VERSION
2.0

DATE
01/2025

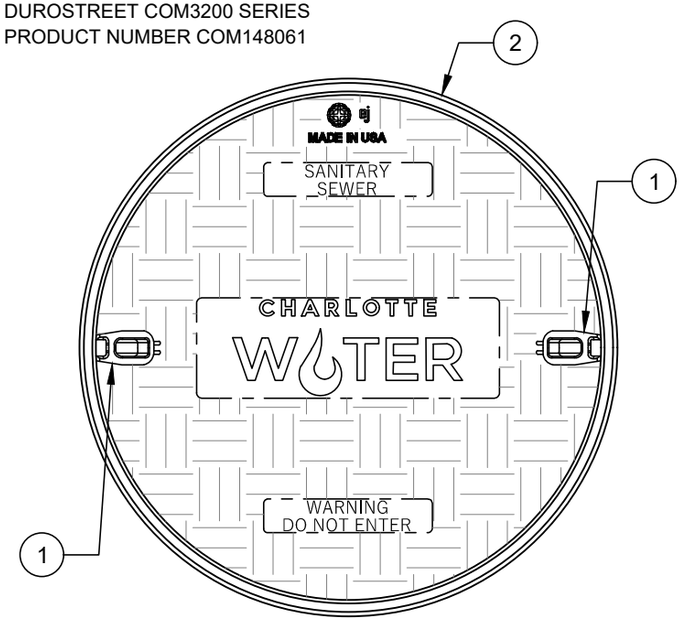
DETAIL
13.12

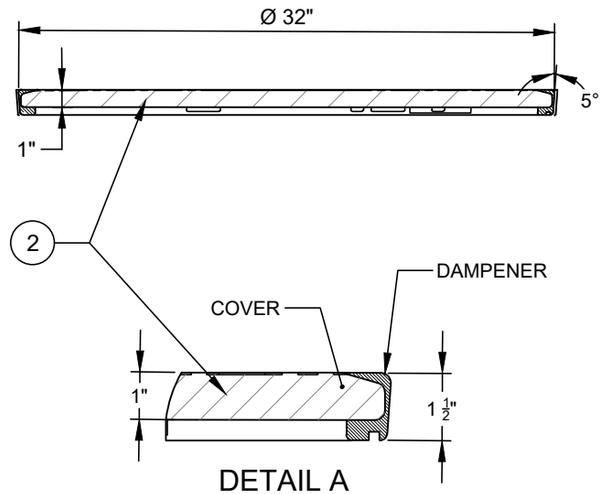
U.S. FOUNDRY & MFG. CORP.

TO BE DETERMINED

EJ (EJ GROUP, INC.)

DUROSTREET COM3200 SERIES
PRODUCT NUMBER COM148061





DETAIL A

COVER WEIGHT - 62 POUNDS

NO.	DESCRIPTION:
1.	GRADE 316 STAINLESS STEEL RECESSED PICK BAR.
2.	GLASS FIBER REINFORCED COMPOSITE COVER.

NOTES:

A. LOAD RATING - HEAVY DUTY.

B. MATERIAL - GLASS FIBER REINFORCED POLYMER (FRP) COMPOSITE.

C. COLOR - BLACK.

D. ADA COMPLIANT.

E. NOT TO BE USED IN TRAFFIC.

F. USE WITH TYPE E INVERTED FRAME - CAST IN.

G. COVER SHALL CONFORM TO DIMENSION AND WEIGHT REQUIREMENTS.

H. COVER SHALL NOT BE OUT OF ROUND.

I. COVER SHALL BE UV RESISTANT.

J. COMPOSITE COVERS ARE REQUIRED INSIDE THE PUMP STATION SECURITY FENCE, AND SHALL NOT BE USED OUTSIDE THE SECURITY FENCE.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

SEWER LIFT STATION

TYPE 7 - FRP COMPOSITE MANHOLE COVER
30-INCH DIAMETER (CLEAR OPENING)
USE INSIDE FENCE AT SEWER PUMP STATIONS - ONLY

NO SCALE

VERSION
3.0

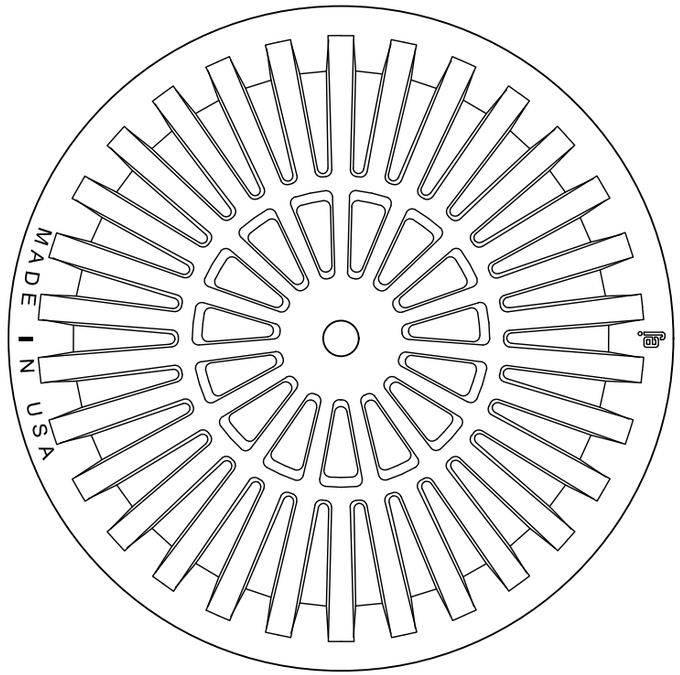
DATE
01/2026

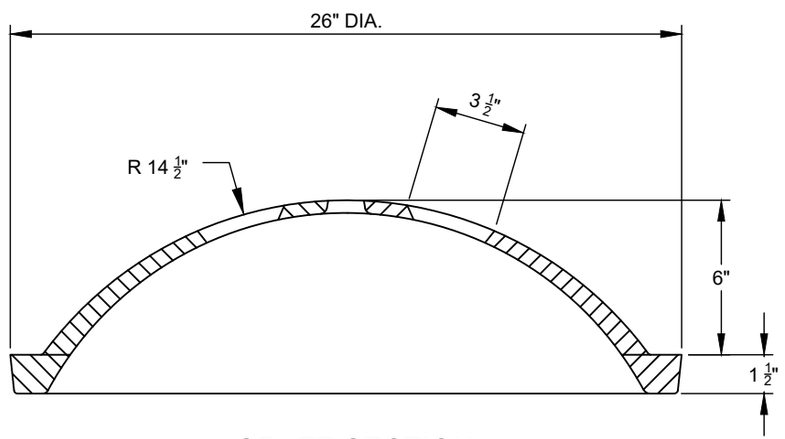
DETAIL
13.13

U.S. FOUNDRY & MFG. CORP.

TO BE DETERMINED

EJ (EJ GROUP, INC.)





GRATE SECTION

APPROX. WEIGHT: 88 POUNDS

NO.	DESCRIPTION:
1.	CAST IRON BEE HIVE GRATE - EJ PRODUCT NUMBER 00104044.

NOTES:

A. LOAD RATING - HEAVY DUTY.

B. MATERIAL - ASTM A48 - CLASS GRAY IRON.

C. GRATE SHALL CONFORM TO DIMENSION AND WEIGHT REQUIREMENTS.

D. GRATE SHALL NOT BE OUT OF ROUND.

E. OPEN AREA - 185 SQUARE INCHES.

F. USE WITH TYPE A MANHOLE FRAME.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

SEWER LIFT STATION

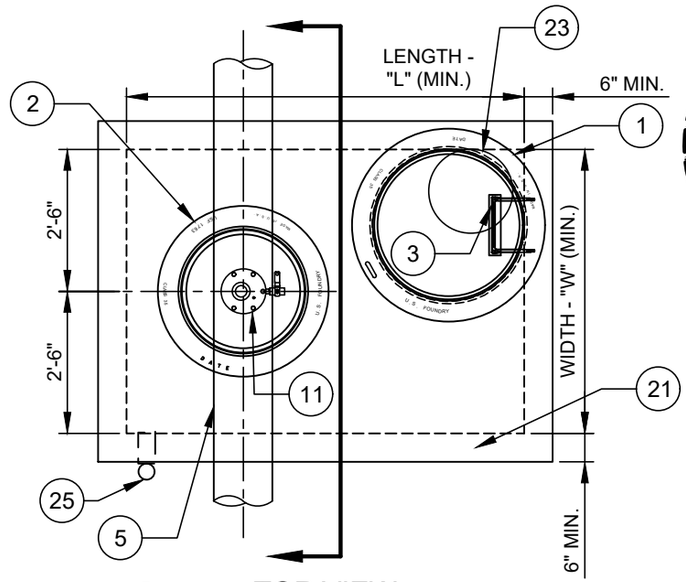
BEEHIVE GRATE
26-INCHES DIAMETER
6-INCHES TALL

NO SCALE

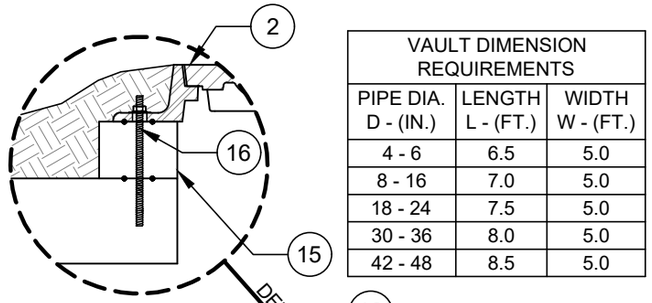
VERSION
3.0

DATE
01/2026

DETAIL
13.14

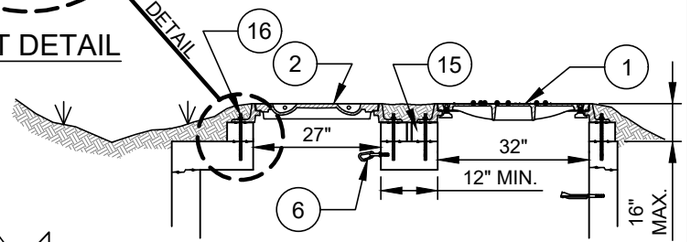


TOP VIEW

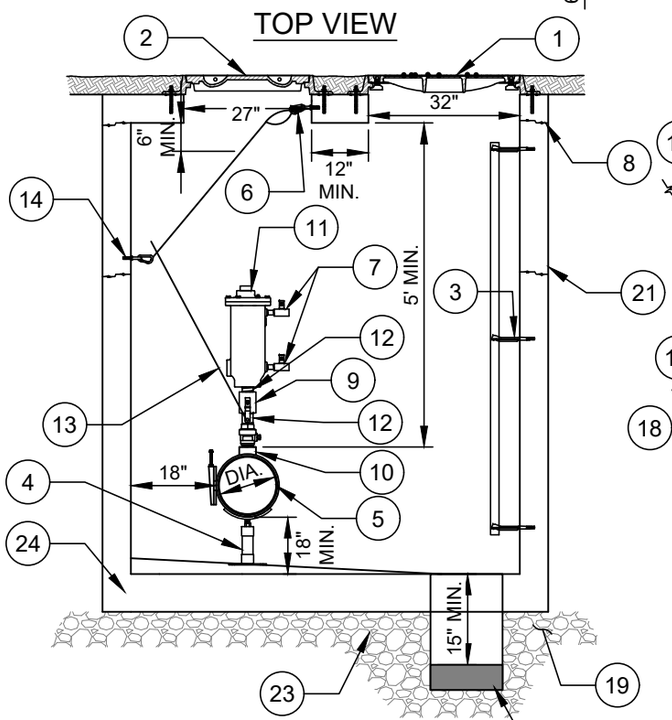


JOINT DETAIL

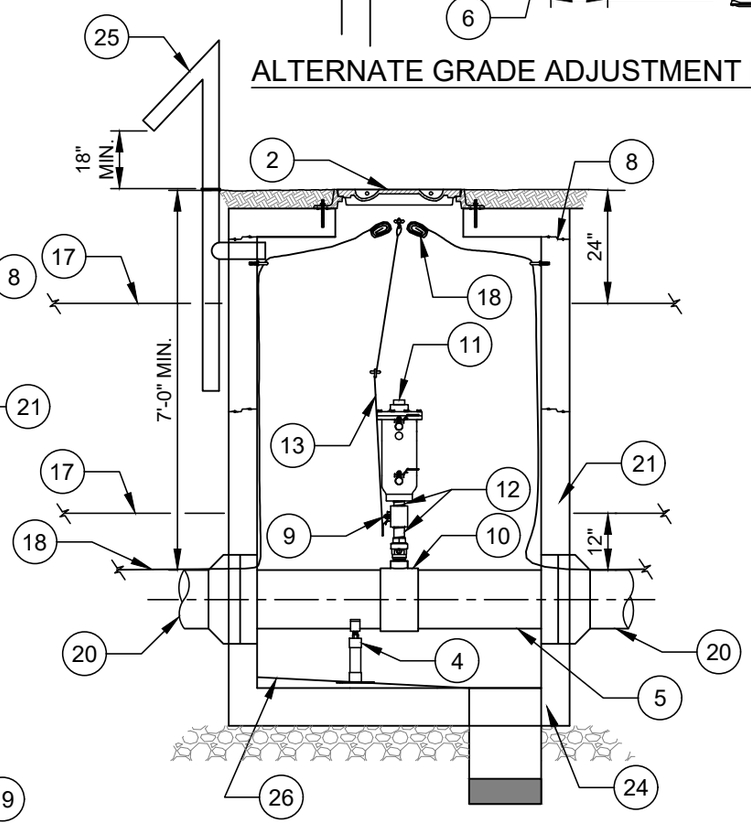
VAULT DIMENSION REQUIREMENTS		
PIPE DIA. D - (IN.)	LENGTH L - (FT.)	WIDTH W - (FT.)
4 - 6	6.5	5.0
8 - 16	7.0	5.0
18 - 24	7.5	5.0
30 - 36	8.0	5.0
42 - 48	8.5	5.0



ALTERNATE GRADE ADJUSTMENT DETAIL



PROFILE VIEW



SECTION VIEW

NO.	DESCRIPTION:
1.	30" CAST IRON MANHOLE FRAME AND COVER (MAN ACCESS) PER CLTW STANDARDS - TYPE D / 4 . ABOVE GRADE USE CAST IN FRAME E (NOT SHOWN).
2.	24" CAST IRON MANHOLE FRAME AND COVER (EQUIPMENT ACCESS) PER CLTW STANDARDS - TYPE A / 1 CENTER OVER AIR / VACUUM VALVE. ABOVE GRADE USE CAST IN FRAME C (NOT SHOWN).
3.	ALUMINUM LADDER - STEPS AT 12" O.C. - CENTERED WITH FRAME NO. 1.
4.	STAINLESS STEEL PIPE SUPPORT WITH SADDLE.
5.	SOLID 18' / 20' PIECE OF PROTECTO 401 LINED DIP FORCE MAIN. CENTERED THROUGH VAULT.
6.	1/2" DIAMETER TYPE 316 STAINLESS STEEL HOOK (ADHESIVE ANCHOR).
7.	STAINLESS STEEL BALL VALVE - 1/4 TURN AND NIPPLE.
8.	JOINT REQUIRED AT FLAT TOP SECTION.
9.	2" STAINLESS STEEL BALL VALVE. (3" AND LARGER - FL X FL PLUG VALVE).
10.	2" BRONZE BALL CORPORATION STOP WITH ALL STAINLESS STEEL (TYPE 316) TAPPING SADDLE - FORD FS 313 - ROMAC STYLE 306 OR APPROVED EQUAL. (3" AND LARGER - RMJ X RMJ X FL TEE)
11.	2" AIR AND VACUUM VALVE (3" AND LARGER - FLANGE A&VV) - SEE SPECIFICATIONS.
12.	2" STAINLESS STEEL PIPING.
13.	ROUTE 1/8" TYPE 316 STAINLESS STEEL CABLE FROM BALL VALVE HANDLE (MOUNTED ON TOP OF CORPORATION STOP THROUGH EYELET TO HOOK) LEAVE 6" SECURED LOOP IN CABLE END TO HANG OVER HOOK.
14.	1/2" DIAMETER TYPE 316 STAINLESS STEEL EYE BOLT (ADHESIVE ANCHOR).
15.	PRECAST CONCRETE GRADE ADJUSTMENT RING (8" WIDE) AS NEEDED.
16.	1/2" DIAMETER GALVANIZED ANCHOR BOLTS - FRAME TO VAULT (ADHESIVE ANCHOR).
17.	GREEN PLASTIC WARNING TAPE.
18.	AWG #12 GAUGE COPPER TRACER WIRE (HDPE) - WITH GREEN INSULATION - TERMINATE AT HOOK NO. 6 WITH 24" EXCESS WIRE (COILED).
19.	6" #57 WASHED STONE.
20.	MAY TRANSITION TO PVC PIPE ON EITHER SIDE OF VAULT DIP (SEE NO. 5) UNLESS CALLED OUT OTHERWISE.
21.	PRECAST CONCRETE OR POLYMER CONCRETE VAULT.
22.	6" THICK REINFORCED CONCRETE PLUG.
23.	18" DIAMETER SUMP - PVC OR DIP PIPE, GROUTED INTO BASE FLOOR.
24.	PRECAST CONCRETE BASE SECTION.
25.	6" VENT PER CLTW STANDARD DETAIL.
26.	SLOPE 1/4" PER FOOT TO SUMP.

NOTES:

A. VAULT SHALL BE SIZED AS NEEDED FOR PIPE (6.5' X 5' MINIMUM) AND RATED FOR NCDOT HS-20 LOADING - SUBMIT SHOP DRAWINGS / P.E. SEALED FOR REVIEW.
B. ALL CONCRETE SHALL BE MINIMUM 4,000 PSI COMPRESSIVE STRENGTH.
C. DESIGN SHALL CONFORM TO ASTM C858 - SPECIFICATIONS FOR "UNDERGROUND PRECAST CONCRETE UTILITY STRUCTURE."
D. STEEL REINFORCING DESIGN SHALL CONFORM TO ASTM C857.
E. REBARS SHALL BE GRADE 60 PER ASTM A615.
F. WELDED WIRE FABRIC SHALL CONFORM TO ASTM A185.
G. DIAGONAL REINFORCING SHALL BE ADDED AT ALL OPENINGS.
H. PIPE PENETRATIONS SHALL BE SEALED WITH FLEXIBLE CONNECTERS (MANHOLE BOOTS) OR WITH 8" OF BRICK & MORTAR (AND 1/2" THICK CONSTRUCTION EXPANSION MATERIAL).
I. ALL VALVES SHALL OPEN COUNTERCLOCKWISE. (OPEN LEFT)
J. FRAME TO BE FLUSH WITH GROUND IN MAINTAINED ROAD OR YARD R/W AND 2' ABOVE GROUND IN SEWER EASEMENT.
K. AIR AND VACUUM VALVE TO BE SHORT BODY TYPE, SIZED PER MANUFACTURER'S RECOMMENDATIONS.
L. VALVE TO BE INSTALLED AT MIDPOINT OF A FULL JOINT OF DUCTILE IRON PIPE WHEN INSTALLING PVC FORCE MAIN.
M. VAULTS LOCATED IN AREAS SUBJECT TO FLOODING SHALL HAVE SOLID CONCRETE FLOOR AND VENT (PER CLTW STANDARD DETAILS) EXTENDING TO 2' ABOVE 100 YEAR FLOOD ELEVATION - FRAME AND COVERS SHALL BE WATERTIGHT TYPE E/5 AND TYPE C/3.
N. ALL JOINTS SHALL BE MADE WATERTIGHT USING 2 RINGS OF BUTYL RUBBER JOINT MASTIC - SEE JOINT DETAIL.
O. PRECAST VAULT COMPONENTS SHALL HAVE MARKINGS PER ASTM C478 REQUIREMENTS.
P. PROVIDE ADDITIONAL REBARS AROUND OPENINGS IN THE TOP OR BOTTOM SLAB, EQUAL TO THE BARS INTERRUPTED, 1/2 ON EACH SIDE, ADDITIONAL BARS IN THE SAME PLANE.
Q. FLEXIBLE PIPE BOOT CONNECTOR IN CORED HOLE. DO NOT FILL WITH MORTAR.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

SEWER LIFT STATION

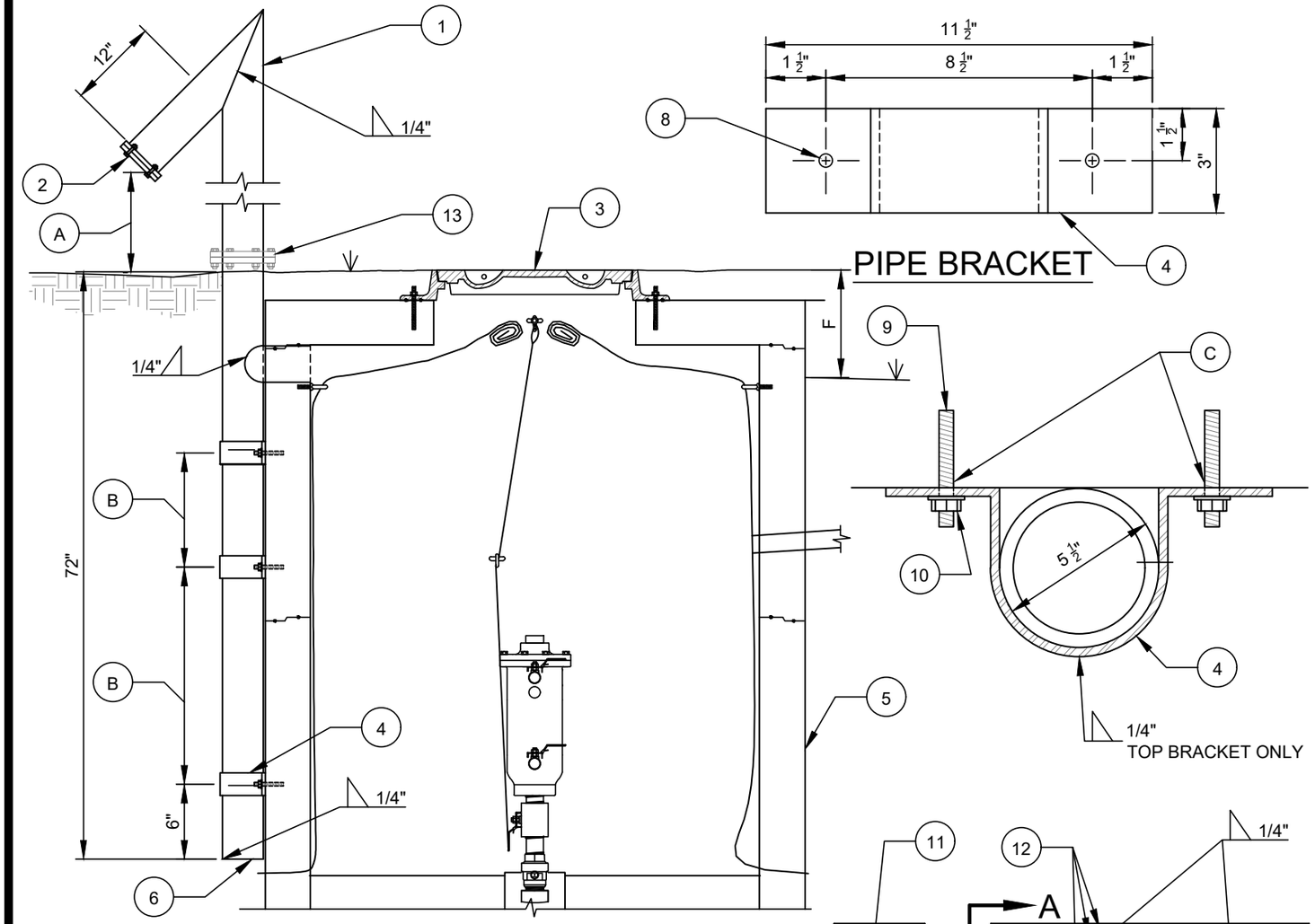
COMBINATION AIR AND VACUUM VALVE FOR SEWER FORCE MAINS

NO SCALE

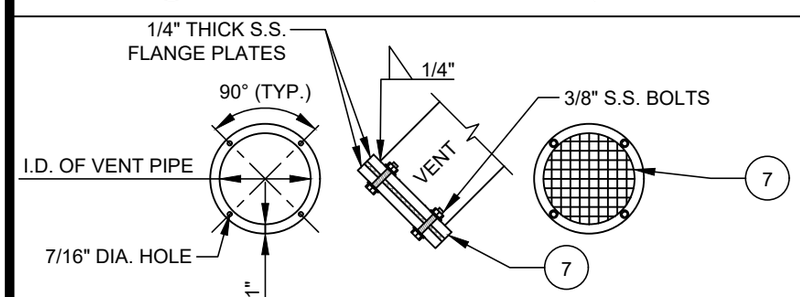
VERSION 3.0

DATE 01/2026

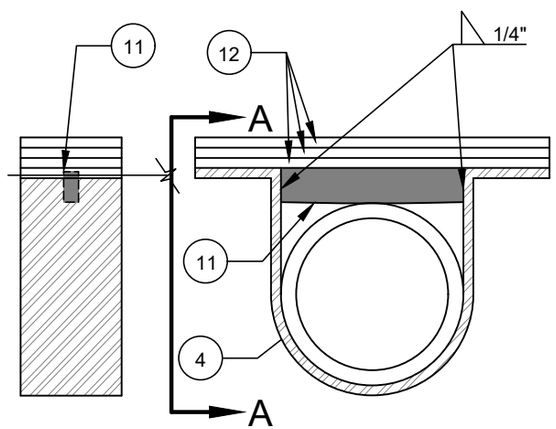
DETAIL 13.15.1



PIPE BRACKET



BOLT ON BIRD SCREEN



SECTION A-A

NO.	DESCRIPTION:
1.	6" DIAMETER STEEL PIPE.
2.	SEE BOLT ON BIRD SCREEN DETAIL THIS SHEET.
3.	24" CAST IRON MANHOLE FRAME AND COVER (EQUIPMENT ACCESS) PER CLTW STANDARDS - TYPE C / 1 CENTER OVER AIR / VACUUM VALVE.
4.	PIPE BRACKET FABRICATED FROM 1/4" STEEL PLATE (SEE THIS SHEET).
5.	PRECAST CONCRETE OR POLYMER CONCRETE VAULT. SEE COMBINATION AIR AND VACUUM VALVE FOR SEWER FORCE MAINS DETAIL.
6.	1/4" STEEL PLUG.
7.	TYPE 316 STAINLESS STEEL MESH BIRD SCREEN BOLTED BETWEEN TWO STAINLESS STEEL PLATES AND WELDED TO VENT PIPE AS SHOWN. USE ALL TYPE 316 STAINLESS STEEL BOLTS, NUTS AND WASHERS. SCREEN SHALL BE CONSTRUCTED OF 1/4" STAINLESS STEEL MESH BIRD SCREEN (WIRE DIAMETER 0.047").
8.	11/16" DIAMETER HOLES DRILLED AS SHOWN.
9.	5/8" x 4" TYPE 304 S.S. ALL THREAD ROD.
10.	TYPE 316 STAINLESS STEEL NUT AND WASHER WITH ANTI-SEIZE COMPOUND.
11.	1/4" STEEL SPACER PLATE.
12.	1/4" WASHER STEEL PLATES TO PLUMB VENT.
13.	BREAK-OFF FLANGE WITH BREAK AWAY FLANGE SS BOLTS.

NOTES:

A. 2' ABOVE 100 YEAR FLOOD ELEV. OR 6' ABOVE FRAME (WHICHEVER IS GREATER).

B. 1'-3" (MAX SPACING). AVOID PLACING PIPE BRACKET AT VAULT JOINTS OR STEPS. MINIMUM OF 3 PIPE BRACKETS REQUIRED PER VENT PIPE.

C. USE EPOXY ADHESIVE, IN CLEANED DRILLED HOLE.

D. VENT AND BRACKETS SHALL BE PAINTED PER SPECS. VENT SHALL HAVE FACTORY APPLIED INTERIOR LINING.

E. ALL THREAD ROD, WASHER, AND NUT SHALL BE 316 STAINLESS STEEL.

F. IN UNMAINTAINED AREAS, RAISE THE VAULT/RIM TO ONE OR TWO FEET ABOVE FINISHED GRADE.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

SEWER LIFT STATION

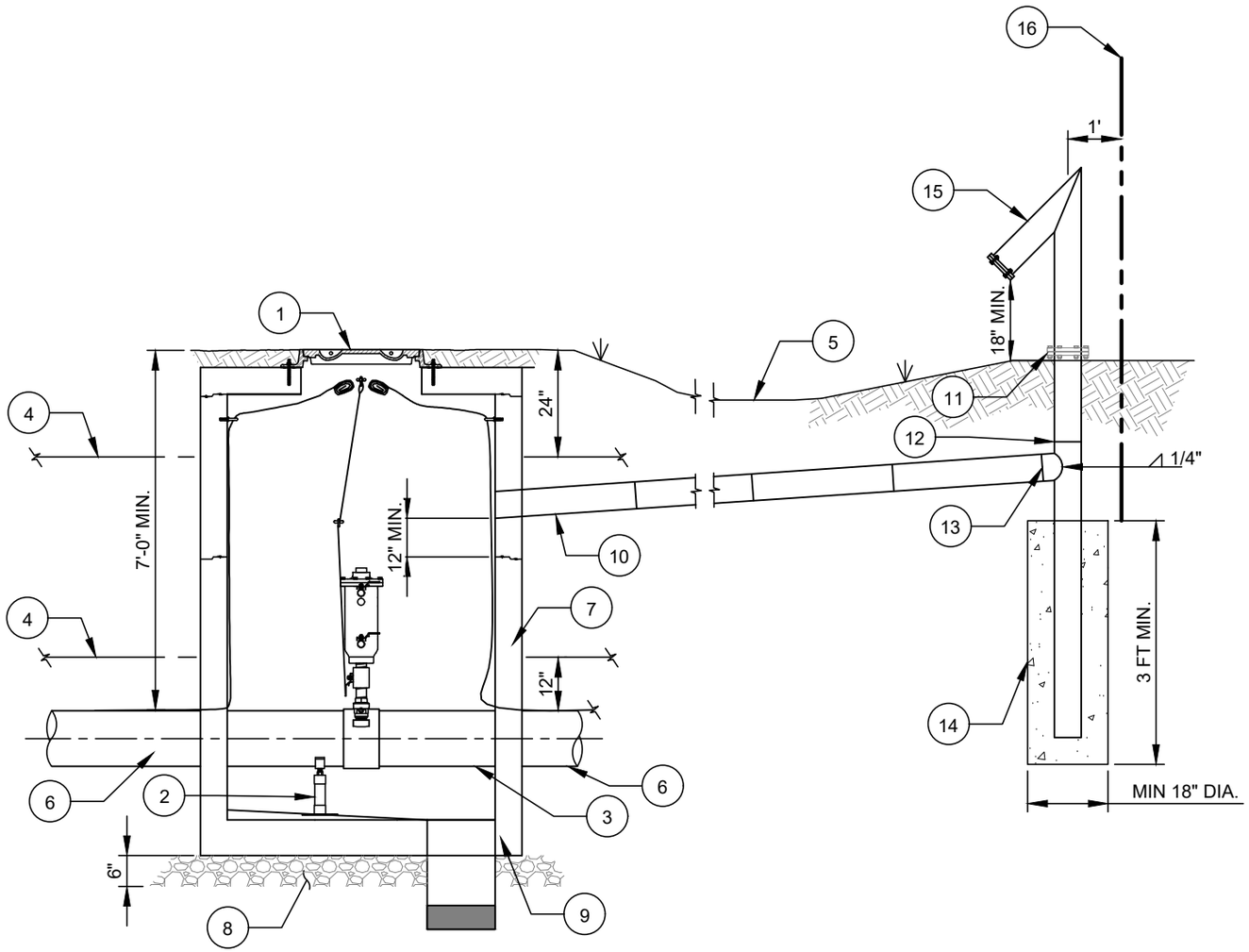
VENT PIPE - FOR USE IN CLT WATER EASEMENT ONLY

NO SCALE

VERSION 2.0

DATE 01/2025

DETAIL 13.15.2



NO.	DESCRIPTION:
1.	24" CAST IRON MANHOLE FRAME AND COVER (EQUIPMENT ACCESS) PER CLTW STANDARDS - TYPE C / 1 CENTER OVER AIR / VACUUM VALVE.
2.	STAINLESS STEEL PIPE SUPPORT WITH SADDLE.
3.	PROTECTO 401 LINED DIP FORCE MAIN. MIN 40' EACH SIDE OF VAULT.
4.	GREEN PLASTIC WARNING TAPE.
5.	ROAD SIDE DITCH UNDISTURBED SOIL.
6.	PVC PIPE ON EITHER SIDE OF VAULT, UNLESS CALLED OUT OTHERWISE.
7.	PRECAST CONCRETE OR POLYMER CONCRETE VAULT. SEE COMBINATION AIR AND VACUUM VALVE FOR SEWER FORCE MAINS DETAIL.
8.	#57 WASHED STONE.
9.	PRECAST CONCRETE BASE SECTION.
10.	6" RJ DIP - MIN. 0.50% POSITIVE SLOPE.
11.	BREAK AWAY FLANGE CONNECTION WITH SS BREAK AWAY BOLTS.
12.	FL JOINT.
13.	RJ FLEXIBLE CONNECTION SLEEVE.
14.	18" DIAMETER AUGER HOLE/CONCRETE FOOTING.
15.	6" STEEL VENT PIPE - SEE STD DETAIL.
16.	ROAD ROW OR CLTW EASEMENT.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

SEWER LIFT STATION

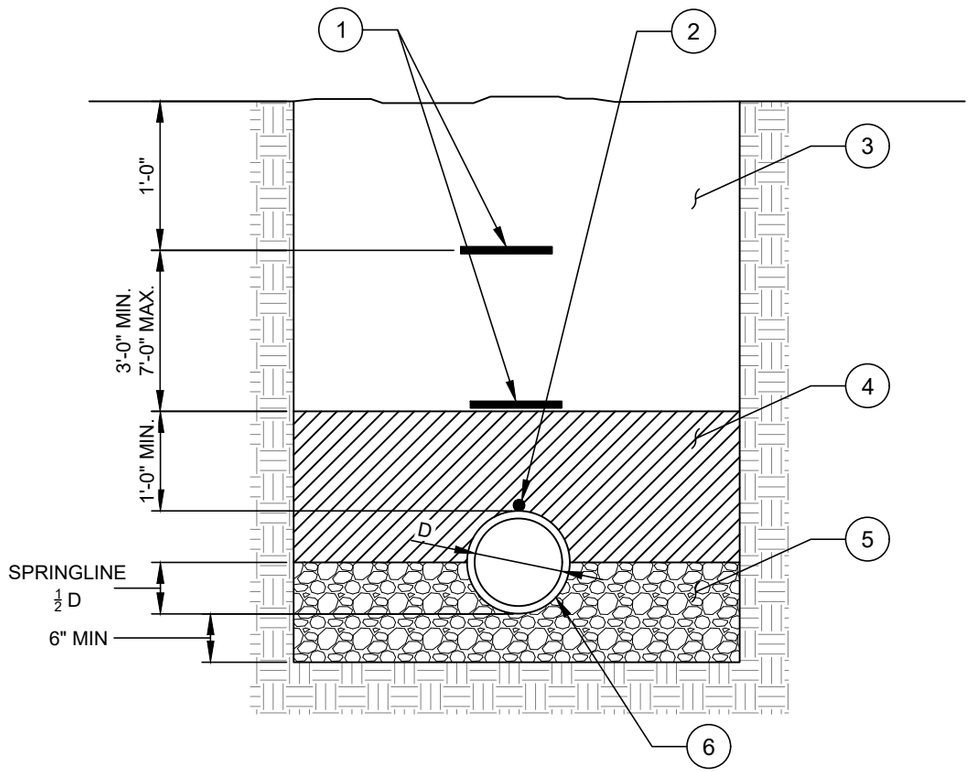
VENT PIPE
FOR USE IN ROAD RIGHT OF WAY

NO SCALE

VERSION
2.0

DATE
01/2025

DETAIL
13.15.3



NO. DESCRIPTION:

1. 6" WIDE GREEN DETECTABLE WARNING TAPE WITH BLACK LETTERING - "CAUTION BURIED SEWER LINE BELOW".
2. #12 AWG SOLID COPPER TRACER WIRE COATED W/ GREEN HDPE INSULATION - (30 MIL HDPE) SECURED TO PIPE AT EACH BELL AND AT CENTER OF EACH PILE LENGTH SECURE TO THE SS HOOK AT AIR RELEASE VALVE VAULTS.
3. 4' MIN. (95% STD. PROCTOR) 6" LOOSE LAYERS TAMPED. IF INSIDE A ROAD RIGHT OF WAY, THE TOP FOOT SHALL BE 100% STD. PROCTOR.
4. MAY USE NATIVE SOILS OF ASTM 2321 CLASS II, III (OR CLASS IA OR IB) ABOVE THE SPRINGLINE. CAREFULLY COMPACTED BACKFILL 95% STANDARD PROCTOR DENSITY (6" LOOSE LAYERS TAMPED).
5. CONTINUOUS AND UNIFORM BEDDING APPROPRIATE FOR THE SOIL TYPE AND PIPE MATERIAL. SEE BEDDING SPECIFICATIONS.
6. FORCEMAIN.

NOTE:

A. WHEN THE TRENCH IS IN PAVEMENT, THE TOP ONE FOOT OF BACKFILL BELOW THE PAVEMENT SUBGRADE MUST BE 100% DENSITY BASED ON STANDARD PROCTOR - 6" LOOSE LAYERS TAMPED.

B. MAXIMUM DEPTH OF COVER SHALL BE 10 FEET. CLTW MAY ELECT TO APPROVE A MAX DEPTH OF 12 FEET FOR SHORT DISTANCES IF IT WILL ELIMINATE THE NEED FOR AN AIR/VAC. VALVE ASSEMBLY. MINIMUM PIPE SLOPES SHALL BE ONE PERCENT.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

SEWER LIFT STATION

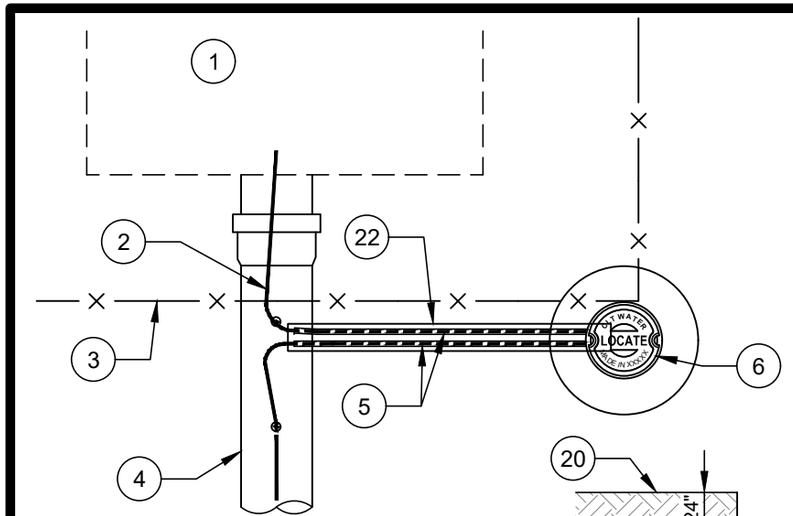
STANDARD TRENCH FOR FORCE MAIN SANITARY PIPE

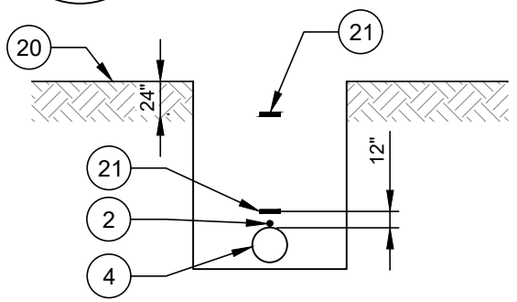
NO SCALE

VERSION
2.0

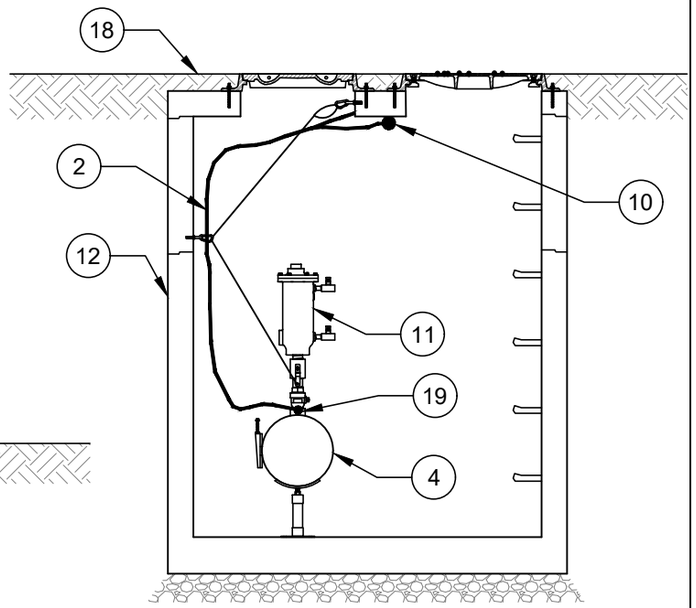
DATE
01/2025

DETAIL
13.16





TRENCH DETAIL
PROFILE VIEW

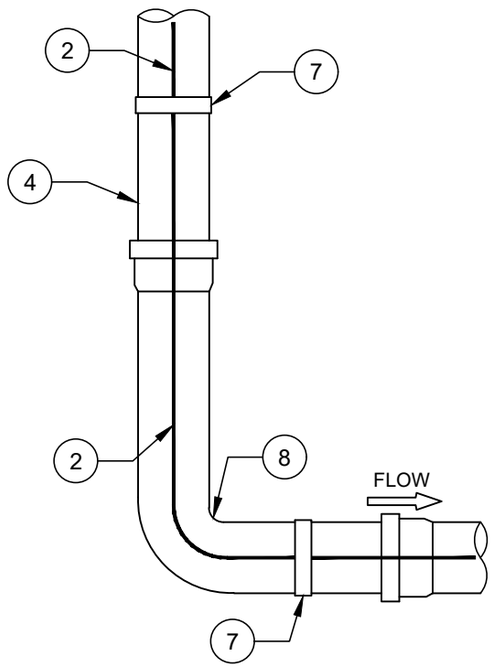


AIR RELEASE VALVE
IN MANHOLE
PROFILE VIEW

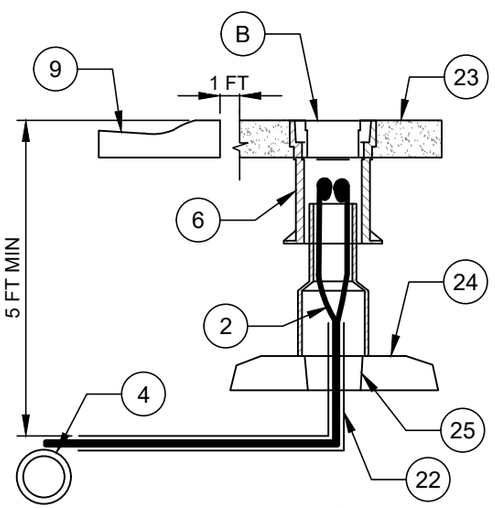
NO.	DESCRIPTION:
1.	VALVE VAULT PUMP STATION.
2.	AWG #12 GAUGE SOLID COPPER TRACER WIRE WITH 30 MILS GREEN HDPE INSULATION (TYP.).
3.	FENCE AROUND PUMP STATION.
4.	FORCE MAIN SEWER.
5.	AWG #12 GAUGE SOLID COPPER TRACER WIRE WITH 30 MILS GREEN HDPE INSULATION (TYP.) WITH CONDUIT.
6.	VALVE BOX ASSEMBLY (TYP.) W/CONC PAD AT R/W LINE.
7.	FASTEN TRACER WIRE TO PIPE WITH ZIP TIES OR DUCT TAPE AROUND THE CIRCUMFERENCE OF PIPE AT 10' INTERVALS (TYP.).
8.	90° BEND.
9.	ROAD CURB.
10.	S.S. EYEBOLT COIL 24" OF TRACER WIRE AROUND EYEBOLT (TYP.).
11.	COMBINATION AIR AND VACUUM VALVE.
12.	MANHOLE (SEE CLTW STD. DETAIL) (COMBINATION AIR AND VACUUM VALVE FOR SEWER FORCE MAINS).
13.	SANITARY SEWER MANHOLE.
14.	FOR TRACER WIRE INSTALLATION AT A SEWER MANHOLE, SEE APPROPRIATE CLTW STD. DETAIL.
15.	NOTCH ON TOP OF CONE (BETWEEN CONE AND FRAME) FOR TRACER WIRE.
16.	COILED AND SECURED TRACER WIRE.
17.	GRAVITY SEWER MAIN.
18.	EXISTING GRADE.
19.	MAIN TRACER WIRE FOR NEW SEWER.
20.	FINISHED GRADE.
21.	WARNING TAPE.
22.	3/4" PVC ELECTRICAL CONDUIT, 5 FEET DEEP.
23.	CAST IN PLACE SQUARE CONCRETE PAD.
24.	PRECAST CONCRETE VALVE DOUGHNUT OR CONC BRICKS.
25.	WASHED STONE.

NOTES:

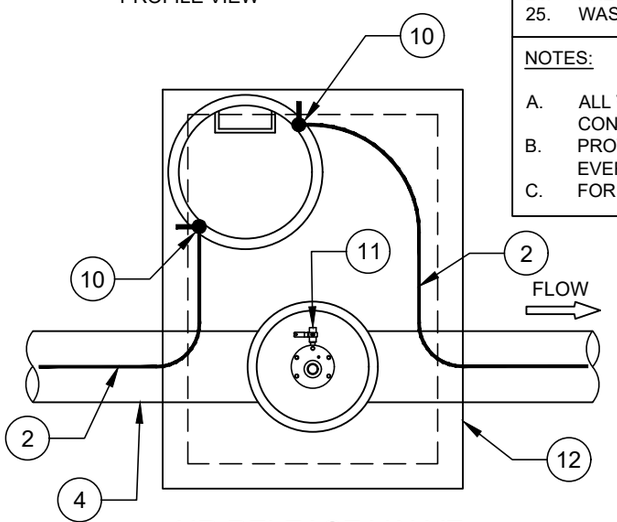
A. ALL VERTICAL WIRE SHALL BE PLACED IN 1/4" OR 3/8" ID CONDUIT SDR 9 PEX TUBING - ASTM F876 (TYP.).
B. PROVIDE A CONNECTION POINT IN VALVE BOX ASSEMBLY EVERY 750' WHERE NO AIR RELEASE VALVES OCCUR.
C. FOR SPLICES IN TRACER WIRE, SEE CLTW STD. DETAILS.



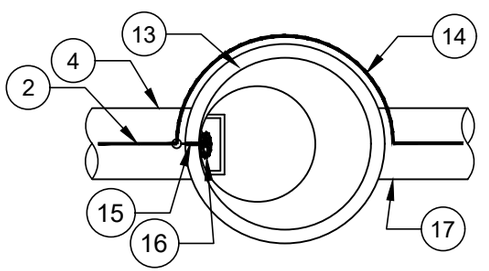
TERMINATION AT PUMP STATION
PLAN VIEW



LOCATOR VALVE BOX
PROFILE VIEW



AIR RELEASE VALVE
IN MANHOLE
PLAN VIEW



TERMINATION AT MANHOLE
PLAN VIEW

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

SEWER LIFT STATION

TRACER WIRE - FORCE MAIN SEWER

NO SCALE

VERSION 2.0

DATE 01/2025

DETAIL 13.17

CHAPTER 14
CROSS CONNECTION / BACKFLOW PREVENTION

CHAPTER 14
CROSS CONNECTION / BACKFLOW PREVENTION DESIGN

1. INTRODUCTION

A. This document includes design requirements for the installation of backflow prevention assemblies specifically for metered connections to the Charlotte Water water system.

B. All industrial, commercial and irrigation customers must install and maintain a backflow prevention assembly at every service connection to the Charlotte Water system before any branching of the private system in accordance with the Charlotte Water's Water and Sewer Design and Construction Standards. All requirements of Chapter 23 of the City of Charlotte Code of Ordinances, titled *Water, Sewers and Industrial Waste Discharge Restrictions*, latest version, including all revisions and updates, applies to this document and must be followed.

C. If the interruption of water service would have a critical impact on the private system, two backflow prevention assemblies must be installed in parallel in order for testing and maintenance requirements to be fulfilled. This will allow one assembly to continue providing water while the other is being tested or repaired.

D. Note that installation of a backflow prevention assembly will prevent release of on-site pressure to the utility water mains. Therefore, it is important that a mechanism to handle temperature/pressure increases be properly installed and maintained by the customer to relieve any excessive increase in on-site pressure due to hot water heating systems, pumps or other activities.

2. RELATED DOCUMENTS

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

3. DEFINITIONS

A. Air Gap Separation: An unobstructed vertical distance through the atmosphere between the lowest opening from any pipe or faucet supplying water from any source to a tank, plumbing fixture, or other device and the flood level rim of the receptacle. An approved, air gap separation shall be at least double the diameter of the supply pipe. In no case shall the air gap separation be less the one (1) inch. An approved, air gap separation is an effective method to prevent backflow and shall be considered as a backflow prevention assembly.

B. Approved: In reference to backflow prevention assemblies or methods, those assemblies or methods which have been accepted by the director as an effective device or method to prevent backflow.

C. Assembly: Backflow prevention assembly.

D. Auxiliary Water Supply: Any water source other than the public water system that is used in conjunction with or is otherwise available to a private water system.

E. Backflow: Any flow of water, other liquid, gas, other substances, or any combination thereof, into the public water system from any source due to an unprotected cross-connection, back pressure, back-siphonage, any combination thereof, or any other cause; provided that, the following activities by Charlotte Water shall not be construed as backflow: the introduction of raw water into a Charlotte Water water treatment plant; the treatment of such water into a Charlotte Water water treatment plant; and the introduction of such treated water by Charlotte Water into the public water system.

F. Backflow Prevention Assembly: An effective device or method used to prevent backflow.

G. Back Pressure: Any pressure on water, other liquid, gas, other substances, or any combination thereof, in a private water system that is connected in any manner to the public water system under circumstances in which such pressure is greater than the pressure on the water in the public water system, so that backflow may occur.

H. Back-Siphonage: Any circumstance in which the pressure on the water in the public water system is less than the pressure on water, other liquid, gas, other substances, or any combination thereof in a private water system that is connected in any manner to the public water system, so that backflow may occur.

I. Certified Tester: An individual person who has proven his/her competency to test, repair, and overhaul backflow prevention assemblies of all types and to prepare reports on such assemblies, as evidenced by successful completion of a training program approved by Charlotte Water.

J. Contamination: The impairment of the quality of water to a degree that human consumption could result in poisoning or the spread of disease.

K. Containment: The prevention of backflow from a private water system by an approved, properly functioning backflow prevention assembly which is installed, operated and maintained in accordance with the provisions of this document.

L. Cross-Connection Control Inspector: An employee of the city designated by the director to administer and enforce the backflow prevention and cross connection control ordinance and provisions of this manual.

M. Customer: Any person who is capable of receiving water from the public water system through the customer's private water system, without regard to whether Charlotte Water is aware of the existence of such customer. If such person does not own the private water system, "customer" shall also be construed to include the person who owns the private water system.

N. Customer's Private Water System: The private water system through which a customer is capable of receiving water from the public water system.

O. Customer's Potable Water System: The private water system through which a customer receives water from the public water system for purposes of human consumption.

P. Degree of Hazard: The evaluation of a hazard within a private water system as low or high.

Q. Double Check Valve Assembly: An approved, properly functioning assembly composed of two, independently acting check valves, including tightly closing shut-off valves attached at each end of the assembly and fitted with properly located test cocks. This assembly may only be used to protect against a low hazard.

R. High Hazard: An actual or potential threat of contamination to the public water system or to a customer's potable water system that could cause serious illness or death.

S. Imminent Hazard: An actual threat of contamination to the public water system that could cause serious illness or death.

T. Low Hazard: An actual or potential threat of damage to the physical components comprising the public water system or a customer's potable water system, or of pollution to the public water system or to a customer's potable water system.

U. Pollution: The presence of any substance in water that tends to degrade the quality of such water or adversely affects the usefulness of such water.

V. Potable Water: Water from any source which has been approved for human consumption by the appropriate agency of the State of North Carolina and/or Mecklenburg County.

W. Private Water System: Any pipe(s), system of pipes or other associated facilities that is not part of the public water system and is used in whole or in part to move or receive water, regardless of the source(s) of the water in such system.

X. Protected Cross-Connection: Any physical connection or other condition which does not permit backflow because containment is achieved.

Y. Public Water System: The potable water system owned and operated by the city through Charlotte Water. This system includes all distribution mains, lines, pipes, connections, storage tanks, and other facilities conveying potable water from the several water treatment plants to the service connection of each customer.

Z. Reduced Pressure Principle Assembly: An approved, properly functioning assembly containing two, independently acting check valves with a hydraulically operating, mechanically independent pressure differential relief valve located between the check valves and at the same time below the first check valve. The assembly must include properly located test cocks and tightly closing shut-off valves at each end of the assembly. This assembly is designed to protect against a high hazard.

AA. Service Connection: The terminal end of a complete service connection, or, in the absence of a complete service connection, the point at which water leaves the public water system and enters a private water system.

BB. Unapproved Water Supply: A water supply which has not been approved for human consumption by the appropriate agency of the State of North Carolina and/or Mecklenburg County.

CC. Unprotected Cross-Connection: Any physical connection or other condition which could permit backflow to occur by any means including, but not limited to, manipulation of valves, improper functioning of valves, or direct discharge. Unprotected cross-connection includes any condition in which backflow could occur as a result of the improper functioning of a backflow prevention assembly.

4. APPROVED ASSEMBLIES

A. All backflow prevention assemblies shall conform to ANSI/AWWA C510 or C511 standards and adhere to applicable ASTM standards. All assemblies installed on fire lines shall have approval by Factory Mutual Global (FM Approved).

B. All backflow prevention assemblies shall meet the American Society of Sanitary Engineering (ASSE) standards and carry an ASSE seal, be on the University of Southern California approval list for testable backflow prevention assemblies or be on the North Carolina State Plumbing Code approval list for approved testable backflow prevention assemblies.

C. All Backflow prevention assemblies must be approved by Charlotte Water. The list of Charlotte Water approved Backflow Prevention Assemblies is located online at:

https://www.charlottenc.gov/water/Commercial-Development/Backflow/Backflow-Construction-Guide

5. LICENSING REQUIREMENTS FOR BACKFLOW ASSEMBLY INSTALLERS

A. For contractors and/or individuals installing outdoor backflow prevention assemblies (non-fire lines):

1. Public Utilities Contractor(s) and/or individual(s) licensed as such by the N.C. Licensing Board for General Contractors (in accordance with N.C. General Statute 87, Article 1), or

2. Plumber licensed by the N.C. State Board of Examiners of Plumbing, Heating and Fire Sprinkler Contractors (in accordance with N.C. General Statute 87, Article 2).

B. For contractors and/or individuals installing indoor backflow prevention assemblies (non-fire lines):

1. Plumber licensed by the N.C. State Board of Examiners of Plumbing, Heating and Fire Sprinkler Contractors (in accordance with N.C. General Statute 87, Article 2).

C. For contractors and/or individuals installing backflow prevention assemblies on fire lines (outdoor or indoor):

1. Fire Sprinkler Contractor licensed by the N.C. State Board of Examiners of Plumbing, Heating and Fire Sprinkler Contractors (in accordance with N.C. General Statute 87, Article 2).

6. DESIGN REQUIREMENTS

A. General

1. The installation location of all backflow prevention assemblies shall be in an area that provides a safe working environment for testing and maintenance. This area shall be readily accessible, away from electrical hazards and free from dirt. The location must meet requirements of all other state and local authorities having jurisdiction over the work, including, but not limited to, City and County planning and building permitting agencies, Charlotte Department of Transportation (CDOT), and the North Carolina Department of Transportation (NCDOT).

2. The installation shall be in accordance with the Manufacturer's information, N.C. Building Code (latest version) and Charlotte Water. Installation of backflow prevention assemblies shall be upstream of the first branch line leading off the service line. If Charlotte Water determines that it is impossible or impractical for the backflow prevention assembly to be installed outside, it may be installed just inside the building.

3. All backflow assemblies shall be installed in a horizontal direction. Vertical installations may be allowed with prior approval from Charlotte Water. Design Engineer shall certify design of vertical support systems if such support systems differ or deviate from the Standard Details of Charlotte Water's Water and Sewer Design and Construction Standards. N.C Building Code may allow for differing pipe material than Charlotte Water standards. In which case, Design Engineer shall certify backflow assemblies are properly supported.

4. The size of any backflow prevention assembly, and the piping to the backflow prevention assembly, shall be the same size as the water meter, or in the case of a fire line, the size of the piping connection to the main.

5. The type of backflow prevention assembly installed will be determined by Charlotte Water and shall depend upon the degree of hazard as stated in the ordinance. If the hazard cannot be determined, then a reduced pressure principle assembly shall be installed. The backflow prevention assemblies installed shall be Charlotte Water approved backflow prevention assemblies which include the shut-off valves on each end of the unit and are considered part of the unit. These shut-off valves shall be those approved with each specific unit and there shall not be any substitutions. There shall be four test cocks provided as specified in the section titled "Approved Assemblies and Materials."

    a. On the upstream side of the first shut off valve (upstream being the side closest to the property line)

    b. Between the first shut off valve and the first check valve

    c. Between the first and second check valve

    d. Between the second check valve and the second shut off valve

6. All installations shall be installed where easily accessible for testing and maintenance.

7. Fire line installations shall be as follows: High hazard fire line installations require a reduced pressure principle assembly (RP) as stated in the ordinance. Low hazard fire line installations require a double check valve assembly. Strainers shall not be installed on fire lines. If there is an existing booster pump, or one will be installed, designer is directed to follow pump Manufacturer's guidance for separation distance upstream and/or downstream between the pump and backflow assembly. Charlotte Water Required backflow prevention assembly must be on the supply side of the pump.

8. Fire line services with only one fire hydrant shall require a minimum of a double check valve backflow prevention assembly. All assemblies on a fire line, or combination domestic and fire, shall be fire line approved installations with OS & Y type shut-off valves. These valves shall be provided with supervisory tamper switches as required by current Building Code enforced by the Fire Marshal.

9. All fire line installations shall be protected to a min. of 40 degrees Fahrenheit or as required by applicable standards of the NC Building Code (latest version adopted). Outdoor above ground installations of backflow assemblies require heated enclosures.

B. Outdoor Installations

1. Water service connections requiring backflow compliance must have the correct type of backflow preventer installed in a location directly behind and as near to the water meter as possible (see zoning setbacks requirements below). Due to the potential for future connections to the water service line and the risks of a catastrophic failure causing flooding conditions, it is Charlotte Water's position that backflow assemblies must go outside. Therefore, backflow preventers shall be installed:

    a. At or near the meter such that no service branches are present between the meter and the backflow prevention assembly,

    b. At an elevation at least one foot above the community and FEMA 100-year floodplains, and

    c. In an area where grades provide positive drainage away from assembly and slope is not excessively steep.

2. Zoning setbacks requirements impact the location allowed for outside above ground installations of backflow prevention assemblies. Above-ground backflow preventers shall be installed just after (on the building side) the front setback line and out of side yards, rear yards, and buffers when required by zoning ordinances.

C. Indoor Installations

1. For sites meeting at least one of the following criteria:

    a. The "footprint" of the existing building occupies almost all the property

b. Building located close to ROW due to minimal setback restrictions

c. Building up fit requires retrofit of existing water service with backflow prevention

2. If Charlotte Water determines that there is no room outside to install the backflow assembly, an indoor installation may be allowed following Charlotte Water indoor installation requirements. In certain new & existing urban developments with zoning designations such as TOD, PED, TS & RE-3 where there is a need to maintain pedestrian flow with a required outdoor streetscape that precludes adequate space for an outdoor backflow installation, an indoor installation may be allowed if the following conditions are met.

   a. Customer shall agree to accept all risks associated with installing the backflow assembly indoors.

   b. Customer will not be exempt from Sec. 23-178 – Right of Entry found in Charlotte's Code of Ordinances. This section states that Authorized Charlotte Water Employees will have access to backflow installation upon request.

   c. Location must never impact customer's ability to comply with initial and annual testing requirements.

   d. Customer shall never allow any connections on the service line between the Charlotte Water meter and its required backflow prevention assembly. When required to, the customer shall mark all exposed piping between the meter and the backflow assembly with signage stating, "DO NOT TAP".

   e. An indoor location must meet the following criteria:

      1) The proposed location of the backflow assembly shall be adjacent to an exterior wall near and directly opposite the meter for the service. (*Note: often this will mean that the customer will have to sacrifice leasable space to meet this requirement.)

      2) The backflow assembly shall be installed at grade elevation such that the required drain system for the backflow assembly can discharge directly out of the building, through the exterior wall, to grade that slopes away from the building. A sanitary floor drain or drain system that is adequately sized to carry the combined maximum potential discharge flow from all RPPA's installed in the space would also be acceptable. Sealing engineer to provide calculations that drainage is sufficient.

      3) All design and construction shall meet the requirements of the NC Building Code and Charlotte Water Standard Details for indoor installations of backflow prevention assemblies.

D. Reduced Pressure Principle Backflow Prevention Assemblies (RP)

1. Reduced pressure principle backflow prevention assemblies (RP) shall be installed above ground outside zoning setback areas and according to Charlotte Water Standard Details.

2. The minimum height from the relief port to the ground shall be 12" and the maximum height shall be 30". A floor drain or an air gap drain shall be provided for RP's installed inside of buildings. Design Engineer shall determine drain size and provide supporting calculations. For 3/4" - 2", the clearance for an RP installed inside a building shall be 4" minimum from the wall to shut off valve, 30" minimum from the wall or any obstruction on the side utilized for testing and 6" minimum on the other to the assembly. For 3" - 10" RP, the clearance shall be 6" minimum from the wall to shut off valve, 30" minimum from the wall or any obstruction on the side utilized for testing and 12" minimum on the other. RP's must be installed in an upright horizontal direction.

E. Double Check Valve Assemblies (DCVA)

1. Double check valve assemblies (DCVA) may be installed above ground or below ground and shall be according to Charlotte Water Standard Details. DCVA's must be installed in an upright horizontal direction. If the DCVA is installed below ground, it must be installed in a vault. The vault must have positive drainage, by gravity to surface of ground, or to a catch basin in a private storm drain system. If positive drainage cannot be accomplished, the DCVA shall be installed above ground outside zoning setback areas. All drainage systems shall be approved by Mecklenburg County Code Enforcement Plumbing Inspection.

2. If drainage is provided to a catch basin in a private storm drain system, the invert elevation of the drainpipe must be at or above the (top) crown level of the main storm drain line pipe flowing out of the catch basin. All Work shall only be performed on the customers property and not in the public road right-of-way. Minimum drain sizes are listed in these specifications. Vault installations shall conform to Charlotte Water Standard Details for DCVA vault installations.

3. If the DCVA is installed in a vault, it must be easily accessible for testing and maintenance. The length and width shall be such that the entire assembly may be removed. For 3/4" and 1" DCVA there shall be a minimum of 8" clearance on either side of the DCVA and 4" clearance on each end. For 1 1/2" and 2" DCVA there shall be a minimum of 12" clearance on either side of the DCVA. There shall be a minimum of 4" clearance on each end. For 3" - 10" DCVA there shall be a minimum of 30" clearance on the side of the assembly used for testing and maintenance, 12" clearance on the other, and 8" clearance on each end. DCVA's shall be installed with a minimum of 12" and a maximum of 30" clearance between the bottom surface of the body and the ground or floor. DCVA’s installed in a vault shall have at least 6” clearance between vault lid and top of assembly but no deeper than 15”. If the DCVA is installed inside a building the maximum height shall be 60". The clearance for 3/4"-2" DCVA installed inside a building shall be 4" minimum from the wall to shut off valve, 30" minimum from the wall to the assembly or obstruction on the side utilized for testing and 6" minimum on the other. For 3" - 10" DCVA, the clearance shall be 6" minimum from the wall to shut off valve, 30" minimum from the wall or obstruction on the side utilized for testing and 12" minimum on the other.

F. Residential Lawn Irrigation Service Installations

1. The backflow prevention assembly must be installed on the irrigation service line before any branching of the private system and in accordance with all other Charlotte Water Installation Guidelines and Standard Details for Backflow Prevention Assemblies. The assembly may be installed adjacent to the house and shall be outside the footprint of the house.

2. All residential lawn irrigation system services tapped from the residential domestic service shall require a backflow prevention assembly on the irrigation service line before any branching of the irrigation system and in accordance with Charlotte Water Installation Guidelines and Standard Details for Backflow Assemblies.

3. Once installation is completed, the customer shall have the backflow prevention assembly inspected by Mecklenburg County Code Enforcement Plumbing Inspection and a Charlotte Water representative and tested by a Charlotte Water approved certified tester. The test results shall be submitted to Charlotte Water for the initial test and annual tests thereafter. All rubber parts shall be replaced every five (5) years.

4. Procedures for Approval of Installation (Irrigation Only): All irrigation systems installed on lots platted after July 1, 2009, must be connected to a separate irrigation meter installed by Charlotte Water. Lots platted prior to July 1, 2009, must acquire a deferment from Charlotte Water Backflow to allow irrigation system to be served water from the private plumbing. In no case shall irrigation every be served water from a dedicated fire line service.

    a. Apply for plumbing permit at Mecklenburg County Code Enforcement.

        1) Apply for plumbing permit at Mecklenburg County Code Enforcement. Turn in completed Backflow Service Application (BSA) with plumbing permit application to Mecklenburg County Code Enforcement. Mecklenburg County Code Enforcement will forward questionnaire to Charlotte Water systems and records.

        2) For quick determination of assembly requirements deliver Backflow Service Application (BSA) to Charlotte Water systems and records.

        3) With Backflow Service Application (BSA) Charlotte Water will specify required assembly type. Charlotte Water will notify owner listed on Backflow Service Application (BSA) and Mecklenburg County Code Enforcement of requirements.

    b. Install irrigation system.

    c. Contact Mecklenburg County Code Enforcement to inspect installation.

    d. With approved installation Charlotte Water requires owner to submit a copy of the backflow prevention assembly test record. See testing requirements.

5. Procedures for Approval of Installation (Irrigation Only)

a. Apply for new lawn meter at Charlotte Water.

    1) Complete Backflow Service Application (BSA).

    2) Turn in completed Backflow Service Application (BSA) with money for service connection fees, to Charlotte Water.

    3) With Backflow Service Application (BSA) Charlotte Water will determine hazard and specify assembly required (RP or DCVA). Charlotte Water will notify owner listed on Backflow Service Application (BSA) and Mecklenburg County Code Enforcement of requirements.

b. Apply for plumbing permit at Mecklenburg County Code Enforcement.

c. Flag location for Charlotte Water crew to install new meter.

d. Install irrigation system.

e. Contact Mecklenburg County Code Enforcement to inspect installation.

f. With approved installation Charlotte Water requires owner to submit a copy of the backflow prevention assembly test record. See testing requirements.

G. Protective Enclosures for Backflow Prevention Assemblies

1. The backflow prevention assembly is the responsibility of the customer to install and maintain. If damage occurs to the assembly for any reason, it is the customers responsibility to repair or replace it.

2. It is required that protective structures be used to prevent freezing for backflow prevention assemblies installed outside above ground. The backflow prevention assembly shall be protected from freezing in accordance with ASSE 1060 certified, and Chapter 6, Water Supply and Distribution, of the N.C. Plumbing Code (latest version). The backflow prevention assembly must be readily accessible for maintenance and testing including removing the entire assembly. Adequate drainage shall be provided by hinged door or drain ports along the bottom of the walls of the protective structure. The minimum drain size shall be provided according to N.C. Plumbing Code, Chapters 6 and 11 (latest versions). Insulation shall not be wrapped around the assembly.

3. If the structure is non-removable and must be entered in order to test or repair the assembly, the same minimum and maximum clearance that is specified for vault installations shall apply.

4. Covers or doors placed above a protective structure or vault shall be lightweight and shall have adequate width and length to remove the entire assembly. Doors or covers for 3" - 10" vault installations shall be double hinged.

7. INSTALLATION APPROVAL PROCEDURES

A. Existing Residential Domestic Service with New Lawn Irrigation System Tied to Existing Service Line (only allowed if property being irrigated was platted prior to July 1st, 2009)

1. Apply for plumbing permit at Mecklenburg County Code Enforcement.

    a. Apply for plumbing permit at Mecklenburg County Code Enforcement. Installer must get an irrigation meter deferment request approved by Charlotte Water. Contact 704-391-5188 to get a completed and approved request form. Submit copy of completed and approved irrigation meter deferment request form with plumbing permit application to Mecklenburg County Code Enforcement.

2. Install irrigation system.

3. Contact Mecklenburg County Code Enforcement to inspect installation.

4. Once plumbing inspection has passed, contact Charlotte Water Backflow inspection at 704-391-5188 to request backflow inspection by Charlotte Water.

5. With approved installation Charlotte Water requires owner to submit a copy of the backflow prevention assembly test record. See testing requirements.

B. New Residential Lawn Irrigation Service with New Lawn Irrigation System Tied to New Lawn Meter

1. Apply for new lawn meter.

    a. Complete Backflow Service Application (BSA).

    b. Turn in completed BSA with service connection fees to Charlotte Water.

    c. Charlotte Water will review BSA, determine hazard classification, and specify required assembly type. Charlotte Water will notify owner listed on BSA form and Mecklenburg County Code Enforcement of requirements.

2. Apply for plumbing permit at Mecklenburg County Code Enforcement.

3. Flag location for Charlotte Water crews to install new meter.

4. Install irrigation system.

5. Contact Mecklenburg County Code Enforcement to inspect installation.

6. Once plumbing inspection has passed, contact Charlotte Water Backflow inspection at 704-391-5188 to request backflow inspection by Charlotte Water. Charlotte Water will unlock meter once inspection has passed.

7. With approved installation Charlotte Water requires owner to submit a copy of the backflow prevention assembly test record. See testing requirements.

C. Existing Commercial Service with Lawn Irrigation or Fire System Tied to Existing Service Line (Note: Lots platted after July 1st, 2009, must get a dedicated meter for irrigation)

1. Apply for plumbing permit at Mecklenburg County Code Enforcement.

    a. Complete application for plumbing permit and pay fee.

    b. Turn in completed backflow service application (BSA) with plumbing permit application to Mecklenburg County Code Enforcement. Mecklenburg County Code Enforcement will forward BSA to Charlotte Water.

    c. For quick determination of hazard and assembly requirements deliver BSA to Charlotte Water.

    d. Charlotte Water will review BSA, determine hazard classification, and specify required assembly type. Charlotte Water will notify owner listed on BSA form and Mecklenburg County Code Enforcement of requirements.

2. Installation of assembly may be subject to other local authority requirements and approval (i.e. Fire, Planning, Zoning, CDOT, or NCDOT).

3. Install irrigation or fire system and backflow prevention assemblies at meter and at connection of new system.

4. Contact Mecklenburg County Code Enforcement to inspect installation.

5. Once plumbing inspection has passed, contact Charlotte Water Backflow inspection at 704-391-5188 to request backflow inspection by Charlotte Water. Charlotte Water will unlock meter once inspection has passed.

6. With approved installation Charlotte Water requires owner to submit a copy of the backflow prevention assembly test record at existing meter. See testing requirements.

D. New Commercial, Lawn Irrigation, or Fire Line Service with New Service, Lawn, or Fire System Tied to New Meter (Note: Lots platted after July 1st, 2009, must get a dedicated meter for irrigation)

1. Apply for plumbing permit at Mecklenburg County Code Enforcement.

    a. Complete application for plumbing permit and pay fee.

    b. Turn in completed backflow service application (BSA) with plumbing permit application to Mecklenburg County Code Enforcement. Mecklenburg County Code Enforcement will forward BSA to Charlotte Water.

    c. For quick determination of hazard and assembly requirements deliver BSA to Charlotte Water.

d. Charlotte Water will review BSA, determine hazard classification, and specify required assembly type. Charlotte Water will notify owner listed on BSA form and Mecklenburg County Code Enforcement of requirements.

2. Installation of assembly may be subject to other local authority requirements and approval (i.e. Fire, Zoning, Planning, CDOT, or NCDOT).

3. Apply for new meter at Charlotte Water.

   a. Turn in copy of completed BSA with money for service connection fees.

   b. Charlotte Water will review BSA, determine hazard classification, and specify required assembly type. Charlotte Water will notify owner listed on BSA form and Mecklenburg County Code Enforcement of requirements.

4. Flag location for Charlotte Water crew to install new meter.

5. Install private water system.

6. Contact Mecklenburg County Code Enforcement to inspect installation.

7. Once plumbing inspection has passed, contact Charlotte Water Backflow inspection at 704-391-5188 to request backflow inspection by Charlotte Water. Charlotte Water will unlock meter once inspection has passed.

8. With approved installation Charlotte Water requires owner to submit a copy of the backflow prevention assembly test record. See testing requirements.

E. Developer Installed Service Tied to new Developer Installed Meter

1. Apply for new water meter at Charlotte Water.

   a. Complete Backflow Service Application (BSA).

   b. Turn in completed BSA with money for service connection fees.

   c. Charlotte Water will review BSA, determine hazard classification, and specify required assembly type. Charlotte Water will notify owner listed on BSA form and Subdivision Inspectors of requirements.

2. Any installation installed in (existing, or future) public road right-of-way, or set-back areas controlled by local authorities are subject to all state and local approvals.

3. Apply for plumbing permit at Mecklenburg County Code Enforcement.

4. Apply for NCDOT encroachment if required.

5. Meter will not be activated until all requirements of Charlotte Water have been met satisfactorily.

6. Contact Mecklenburg County Code Enforcement to inspect installation.

7. Once plumbing inspection has passed, contact Charlotte Water Backflow inspection at 704-391-5188 to request backflow inspection by Charlotte Water. Charlotte Water will unlock meter once inspection has passed.

8. With approved installation Charlotte Water requires owner to submit a copy of the backflow prevention assembly test record. See testing requirements.

F. New or Existing Irrigation Service for a Public Roadway

1. Apply for new lawn meter at Charlotte Water.

   a. Complete Backflow Service Application (BSA).

   b. Turn in completed BSA with money for service connection fees.

   c. Charlotte Water will review BSA, determine hazard classification, and specify required assembly type. Charlotte Water will notify owner listed on BSA form and Mecklenburg County Code Enforcement of requirements.

2. Any installation installed in (existing, or future) public road right-of-way, or set-back areas controlled by local authorities are subject to all state and local approvals.

3. Apply for plumbing permit at Mecklenburg County Code Enforcement.

4. Apply for NCDOT encroachment if required.

5. Flag location for Charlotte Water meter.

6. Install irrigation system.

7. Contact Mecklenburg County Code Enforcement to inspect installation.

8. Once plumbing inspection has passed, contact Charlotte Water Backflow inspection at 704-391-5188 to request backflow inspection by Charlotte Water. Charlotte Water will unlock meter once inspection has passed.

9. With approved installation Charlotte Water will notify owner listed on BSA to send a copy of the backflow prevention assembly test record. See testing requirements.

8. TESTING REQUIREMENTS

A. Customer Testing Requirements after Installation, Approval, and Acceptance

1. Charlotte City code requires backflow prevention assemblies to be installed and maintained by the customer. The customer is required to have assemblies tested annually by a Charlotte Water approved certified tester. If the interruption of water service would have a critical impact on your operation, two backflow prevention assemblies must be installed in parallel in order for testing and maintenance requirements to be fulfilled. This will allow one assembly to continue providing water while the other is being tested or repaired.

2. When assemblies have been installed and approved it is a requirement of the customer to have assemblies tested. Such test as may be prescribed by Charlotte Water must be conducted by a certified tester on each backflow-prevention assembly required by this article at each of the following times:

    a. Immediately after the installation of each backflow-prevention assembly,

    b. On an annual basis thereafter,

    c. Upon completing any repairs of each backflow-prevention assembly, and

    d. At any time that Charlotte Water has reason to believe that a required backflow prevention assembly may not be operating properly.

B. The customer is required to submit satisfactory test results to Charlotte Water within 30 days upon notification from Charlotte Water.

C. All testing of Charlotte Water regulated backflow prevention assemblies shall be performed by only Charlotte Water approved certified testers using Charlotte Water approved test kits. Refer to requirements of Charlotte Water approved testers and test kits.

D. In the event an assembly requires repairs before an annual test period, the customer is required to have repairs made immediately. As soon as repairs have been completed the customer must have a Charlotte Water approved certified tester conduct a test showing the assembly is in good working order. Any repairs made shall be with manufacturer approved parts. All work shall be documented with a copy of the satisfactory test and repair records sent to Charlotte Water.

E. Testing for assemblies on fire protection systems must include standard operating procedures during the testing process. The customer is responsible for notifying any affected parties that the fire system will be shut down (i.e. alarm company, insurance carrier, fire official).

F. The customer may be required to have an approved plan to protect life and property during any period of time a fire system is out of service. Standard Operating Procedures should be written by the customer and should be approved by the fire official for use in the event of an emergency. No customer shall allow any testing to begin until such procedures are in place and effective. It is the responsibility of the customer to provide safety for life and property during the entire test or repair. The customer is required to meet all code and regulations as imposed by the governing fire official.

9. REQUIREMENTS FOR CERTIFIED TESTER

A. Any person interested in becoming an approved certified tester must request to Charlotte Water in writing to become a Charlotte Water approved certified tester. The tester shall complete an application which includes full name, mailing address, phone number they can be reached between 8 am and 5 pm, and the name of school certification was obtained from. A copy of the current valid training certification must be attached to the application. The tester must attend an orientation conducted by Charlotte

Water. Charlotte Water will conduct an orientation periodically where the tester will be required to provide evidence of a valid certificate of training in backflow prevention assembly testing and maintenance from one of the schools listed on the current list of Charlotte Water approved schools. During the orientation Charlotte Water will provide the tester with information on the current testing program. The tester will have the following requirements:

1. The tester must have knowledge and understanding of the City of Charlotte Backflow Prevention ordinance Article V of Chapter 23 of the City Code. The tester is required to keep abreast of the current Charlotte Water requirements and specifications in the current Backflow Prevention Program Manual. Any violation of the ordinance may result in civil penalties as outlined in the ordinance.

2. The tester must understand and strictly adhere to testing procedures approved by Charlotte Water.

3. No tester is allowed to conduct any test without the customers full consent and cooperation. Any tester conducting a test on fire protection systems must consult the owner on standard operating procedures during the testing process. No tester shall allow any testing to begin until such procedures are in place and effective. It is the responsibility of the tester to make sure the customer can provide safety for life and property during the entire test or repair. If the customer cannot provide this measure of safety the test is not to be completed until these safety requirements are met. The tester is required to meet all code and regulations as imposed by the governing fire official. See Bulletin #8 GUIDELINES FOR TESTING BACKFLOW PREVENTION ASSEMBLIES ON FIRELINES.

4. The tester shall agree to keep their certification current by completing recertification on or before the date their current certificate expires. Any laps in certification shall be reported to Charlotte Water. Failure to report laps or loss of certification may result in penalties as outlined in the ordinance.

5. The tester is required to use only Charlotte Water approved test kits which have been registered with Charlotte Water. (Refer to requirements for Charlotte Water approved test kits). The tester must agree to abide by requirements for test kits.

6. Any work completed by the tester to achieve satisfactory test results for the customer must be documented on Charlotte Water approved test forms. All parts used to repair or overhaul a backflow prevention assembly must be recommended for use by that approved Manufacturer for that particular application only. No tester shall be allowed to substitute any other Manufacturer's products for the use in another Manufacturer's product.

7. A tester is required to report any nonstandard installation not conforming with Charlotte Water Water and Sewer Design and Construction Standards. This can be done in the comments portion of test the form.

8. It is required that the tester provide the customer with accurate and complete test records. The customer will be responsible for submitting the completed Charlotte Water approved test form with satisfactory test results including information of any necessary repairs.

9. It will be the responsibility of the tester to make safe or require the customer to provide a safe working environment. Precautions must be taken with hazards related but not limited to:

    a. Confined space

    b. Vehicle traffic

    c. Insect and animals

    d. Tool utilized, etc.

10. The tester shall never place any person or property in any danger such as fire or water contamination during the testing of any assembly. Tester must sign the certified tester agreement and comply with exhibit A therewith. If the tester fails to comply with the agreement, Charlotte Water certification may be revoked.

11. Falsification of records, or failure to meet any of the requirements as outlined will result in removal from approved certified tester list and/or penalties as outlined in ordinance.

12. The tester will be required to sign an agreement with a code of ethics for Charlotte Water stating his/her responsibilities as a Charlotte Water certified tester.

10. REQUIREMENTS FOR TEST KITS

A. Any person approved as a certified tester by Charlotte Water is required to use a Charlotte Water approved test kit. An approved test kit will meet and be approved by the current requirements of the University of Southern California Foundation for Cross-Connection Control and Hydraulic Research standards for backflow test kits. Each kit will have the following requirements:

    1. The test kit is required to be an approved test kit listed on the current list of Charlotte Water approved backflow prevention assembly test kits.

    2. Each kit must be registered with Charlotte Water with a current calibration certificate (less than 1 yr. old). All test kits approved to test Charlotte Water regulated backflow prevention assemblies will be registered with the following:

        a. Manufacturer of kit

        b. Type of kit (Duplex / Differential)

        c. Serial number

        d. Owner - name, address, and phone

        e. Calibration Date

3. All registered test kits are required to be recalibrated annually. The Recalibration certificate signed by a technician shall be submitted to Charlotte Water by the owner within 30 days. The technician calibrating the test kit shall use the most current edition of the Manual of Cross-Connection Control from the University of Southern California Foundation for Cross-Connection Control and Hydraulic Research Section 9.5.1, 9.5.2, and 9.5.3 to do a differential pressure gage calibration check and duplex pressure gage calibration check as well as section 6 of the ANSI/ASME Standard B40.1-1985 for pressure gage testing.

4. All registered test kits shall be kept in accurate working order. All repairs shall be made immediately, and recalibration is required with a current certificate to be submitted to Charlotte Water upon completion of the repair. Failure to notify Charlotte Water of a malfunctioning test kit may cause it to be removed from the approved list. Additionally, Charlotte Water reserves the right to remove a tester from the approved tester list for failure to maintain equipment.

5. Upon request any Charlotte Water approved test kit shall be operated in the presence of a Charlotte Water representative. If repairs are required, a certification of calibration shall be submitted to Charlotte Water showing repairs have been completed and the test kit is in good operating order.

6. Charlotte Water will remove or disapprove any test kit which does not comply with the current requirements of this policy.

11. Charlotte Water APPROVED BACKFLOW PREVENTION ASSEMBLY TESTING EQUIPMENT

A. Charlotte Water maintains a list of approved backflow prevention assembly testing equipment. See:

https://www.charlottenc.gov/water/Commercial-Development/Backflow/Backflow-Construction-Guide

12. Charlotte Water APPROVED TESTERS SCHOOLS

A. Charlotte Water maintains a list of approved backflow prevention assembly testing schools. See:

https://www.charlottenc.gov/water/Commercial-Development/Backflow/Backflow-Construction-Guide

13. Charlotte Water APPROVED TESTERS

A. Charlotte Water maintains a list of approved certified backflow prevention assembly testers. See:

https://www.charlottenc.gov/water/Commercial-Development/Backflow

14. GUIDELINES FOR TESTING OF BACKFLOW PREVENTION ASSEMBLIES

A. Fire Lines: All testing shall be in accordance with the latest version of the City of Charlotte Code of Ordinances and Bulletin #8, Approved Field Test Procedures for Backflow Prevention Assemblies.

B. Non-Fire Lines: Charlotte Water requires all approved certified testers to utilize North Carolina Water Treatment Facility Operator Board Approved Field Test Procedures for Backflow Prevention Assemblies.

END OF SECTION

CHAPTER 14
CROSS CONNECTION / BACKFLOW PREVENTION

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PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Backflow Prevention Assemblies
2. Protective Enclosures

B. The specifications for backflow prevention described herein are specifically for metered water connections to the Charlotte Water system only.

C. Contractor shall ensure compliance with requirements from all other authorities having jurisdictional requirements for backflow requirements.

D. All backflow prevention assemblies shall be approved by the University of Southern California Foundation for Cross Connection Control and Hydraulic Research (USCFCCHR), The American Society of Sanitary Engineering (A.S.S.E.), conform to AWWA C506, and adhere to applicable ANSI and ASTM standards. All assemblies installed on fire lines shall have approval by Factory Mutual System (FM).

E. Backflow prevention assemblies must be approved by Charlotte Water. Charlotte Water will provide a list of approved assemblies.

1.2 RELATED DOCUMENTS

A. Chapter 14, Cross Connection / Backflow Prevention Design Requirements.

B. Chapter 10, Water Distribution Piping Specifications.

C. Charlotte Water Water and Sewer Design and Construction Standard Details.

1.3 DEFINITIONS AND ABBREVIATIONS

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

1.4 LICENSING REQUIREMENTS FOR BACKFLOW ASSEMBLY INSTALLERS

A. For contractors and/or individuals installing outdoor backflow prevention assemblies (non-fire lines):

1. Public Utilities Contractor and/or individuals(s) licensed as such by the N.C. Licensing Board for General Contractors (in accordance with N.C. General Statute 87, Article 1), or
2. Plumbers(s) licensed by the N.C. State Board of Examiners of Plumbing, Heating and Fire Sprinkler Contractors (in accordance with N.C. General Statute 87, Article 2).

B. For contractors and/or individuals installing indoor backflow prevention assemblies (non-fire lines):

1. Plumbers(s) licensed by the N.C. State Board of Examiners of Plumbing, Heating and Fire Sprinkler Contractors (in accordance with N.C. General Statute 87, Article 2).

C. For contractors and/or individuals installing backflow prevention assemblies on fire lines (outdoor or indoor):

1. Fire Sprinkler Contractor licensed by the N.C. State Board of Examiners of Plumbing, Heating and Fire Sprinkler Contractors (in accordance with N.C. General Statute 87, Article 2).

1.5 SUBMITTALS

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

1. Product brochures
2. Catalog cut sheets
3. Shop drawings including dimensions and part/material lists
4. Certification of compliance with applicable reference standards
5. Prior product acceptance test reports
6. Reference contact data
7. Shipping tickets and purchase invoices

1.6 QUALITY ASSURANCE

A. Provide manufacturer's affidavit indicating product has been manufactured and tested in accordance with referenced standards.

B. Products to be permanently identified with manufacturer's name, pressure rating and size.

1.7 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall be responsible for the safe storage of materials furnished by or to them, and accepted by them and intended for the Work, until they have been incorporated in the completed project. Handling and storage of all project materials are to be in compliance with the manufacturer's recommendations for handling and storage. The interior of all pipes, fittings and other accessories shall be kept free from dirt and foreign materials at all times.

B. Transportation of Materials and Equipment: The Contractor and their Suppliers are directed to contact the North Carolina Department of Transportation (NCDOT) to verify axle load limits on State maintained roads (and bridges) which would be used for hauling of equipment and materials for this project. The Contractor and their Suppliers shall do all that is necessary to satisfy the Department of Transportation requirements and will be responsible for any damage to said roads which may be attributed to this project. Unless otherwise specified, all materials required to construct this project shall be furnished by the Contractor and shall be delivered and distributed at the site by the Contractor or their material supplier.

1.8 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 USE OF LEAD-FREE PIPES, FITTINGS, FIXTURES, SOLDER, AND FLUX FOR DRINKING WATER ("LEAD FREE")

A. All products provided shall comply with the Safe Drinking Water Act, 42 U.S.C. 300f et seq. including sections 1417, 1445, 1450, and 1461 of the SDWA, 42 U.S.C. 300j-6, 300j-4, 300j-9, and 300j-21.

2.2 BACKFLOW PREVENTION ASSEMBLIES

A. All internal parts shall be replaceable in line. All internal metal parts shall be bronze or stainless steel. There shall be a minimum of dissimilar metals in an assembly in order to prevent corrosion due to electrolysis. When there are dissimilar metals, the metals shall be electronically similar as possible and insulated if possible.

B. All backflow prevention assemblies must comply with, at a minimum, the following standards:

1. Double Check Valve Assemblies: ASSE 1015, lead free
2. Dual Check Valve Assemblies: ASSE 1024, lead free
3. Reduced Pressure Zone Assemblies: ASSE 1013/ANSI C511, lead-free

C. All assemblies shall have 1/4 turn ball valve test cocks with raised slotted operators or lever type operators. All assemblies shall have four resilient seated test cocks located in the following manner:

1. On the upstream side of the first shut off valve (upstream being the side closest to the property line)
2. Between the first shut off valve and the first check valve
3. Between the first and second check valve
4. Between the second check valve and the second shut off valve

D. All exterior control piping shall be flexible hose or standard size copper tubing with standard end connections.

E. All interior control piping or passageways shall be corrosion resistant. All sensing tubes or passages shall be placed in a manner that prevents clogging or trapping of foreign materials or air.

F. If special tools or devices are required to repair or maintain an assembly, they shall be supplied by the manufacturer at no extra cost.

G. An assembly will be removed from the Charlotte Water approved list if it no longer meets Charlotte Water specifications or fails to operate satisfactorily in the field.

H. Charlotte Water shall be notified in writing of any changes to the design, components, materials, or operation of an assembly. Charlotte Water shall also be notified of any failures, defects, or defective material. Failure to do so will result in removal from the Charlotte Water approval list.

I. Any backflow prevention assembly not on the approved list may be submitted for review and approval by Charlotte Water. If an assembly was previously rejected, it shall not be submitted or resubmitted unless the design has been revised to meet Charlotte Water specifications. Two assemblies shall be submitted for a one-year field evaluation prior to being approved. Shop drawings and specifications of all materials must be furnished as well.

J. The list of Charlotte Water approved Backflow Prevention Assemblies is located online at:

https://www.charlottenc.gov/water/Commercial-Development/Backflow/Backflow-Construction-Guide

2.3 PROTECTIVE ENCLOSURES

A. Type: ASSE 1060 certified, Class I - Freeze Protection Enclosures anchored to concrete slab.

B. Materials

1. RPZs up to and Including 4-inches in Diameter

   a. Fiberglass Construction: Molded 1/8" thick Thixotropic polyester resin reinforced with fiberglass strand, smooth finish, protected with UV inhibited isophthalic polyester gel coat; continuous hinged or removable top. Color as selected by Charlotte Water from Manufacturer's standards.

2. RPZs Larger than 4-inches in Diameter

   a. Aluminum Construction: 3003 aluminum (.050"/18 gauge), continuous hinged or removable doors, stucco embossed finish, ASTM B209; sectionalized factory-assembled tongue and groove sections with four-point locking system. Color as selected by Charlotte Water from Manufacturer's standards.

3. Bracing

   a. 6063-T52 aluminum, ASTM B221. No wood or particle board should be used in the construction of the enclosure.

   b. Load Rating: 100 lbs/sf.

   c. Wind Speed Rating

      1) Up to 36" W x 105" L x 64" H: 120 mph

      2) All Larger Sizes: 80 mph

4. Anchor pads: Galvanized steel, 3/8-16 unc. x 2¾ long zinc plated wedge anchors.

5. Insulation: 1.5-inch unicellular, non-wicking, polyisocyanate foam sprayed in place to form a monolithic bond between the aluminum bracing and aluminum sheeting. Insulation properties:

   a. R-Value: 10

b. Dimensional Stability: less than 2% linear change

c. Compressive Strength: 51 psi

d. Flame Point: 325 degrees

e. Water Absorption: 0.037 psf

f. Porosity: 91 percent

C. Heating Equipment

1. Provide heating equipment to protect the piping and equipment from exterior temperatures to -30°F. ETL-listed thermostatically controlled wall mounted air forced heaters or UL listed self-regulating cable(s) shall be furnished and designed by the Manufacturer of the enclosure to maintain the equipment at +40°F, in accordance with ASSE 1060 1.2.2.1.

2. Heating equipment shall be wall mounted to the supplied heater plates and a minimum 8” above the slab unless it is UL or ETL-certified and NEC approved for submersion.

3. Power source shall be 120V protected with a GFI receptacle, U.L. 943, NEMA 3R. Mounted a minimum of 8” from the bottom of the receptacle to the top of the slab. GFCI electrical receptacle shall be in accordance with NC Electrical Code for outdoor operation.

4. Separate 20-amp circuits are recommended for each heater, so in the event a circuit fails all other circuits will remain powered. Installations must be in accordance with the local and national codes.

5. The heaters shall be ETL listed for wet/damp locations.

D. Drain Ports: One-way, sized for full flow discharge.

E. Equipment Pad: Concrete Slab: Class I concrete; construct slab 12-inches larger than the interior dimensions of the enclosure.

F. Manufacturers

1. Hot Box,

2. Or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. The installation shall be in accordance with the Manufacturer’s information, N.C. Building Code (latest version) and Charlotte Water. Installation of backflow prevention assemblies shall be upstream of the first branch line leading off the service line. If Charlotte Water determines that it is impossible or impractical for the backflow prevention assembly to be installed outside, it may be installed just inside the building.

B. All backflow assemblies shall be installed in a horizontal direction. Vertical installations may be allowed with prior approval from Charlotte Water. Design Engineer shall certify design of vertical support systems if such support systems differ or deviate from the Standard Details of Charlotte Water’s Water and Sewer Design and Construction

Standards. N.C Building Code may allow for differing pipe material than Charlotte Water standards. In which case, Design Engineer shall certify backflow assemblies are properly supported.

C. Fire line installations shall be as follows: High hazard fire line installations require a reduced pressure principle assembly (RPPA) as stated in the ordinance. Low hazard fire line installations require a double check valve assembly. Strainers shall not be installed on fire lines. If there is an existing booster pump, or one will be installed, Contractor is directed to follow pump Manufacturer's guidance for separation distance upstream and/or downstream between the pump and backflow assembly. Charlotte Water Required backflow prevention assembly must be on the supply side of the pump.

D. Fire line services with only one fire hydrant shall require a minimum of a double check valve backflow prevention assembly. All assemblies on a fire line, or combination domestic and fire, shall be fire line approved installations with OS & Y type shut-off valves. These valves shall be provided with supervisory tamper switches as required by current Building Code enforced by the Fire Marshal.

E. All fire line installations shall be protected to a min. of 40 degrees Fahrenheit or as required by applicable standards of the NC Building Code (latest version adopted). Heated enclosures are required for BFPs or RPs for fire installations.

3.2 INSTALLATION AND APPROVAL GUIDELINES

A. Existing Residential Domestic Service with New Lawn Irrigation System Tied to Existing Service Line (only allowed if property being irrigated was platted prior to July 1st, 2009)

1. Requirements for Backflow Prevention Assembly Installation

    a. Install RPPA assembly before any branches in new irrigation system outside zoning setback areas, per Charlotte Water Standard Details.

    b. Locate 12" above ground min. 30" max. in horizontal direction. 30" min. clear of any permanent obstruction.

    c. Use type "L" or "K" copper, galvanized steel pipe (1" diameter min.), or Schedule 80 PVC pipe (with Schedule 80 fittings), from 5' before to 5' past assembly.

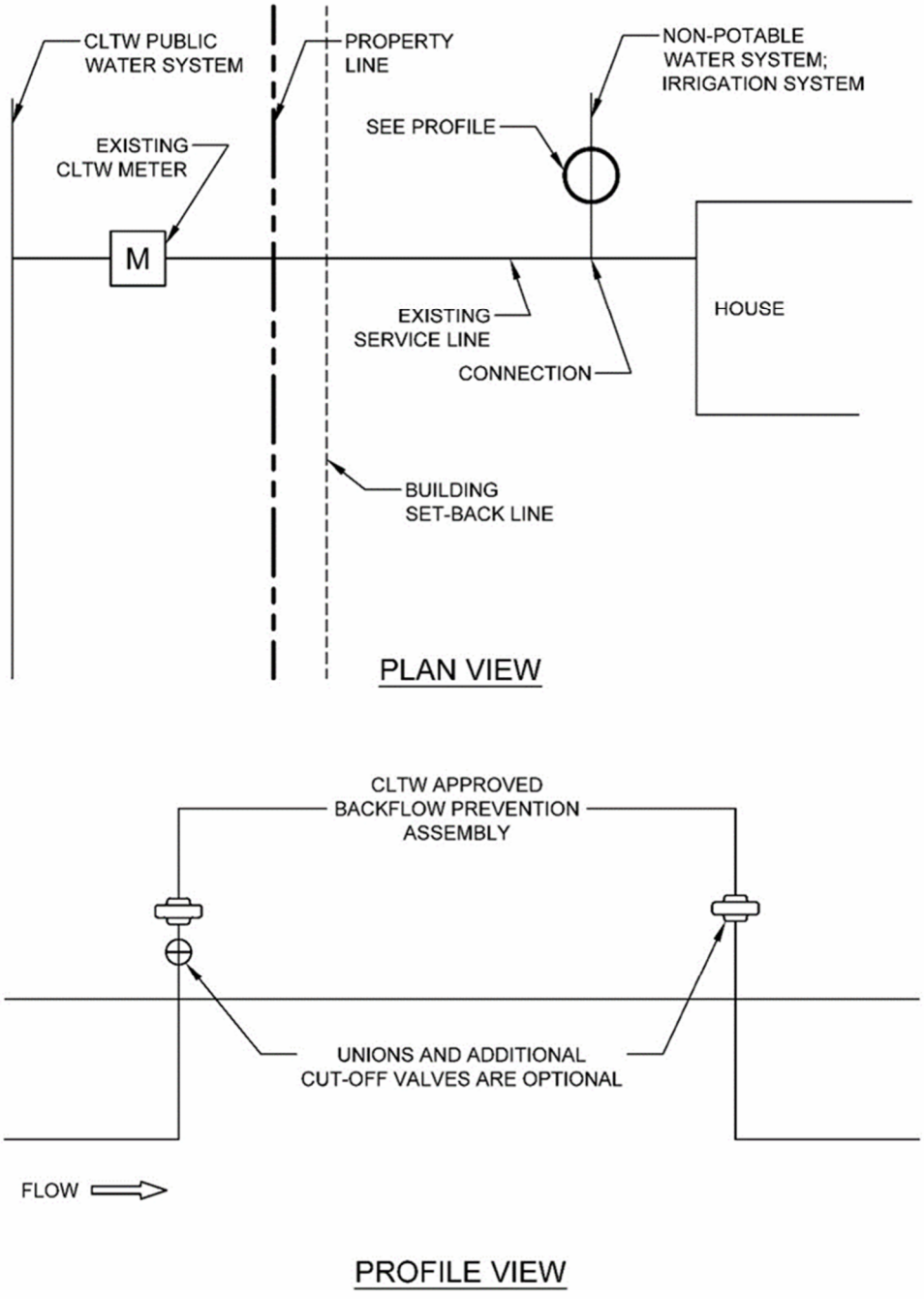
    d. Protective enclosures are required in accordance with ASSE 1060 Class II. Insulation shall not be wrapped around assembly.

    e. Location of connection and backflow prevention assembly will be located outside and accessible to Charlotte Water at all times.

    f. If unions are used, caps must be provided and stored with assembly, for use any time the assembly is removed. It is required to cap remaining piping to service line and is subject to Charlotte Water inspection at any time assembly is removed.

Existing Residential Domestic Service with New Lawn
Irrigation System Tied to Existing Service Line

(Only allowed if property being irrigated was platted prior to July 1st, 2009)



B. New Residential Lawn Irrigation Service with New Lawn Irrigation System Tied to New Lawn Meter

1. Requirements for Backflow Prevention Assembly Installation

a. Install RPPA assembly before any branches in new irrigation system outside zoning set back areas, per Charlotte Water Standard Details.

b. Locate 12" above ground min. 30" max. in horizontal direction. 30" min. clear of any permanent obstruction.

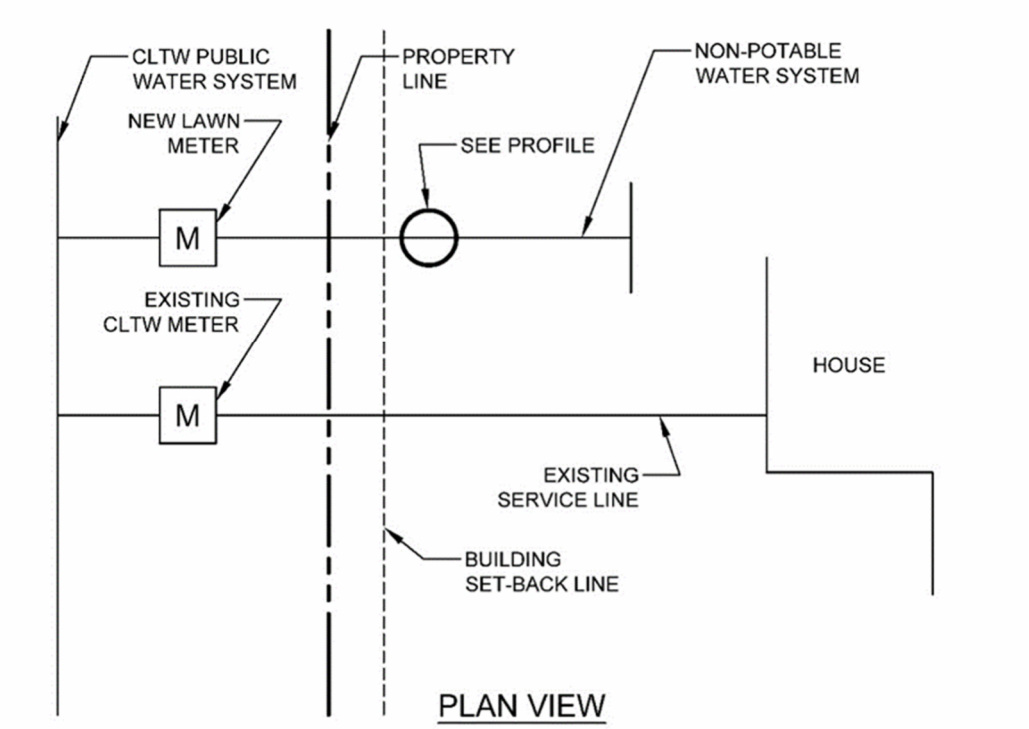
c. Use type "L" or "K" copper, galvanized steel pipe (1" diameter min.), or Schedule 80 PVC pipe (with Schedule 80 fittings), from 5' before to 5' past assembly.

d. Protective enclosures are required in accordance with ASSE 1060 Class II. Insulation shall not be wrapped around assembly.

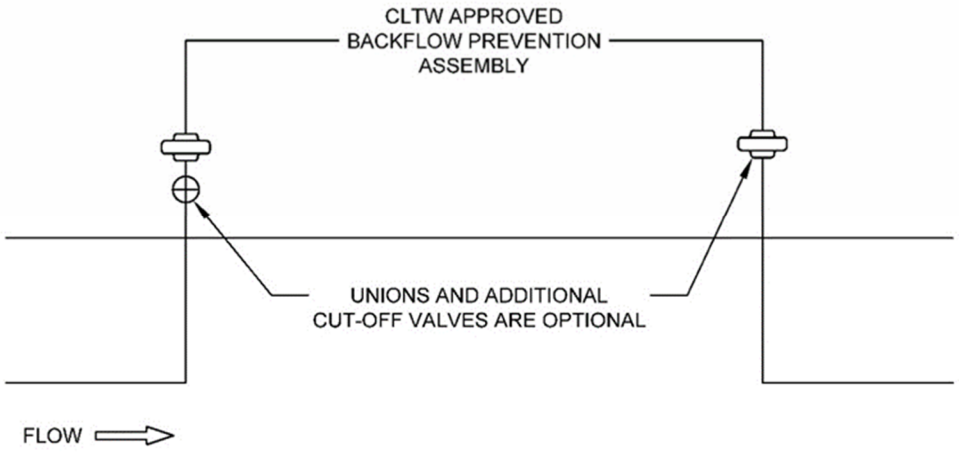
e. Location of connection and backflow prevention assembly will be located outside and accessible to Charlotte Water at all times.

f. If unions are used, caps must be provided and stored with assembly, for use any time the assembly is removed. It is required to cap remaining piping to service line and is subject to Charlotte Water inspection at any time assembly is removed.

New Residential Lawn Irrigation Service with
New Lawn Irrigation System Tied to New Lawn Meter



PLAN VIEW



PROFILE VIEW

C. Existing Commercial Service with Lawn Irrigation or Fire System Tied to Existing Service Line (Note: Lots platted after July 1st, 2009, must get a dedicated meter for irrigation)

1. All new water service connection 1-1/2” and larger must go through Capacity Assurance program review prior to new service connection approval.

2. Requirements for Backflow Prevention Assembly Installation

a. Charlotte Water Requirements at Existing Meter

1) Install assembly before any branches in new system outside zoning setback areas, per Charlotte Water Standard Details outside and accessible to Charlotte Water at all times. On fire lines shut-off valves must be OS&Y type and be provided with supervisory tamper switches with trouble signal to go to the emergency control station as required by current building code.

2) Locate 12" above ground min. 30" max. in horizontal direction. 30" min. clear of any permanent obstruction. Strainers shall not be installed on fire systems. See installation specifications for below ground requirements.

3) Use type “L” or "K" copper, DIP (2-1/2”" - 12" diameter), galvanized steel pipe (1" diameter min.), or Schedule 80 PVC pipe (with Schedule 80 fittings), from 5' before to 5' past assembly.

4) Protective enclosures are required in accordance with ASSE 1060 Class II. Insulation shall not be wrapped around assembly. All assemblies used on fire line services shall be protected to min. of 40 degrees Fahrenheit or as required by current building code.

5) If unions are used (3/4"-2"), caps must be provided and stored with assembly, for use any time the assembly is removed. It is required to cap remaining piping to service line and is subject to Charlotte Water inspection at any time assembly is removed.

b. Mecklenburg County Code Enforcement Requirements for Backflow Assembly at Connection of New Lawn Irrigation or Fire System

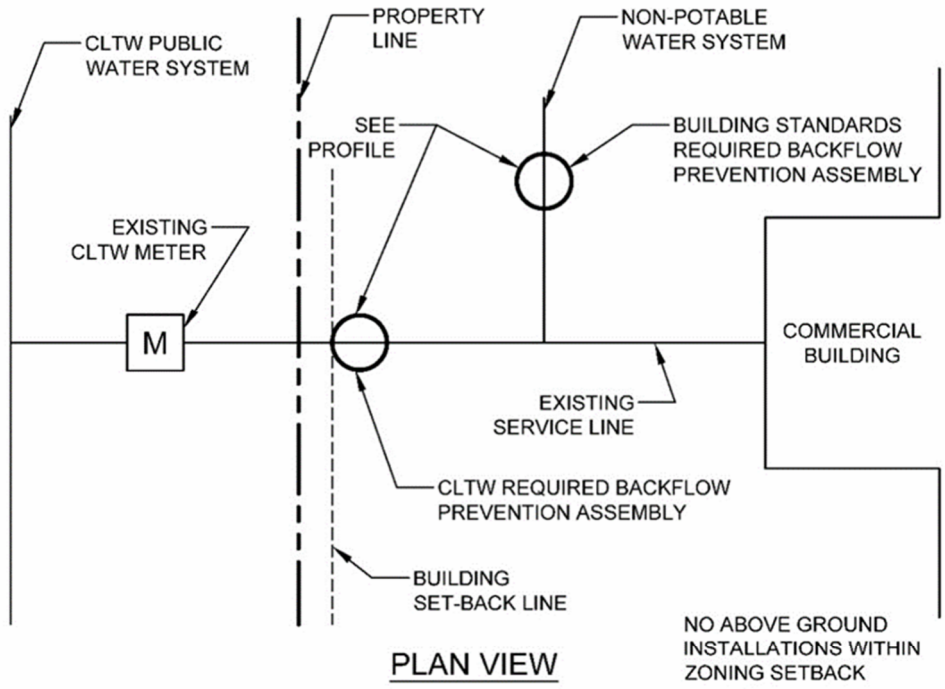
1) Locate 12" above ground min. 30" max. before any branches in new system, 30" min. from any obstruction.

2) Protective enclosures are required in accordance with ASSE 1060. Insulation shall not be wrapped around assembly. All assemblies used on fire line services shall be protected to min. 40 degrees Fahrenheit or as required by current building code.

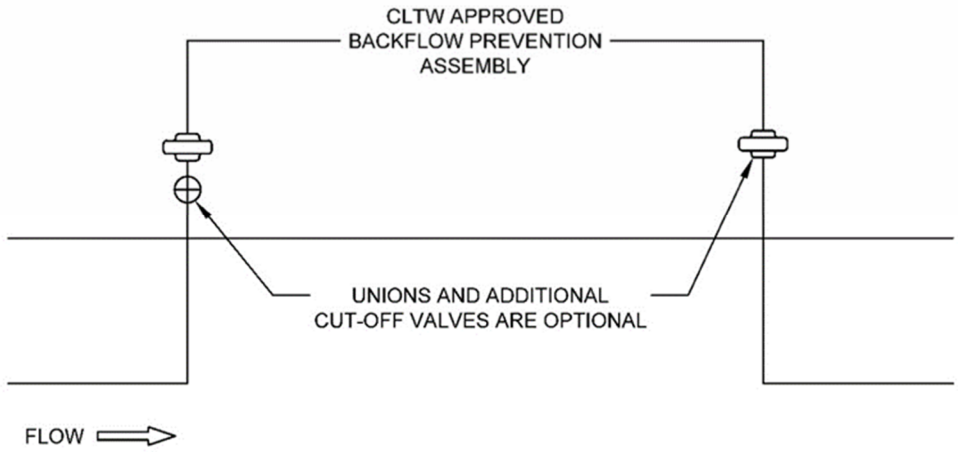
3) If unions are used (3/4"-2"), caps must be provided and stored with assembly, for use any time the assembly is removed.

Existing Commercial Service with Lawn Irrigation or
Fire System Tied to Existing Service Line

(Note: Lots platted after July 1st, 2009, must get a dedicated meter for irrigation)



PLAN VIEW



PROFILE VIEW

D. New Commercial, Lawn Irrigation, or Fire Line Service with New Service, Lawn, or Fire System Tied to New Meter (Note: Lots platted after July 1st, 2009, must get a dedicated meter for irrigation)

1. All new water service connections 1-1/2” and larger must go through Capacity Assurance program review prior to new service connection approval.

2. Requirements for Backflow Prevention Assembly Installation

a. Charlotte Water Requirements

1) Install assembly before any branches in new system outside zoning setback areas, per Charlotte Water Standard Details. On fire lines shut-off valves shall be OS&Y type and be provided with supervisory tamper switches with trouble signal to go to the emergency control station as required by current building code.

2) Locate 12" above ground min. 30" max. in horizontal direction. 30" min. clear of any permanent obstruction. No strainers shall be installed on fire systems. See installation specifications for below ground requirements.

3) Use type “L” or "K" copper, DIP (2-1/2" - 12" diameter), galvanized steel pipe (1" diameter min.), or Schedule 80 PVC pipe (with Schedule 80 fittings), from 5' before to 5' past assembly.

4) Protective enclosures are required in accordance with ASSE 1060 Class II, or Fire Class I. Insulation shall not be wrapped around assembly. All assemblies used on fire line services shall be protected to min. of 40 degrees Fahrenheit or as required by current building code.

5) Location of connection and backflow prevention assembly will be located outside and accessible to Charlotte Water at all times.

6) If unions are used (3/4"-2"), caps must be provided and stored with assembly, for use any time the assembly is removed. It is required to cap remaining piping to service line and is subject to Charlotte Water inspection at any time assembly is removed.

b. Mecklenburg County Code Enforcement Requirements for Backflow Assembly at Connection of New Lawn Irrigation or Fire System

1) Locate 12" above ground min. 30" max. before any branches in new system, in horizontal direction. 30" min. from any obstruction.

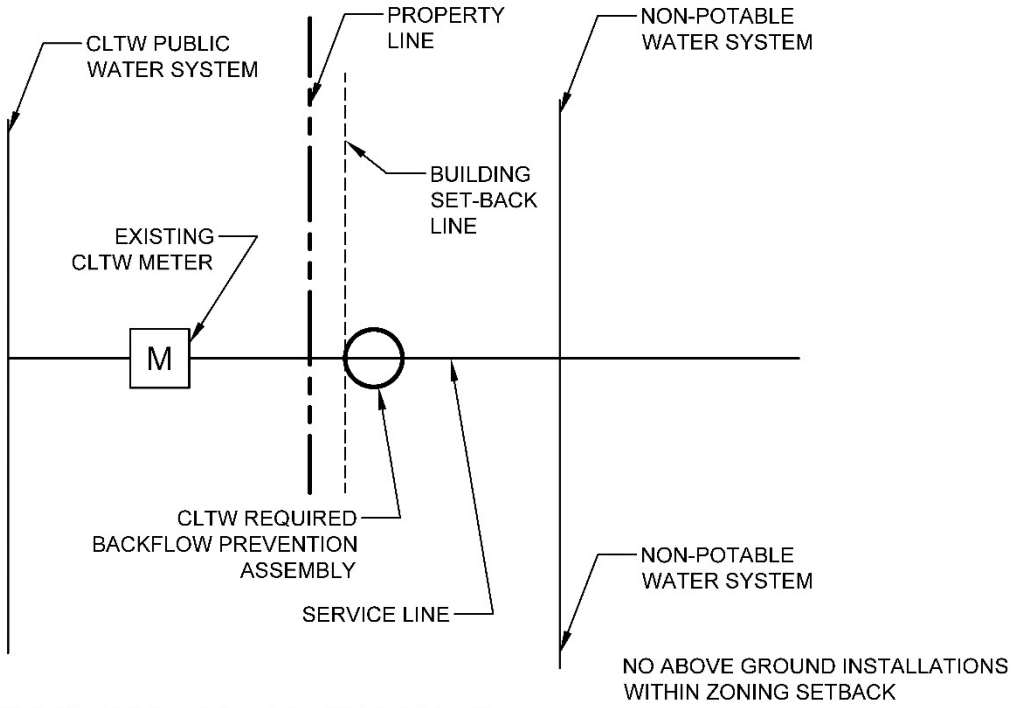
2) Protective enclosures are required in accordance with ASSE 1060. Insulation shall not be wrapped around assembly. All assemblies used on fire line services shall be protected to min. of 40 degrees Fahrenheit or as required by current building code.

3) If unions are used (3/4"-2"), caps must be provided and stored with assembly, for use any time the assembly is removed.

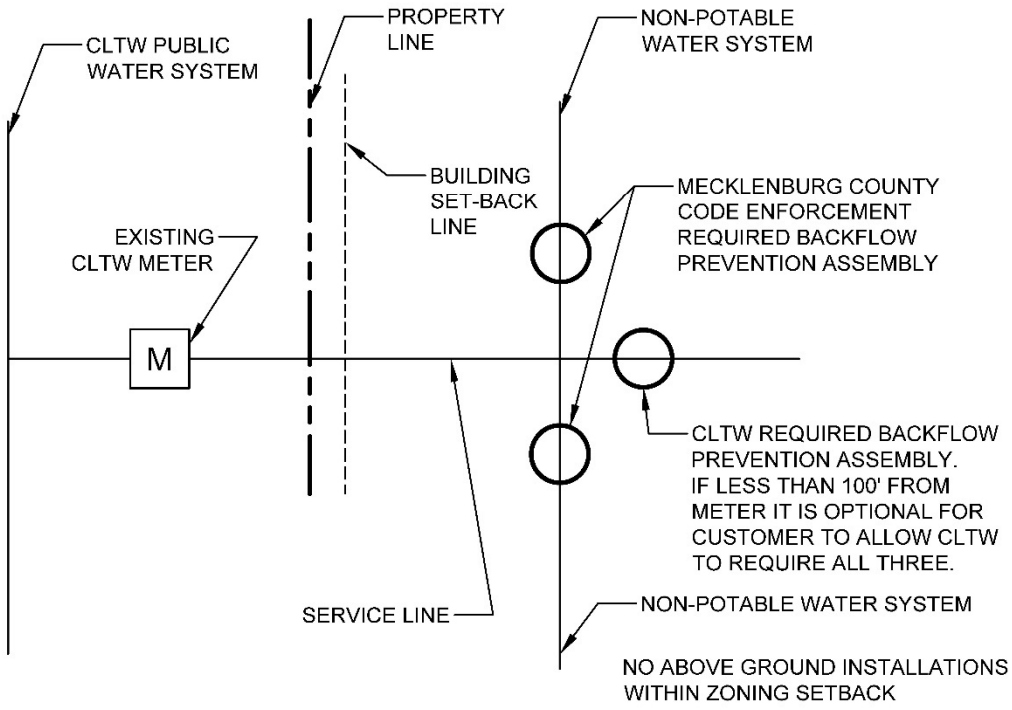
New Commercial, Lawn Irrigation, or Fire Line Service with
New Service, Lawn, or Fire System Tied to New Meter

(Note: Lots platted after July 1st, 2009, must get a dedicated meter for irrigation)

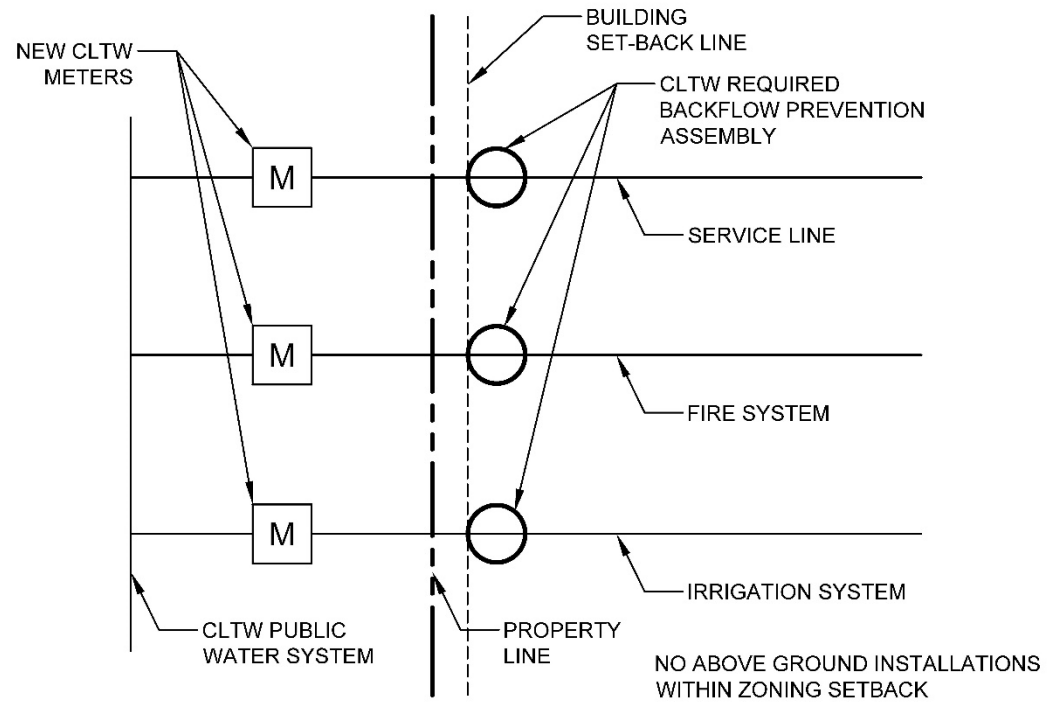
COMBINATION METER (OPTION 1)



COMBINATION METER (OPTION 2)



SEPARATE METERS



1

E. Developer Installed Service Tied to New Developer Installed Meter

1. All new water service connection 1-1/2” and larger must go through Capacity Assurance program review prior to new service connection approval.

2. Requirements for Backflow Prevention Assembly Installation

a. On Customer Property for Private System

1) Installations must be installed outside the public road right-of-way, and outside zoning setback areas on customer property.

2) Install assembly before any branches in new service, per Charlotte Water Standard Details. On fire lines shut-off valves shall be OS&Y type and be provided with supervisory tamper switches with trouble signal to go to the emergency control station as required by current building code.

3) Locate 12" above ground min. 30" max. in horizontal direction. 30" min. clear of any permanent obstruction. No more than 100' upstream of new meter. No strainers shall be installed on fire systems. See installation specifications for below ground requirements.

4) Use type "K" copper, DIP (2-1/2" - 12" diameter), galvanized steel pipe (1" diameter min.), or Schedule 80 PVC pipe (with Schedule 80 fittings), from 5' before to 5' past assembly.

5) Protective enclosures are required in accordance with ASSE 1060 Class II, or Fire Class I. Insulation shall not be wrapped around assembly. All assemblies used on fire line services shall be protected to min. of 40 degrees Fahrenheit or as required by current building code.

6) All installations are required to be outside of site distance triangle.

b. Within Public Road Right-of-Way (Existing or Future) for Roadway Irrigation Systems

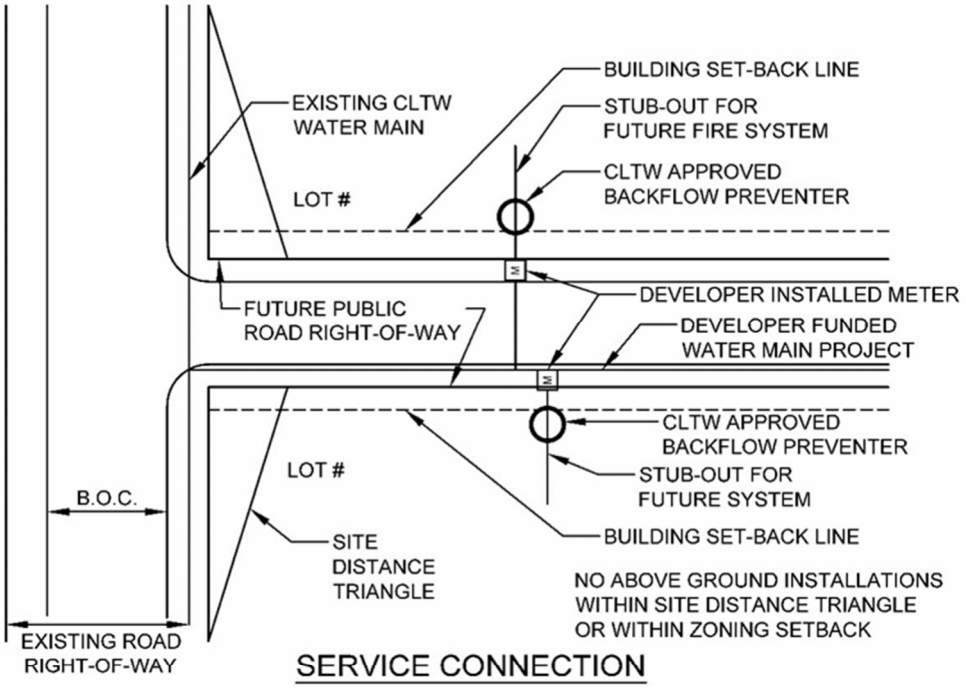
1) All construction activities, and materials in an existing or future public road right-of-way shall comply with the current NCDOT policies and procedures for accommodating utilities on highway rights of way, or CDOT policies and procedures and any additional requirements of active encroachment agreements.

2) No backflow prevention assembly shall be installed in any fully controlled or limited controlled access roads.

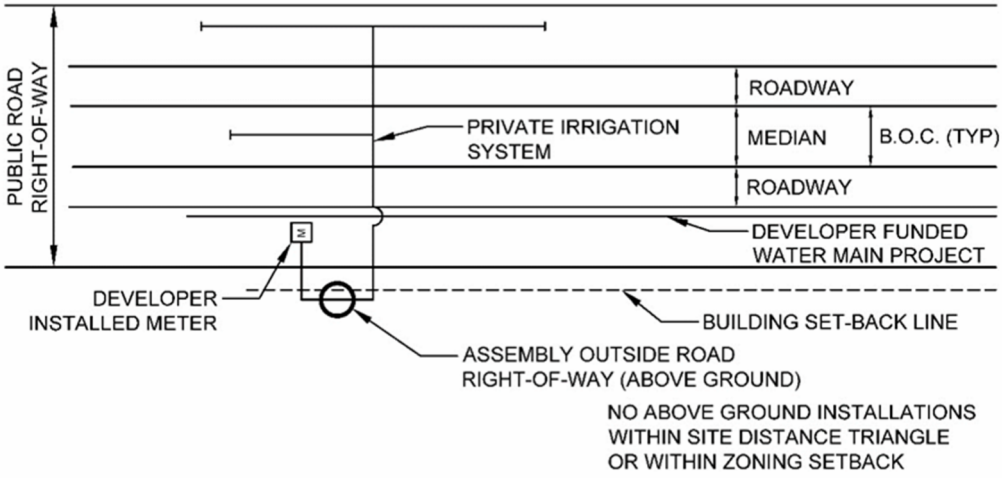
3) No backflow prevention assembly shall be installed above ground in a public road right-of-way. Note all reduced pressure principle backflow prevention assembly are required to be installed above ground outside of the public road right-of-way, and outside zoning setback areas on customer property.

4) All construction shall conform to the requirements for water main construction within the jurisdiction of Charlotte Water, from the meter to and 5 feet beyond the backflow prevention assembly installation.

Developer Installed Service Tied to New Developer Installed Meter



SERVICE CONNECTION FOR FUTURE USE



IRRIGATION SYSTEM IN PUBLIC ROAD RIGHT-OF-WAY

F. New or Existing Irrigation Service for a Public Roadway

1. All new water service connections 1-1/2” and larger must go through Capacity Assurance program review prior to new service connection approval.

2. Requirements for Backflow Prevention Assembly Installation

a. Outside of Public Road Right-of-Way

1) Any above ground installations must be installed outside the public road right-of-way, and outside zoning setback areas on private property. All installations are required to be located outside area of site distance triangle. Any work in an existing public road right-of-way(r/w) requires an encroachment agreement with owner of r/w.

2) The assembly must be installed before any branches in new system, per Charlotte Water Standard Details.

3) Locate 12" above ground min. 30" max. in horizontal direction. 30" min. clear of any permanent obstruction. No more than 100' upstream of new meter.

4) Use type "K" copper, DIP (3" - 10" diameter), galvanized steel pipe (1" diameter min.), or Schedule 80 PVC pipe (with Schedule 80 fittings), from 5' before to 5' past assembly.

5) Protective enclosures are required in accordance with ASSE 1060 Class II. Insulation shall not be wrapped around assembly. All assemblies used on fire line services shall be protected to min. of 40 degrees Fahrenheit or as required by current building code.

6) Location of connection and backflow prevention assembly will be located outside and accessible to Charlotte Water at all times.

7) If unions are used (3/4"-2"), caps must be provided and stored with assembly, for use any time the assembly is removed. It is required to cap remaining piping to service line and is subject to Charlotte Water inspection at any time assembly is removed.

b. Within (Existing or Future) Public Road Right-of-Way

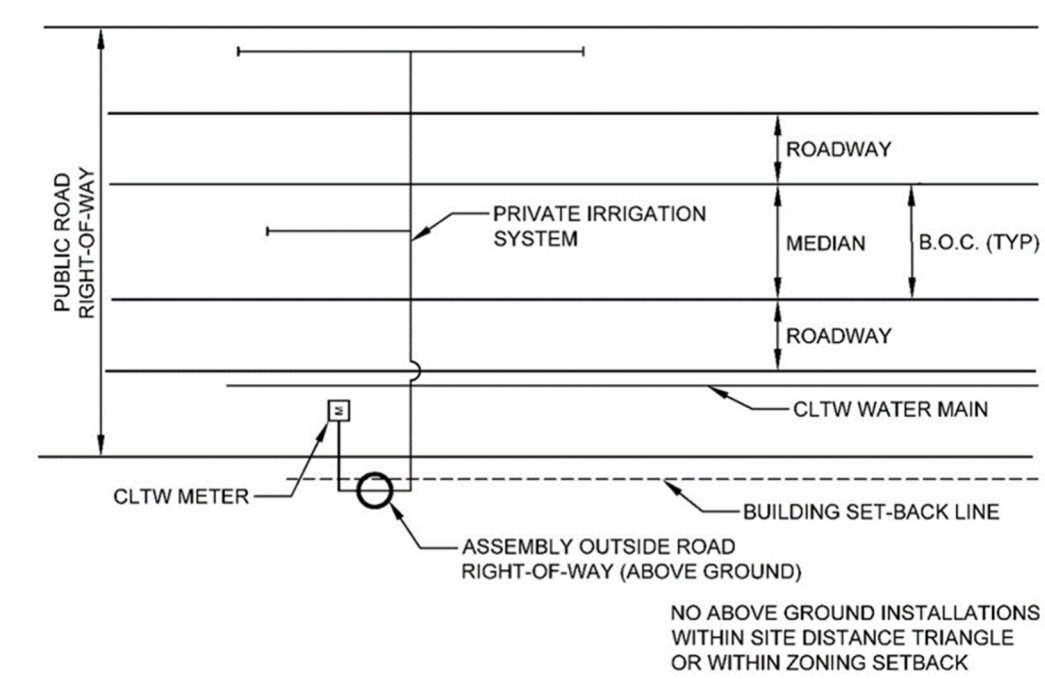
1) All construction activities, and materials in an existing or future public road right-of-way shall comply with the current NCDOT policies and procedures for accommodating utilities on highway rights of way, or CDOT policies and procedures and any additional requirements of active encroachment agreements.

2) No assemblies shall be installed in any fully controlled or limited controlled access roads.

3) No backflow prevention assembly shall be installed above ground in a public road right-of-way. Note all reduced pressure principle backflow prevention assembly are required to be installed above ground outside of the public road right-of-way, and outside zoning setback areas on private property.

4) All construction shall conform to the requirements for water main construction within the jurisdiction of Charlotte Water, from the meter to and 5 feet beyond the backflow prevention assembly installation.

New or Existing Irrigation Service for a Public Roadway



3.3 TESTING REQUIREMENTS

A. The Construction Contractor shall procure the services of a Charlotte Water approved tester. See Chapter 14, Cross Connection / Backflow Prevention Design Requirements, of the Charlotte Water Water and Sewer Design and Construction Standards, for approved tester requirements.

B. Unless otherwise directed by the Engineer, all testing and disinfection of mains and service lines connected to the new backflow assembly(s) will be completed prior to testing of the new backflow assembly(s). All testing and disinfection shall be performed in accordance with testing and inspection requirements of Chapter 10, Water Distribution Piping, of the Charlotte Water Water and Sewer Design and Construction Standards.

C. Customer testing requirements after installation, approval, and acceptance are identified in Chapter 14, Cross Connection / Backflow Prevention Design Requirements, of the Charlotte Water Water and Sewer Design and Construction Standards.

END OF SECTION

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CROSS CONNECTION / BACKFLOW PREVENTION DETAILS
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14.1.2 DOUBLE CHECK VALVE ASSEMBLY (DC) 2 1/2" - 12" ABOVE GROUND

14.1.3 DOUBLE CHECK VALVE ASSEMBLY (DC) 3/4" & 1" BELOW GROUND VAULT

14.1.4 DOUBLE CHECK VALVE ASSEMBLY (DC) 1 1/2" & 2" BELOW GROUND VAULT

14.1.5 DOUBLE CHECK VALVE ASSEMBLY (DC) 2 1/2" - 12" BELOW GROUND VAULT

14.1.6 DOUBLE CHECK VALVE ASSEMBLY (DC) 3/4" - 2" INDOOR

14.1.7 DOUBLE CHECK VALVE ASSEMBLY (DC) 2 1/2" - 12" INDOOR

14.1.8 DOUBLE CHECK VALVE ASSEMBLY (DC) 3/4" & 1" ABOVE GROUND

14.2.1 REDUCED PRESSURE PRINCIPLE ASSEMBLY (RP) 1 1/2" & 2" ABOVE GROUND

14.2.2 REDUCED PRESSURE PRINCIPLE ASSEMBLY (RP) 2 1/2" - 12" ABOVE GROUND

14.2.3 REDUCED PRESSURE PRINCIPLE ASSEMBLY (RP) 3/4" - 2" INDOOR

14.2.4 REDUCED PRESSURE PRINCIPLE ASSEMBLY (RP) 2 1/2" - 12" INDOOR

14.2.5 REDUCED PRESSURE PRINCIPLE ASSEMBLY (RP) 3/4" - 1" ABOVE GROUND

14.3.1 TEST COCK LOCATION

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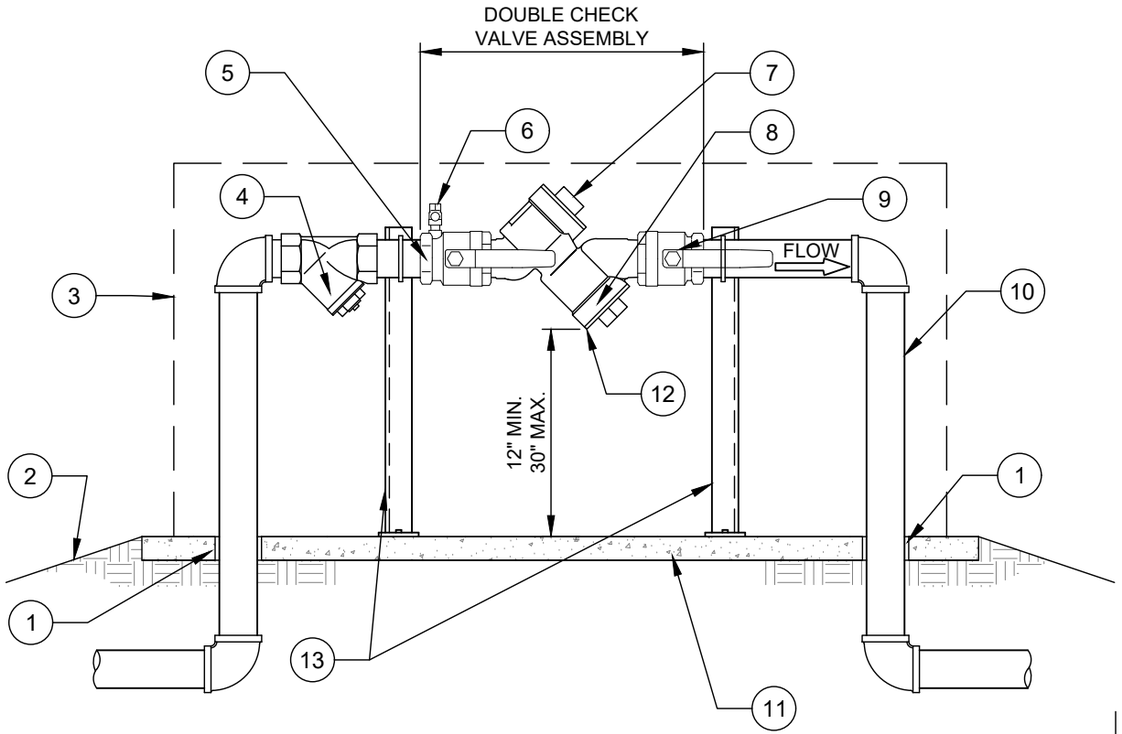
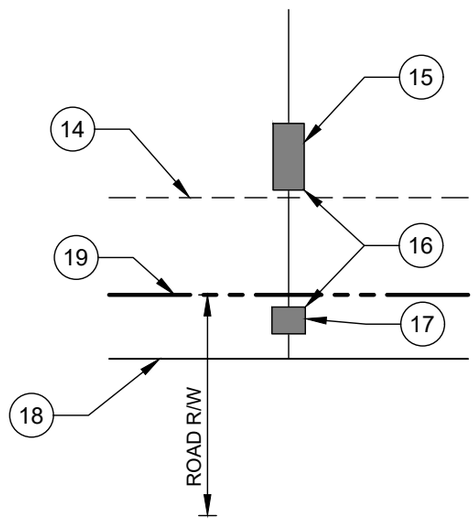




TYPICAL LOCATION REQUIREMENT
FOR ABOVE GROUND INSTALLATION

N.T.S.

NO.	DESCRIPTION:
1.	SLEEVE REQUIRED (TYP.).
2.	SLOPE GROUND AWAY FROM COVER (TYP.).
3.	HINGED ACCESS OR REMOVABLE INSULATED ENCLOSURE MEETING ASSE 1060 SPECIFICATIONS. ENCLOSURE TO INCLUDE DRAIN PORT(S) PER CLTW REQUIREMENT.
4.	STRAINER RECOMMENDED EXCEPT ON FIRE SERVICE.
5.	SHUT-OFF VALVE #1.
6.	TEST COCK #1.
7.	CHECK VALVE #1.
8.	CHECK VALVE #2.
9.	SHUT-OFF VALVE #2.
10.	TYPE K OR L COPPER TUBING PIPE OR GALVANIZED STEEL (MIN. OF 1 INCH DIAMETER AND CONFORMS TO ASTM A53) PIPE FOR MIN. OF 5' ON EACH END OF THE ASSEMBLY. SEE NOTE B.
11.	MIN. 4" THICK CONCRETE PAD REQUIRED. SEE NOTE H.
12.	LOWEST POINT.
13.	SUPPORT AS REQUIRED BY DESIGNER.
14.	ZONING SETBACK.
15.	CLTW REQUIRED BPA ABOVE GROUND.
16.	SEE NOTES D AND E.
17.	CLTW METER.
18.	PUBLIC WATER MAIN.
19.	PROPERTY LINE OR R/W.

NOTES:

A. BACKFLOW PREVENTION ASSEMBLIES (BPA's) SHALL CONFORM TO CLTW SPECIFICATIONS. SHUT-OFF VALVES ARE SPECIFIC TO EACH APPROVED BPA AND NO SUBSTITUTIONS OF SHUT-OFF VALVES ARE PERMITTED. REFER TO CLTW APPROVED LIST OF BPA's.

B. PIPE MATERIAL AND FITTINGS SHALL BE AS SPECIFIED IN CLTW STANDARDS & SPECIFICATIONS.

C. INSULATED ENCLOSURE SHALL BE AS SPECIFIED IN CLTW ENCLOSURE INFORMATION AND COMPLY WITH ASSE 1060 ENCLOSURE REQUIREMENTS - HEATED INSULATED ENCLOSURE IS RECOMMENDED. NO INSULATION SHALL BE WRAPPED AROUND BPA. COVER MUST NOT OBSTRUCT THE VALVE BEING FULLY OPENED.

D. ALL LOCATIONS FOR BPA's REQUIRE CLTW APPROVAL AND MUST BE OUTSIDE OF ZONING SET-BACK DIRECTLY BEHIND METER.

E. THERE SHALL BE NO TAPS, PIPING BRANCHES, UNAPPROVED BYPASS PIPING, HYDRANTS, FIRE DEPT. CONNECTION POINTS, OR OTHER WATER - USING APPURTENANCES CONNECTED TO THE SUPPLY LINE BETWEEN ANY WATER METER AND ITS CLTW - REQUIRED BACKFLOW PREVENTER.

F. EACH CLTW-REQUIRED BPA IS REQUIRED TO BE TESTED BY A CLTW - APPROVED CERTIFIED TESTER PRIOR TO PLACING THE WATER SYSTEM IN SERVICE. TEST RESULTS SHALL BE SUBMITTED TO CLTW WITHIN 30 DAYS AND TESTED ANNUALLY THEREAFTER SUBMITTING RESULTS TO CLTW.

G. ALL INSTALLATIONS INTENDED FOR ADDRESSING CLTW REQUIREMENTS, REQUIRE PRIOR APPROVAL FROM THE APPROPRIATE CLTW BACKFLOW INSPECTOR.

H. PAD MUST BE NO LOWER THAN 100-YEAR FLOOD AND HAVE ADEQUATE GRAVITY DRAINAGE. BACKFLOW DEVICE CANNOT BE INSTALLED BELOW GRADE, IN ANY LOCATION SUBJECT TO FLOODING, AND/OR CONSTRUCTED TO SUBMERGE THE RELIEF VALVE OPENING.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
BACKFLOW PREVENTION

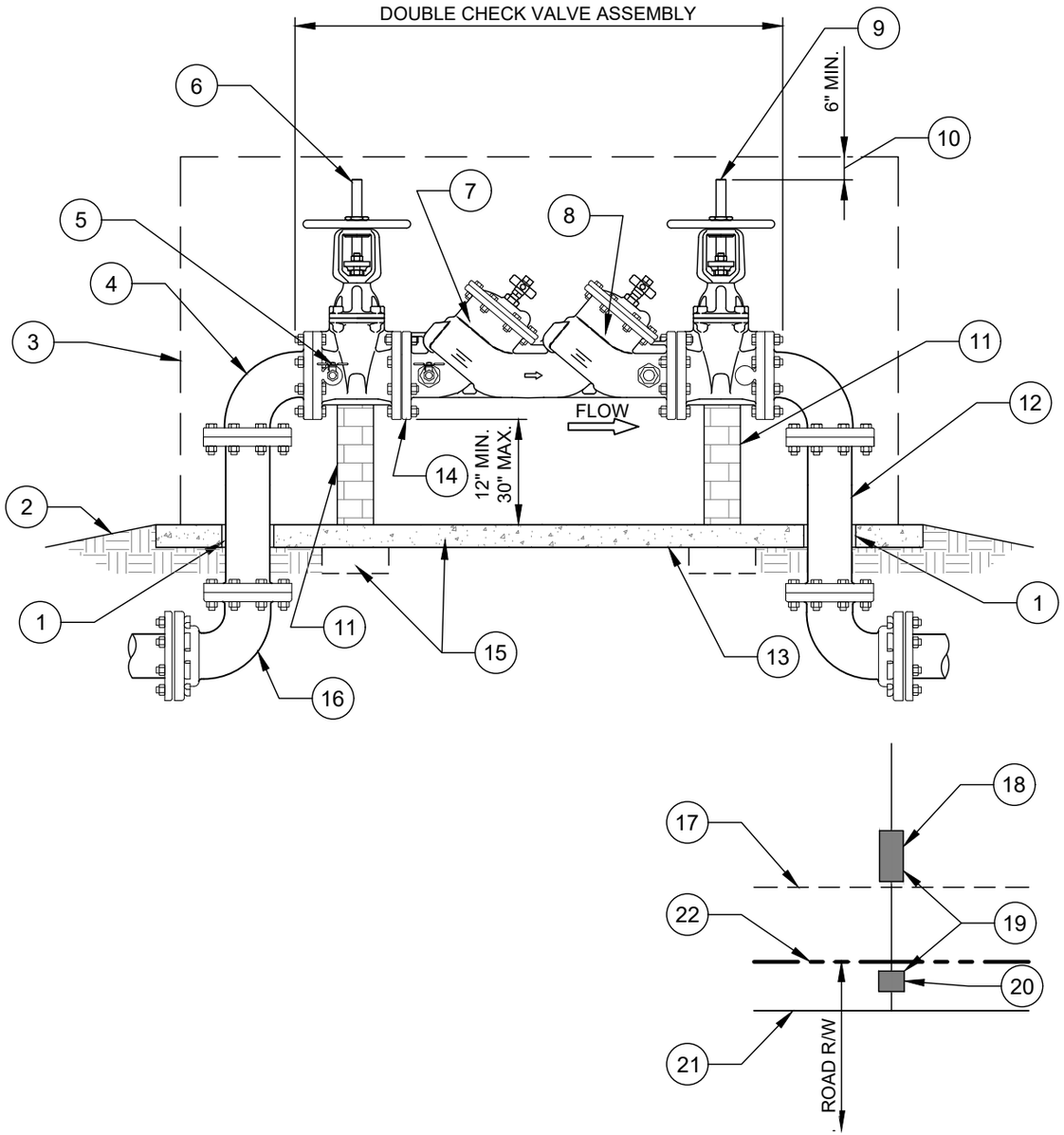
DOUBLE CHECK VALVE ASSEMBLY (DC) 1 1/2" & 2" ABOVE GROUND

NO SCALE

VERSION 1.0

DATE 04/2024

DETAIL 14.1.1



TYPICAL LOCATION REQUIREMENT FOR ABOVE GROUND INSTALLATION

N.T.S.

NO.	DESCRIPTION:
1.	SLEEVE REQUIRED (TYP.).
2.	SLOPE GROUND AWAY FROM COVER.
3.	HINGED ACCESS OR REMOVABLE INSULATED ENCLOSURE MEETING ASSE 1060 SPECIFICATIONS. ENCLOSURE TO INCLUDE DRAIN PORT(S) PER CLTW REQUIREMENT.
4.	RESTRAINED JOINT. SEE NOTE C.
5.	TEST COCK #1.
6.	SHUT-OFF VALVE #1. SEE NOTE B.
7.	CHECK VALVE #1.
8.	CHECK VALVE #2.
9.	SHUT-OFF VALVE #2. SEE NOTE B.
10.	COVER MUST NOT OBSTRUCT VALVE BEING FULLY OPENED.
11.	SEE NOTE D.
12.	DUCTILE IRON PIPE OR TYPE K OR L COPPER TUBING FOR MIN. OF 5' ON EACH END OF ASSEMBLY. SEE NOTE C.
13.	MIN. 4" THICK CONCRETE PAD REQUIRED. SEE NOTE J.
14.	LOWEST POINT.
15.	SUPPORT, PAD AND CONCRETE FOOTINGS AS REQUIRED BY SYSTEM DESIGNER.
16.	RESTRAINED JOINT. SEE NOTE C.
17.	ZONING SETBACK.
18.	CLTW REQUIRED BPA ABOVE GROUND.
19.	SEE NOTES F AND G.
20.	CLTW METER.
21.	PUBLIC WATER MAIN.
22.	PROPERTY LINE OR R/W.

NOTES:

A. BACKFLOW PREVENTION ASSEMBLIES (BPA's) SHALL CONFORM TO CLTW SPECIFICATIONS. SHUT-OFF VALVES ARE SPECIFIC TO EACH APPROVED BPA AND NO SUBSTITUTIONS OF SHUT-OFF VALVES ARE PERMITTED. REFER TO CLTW APPROVED LIST OF BPA's.

B. FIRE LINE SERVICES SHALL HAVE OUTSIDE STEM AND YOKE (OS & Y) HANDWHEEL OPERATORS OR BUTTERFLY VALVES, AND LISTED ON APPROVED LIST AS FIRE APPROVED. IF SERVING FIRE SPRINKLERS, TAMPER SWITCHES ARE REQUIRED.

C. PIPE MATERIAL AND FITTINGS SHALL BE AS SPECIFIED IN CLTW STANDARDS & SPECIFICATIONS. ALL JOINTS SHALL BE RESTRAINED WITH MEGALUG RESTRAINTS OR APPROVED EQUAL.

D. SUPPORT OF ASSEMBLY SHALL BE DESIGNED BY OWNER, 8" - 12" SHALL BE SUPPORTED AT EACH VALVE.

E. INSULATED ENCLOSURE SHALL BE AS SPECIFIED IN CLTW ENCLOSURE INFORMATION AND COMPLY WITH ASSE 1060 ENCLOSURE REQUIREMENTS - HEATED INSULATED ENCLOSURE ARE REQUIRED FOR FIRE LINE SERVICES. NO INSULATION SHALL BE WRAPPED AROUND BPA. COVER MUST NOT OBSTRUCT THE VALVE BEING FULLY OPENED.

F. ALL LOCATIONS FOR BPA's REQUIRE CLTW APPROVAL AND MUST BE OUTSIDE OF ZONING SET-BACK DIRECTLY BEHIND METER.

G. THERE SHALL BE NO TAPS, PIPING BRANCHES, UNAPPROVED BYPASS PIPING, HYDRANTS, FIRE DEPT. CONNECTION POINTS, OR OTHER WATER - USING APPURTENANCES CONNECTED TO THE SUPPLY LINE BETWEEN ANY WATER METER AND ITS CLTW - REQUIRED BACKFLOW PREVENTER.

H. EACH CLTW-REQUIRED BPA IS REQUIRED TO BE TESTED BY A CLTW - APPROVED CERTIFIED TESTER PRIOR TO PLACING THE WATER SYSTEM IN SERVICE. TEST RESULTS SHALL BE SUBMITTED TO CLTW WITHIN 30 DAYS AND TESTED ANNUALLY THEREAFTER SUBMITTING RESULTS TO CLTW.

I. ALL INSTALLATIONS INTENDED FOR ADDRESSING CLTW REQUIREMENTS, REQUIRE PRIOR APPROVAL FROM THE APPROPRIATE CLTW BACKFLOW INSPECTOR.

J. PAD MUST BE NO LOWER THAN 100-YEAR FLOOD AND HAVE ADEQUATE GRAVITY DRAINAGE. BACKFLOW DEVICE CANNOT BE INSTALLED BELOW GRADE, IN ANY LOCATION SUBJECT TO FLOODING, AND/OR CONSTRUCTED TO SUBMERGE THE RELIEF VALVE OPENING.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

BACKFLOW PREVENTION

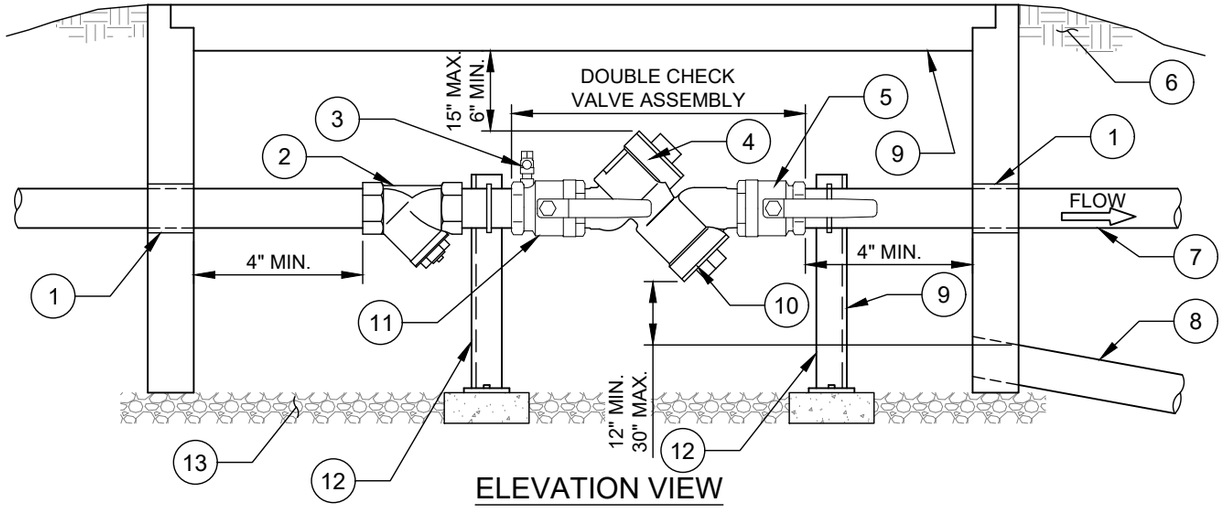
DOUBLE CHECK VALVE ASSEMBLY (DC) 2 1/2" - 12" ABOVE GROUND

NO SCALE

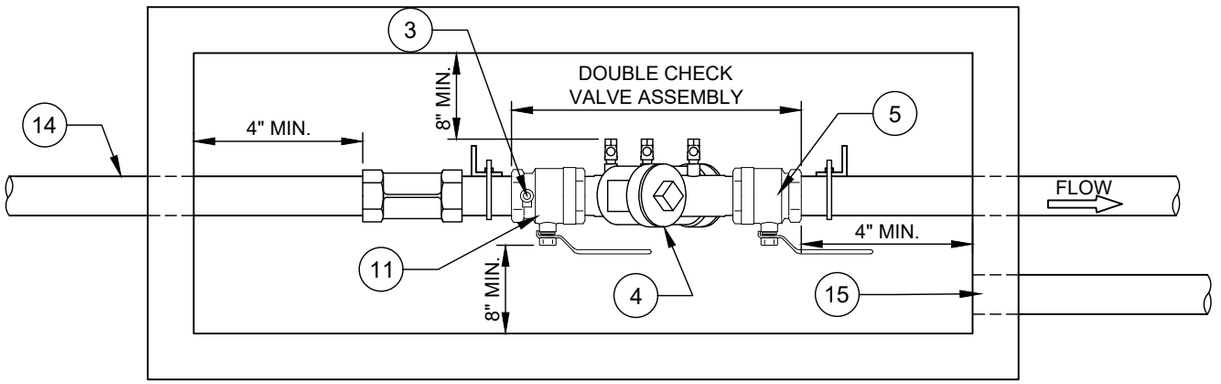
VERSION 1.0

DATE 04/2024

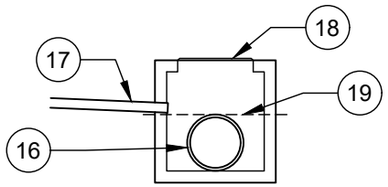
DETAIL 14.1.2



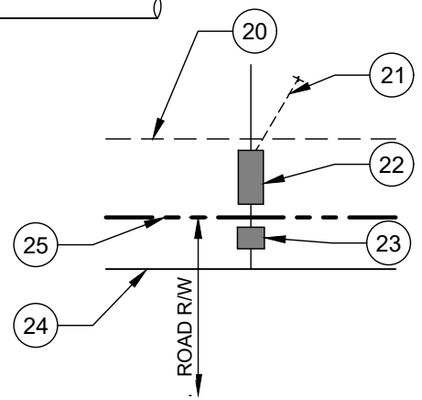
ELEVATION VIEW



PLAN VIEW



DRAIN ALTERNATIVE:
TIE INTO CATCH BASIN OR STORMWATER MANHOLE PER DETAIL SHOWN ABOVE. NO TIE IN TO STORMWATER PIPE WILL BE ACCEPTED.



TYPICAL LOCATION REQUIREMENT
FOR BELOW GROUND INSTALLATION

N.T.S.

NO.	DESCRIPTION:
1.	SLEEVE REQUIRED (TYP.).
2.	STRAINER RECOMMENDED EXCEPT ON FIRE SERVICE.
3.	TEST COCK #1.
4.	CHECK VALVE #1.
5.	SHUT-OFF VALVE #2.
6.	FINISHED GRADE TO BE SLOPED AWAY FROM COVER.
7.	TYPE K OR L COPPER TUBING PIPE, 1 INCH MIN. GALVANIZED STEEL PIPE (CONFORMS TO ASTM A53) OR SCH. 40 PVC PIPE WITH SCH. 80 PVC FITTINGS. SEE NOTE B.
8.	2" MIN. DIAMETER DRAIN BY GRAVITY TO ATMOSPHERE AS REQUIRED BY CLTW SPECIFICATIONS. SEE NOTE D.
9.	SEE NOTE C.
10.	CHECK VALVE #2.
11.	SHUT-OFF VALVE #1.
12.	SUPPORT AS REQUIRED BY DESIGNER.
13.	MIN. 4" THICK #57 WASHED STONE OR VAULT BOTTOM.
14.	SEE NOTE F.
15.	2" MIN. DRAIN TO ATMOSPHERE.
16.	STORM PIPE.
17.	DRAIN FROM BACKFLOW VAULT.
18.	CATCH BASIN WITH GRATE.
19.	TOP OF DISCHARGING STORM PIPE.
20.	ZONING SETBACK.
21.	DRAIN.
22.	CLTW REQUIRED BPA BELOW GROUND. SEE NOTE E AND F.
23.	CLTW METER.
24.	PUBLIC WATER MAIN.
25.	PROPERTY LINE OR R/W.

NOTES:

A. BACKFLOW PREVENTION ASSEMBLIES (BPA's) SHALL CONFORM TO CLTW SPECIFICATIONS. SHUT-OFF VALVES ARE SPECIFIC TO EACH APPROVED BPA AND NO SUBSTITUTIONS OF SHUT-OFF VALVES ARE PERMITTED. REFER TO CLTW APPROVED LIST OF BPA's.

B. PIPE MATERIAL AND FITTINGS SHALL BE AS SPECIFIED IN CLTW STANDARDS & SPECIFICATIONS.

C. VAULT, DOORS, OR COVERS AND SUPPORT OF ASSEMBLY SHALL BE DESIGNED BY DESIGNER AND AS REQUIRED.

D. DRAIN INLET MAY BE PROVIDED AS SHOWN OR AS FLOOR DRAIN.

E. ALL LOCATIONS FOR BPA's REQUIRE CLTW APPROVAL.

F. THERE SHALL BE NO TAPS, PIPING BRANCHES, UNAPPROVED BYPASS PIPING, HYDRANTS, FIRE DEPT. CONNECTION POINTS, OR OTHER WATER - USING APPURTENANCES CONNECTED TO THE SUPPLY LINE BETWEEN ANY WATER METER AND ITS CLTW - REQUIRED BACKFLOW PREVENTER.

G. EACH CLTW-REQUIRED BPA IS REQUIRED TO BE TESTED BY A CLTW - APPROVED CERTIFIED TESTER PRIOR TO PLACING THE WATER SYSTEM IN SERVICE. TEST RESULTS SHALL BE SUBMITTED TO CLTW WITHIN 30 DAYS AND TESTED ANNUALLY THEREAFTER SUBMITTING RESULTS TO CLTW.

H. INSTALLATIONS INTENDED FOR ADDRESSING CLTW REQUIREMENTS, REQUIRE PRIOR APPROVAL FROM THE APPROPRIATE CLTW BACKFLOW INSPECTOR.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

BACKFLOW PREVENTION

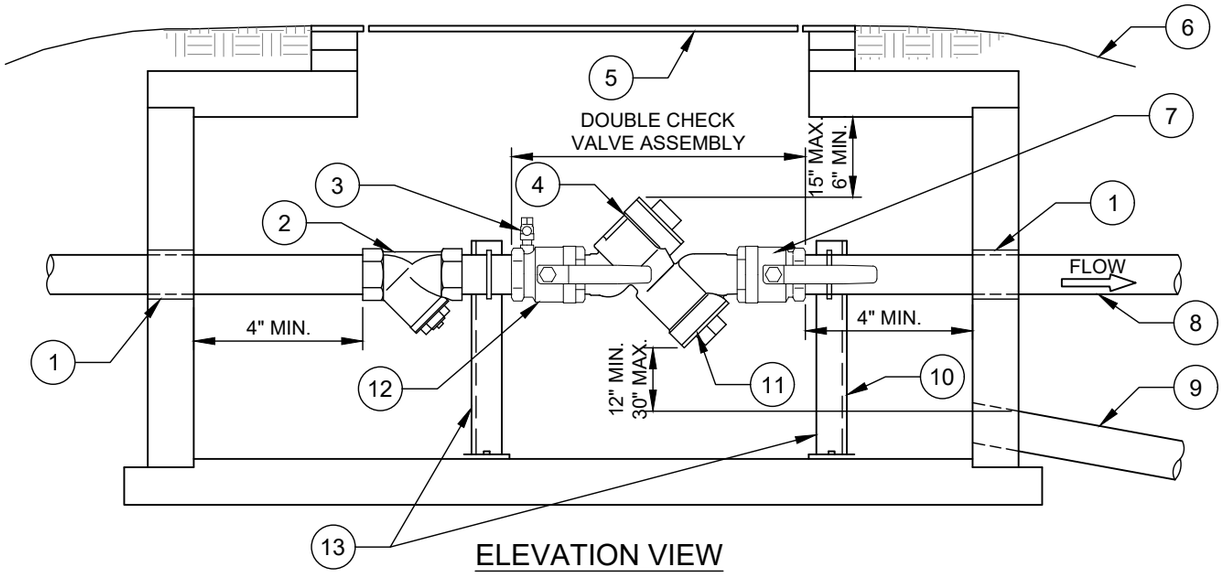
DOUBLE CHECK VALVE ASSEMBLY (DC) 3/4" & 1" BELOW GROUND VAULT

NO SCALE

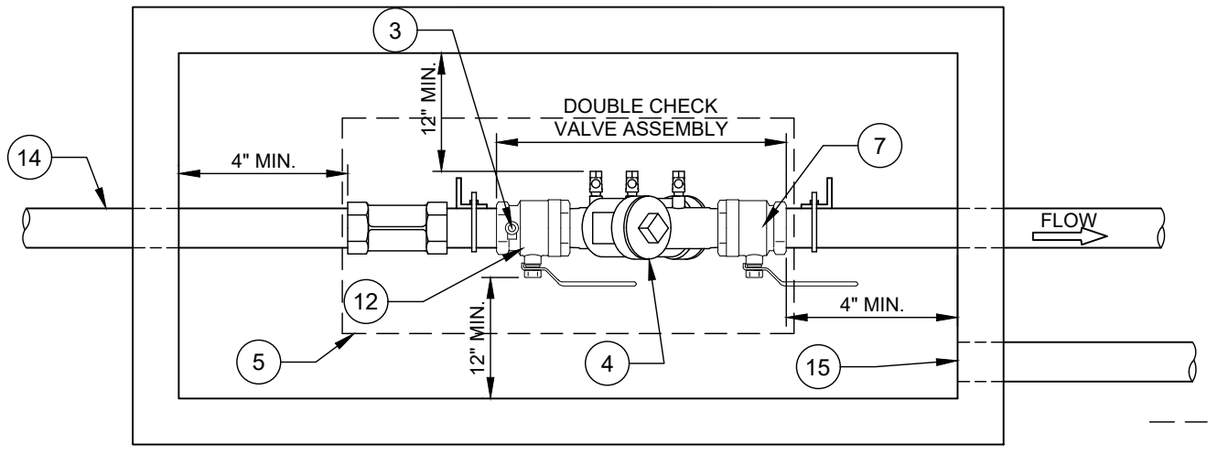
VERSION 1.0

DATE 04/2024

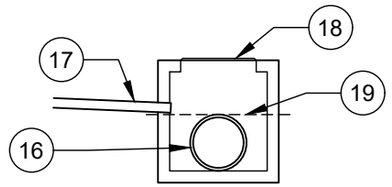
DETAIL 14.1.3



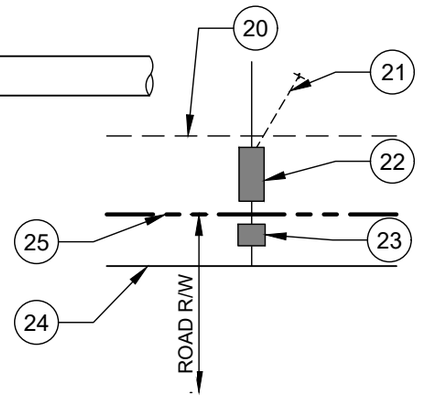
ELEVATION VIEW



PLAN VIEW



DRAIN ALTERNATIVE:
TIE INTO CATCH BASIN OR STORMWATER MANHOLE PER DETAIL SHOWN ABOVE. NO TIE IN TO STORMWATER PIPE WILL BE ACCEPTED.



TYPICAL LOCATION REQUIREMENT
FOR BELOW GROUND INSTALLATION

N.T.S.

NO.	DESCRIPTION:
1.	SLEEVE REQUIRED (TYP.).
2.	STRAINER RECOMMENDED EXCEPT ON FIRE SERVICE.
3.	TEST COCK #1.
4.	CHECK VALVE #1.
5.	VAULT LID. SEE NOTE C.
6.	FINISHED GRADE TO BE SLOPED AWAY FROM COVER.
7.	SHUT-OFF VALVE #2.
8.	TYPE K OR L COPPER TUBING OR 1 INCH MIN. GALVANIZED STEEL PIPE (CONFORMS TO ASTM A53) FOR MIN. OF 5' ON EACH END OF THE ASSEMBLY. SEE NOTE B.
9.	2" MIN. DIAMETER DRAIN BY GRAVITY TO ATMOSPHERE AS REQUIRED BY CLTW SPECIFICATIONS. SEE NOTE D.
10.	SEE NOTE C.
11.	CHECK VALVE #2.
12.	SHUT-OFF VALVE #1.
13.	SUPPORT AS REQUIRED BY DESIGNER.
14.	SEE NOTE F.
15.	2" MIN. DRAIN TO ATMOSPHERE.
16.	STORM PIPE.
17.	DRAIN FROM BACKFLOW VAULT.
18.	CATCH BASIN WITH GRATE.
19.	TOP OF DISCHARGING STORM PIPE.
20.	ZONING SETBACK.
21.	DRAIN.
22.	CLTW REQUIRED BPA BELOW GROUND. SEE NOTE E AND F.
23.	CLTW METER.
24.	PUBLIC WATER MAIN.
25.	PROPERTY LINE OR R/W.

NOTES:

A. BACKFLOW PREVENTION ASSEMBLIES (BPA's) SHALL CONFORM TO CLTW SPECIFICATIONS. SHUT-OFF VALVES ARE SPECIFIC TO EACH APPROVED BPA AND NO SUBSTITUTIONS OF SHUT-OFF VALVES ARE PERMITTED. REFER TO CLTW APPROVED LIST OF BPA's.

B. PIPE MATERIAL AND FITTINGS SHALL BE AS SPECIFIED IN CLTW STANDARDS & SPECIFICATIONS.

C. VAULT, DOORS, OR COVERS AND SUPPORT OF ASSEMBLY SHALL BE DESIGNED BY DESIGNER AND AS REQUIRED.

D. DRAIN INLET MAY BE PROVIDED AS SHOWN OR AS FLOOR DRAIN.

E. ALL LOCATIONS FOR BPA's REQUIRE CLTW APPROVAL.

F. THERE SHALL BE NO TAPS, PIPING BRANCHES, UNAPPROVED BYPASS PIPING, HYDRANTS, FIRE DEPT. CONNECTION POINTS, OR OTHER WATER - USING APPURTENANCES CONNECTED TO THE SUPPLY LINE BETWEEN ANY WATER METER AND ITS CLTW - REQUIRED BACKFLOW PREVENTER.

G. EACH CLTW-REQUIRED BPA IS REQUIRED TO BE TESTED BY A CLTW - APPROVED CERTIFIED TESTER PRIOR TO PLACING THE WATER SYSTEM IN SERVICE. TEST RESULTS SHALL BE SUBMITTED TO CLTW WITHIN 30 DAYS AND TESTED ANNUALLY THEREAFTER SUBMITTING RESULTS TO CLTW.

H. INSTALLATIONS INTENDED FOR ADDRESSING CLTW REQUIREMENTS, REQUIRE PRIOR APPROVAL FROM THE APPROPRIATE CLTW BACKFLOW INSPECTOR.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

BACKFLOW PREVENTION

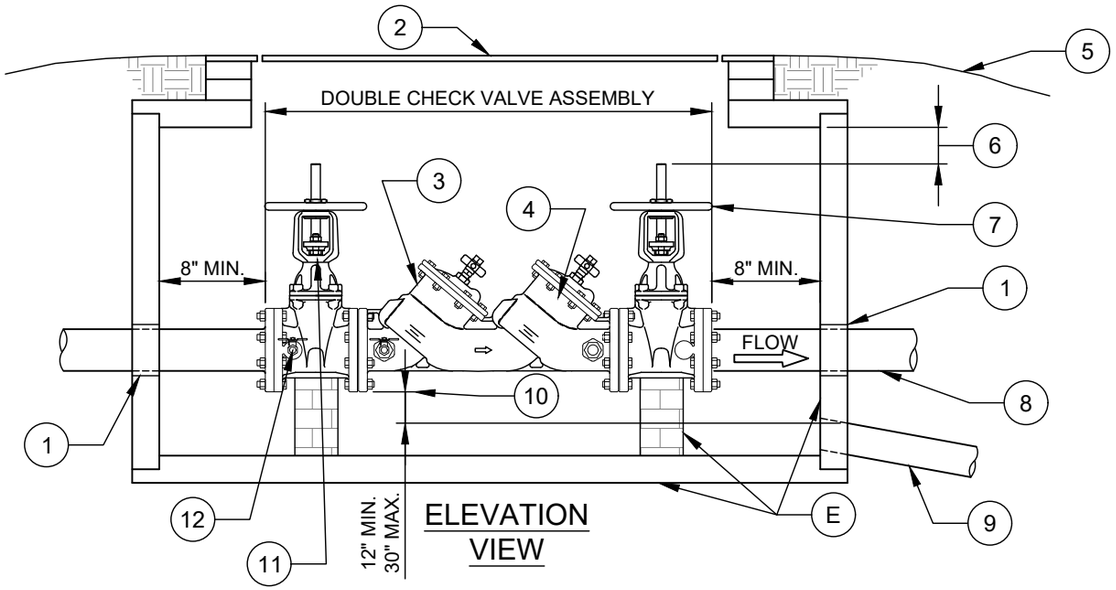
DOUBLE CHECK VALVE ASSEMBLY (DC) 1 1/2" & 2" BELOW GROUND VAULT

NO SCALE

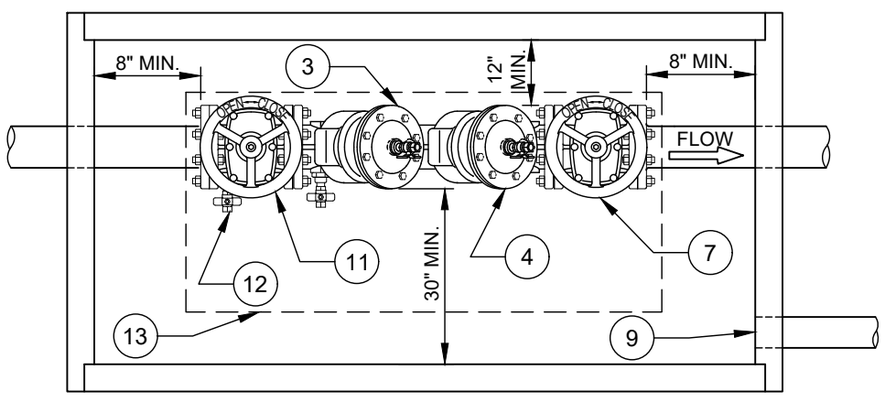
VERSION 1.0

DATE 04/2024

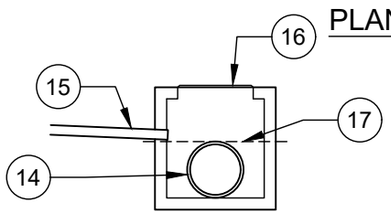
DETAIL 14.1.4



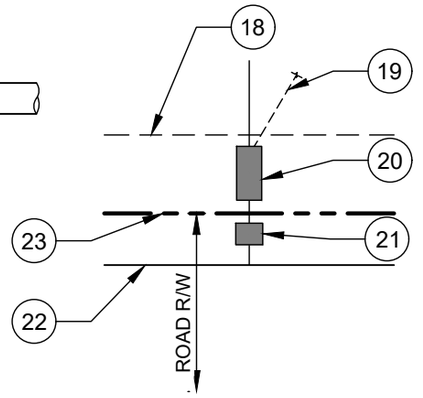
ELEVATION VIEW



PLAN VIEW



DRAIN ALTERNATIVE:
TIE INTO PRIVATE CATCH BASIN OR PRIVATE STORMWATER MANHOLE PER DETAIL SHOWN ABOVE. NO TIE IN TO STORMWATER PIPE OR PUBLIC CATCH BASIN / MANHOLE WILL BE ACCEPTED.



TYPICAL LOCATION REQUIREMENT FOR BELOW GROUND INSTALLATION

N.T.S.

NO.	DESCRIPTION:
1.	SLEEVE REQUIRED (TYP.).
2.	4' X 5', 5' X 5' OR 4' X 6' DOUBLE LEAF STEEL OR ALUMINUM DOORS HINGED AND LOCKABLE. SEE NOTE F.
3.	CHECK VALVE #1.
4.	CHECK VALVE #2.
5.	FINISHED GRADE TO BE SLOPED AWAY FROM COVER.
6.	6" MIN. WHEN VALVE IS FULLY OPEN. VALVE CANNOT EXTEND THROUGH TOP.
7.	SHUT-OFF VALVE #2. SEE NOTE B.
8.	DIP OR TYPE K OR L COPPER TUBING FOR MIN. OF 5' ON EACH END OF ASSEMBLY. SEE NOTE D.
9.	4" MIN. DIAMETER DRAIN BY GRAVITY TO ATMOSPHERE AS REQUIRED BY CLTW SPECIFICATIONS. SEE NOTE G.
10.	LOWEST POINT.
11.	SHUT-OFF VALVE #1. SEE NOTE B.
12.	TEST COCK #1.
13.	VAULT LID.
14.	STORM PIPE.
15.	DRAIN FROM BACKFLOW VAULT.
16.	CATCH BASIN WITH GRATE.
17.	TOP OF DISCHARGING STORM PIPE.
18.	ZONING SETBACK.
19.	DRAIN.
20.	CLTW REQUIRED BPA BELOW GROUND. SEE NOTE H AND I.
21.	CLTW METER.
22.	PUBLIC WATER MAIN.
23.	PROPERTY LINE OR R/W.

NOTES:

A. BACKFLOW PREVENTION ASSEMBLIES (BPA's) SHALL CONFORM TO CLTW SPECIFICATIONS. SHUT-OFF VALVES ARE SPECIFIC TO EACH APPROVED BPA AND NO SUBSTITUTIONS OF SHUT-OFF VALVES ARE PERMITTED. REFER TO CLTW APPROVED LIST OF BPA's.

B. FIRE LINE SERVICES SHALL HAVE OUTSIDE STEM AND YOKE (OS & Y) HANDWHEEL OPERATORS OR BUTTERFLY VALVES, AND LISTED ON APPROVED LIST AS FIRE APPROVED. IF SERVING FIRE SPRINKLERS, TAMPER SWITCHES ARE REQUIRED.

C. ASSEMBLIES SHALL BE INSTALLED UPRIGHT AND IN THE HORIZONTAL POSITION.

D. PIPE MATERIAL AND FITTINGS SHALL BE AS SPECIFIED IN CLTW STANDARDS & SPECIFICATIONS.

E. VAULT AND SUPPORT OF ASSEMBLY SHALL BE DESIGNED BY OWNER, 8" - 12" SHALL BE SUPPORTED AT EACH VALVE.

F. ACCESS DOORS SHALL BE AS SPECIFIED IN CLTW WATER DETAILS OR APPROVED EQUAL.

G. DRAINAGE INLET MAY BE PROVIDED AS SHOWN OR AS FLOOR DRAIN.

H. ALL LOCATIONS FOR BPA's REQUIRE CLTW APPROVAL.

I. THERE SHALL BE NO TAPS, PIPING BRANCHES, UNAPPROVED BYPASS PIPING, HYDRANTS, FIRE DEPT. CONNECTION POINTS, OR OTHER WATER - USING APPURTENANCES CONNECTED TO THE SUPPLY LINE BETWEEN ANY WATER METER AND ITS CLTW - REQUIRED BACKFLOW PREVENTER.

J. EACH CLTW-REQUIRED BPA IS REQUIRED TO BE TESTED BY A CLTW - APPROVED CERTIFIED TESTER PRIOR TO PLACING THE WATER SYSTEM IN SERVICE. TEST RESULTS SHALL BE SUBMITTED TO CLTW WITHIN 30 DAYS AND TESTED ANNUALLY THEREAFTER SUBMITTING RESULTS TO CLTW.

K. ALL INSTALLATIONS INTENDED FOR ADDRESSING CLTW REQUIREMENTS, REQUIRE PRIOR APPROVAL FROM THE APPROPRIATE CLTW BACKFLOW INSPECTOR.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

BACKFLOW PREVENTION

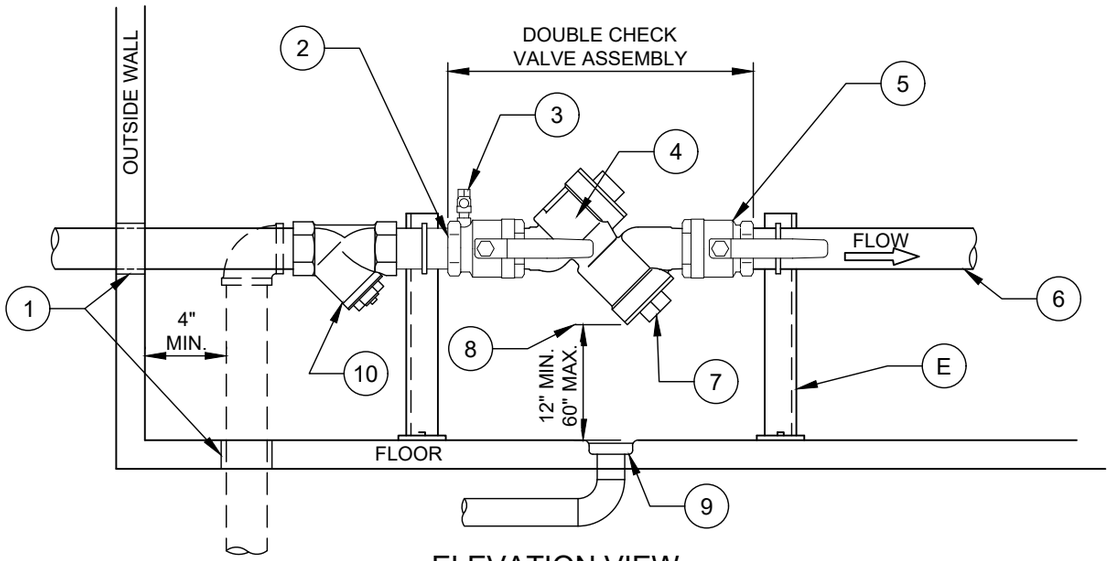
DOUBLE CHECK VALVE ASSEMBLY (DC) 2 1/2" - 12" BELOW GROUND VAULT

NO SCALE

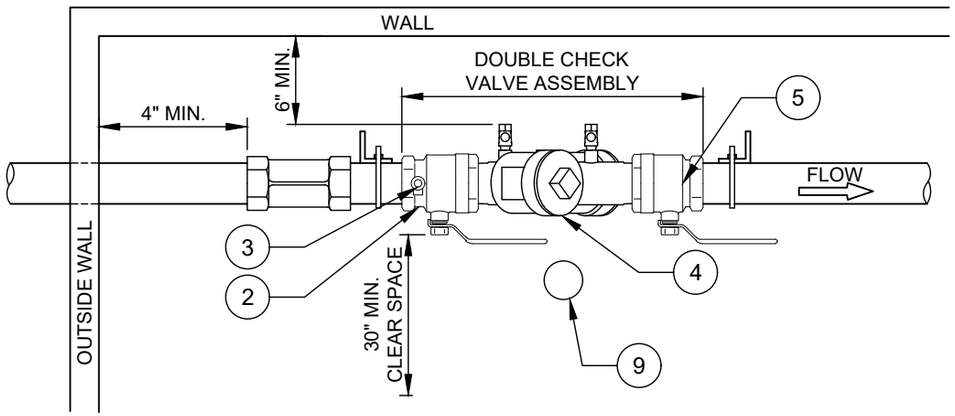
VERSION 1.0

DATE 04/2024

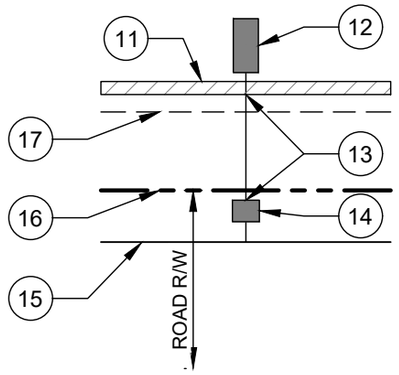
DETAIL 14.1.5



ELEVATION VIEW



PLAN VIEW



TYPICAL LOCATION REQUIREMENT
FOR INSIDE INSTALLATION

N.T.S.

NO. DESCRIPTION:

1. SLEEVE PER NC BLDG. CODE (TYP.).
2. SHUT-OFF VALVE #1.
3. TEST COCK #1.
4. CHECK VALVE #1.
5. SHUT-OFF VALVE #2.
6. TYPE K OR L COPPER TUBING OR 1 INCH MIN. GALVANIZED STEEL PIPE (CONFORMS TO ASTM A53) FOR MIN. OF 5' ON EACH END OF THE ASSEMBLY. SEE NOTE D.
7. CHECK VALVE #2.
8. LOWEST POINT.
9. DRAIN RECOMMENDED.
10. STRAINER RECOMMENDED EXCEPT ON FIRE SERVICE.
11. EXTERIOR BUILDING WALL.
12. CLTW REQUIRED BPA INSIDE.
13. SEE NOTE F AND G.
14. CLTW METER.
15. PUBLIC WATER MAIN.
16. PROPERTY LINE OR R/W.
17. ZONING SETBACK.

NOTES:

A. INDOOR INSTALLATION SHALL ONLY BE PERMITTED IN CASES WHERE ADEQUATE SPACE FOR THE BACKFLOW PREVENTION ASSEMBLY IS NOT AVAILABLE OUTSIDE. CLTW WILL REVIEW ON A CASE BY CASE BASIS.

B. BACKFLOW PREVENTION ASSEMBLIES (BPA's) SHALL CONFORM TO CLTW SPECIFICATIONS. SHUT-OFF VALVES ARE SPECIFIC TO EACH APPROVED BPA AND NO SUBSTITUTIONS OF SHUT-OFF VALVES ARE PERMITTED. REFER TO CLTW APPROVED LIST OF BPA's.

C. ASSEMBLIES SHALL BE INSTALLED UPRIGHT AND IN THE HORIZONTAL POSITION.

D. PIPE MATERIAL AND FITTINGS SHALL BE AS SPECIFIED IN CLTW STANDARDS & SPECIFICATIONS.

E. SUPPORT FOR ASSEMBLY SHALL BE DESIGNED BY OWNER AS REQUIRED.

F. ALL LOCATIONS FOR BPA's REQUIRE CLTW APPROVAL.

G. THERE SHALL BE NO TAPS, PIPING BRANCHES, UNAPPROVED BYPASS PIPING, HYDRANTS, FIRE DEPT. CONNECTION POINTS, OR OTHER WATER - USING APPURTENANCES CONNECTED TO THE SUPPLY LINE BETWEEN ANY WATER METER AND ITS CLTW - REQUIRED BACKFLOW PREVENTER.

H. EACH CLTW-REQUIRED BPA IS REQUIRED TO BE TESTED BY A CLTW - APPROVED CERTIFIED TESTER PRIOR TO PLACING THE WATER SYSTEM IN SERVICE. TEST RESULTS SHALL BE SUBMITTED TO CLTW WITHIN 30 DAYS AND TESTED ANNUALLY THEREAFTER SUBMITTING RESULTS TO CLTW.

I. ALL INSTALLATIONS INTENDED FOR ADDRESSING CLTW REQUIREMENTS, REQUIRE PRIOR APPROVAL FROM THE APPROPRIATE CLTW BACKFLOW INSPECTOR.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

BACKFLOW PREVENTION

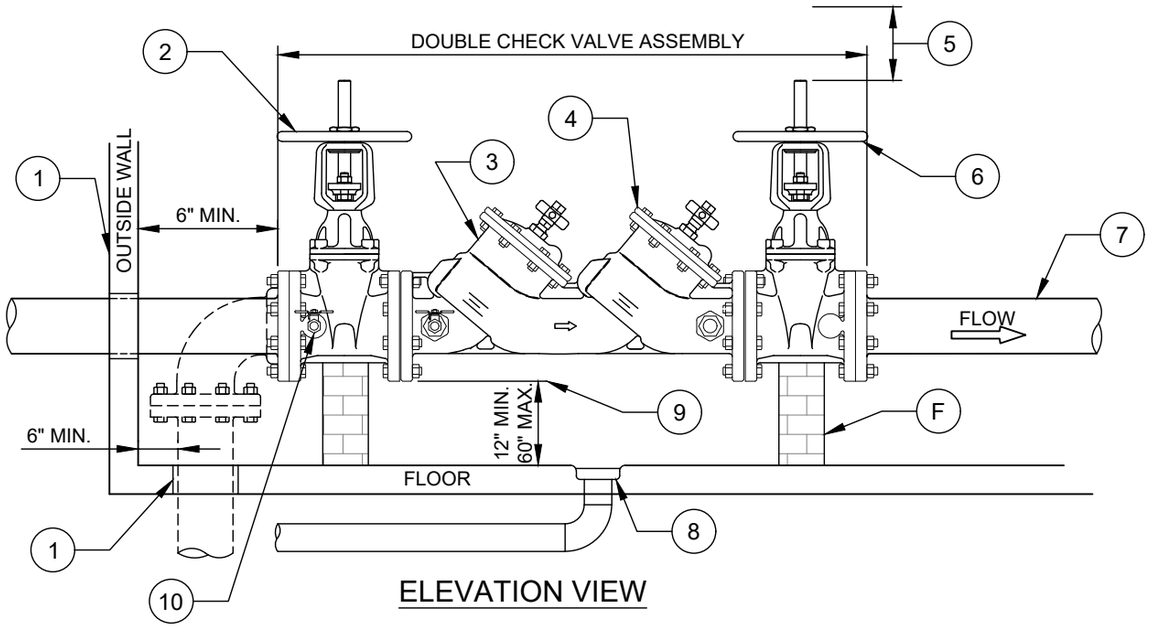
DOUBLE CHECK VALVE ASSEMBLY (DC) 3/4" - 2" INDOOR

NO SCALE

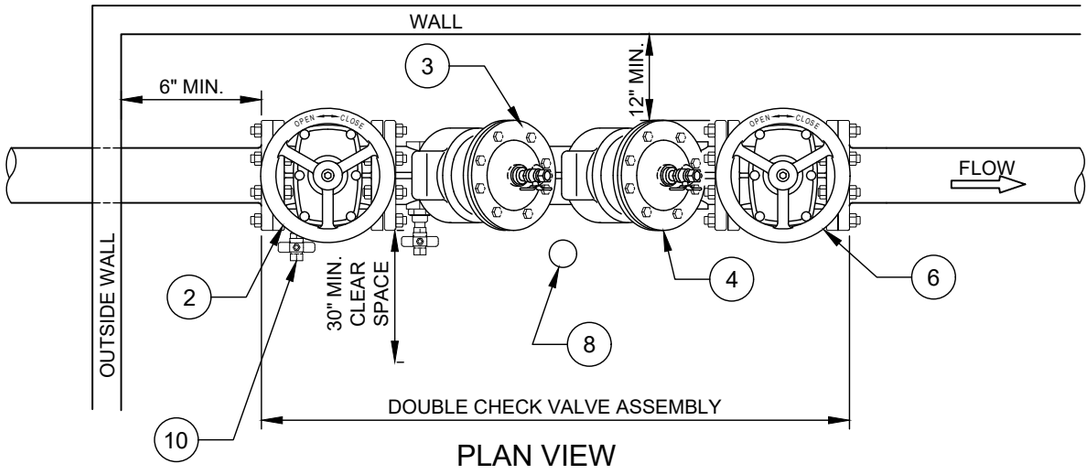
VERSION 1.0

DATE 04/2024

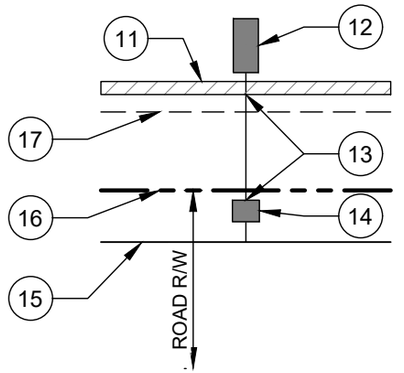
DETAIL 14.1.6



ELEVATION VIEW



PLAN VIEW



TYPICAL LOCATION REQUIREMENT
FOR INSIDE INSTALLATION

N.T.S.

NO. DESCRIPTION:

1. SLEEVE PER NC BLDG. CODE (TYP.).
2. SHUT-OFF VALVE #1. SEE NOTE C.
3. CHECK VALVE #1.
4. CHECK VALVE #2.
5. 6" CLEAR OF OBSTRUCTIONS WHEN VALVE IS FULLY OPEN.
6. SHUT-OFF VALVE #2. SEE NOTE C.
7. DIP OR TYPE K OR L COPPER TUBING FOR MIN. OF 5' ON EACH END OF ASSEMBLY. SEE NOTE E.
8. DRAIN RECOMMENDED.
9. LOWEST POINT.
10. TEST COCK #1.
11. EXTERIOR BUILDING WALL.
12. CLTW REQUIRED BPA INSIDE.
13. SEE NOTE G AND H.
14. CLTW METER.
15. PUBLIC WATER MAIN.
16. PROPERTY LINE OR R/W.
17. ZONING SETBACK.

NOTES:

A. INDOOR INSTALLATION SHALL ONLY BE PERMITTED IN CASES WHERE ADEQUATE SPACE FOR THE BACKFLOW PREVENTION ASSEMBLY IS NOT AVAILABLE OUTSIDE. CLTW WILL REVIEW ON A CASE BY CASE BASIS.

B. BACKFLOW PREVENTION ASSEMBLIES (BPA's) SHALL CONFORM TO CLTW SPECIFICATIONS. SHUT-OFF VALVES ARE SPECIFIC TO EACH APPROVED BPA AND NO SUBSTITUTIONS OF SHUT-OFF VALVES ARE PERMITTED. REFER TO CLTW APPROVED LIST OF BPA's.

C. FIRE LINE INSTALLATIONS SHALL HAVE OUTSIDE STEM AND YOKE (OS&Y) HANDWHEEL OPERATORS OR BUTTERFLY VALVES, AND LISTED ON APPROVED LIST AS FIRE APPROVED. IF SERVING FIRE SPRINKLERS, TAMPER SWITCHES ARE REQUIRED.

D. ASSEMBLIES SHALL BE INSTALLED UPRIGHT AND IN THE HORIZONTAL POSITION.

E. PIPE MATERIAL AND FITTINGS SHALL BE AS SPECIFIED IN CLTW STANDARDS & SPECIFICATIONS.

F. SUPPORT FOR ASSEMBLY SHALL BE DESIGNED BY OWNER, 8" - 12" SHALL BE SUPPORTED AT EACH VALVE.

G. ALL LOCATIONS FOR BPA's REQUIRE CLTW APPROVAL.

H. THERE SHALL BE NO TAPS, PIPING BRANCHES, UNAPPROVED BYPASS PIPING, HYDRANTS, FIRE DEPT. CONNECTION POINTS, OR OTHER WATER - USING APPURTENANCES CONNECTED TO THE SUPPLY LINE BETWEEN ANY WATER METER AND ITS CLTW - REQUIRED BACKFLOW PREVENTER.

I. EACH CLTW-REQUIRED BPA IS REQUIRED TO BE TESTED BY A CLTW - APPROVED CERTIFIED TESTER PRIOR TO PLACING THE WATER SYSTEM IN SERVICE. TEST RESULTS SHALL BE SUBMITTED TO CLTW WITHIN 30 DAYS AND TESTED ANNUALLY THEREAFTER SUBMITTING RESULTS TO CLTW.

J. ALL INSTALLATIONS INTENDED FOR ADDRESSING CLTW REQUIREMENTS, REQUIRE PRIOR APPROVAL FROM THE APPROPRIATE CLTW BACKFLOW INSPECTOR.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

BACKFLOW PREVENTION

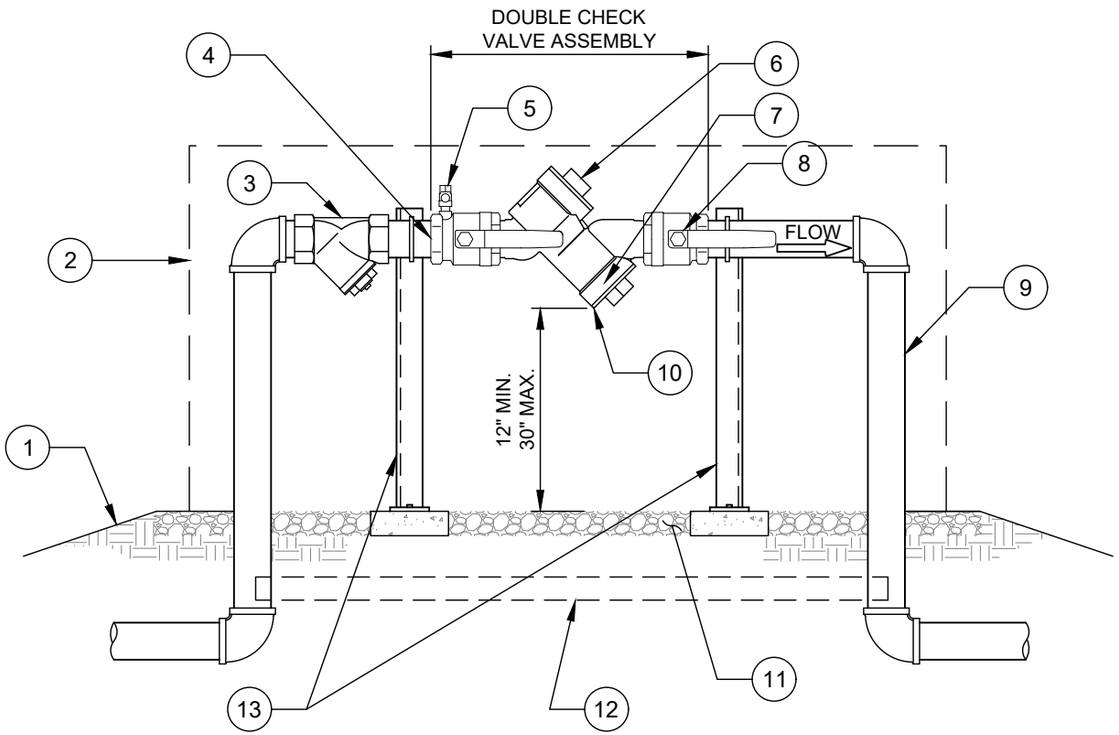
DOUBLE CHECK VALVE ASSEMBLY (DC) 2 1/2" -12" INDOOR

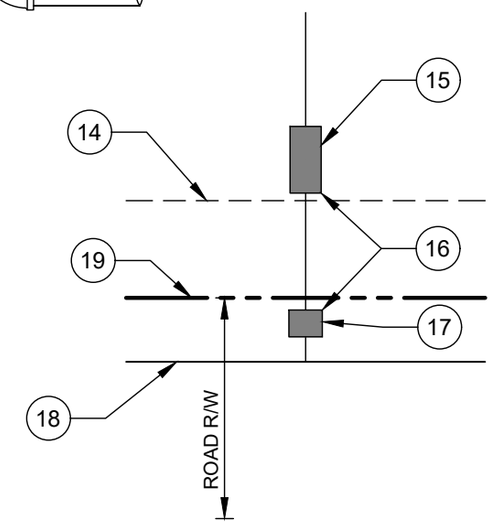
NO SCALE

VERSION 1.0

DATE 04/2024

DETAIL 14.1.7





TYPICAL LOCATION REQUIREMENT
FOR ABOVE GROUND INSTALLATION

N.T.S.

NO.	DESCRIPTION:
1.	SLOPE GROUND AWAY FROM COVER (TYP.).
2.	HINGED ACCESS OR REMOVABLE INSULATED ENCLOSURE MEETING ASSE 1060 SPECIFICATIONS. ENCLOSURE TO INCLUDE DRAIN PORT(S) PER CLTW REQUIREMENTS.
3.	STRAINER RECOMMENDED EXCEPT ON FIRE SERVICE.
4.	SHUT-OFF VALVE #1.
5.	TEST COCK #1.
6.	CHECK VALVE #1.
7.	CHECK VALVE #2.
8.	SHUT-OFF VALVE #2.
9.	TYPE K OR L COPPER TUBING PIPE, 1 INCH MIN. GALVANIZED STEEL PIPE (CONFORMS TO ASTM A53) OR SCH. 80 PVC PIPE WITH SCH. 80 PVC FITTINGS. SEE NOTE B.
10.	LOWEST POINT.
11.	4" MINIMUM #57 WASHED STONE OR CONCRETE PAD. SEE NOTE H.
12.	IF USING PVC PIPE, HORIZONTAL BRACING IS RECOMMENDED.
13.	IF USING PVC PIPE - VERTICAL BRACING IS REQUIRED.
14.	ZONING SETBACK.
15.	CLTW REQUIRED BPA ABOVE GROUND.
16.	SEE NOTES D AND E.
17.	CLTW METER.
18.	PUBLIC WATER MAIN.
19.	PROPERTY LINE OR R/W.

NOTES:

A. BACKFLOW PREVENTION ASSEMBLIES (BPA's) SHALL CONFORM TO CLTW SPECIFICATIONS. SHUT-OFF VALVES ARE SPECIFIC TO EACH APPROVED BPA AND NO SUBSTITUTIONS OF SHUT-OFF VALVES ARE PERMITTED. REFER TO CLTW APPROVED LIST OF BPA's.

B. PIPE MATERIAL AND FITTINGS SHALL BE AS SPECIFIED IN CLTW STANDARDS & SPECIFICATIONS.

C. INSULATED ENCLOSURE SHALL BE AS SPECIFIED IN CLTW ENCLOSURE INFORMATION AND COMPLY WITH ASSE 1060 ENCLOSURE REQUIREMENTS - HEATED INSULATED ENCLOSURE ARE REQUIRED FOR FIRE LINE SERVICES. NO INSULATION SHALL BE WRAPPED AROUND BPA.

D. ALL LOCATIONS FOR BPA's REQUIRE CLTW APPROVAL AND MUST BE OUTSIDE OF ZONING SET-BACK DIRECTLY BEHIND METER.

E. THERE SHALL BE NO TAPS, PIPING BRANCHES, UNAPPROVED BYPASS PIPING, HYDRANTS, FIRE DEPT. CONNECTION POINTS, OR OTHER WATER - USING APPURTENANCES CONNECTED TO THE SUPPLY LINE BETWEEN ANY WATER METER AND ITS CLTW - REQUIRED BACKFLOW PREVENTER.

F. EACH CLTW-REQUIRED BPA IS REQUIRED TO BE TESTED BY A CLTW - APPROVED CERTIFIED TESTER PRIOR TO PLACING THE WATER SYSTEM IN SERVICE. TEST RESULTS SHALL BE SUBMITTED TO CLTW WITHIN 30 DAYS AND TESTED ANNUALLY THEREAFTER SUBMITTING RESULTS TO CLTW.

G. ALL INSTALLATIONS INTENDED FOR ADDRESSING CLTW REQUIREMENTS, REQUIRE PRIOR APPROVAL FROM THE APPROPRIATE CLTW BACKFLOW INSPECTOR.

H. PAD MUST BE NO LOWER THAN 100-YEAR FLOOD AND HAVE ADEQUATE GRAVITY DRAINAGE. BACKFLOW DEVICE CANNOT BE INSTALLED BELOW GRADE, IN ANY LOCATION SUBJECT TO FLOODING, AND/OR CONSTRUCTED TO SUBMERGE THE RELIEF VALVE OPENING.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

BACKFLOW PREVENTION

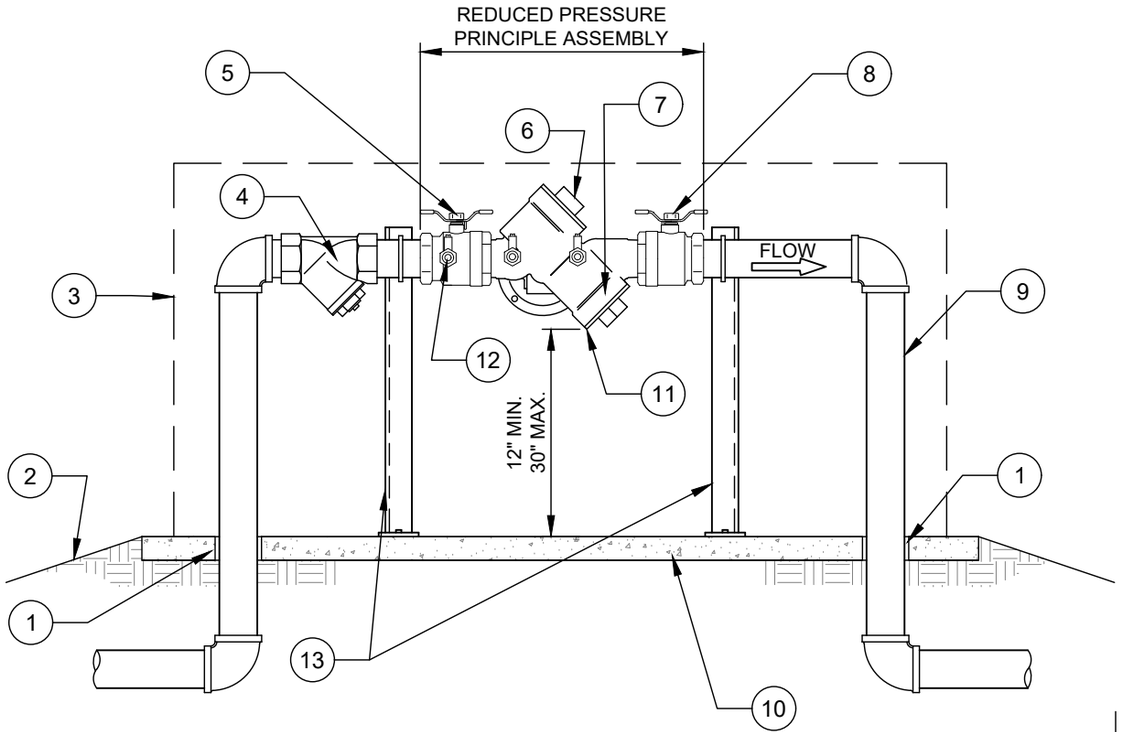
DOUBLE CHECK VALVE ASSEMBLY (DC) 3/4" & 1" ABOVE GROUND

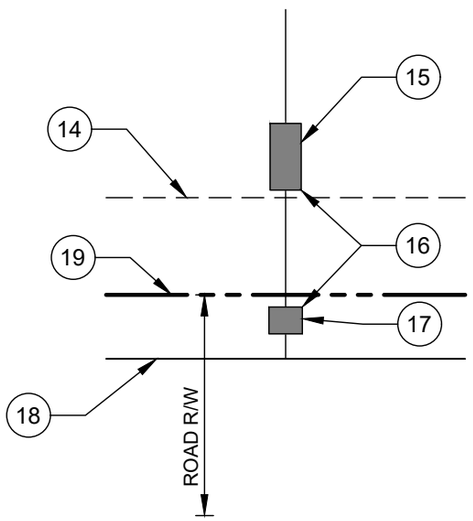
NO SCALE

VERSION 1.0

DATE 04/2024

DETAIL 14.1.8





TYPICAL LOCATION REQUIREMENT
FOR ABOVE GROUND INSTALLATION

N.T.S.

NO.	DESCRIPTION:
1.	SLEEVE REQUIRED (TYP.).
2.	SLOPE GROUND AWAY FROM COVER (TYP.).
3.	HINGED ACCESS OR REMOVABLE INSULATED ENCLOSURE MEETING ASSE 1060 SPECIFICATIONS. ENCLOSURE TO INCLUDE DRAIN PORT(S) PER CLTW REQUIREMENT.
4.	STRAINER RECOMMENDED EXCEPT ON FIRE SERVICE.
5.	SHUT-OFF VALVE #1.
6.	CHECK VALVE #1.
7.	CHECK VALVE #2.
8.	SHUT-OFF VALVE #2.
9.	TYPE K OR L COPPER TUBING PIPE OR GALVANIZED STEEL (MIN. OF 1 INCH DIAMETER AND CONFORMS TO ASTM A53) PIPE FOR MIN. OF 5' ON EACH END OF THE ASSEMBLY. SEE NOTE B.
10.	MIN. 4" THICK CONCRETE PAD REQUIRED. SEE NOTE H.
11.	LOWEST POINT OR RELIEF VALVE OUTLET.
12.	TEST COCK #1.
13.	SUPPORT AS REQUIRED BY DESIGNER.
14.	ZONING SETBACK.
15.	CLTW REQUIRED BPA ABOVE GROUND.
16.	SEE NOTES D AND E.
17.	CLTW METER.
18.	PUBLIC WATER MAIN.
19.	PROPERTY LINE OR R/W.

NOTES:

A. BACKFLOW PREVENTION ASSEMBLIES (BPA's) SHALL CONFORM TO CLTW SPECIFICATIONS. SHUT-OFF VALVES ARE SPECIFIC TO EACH APPROVED BPA AND NO SUBSTITUTIONS OF SHUT-OFF VALVES ARE PERMITTED. REFER TO CLTW APPROVED LIST OF BPA's.

B. PIPE MATERIAL AND FITTINGS SHALL BE AS SPECIFIED IN CLTW STANDARDS & SPECIFICATIONS.

C. INSULATED ENCLOSURE SHALL BE AS SPECIFIED IN CLTW ENCLOSURE INFORMATION AND COMPLY WITH ASSE 1060 ENCLOSURE REQUIREMENTS - HEATED INSULATED ENCLOSURE IS RECOMMENDED. NO INSULATION SHALL BE WRAPPED AROUND BPA.

D. ALL LOCATIONS FOR BPA'S REQUIRE CLTW APPROVAL AND MUST BE OUTSIDE OF ZONING SET-BACK/DIRECTLY BEHIND METER.

E. THERE SHALL BE NO TAPS, PIPING BRANCHES, UNAPPROVED BYPASS PIPING, HYDRANTS, FIRE DEPT. CONNECTION POINTS, OR OTHER WATER - USING APPURTENANCES CONNECTED TO THE SUPPLY LINE BETWEEN ANY WATER METER AND ITS CLTW - REQUIRED BACKFLOW PREVENTER.

F. EACH CLTW-REQUIRED BPA IS REQUIRED TO BE TESTED BY A CLTW - APPROVED CERTIFIED TESTER PRIOR TO PLACING THE WATER SYSTEM IN SERVICE. TEST RESULTS SHALL BE SUBMITTED TO CLTW WITHIN 30 DAYS AND TESTED ANNUALLY THEREAFTER SUBMITTING RESULTS TO CLTW.

G. ALL INSTALLATIONS INTENDED FOR ADDRESSING CLTW REQUIREMENTS, REQUIRE PRIOR APPROVAL FROM THE APPROPRIATE CLTW BACKFLOW INSPECTOR.

H. PAD MUST BE NO LOWER THAN 100-YEAR FLOOD AND HAVE ADEQUATE GRAVITY DRAINAGE. BACKFLOW DEVICE CANNOT BE INSTALLED BELOW GRADE, IN ANY LOCATION SUBJECT TO FLOODING, AND/OR CONSTRUCTED TO SUBMERGE THE RELIEF VALVE OPENING.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
BACKFLOW PREVENTION

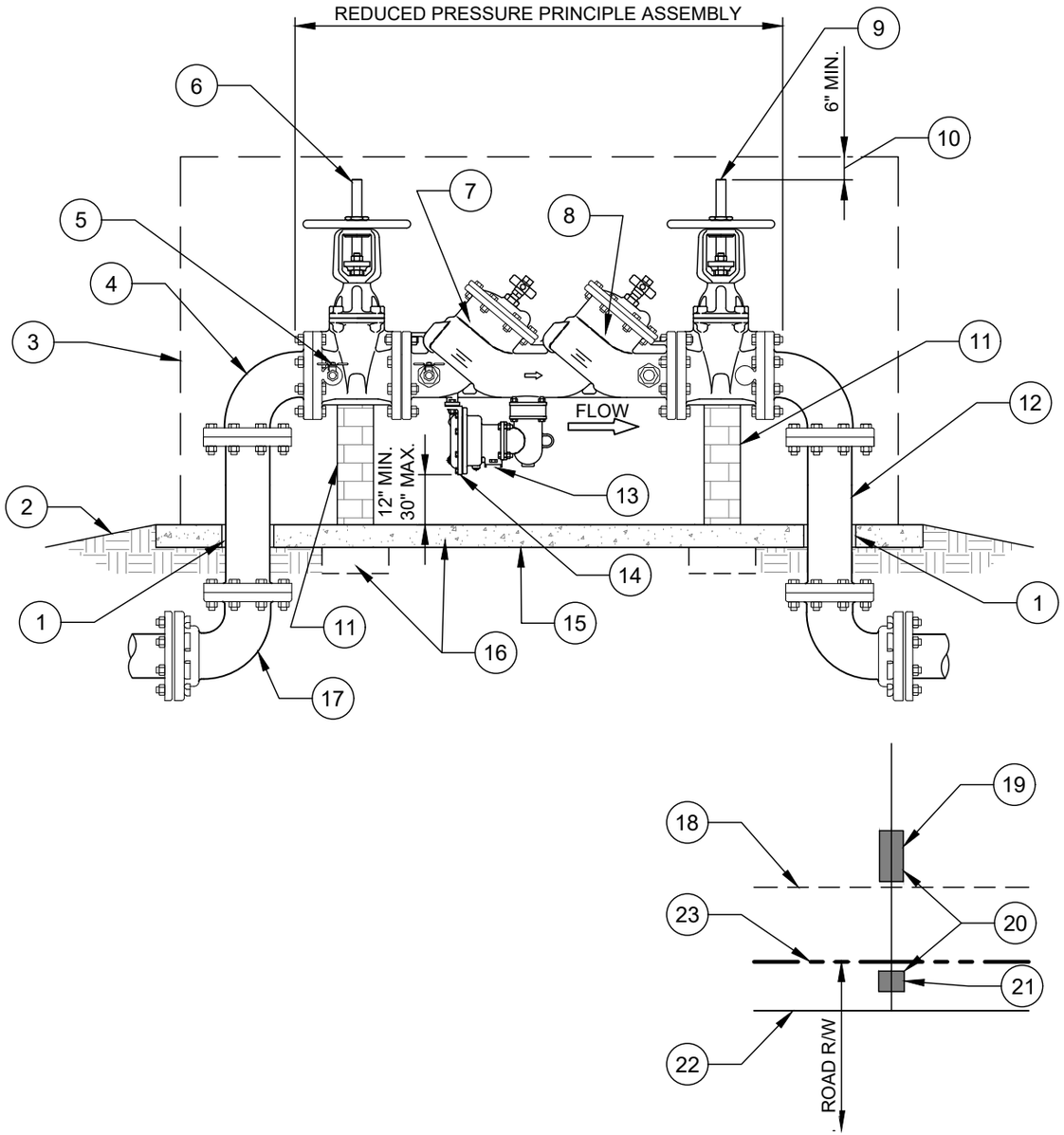
REDUCED PRESSURE PRINCIPLE ASSEMBLY (RP) 1 1/2" & 2" ABOVE GROUND

NO SCALE

VERSION 1.0

DATE 04/2024

DETAIL 14.2.1



TYPICAL LOCATION REQUIREMENT FOR ABOVE GROUND INSTALLATION

N.T.S.

NO.	DESCRIPTION:
1.	SLEEVE REQUIRED (TYP.).
2.	SLOPE GROUND AWAY FROM COVER.
3.	HINGED ACCESS OR REMOVABLE INSULATED ENCLOSURE MEETING ASSE 1060 SPECIFICATIONS. ENCLOSURE TO INCLUDE DRAIN PORT(S) PER CLTW REQUIREMENT.
4.	RESTRAINED JOINT. SEE NOTE C.
5.	TEST COCK #1.
6.	SHUT-OFF VALVE #1. SEE NOTE B.
7.	CHECK VALVE #1.
8.	CHECK VALVE #2.
9.	SHUT-OFF VALVE #2. SEE NOTE B.
10.	COVER MUST NOT OBSTRUCT VALVE BEING FULLY OPENED.
11.	SUPPORTS. SEE NOTE D.
12.	DIP OR TYPE K OR L COPPER TUBING FOR MIN. OF 5' ON EACH END OF ASSEMBLY. SEE NOTE C.
13.	RELIEF VALVE OUTLET.
14.	LOWEST POINT OR RELIEF VALVE OUTLET.
15.	MIN. 4" THICK CONCRETE PAD REQUIRED. SEE NOTE J.
16.	SUPPORT, PAD AND CONCRETE FOOTINGS AS REQUIRED BY SYSTEM DESIGNER.
17.	RESTRAINED JOINT. SEE NOTE C.
18.	ZONING SETBACK.
19.	CLTW REQUIRED BPA ABOVE GROUND.
20.	SEE NOTES F AND G.
21.	CLTW METER.
22.	PUBLIC WATER MAIN.
23.	PROPERTY LINE OR R/W.

NOTES:

A. BACKFLOW PREVENTION ASSEMBLIES (BPA's) SHALL CONFORM TO CLTW SPECIFICATIONS. SHUT-OFF VALVES ARE SPECIFIC TO EACH APPROVED BPA AND NO SUBSTITUTIONS OF SHUT-OFF VALVES ARE PERMITTED. REFER TO CLTW APPROVED LIST OF BPA's.

B. FIRE LINE SERVICES SHALL HAVE OUTSIDE STEM AND YOKE (OS & Y) HANDWHEEL OPERATORS OR BUTTERFLY VALVES, AND LISTED ON APPROVED LIST AS FIRE APPROVED. IF SERVING FIRE SPRINKLERS, TAMPER SWITCHES ARE REQUIRED.

C. PIPE MATERIAL AND FITTINGS SHALL BE AS SPECIFIED IN CLTW STANDARDS & SPECIFICATIONS. ALL JOINTS SHALL BE RESTRAINED WITH MEGALUG RESTRAINTS OR APPROVED EQUAL.

D. SUPPORT OF ASSEMBLY SHALL BE DESIGNED BY OWNER, 8" - 12" SHALL BE SUPPORTED AT EACH VALVE AND SHALL NOT BLOCK RELIEF VALVE ON DRAIN PORT.

E. INSULATED ENCLOSURE SHALL BE AS SPECIFIED IN CLTW ENCLOSURE INFORMATION AND COMPLY WITH ASSE 1060 ENCLOSURE REQUIREMENTS - HEATED INSULATED ENCLOSURE ARE REQUIRED FOR FIRE LINE SERVICES. NO INSULATION SHALL BE WRAPPED AROUND BPA. COVER MUST NOT OBSTRUCT THE VALVE BEING FULLY OPENED.

F. ALL LOCATIONS FOR BPA's REQUIRE CLTW APPROVAL AND MUST BE OUTSIDE OF ZONING SET-BACK DIRECTLY BEHIND METER.

G. THERE SHALL BE NO TAPS, PIPING BRANCHES, UNAPPROVED BYPASS PIPING, HYDRANTS, FIRE DEPT. CONNECTION POINTS, OR OTHER WATER - USING APPURTENANCES CONNECTED TO THE SUPPLY LINE BETWEEN ANY WATER METER AND ITS CLTW - REQUIRED BACKFLOW PREVENTER.

H. EACH CLTW-REQUIRED BPA IS REQUIRED TO BE TESTED BY A CLTW - APPROVED CERTIFIED TESTER PRIOR TO PLACING THE WATER SYSTEM IN SERVICE. TEST RESULTS SHALL BE SUBMITTED TO CLTW WITHIN 30 DAYS AND TESTED ANNUALLY THEREAFTER SUBMITTING RESULTS TO CLTW.

I. ALL INSTALLATIONS INTENDED FOR ADDRESSING CLTW REQUIREMENTS, REQUIRE PRIOR APPROVAL FROM THE APPROPRIATE CLTW BACKFLOW INSPECTOR.

J. PAD MUST BE NO LOWER THAN 100-YEAR FLOOD AND HAVE ADEQUATE GRAVITY DRAINAGE. BACKFLOW DEVICE CANNOT BE INSTALLED BELOW GRADE, IN ANY LOCATION SUBJECT TO FLOODING, AND/OR CONSTRUCTED TO SUBMERGE THE RELIEF VALVE OPENING.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

BACKFLOW PREVENTION

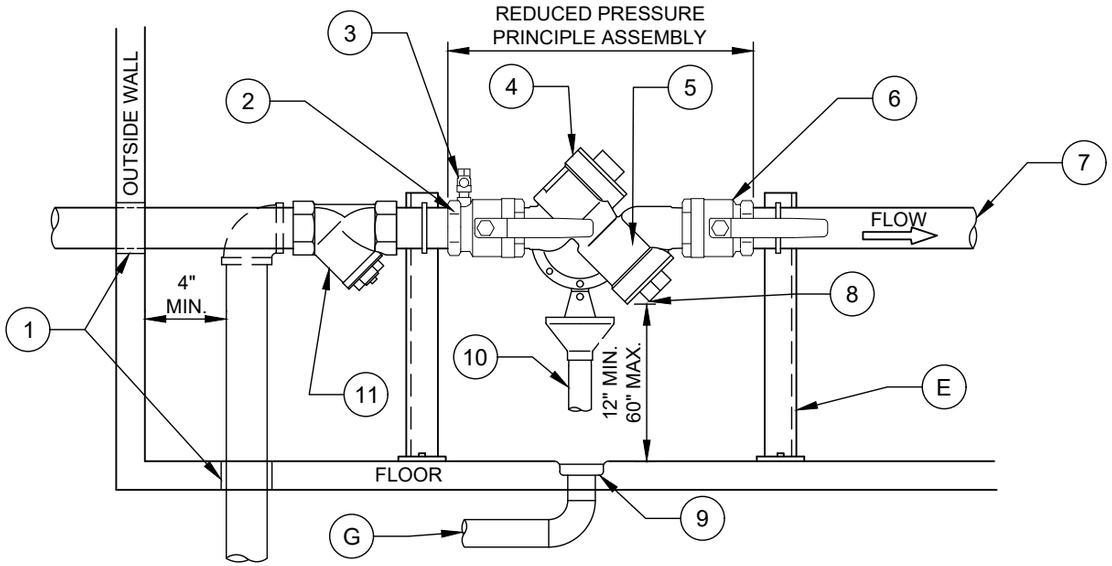
REDUCED PRESSURE PRINCIPLE ASSEMBLY (RP) 2 1/2" - 12" ABOVE GROUND

NO SCALE

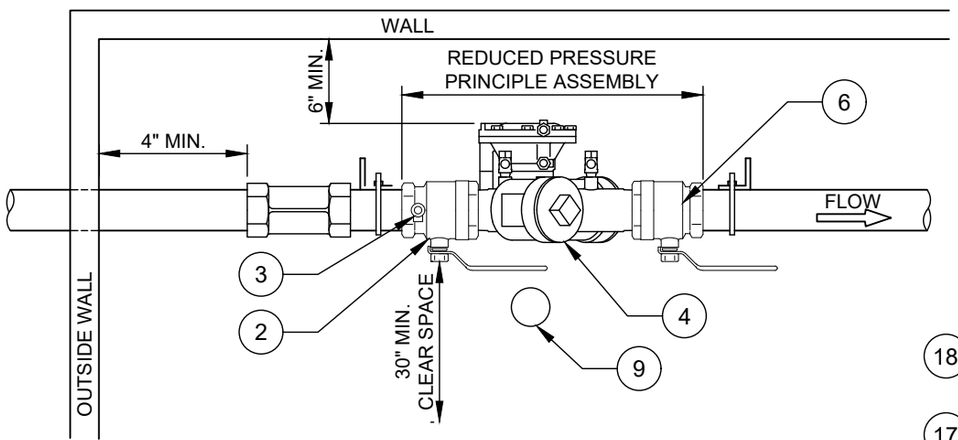
VERSION 1.0

DATE 04/2024

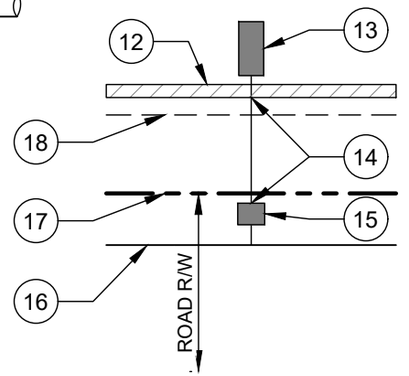
DETAIL 14.2.2



ELEVATION VIEW



PLAN VIEW



TYPICAL LOCATION REQUIREMENT
FOR INSIDE INSTALLATION

N.T.S.

NO. DESCRIPTION:

1. SLEEVE PER NC BLDG. CODE (TYP.).
2. SHUT-OFF VALVE #1.
3. TEST COCK #1.
4. CHECK VALVE #1.
5. CHECK VALVE #2.
6. SHUT-OFF VALVE #2.
7. TYPE K OR L COPPER TUBING OR 1 INCH MIN. GALVANIZED STEEL PIPE (CONFORMS TO ASTM A53) FOR MIN. OF 5' ON EACH END OF THE ASSEMBLY. SEE NOTE D.
8. LOWEST POINT OR RELIEF VALVE OUTLET.
9. DRAIN BY GRAVITY.
10. RELIEF VALVE OUTLET. SEE NOTE F.
11. STRAINER RECOMMENDED EXCEPT ON FIRE SERVICE.
12. EXTERIOR BUILDING WALL.
13. CLTW REQUIRED BPA INSIDE.
14. SEE NOTE H AND I.
15. CLTW METER.
16. PUBLIC WATER MAIN.
17. PROPERTY LINE OR R/W.
18. ZONING SETBACK.

NOTES:

A. INDOOR INSTALLATION SHALL ONLY BE PERMITTED IN CASES WHERE ADEQUATE SPACE FOR THE BACKFLOW PREVENTION ASSEMBLY IS NOT AVAILABLE OUTSIDE. CLTW WILL REVIEW ON A CASE BY CASE BASIS.

B. BACKFLOW PREVENTION ASSEMBLIES (BPA's) SHALL CONFORM TO CLTW SPECIFICATIONS. SHUT-OFF VALVES ARE SPECIFIC TO EACH APPROVED BPA AND NO SUBSTITUTIONS OF SHUT-OFF VALVES ARE PERMITTED. REFER TO CLTW APPROVED LIST OF BPA's.

C. ASSEMBLIES SHALL BE INSTALLED UPRIGHT AND IN THE HORIZONTAL POSITION.

D. PIPE MATERIAL AND FITTINGS SHALL BE AS SPECIFIED IN CLTW STANDARDS & SPECIFICATIONS.

E. SUPPORT FOR ASSEMBLY SHALL BE DESIGNED BY OWNER AS REQUIRED.

F. AN AIR GAP DRAIN IS RECOMMENDED TO REDUCE SPLASHING OF MINOR DISCHARGES FROM THE RELIEF VALVE DRAIN PORT.

G. INDOOR INSTALLATIONS OF RP'S SHOULD PROVIDE FOR DRAINAGE CAPABLE OF HANDLING IN EXCESS OF THE MAXIMUM DISCHARGE RATE EXPECTED BY THE BACKFLOW ASSEMBLY MANUFACTURER. SEALING ENGINEER TO PROVIDE CALCULATIONS THAT DRAINAGE IS SUFFICIENT.

H. ALL LOCATIONS FOR BPA's REQUIRE CLTW APPROVAL.

I. THERE SHALL BE NO TAPS, PIPING BRANCHES, UNAPPROVED BYPASS PIPING, HYDRANTS, FIRE DEPT. CONNECTION POINTS, OR OTHER WATER - USING APPURTENANCES CONNECTED TO THE SUPPLY LINE BETWEEN ANY WATER METER AND ITS CLTW - REQUIRED BACKFLOW PREVENTER.

J. EACH CLTW-REQUIRED BPA IS REQUIRED TO BE TESTED BY A CLTW - APPROVED CERTIFIED TESTER PRIOR TO PLACING THE WATER SYSTEM IN SERVICE. TEST RESULTS SHALL BE SUBMITTED TO CLTW WITHIN 30 DAYS AND TESTED ANNUALLY THEREAFTER SUBMITTING RESULTS TO CLTW.

K. ALL INSTALLATIONS INTENDED FOR ADDRESSING CLTW REQUIREMENTS, REQUIRE PRIOR APPROVAL FROM THE APPROPRIATE CLTW BACKFLOW INSPECTOR.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

BACKFLOW PREVENTION

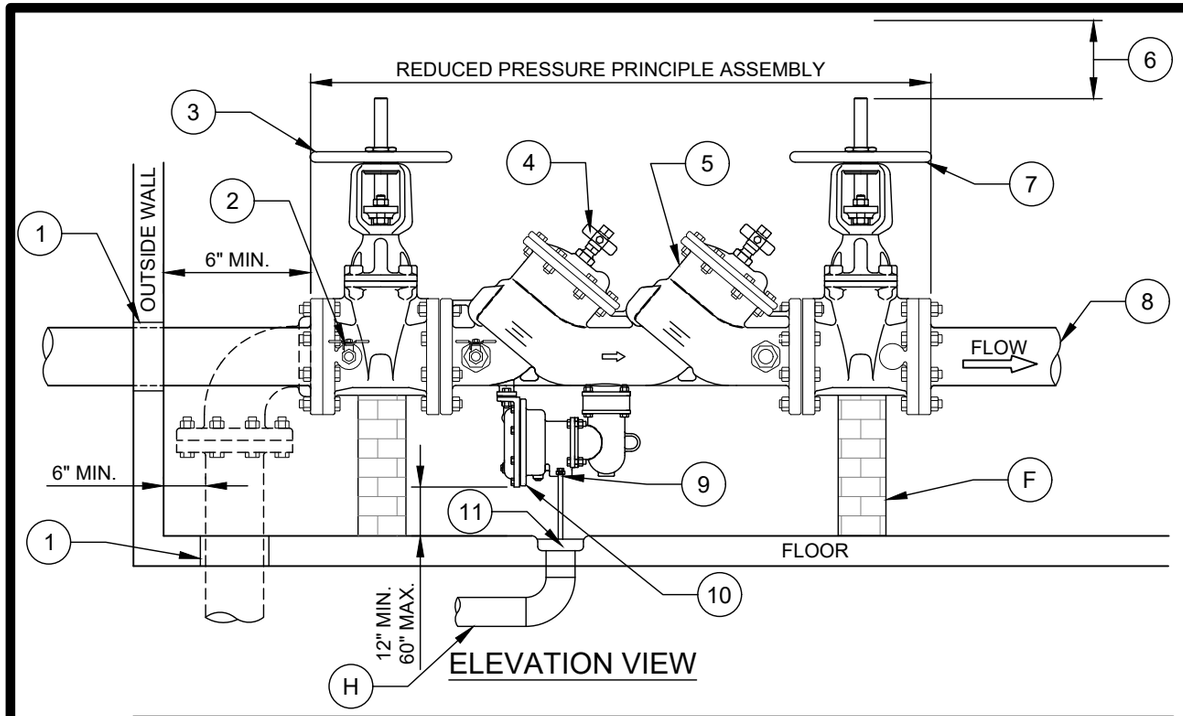
REDUCED PRESSURE PRINCIPLE ASSEMBLY (RP) 3/4" - 2" INDOOR

NO SCALE

VERSION 1.0

DATE 04/2024

DETAIL 14.2.3



TYPICAL LOCATION REQUIREMENT
FOR INSIDE INSTALLATION

N.T.S.

NO.	DESCRIPTION:
1.	SLEEVE PER NC BLDG. CODE (TYP.).
2.	TEST COCK #1.
3.	SHUT-OFF VALVE #1. SEE NOTE C.
4.	CHECK VALVE #1.
5.	CHECK VALVE #2.
6.	6" CLEAR OF OBSTRUCTIONS WHEN VALVE IS FULLY OPEN.
7.	SHUT-OFF VALVE #2. SEE NOTE C.
8.	DIP OR TYPE K OR L COPPER TUBING FOR MIN. OF 5' ON EACH END OF ASSEMBLY. SEE NOTE E.
9.	RELIEF VALVE OUTLET. SEE NOTE G.
10.	LOWEST POINT OR RELIEF VALVE OUTLET.
11.	DRAIN.
12.	EXTERIOR BUILDING WALL.
13.	CLTW REQUIRED BPA INSIDE.
14.	SEE NOTE I AND J.
15.	CLTW METER.
16.	PUBLIC WATER MAIN.
17.	PROPERTY LINE OR R/W.
18.	ZONING SETBACK.

NOTES:

A. INDOOR INSTALLATION SHALL ONLY BE PERMITTED IN CASES WHERE ADEQUATE SPACE FOR THE BACKFLOW PREVENTION ASSEMBLY IS NOT AVAILABLE OUTSIDE. CLTW WILL REVIEW ON A CASE BY CASE BASIS.

B. BACKFLOW PREVENTION ASSEMBLIES (BPA's) SHALL CONFORM TO CLTW SPECIFICATIONS. SHUT-OFF VALVES ARE SPECIFIC TO EACH APPROVED BPA AND NO SUBSTITUTIONS OF SHUT-OFF VALVES ARE PERMITTED. REFER TO CLTW APPROVED LIST OF BPA's.

C. FIRE LINE INSTALLATIONS SHALL HAVE OUTSIDE STEM AND YOKE (OS&Y) HANDWHEEL OPERATORS OR BUTTERFLY VALVES, AND LISTED ON APPROVED LIST AS FIRE APPROVED. IF SERVING FIRE SPRINKLERS, TAMPER SWITCHES ARE REQUIRED.

D. ASSEMBLIES SHALL BE INSTALLED UPRIGHT AND IN THE HORIZONTAL POSITION.

E. PIPE MATERIAL AND FITTINGS SHALL BE AS SPECIFIED IN CLTW STANDARDS & SPECIFICATIONS.

F. SUPPORT FOR ASSEMBLY SHALL BE DESIGNED BY OWNER, 8" - 12" SHALL BE SUPPORTED AT EACH VALVE AND SHALL NOT BLOCK RELIEF VALVE ON DRAIN PORT.

G. AN AIR GAP DRAIN IS RECOMMENDED TO REDUCE SPLASHING OF MINOR DISCHARGES FROM THE RELIEF VALVE DRAIN PORT.

H. INDOOR INSTALLATIONS OF RP'S SHOULD PROVIDE FOR DRAINAGE CAPABLE OF HANDLING IN EXCESS OF THE MAXIMUM DISCHARGE RATE EXPECTED BY THE BACKFLOW ASSEMBLY MANUFACTURER. SEALING ENGINEER TO PROVIDE CALCULATIONS THAT DRAINAGE IS SUFFICIENT.

I. ALL LOCATIONS FOR BPA's REQUIRE CLTW APPROVAL.

J. THERE SHALL BE NO TAPS, PIPING BRANCHES, UNAPPROVED BYPASS PIPING, HYDRANTS, FIRE DEPT. CONNECTION POINTS, OR OTHER WATER - USING APPURTENANCES CONNECTED TO THE SUPPLY LINE BETWEEN ANY WATER METER AND ITS CLTW - REQUIRED BACKFLOW PREVENTER.

K. EACH CLTW-REQUIRED BPA IS REQUIRED TO BE TESTED BY A CLTW - APPROVED CERTIFIED TESTER PRIOR TO PLACING THE WATER SYSTEM IN SERVICE. TEST RESULTS SHALL BE SUBMITTED TO CLTW WITHIN 30 DAYS AND TESTED ANNUALLY THEREAFTER SUBMITTING RESULTS TO CLTW.

L. ALL INSTALLATIONS INTENDED FOR ADDRESSING CLTW REQUIREMENTS, REQUIRE PRIOR APPROVAL FROM THE APPROPRIATE CLTW BACKFLOW INSPECTOR.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

BACKFLOW PREVENTION

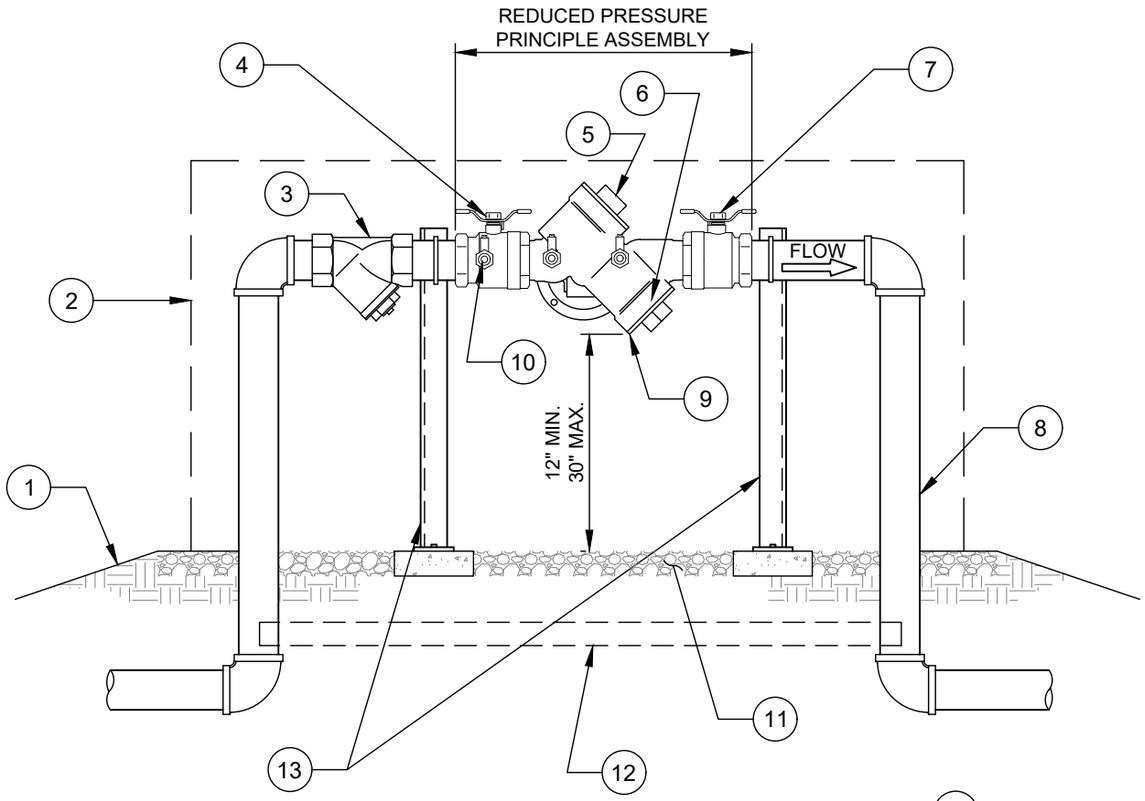
REDUCED PRESSURE PRINCIPLE ASSEMBLY (RP) 2 1/2" - 12" INDOOR

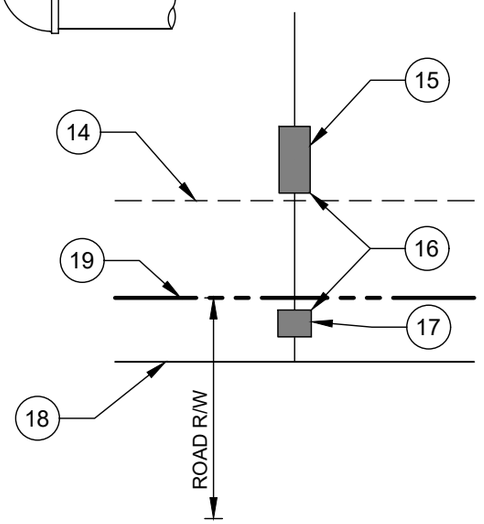
NO SCALE

VERSION 1.0

DATE 04/2024

DETAIL 14.2.4





TYPICAL LOCATION REQUIREMENT
FOR ABOVE GROUND INSTALLATION

N.T.S.

NO.	DESCRIPTION:
1.	SLOPE GROUND AWAY FROM COVER (TYP.).
2.	HINGED ACCESS OR REMOVABLE INSULATED ENCLOSURE MEETING ASSE 1060 SPECIFICATIONS. ENCLOSURE TO INCLUDE DRAIN PORT(S) PER CLTW REQUIREMENTS.
3.	STRAINER RECOMMENDED EXCEPT ON FIRE SERVICE.
4.	SHUT-OFF VALVE #1.
5.	CHECK VALVE #1.
6.	CHECK VALVE #2.
7.	SHUT-OFF VALVE #2.
8.	TYPE K OR L COPPER TUBING PIPE, 1 INCH MIN. GALVANIZED STEEL PIPE (CONFORMS TO ASTM A53) OR SCH. 80 PVC PIPE WITH SCH. 80 PVC FITTINGS. SEE NOTE B.
9.	LOWEST POINT OR RELIEF VALVE OUTLET.
10.	TEST COCK #1.
11.	MIN. 4" THICK #57 WASHED STONE OR CONCRETE PAD. SEE NOTE H.
12.	IF USING PVC PIPE, HORIZONTAL BRACING IS RECOMMENDED.
13.	IF USING PVC PIPE - VERTICAL BRACING IS REQUIRED.
14.	ZONING SETBACK.
15.	CLTW REQUIRED BPA ABOVE GROUND.
16.	SEE NOTES D AND E.
17.	CLTW METER.
18.	PUBLIC WATER MAIN.
19.	PROPERTY LINE OR R/W.

NOTES:

A. BACKFLOW PREVENTION ASSEMBLIES (BPA's) SHALL CONFORM TO CLTW SPECIFICATIONS. SHUT-OFF VALVES ARE SPECIFIC TO EACH APPROVED BPA AND NO SUBSTITUTIONS OF SHUT-OFF VALVES ARE PERMITTED. REFER TO CLTW APPROVED LIST OF BPA's.

B. PIPE MATERIAL AND FITTINGS SHALL BE AS SPECIFIED IN CLTW STANDARDS & SPECIFICATIONS. IF USING PVC PIPE / FITTINGS, VERTICAL SUPPORT IS REQUIRED AND HORIZONTAL BRACING IS RECOMMENDED.

C. INSULATED ENCLOSURE SHALL BE AS SPECIFIED IN CLTW ENCLOSURE INFORMATION AND COMPLY WITH ASSE 1060 ENCLOSURE REQUIREMENTS - HEATED INSULATED ENCLOSURE IS RECOMMENDED. NO INSULATION SHALL BE WRAPPED AROUND BPA.

D. ALL LOCATIONS FOR BPA's REQUIRE CLTW APPROVAL AND MUST BE OUTSIDE OF ZONING SET-BACK DIRECTLY BEHIND METER.

E. THERE SHALL BE NO TAPS, PIPING BRANCHES, UNAPPROVED BYPASS PIPING, HYDRANTS, FIRE DEPT. CONNECTION POINTS, OR OTHER WATER - USING APPURTENANCES CONNECTED TO THE SUPPLY LINE BETWEEN ANY WATER METER AND ITS CLTW - REQUIRED BACKFLOW PREVENTER.

F. EACH CLTW-REQUIRED BPA IS REQUIRED TO BE TESTED BY A CLTW - APPROVED CERTIFIED TESTER PRIOR TO PLACING THE WATER SYSTEM IN SERVICE. TEST RESULTS SHALL BE SUBMITTED TO CLTW WITHIN 30 DAYS AND TESTED ANNUALLY THEREAFTER SUBMITTING RESULTS TO CLTW.

G. ALL INSTALLATIONS INTENDED FOR ADDRESSING CLTW REQUIREMENTS, REQUIRE PRIOR APPROVAL FROM THE APPROPRIATE CLTW BACKFLOW INSPECTOR.

H. PAD MUST BE NO LOWER THAN 100-YEAR FLOOD AND HAVE ADEQUATE GRAVITY DRAINAGE. BACKFLOW DEVICE CANNOT BE INSTALLED BELOW GRADE, IN ANY LOCATION SUBJECT TO FLOODING, AND/OR CONSTRUCTED TO SUBMERGE THE RELIEF VALVE OPENING.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

BACKFLOW PREVENTION

REDUCED PRESSURE PRINCIPLE ASSEMBLY (RP) 3/4" -1" ABOVE GROUND

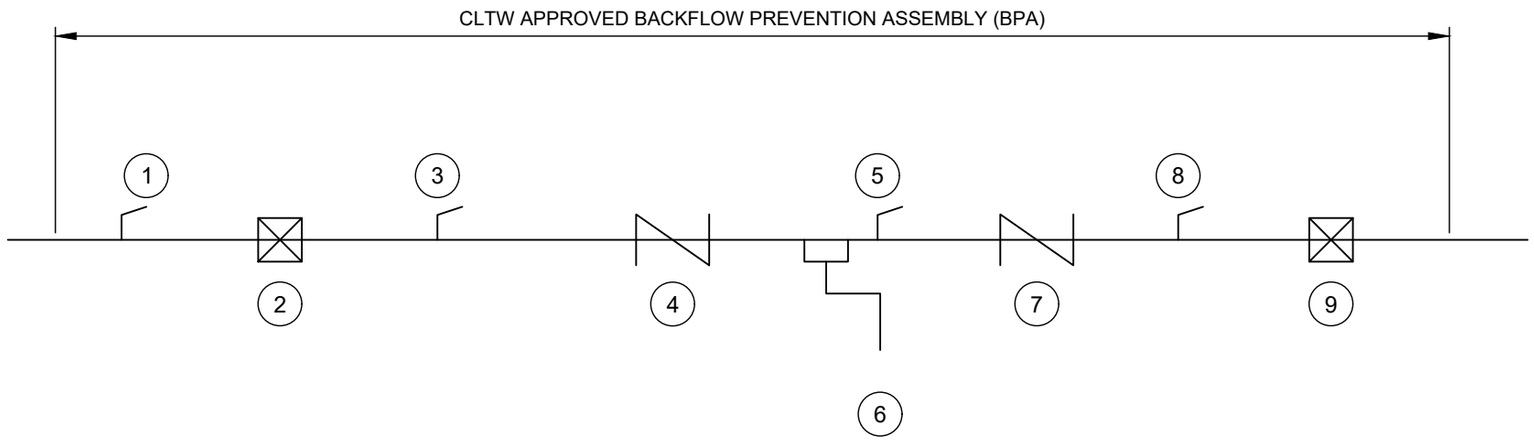
NO SCALE

VERSION 1.0

DATE 04/2024

DETAIL 14.2.5

NO.	DESCRIPTION:
1.	TEST COCK #1.
2.	#1 SHUT-OFF VALVE.
3.	TEST COCK #2.
4.	CHECK VALVE #1.
5.	TEST COCK #3.
6.	IF APPLICABLE, REDUCE PRESSURE RELIEF VALVE AND OUTLET.
7.	CHECK VALVE #2.
8.	TEST COCK #4.
9.	#2 SHUT-OFF VALVE.



CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

BACKFLOW PREVENTION

TEST COCK LOCATION

NO SCALE

VERSION
1.0

DATE
04/2024

DETAIL
14.3.1

CHAPTER 15
WATER METERS

CHAPTER 15
WATER METER DESIGN

1. GENERAL

A. This chapter covers the minimum design criteria to be used for designing water meters for connections to the Public Water System as operated by Charlotte Water. All other systems are the responsibility of the respective property owner unless otherwise documented via agreement with Charlotte Water.

B. All engineering plans for water pipelines must meet the Charlotte Water design standards as presented in Chapter 10 and the State standards as indicated in the most recent amended *North Carolina Administrative Code, Title 15A, Subchapter 18C, Section .0900 Distribution Systems* administered by the North Carolina Department of Environmental Quality (NCDEQ). In general, the Charlotte Water standards should be the primary source for design guidance with the State standards as a supplement. In some cases, the Charlotte Water standard is more stringent than the State standard.

C. All calculations must be submitted and sealed by a North Carolina professional engineer.

2. HYDRAULIC DESIGN

A. Demands

1) Residential development, both single family and multi-family, domestic water demands shall be calculated using the International Association of Plumbing and Mechanical Officials (IAPMO) Water Demand Calculator found on IAPMO's website and approved for public use.

2) Commercial development domestic water demands shall be calculated using methodology in AWWA M22 - Sizing Water Service Lines and Meters, latest edition.

B. Sizing

1) Use Charlotte Water's *Domestic Meter Assembly Selection Guidelines* for meter selection to achieve calculated domestic demand flow. The latest edition of the guideline is provided in Appendix A and found on Charlotte Water's website, www.charlottenc.gov/water under: Development Projects/Donated Projects/Design Phase Resources/Domestic Meter Selection Guidelines.

2) The minimum service size shall be a 3/4-inch service line with a 5/8-inch meter. With Charlotte Water approval, one service line may serve up to 2 common-ownership units on a single parcel (i.e. duplex or auxiliary building).

3) A 1-inch (minimum) meter is required for service to 3 to 5 multi-family units from a single meter on a single parcel (i.e. triplex or quadplex).

4) A 1.5-inch (minimum) meter is required for service for 6 or more multi-family units from a single meter.

C. Velocities

1) The maximum rated velocity allowed within services and meters is 10 feet per second.

D. Split Services

1) Split services are allowed from combination fire/domestic service lines and dedicated fire lines (with a maximum of 3 total off any one service line).

2) Split services are not allowed from dedicated domestic service lines 1-inch and larger.

3) Split services are not allowed on 1-inch and larger short side services. Short side services 1-inch and larger shall connect directly to the public water main.

3. LOCATION AND DEPTH

A. Water meters and services shall be located at clearances and depths shown in the Standard Water Meter Details.

B. Charlotte Water must approve any meters to be located in sidewalks.

C. Meters shall NOT be installed in ADA ramps nor impede ADA access requirements.

4. ABANDONMENT AND DISMANTLEMENT

A. All water mains and appurtenances, including water meters, to be abandoned per Chapter 10.

B. In general, when a water service dismantlement is requested, the water service and meter shall be dismantled to the corporation stop at the water main, close the corporation stop and install a brass plug or cap.

END OF SECTION

CHAPTER 15
WATER METERS

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GENERAL

1.1 SUMMARY

A. Section Includes:

1. Water Services
2. Endpoint / Meter Communication Device
3. Displacement Meters
4. Compound Meters
5. Combined Fire and Domestic Meters (FMCT)
6. Time Transit Ultrasonic Meters
7. Turbine Meters
8. Separate Irrigation Meters
9. Meter Boxes and Lids
10. Meter Vault Access Doors
11. Brickwork for Vaults

B. Utility furnished products include water meters that will be furnished to the site, ready for installation.

1.2 RELATED DOCUMENTS

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

1.3 DEFINITIONS AND ABBREVIATIONS

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

1.4 SUBMITTALS

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

1. Product brochures
2. Catalog cut sheets
3. Shop drawings including dimensions and part/material lists
4. Certification of compliance with applicable reference standards

B. Shop Drawings:

1. Details of standard pipe, joints, specials, and fittings.

C. Product Certificates:

1. Required for all products furnished.
2. Comply with NSF 61 Annex G for materials for water service piping and specialties for domestic water.

1.5 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall be responsible for the safe storage of materials furnished by or to them, and accepted by them and intended for the work, until they have been incorporated in the completed project. Handling and storage of all project materials are to be in compliance with the manufacturer's recommendations for handling and storage. The interior of all pipe, fittings and other accessories shall be kept free from dirt and foreign materials at all times.

B. Transportation of Materials and Equipment: The Contractor and their Suppliers are directed to contact the North Carolina Department of Transportation to verify axle load limits on State maintained roads (and bridges) which would be used for hauling of equipment and materials for this project. The Contractor and their Suppliers shall do all that is necessary to satisfy the Department of Transportation requirements and will be responsible for any damage to said roads which may be attributed to this project. Unless otherwise specified, all materials required to construct this project shall be furnished by the Contractor and shall be delivered and distributed at the site by the Contractor or their material supplier.

1.6 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. All water meters installed under this contract must conform to the most recent American Water Works Association standards as specified herein.

B. The manufacturer's serial number must be clearly imprinted on the outer case of the meter and on the register lid. The serial number must be a minimum of eight digits in length, with the two leftmost digits representing the year of manufacture. For example, 25123456.

C. Registers for the various types and sizes of meters specified in this contract must all be magnetic drive, straight reading, recording in cubic feet. Registers must be dehumidified, airtight, and permanently hermetically sealed. All register numerals must read zero. Each digit on the rightmost movable dial must represent no more than one hundred cubic feet. Thousand cubic foot registers are not acceptable. The month & year of manufacture, meter size, and meter model must be imprinted on the register face. All 5/8" and 1" meter registers must include a low flow (leak) detector. Leak detectors on 1 ½" thru 4" meters are preferred. In place of a leak detector, the register can display flowrate.

D. The manufacturer must furnish with each meter a certificate of accuracy which references the particular meter serial number. The certificate of accuracy must be furnished to the Engineer before the meter is activated. The certificate must reference the job name or number. The number can be added by the supplier or Contractor.

E. The manufacturer shall guarantee that all meters furnished under this specification will meet the required new meter accuracy standards in accordance with AWWA standards.

2.2 NO LEAD PIPE MATERIALS

A. All water meter assemblies shall conform to the requirements of Safe Drinking Water Act and the Reduction in Lead in Drinking Water Act – USA Public Law 111-380.

B. No Lead Compliance: All meter assemblies/brass components of proposed water services shall comply with the requirements of USA Public Law 111-380. All meter assemblies/brass components used in the Charlotte Water potable water system shall conform to the requirements of the Safe Drinking Water Act and the Reduction in Lead in Drinking Water Act – USA Public Law 111-380. Lead Free Brass components in contact with potable water shall be of Lead-Free Alloy (UNS/CDA No C89833 or C89520). Components that do not come in contact with potable water may be UNS/CDA No C83600 - 85-5-5-5 or Lead-Free Alloy (UNS/CDA No C89833 or C89520) and shall conform to AWWA Standard C800 (ASTM B-62 and ASTM B-584).

1. Ford Meter Box Company No-Lead products shall be identified by “NL” cast on the major body component.
2. A. Y. McDonald Company and Cambridge No-Lead products shall be identified by “NL” cast on the major body component.
3. Mueller Water Products No-Lead products shall be identified by “EB II” (Alloy C89520), or “FD” (Alloy 89833) cast on the major body component.
4. All brass components and fittings shall be stamped or embossed with a mark indicating that the product is manufactured from a lead-free alloy indicated above.

2.3 WATER SERVICES

A. 3/4 – 1-Inch Water Services

1. Meter Yoke Assembly: Meter yokes shall be the angle ball stop type, with compression connections for water service tubing. Yokes shall be equipped with brass angle ball stop valves and coupling on both sides of yoke bar. The angle ball stop valves for 5/8" meters (3/4" services) shall be 5/8"x3/4" (5/8” diameter ball valve port, with 5/8” meter connection and 3/4” copper tubing connection). The angle ball valves shall have lock wings that allow the valve to be locked in the closed position. On manifold assembles, the customer side valve will be a straight ball valve (yoke star nut x 3/4” FNPT). On irrigation services, the customer side angle valve is replaced with a 90 bend yoke connector (yoke star nut x FNPT). The yoke bar shall be of Cast or Ductile Iron. Horizontal type meter yokes may be used for special situations, as approved by the Engineer. Meter yoke assemblies shall be provided for all 5/8" and 1" meters and on fire line detection meters up to 1-inch. Expansion wheel connection between meter and yoke shall be 3-piece units by Ford, AY McDonald, or Mueller.
2. The following meter yoke bars are approved:

Meter Yoke Assemblies		
Manufacturer	**5/8" Meter**	**1" Meter**
Ford	Y501	Y504
AY McDonald	14-1	14-4
Cambridge	460-1	460-4
Mueller	H-5010	H-5040
Jones Water Products	J-5010	J-5040

3. The following angle ball valves are approved:

Ball Angle Valves		
Manufacturer	**5/8" Meter**	**1" Meter**
Ford	BA94-313WGNL	BA94-444WGNL
AY McDonald	74642BYT 3/4x5/8x01	74602BYT 1x1x04
Cambridge	210NL-GJ3SR1	210NL-GJ4SR4
Mueller	G24273 N	G24273 N

4. The following straight ball valves are approved for use in manifold assemblies:

Manufacturer	5/8" Meter
Ford	B91-313W-NL
AY McDonald	76101WY
Cambridge	212NL-F3SR1
Mueller	B24360RN

B. 1 1/2-Inch and Larger Water Services

1. All meters 1-1/2-inch and larger shall be installed in precast concrete vaults conforming to the Standard Details. Vaults shall be approved by and for use within North Carolina Department of Transportation (NCDOT) right-of-way and shall be designed for H-20 loading. Vaults may be adjusted as shown on the Standard Details using standard/jumbo size concrete brick conforming to NCDOT specifications, or precast concrete curbing sections. Vaults shall have single or double leaf steel covers conforming to the Standard Details. Service numbers supplied by Charlotte Water shall be bead welded on the cover. All meters shall conform to American Water Works Association (AWWA) standards as specified below. The manufacturers meter serial number shall be imprinted on the outer case of the meter and on the register lid.

C. Brass Meter Setter Assembly – No solder Joints Permitted – Sizes 1-1/2” and 2”

The following manufacturers and models are currently approved:

Manufacturer	1-1/2”" Model	2" Model
Ford	VB76-95311-005-NL	VB77-95311-002-NL
Mueller	098B 242343N	106B 2423----43N
Cambridge	6020-NL-618F6F6-UUBS	6020-NL-718F7F7-UUBS
McDonald	720B618WTFF 665.3x416	720B718WTFF 775.3x416

D. Pipe and Tubing

1. All services shall be constructed using a single continuous pipe or tubing from the corporation to the meter assembly. Couplings shall not be permitted.

2. Copper tubing shall be installed in a single segment between the corporation stop on the water main pipe and the water meter. No fittings shall be used on the tubing. Couplings may not be installed between the corporation stop and the meter box.

3. PE tubing shall be installed in a single segment between the corporation stop on the water main pipe and the water meter. No fittings shall be used on the tubing.

4. High Density Polyethylene (HDPE) pipe and tubing shall be required on long services where copper is not available in sufficient lengths to complete the service between the corporation and the meter assembly without a splice coupling. HDPE pipe shall be 200 PSI pressure class, OD based Iron Pipe Size (IPS) pipe and must meet the dimension ratio (DR) specified.

   a. 3/4-inch and 1-inch HDPE tubing shall be blue SDR 9 (CTS). Stainless steel inserts shall be used with compression fittings. Inserts shall be as required by the HDPE manufacturer and the brass fitting manufacturer. Compression couplings or mechanical couplings of any type are prohibited.

   b. 1.5-inch and 2-inch diameter pipe shall be blue/black HDPE DR 9 pipe (IPS). The HDPE pipe shall be provided with stainless steel threaded end adaptors, as specified, to connect to the brass corporation stop and meter assembly. Adaptors shall be connected to the HDPE pipe by butt fusion splice or electrofusion couplings. The electrofusion controller shall be computer controlled. Compression couplings or mechanical couplings of any type are prohibited. Should bends be required, HDPE butt fused, or electro-fusion bends will be required.

   c. 3-inch through 12-inch diameter pipe shall be HDPE DR 11 pipe (IPS). The HDPE pipe shall be provided with HDPE MJ adaptors, as specified, to connect to the tapping sleeve and valve and meter assembly. Adaptors shall be connected to the HDPE pipe by butt fusion splice or electrofusion couplings. The electrofusion controller shall be computer controlled. Compression couplings or mechanical couplings of any type are prohibited. Should bends be required, HDPE butt fused, or electro-fusion bends will be required.

5. See Chapter 10, Water Distribution Piping Specifications, of the Charlotte Water Water and Sewer Design and Construction Standards for all additional requirements.

2.4 ENDPOINT / METER COMMUNICATION DEVICES

A. Charlotte Water requires that readings on all new meters in sizes 5/8” through 12” be obtained quickly and accurately without opening meter vault lids or entering the vaults. All new meters in these sizes must include the meter equipped with submersible Absolute Encoded registers, End cap Badger twist tight connector completely assembled and programmed at the factory and shipped as a complete unit (Absolute Encoded - Electronic register that reads the exact position of the hands at the moment of interrogation). 5/8 and 1-inch meters shall come with 3 feet of wire. All meters 1.5-inch and larger shall come with 25 feet of wire.

B. In the interest of standardization, meters will have an Absolute Encoded register that is interfaceable with the Badger Orion Cellular endpoint and applicable installation appurtenances to properly mount the endpoint. The following meter companies will be used: Badger, Master Meter and Neptune. Charlotte Water will provide and install the endpoints for all meters.

C. All meters must be sealed so that removal of the register impacts the seal. Tamperproof seal screws or pins are preferred. Screws that are not tamperproof must have the head drilled two ways, sealed with a copper wire and non-lead seal before delivery.

D. The Manufacturer must guarantee that all meters furnished under this specification will meet the required AWWA new meter accuracy standards for a period of at least one year from the date first placed in service and repaired meter accuracy standards for at least 14 additional years. Certified wet bench test results must be furnished for each meter.

E. The Manufacturer must guarantee that all ultrasonic meters furnished under this specification will meet the required AWWA new meter accuracy standards for a period of at least 10 years from the date first placed in service. Certified wet bench test results must be furnished for each meter.

F. The warranty period for Absolute Encoded register, wiring, and End cap must be at least 15 years.

G. The metering technology that may be used for various sizes are as follows:

1.	5/8”, 1”, 1.5”, 2”	Displacement
2.	3”, 4”, 6”	Compound
3.	1.5” – 12”	Ultrasonic
4.	4”, 6”, 8”, 10”, 12”	Fire and Domestic

H. All fogged registers must be replaced at no cost to Charlotte Water for the full warranty period. Charlotte Water will not accept any meter, piping, valves, parts, or any other component, which allows water to come into contact with lead or allows lead to leak into the water over any period of time.

2.5 DISPLACEMENT METERS

A. Sizes 5/8” and 1”:

1. Meters in these sizes must be positive displacement type conforming to AWWA C700, latest revision.
2. All meters must be furnished without end connections.
3. Meters shall use a nutating disc for flow measurement.

4. Main casings and bottom plates shall be of a copper alloy containing not less than 75% copper.

5. Measuring chambers shall be of a copper alloy containing not less than 85% copper or a suitable synthetic polymer.

6. All meters are to have internal strainers.

7. All meters must have submersible Absolute Encoded register with neutral trial gear combinations. The Contractor must furnish Charlotte Water a certificate from the manufacturer which unconditionally guarantees the registers for a minimum period of 15 years against defects in material or workmanship. All registers must have low flow (leak) detector.

8. Currently, only the following models shall be provided:

    a. Badger Meter Recordall® Model 25 (5/8”), Model 70 (1”)

    b. Neptune Technology Group Model T-10® (5/8” and 1”)

B. Sizes 1 1/2" and 2":

1. Meters in these sizes must be positive displacement type conforming to AWWA C700, latest revision.

2. All meters in these sizes shall be furnished with a 2-bolt flange and must be of standard laying length.

3. Meters shall use a nutating disc for flow measurement.

4. Main casings and bottom plates shall be of a copper alloy containing not less than 75% copper, or of lead-free bronze alloy.

5. Measuring chambers shall be of a copper alloy containing not less than 85% copper, or of lead-free bronze alloy.

6. All meters are to have strainers.

7. All meters must have submersible Absolute Encoded register with neutral trial gear combinations. The Contractor must furnish Charlotte Water a certificate from the manufacturer which unconditionally guarantees the registers for a minimum period of 15 years against defects in material or workmanship.

8. All meters must have bolted top or bottom plates.

9. Only the following models are acceptable:

    a. Badger Meter Recordall® Model 120 (1 ½”), Model 170 (2”)

    b. Neptune Technology Group Model T-10® (1 ½” and 2”)

2.6 COMPOUND METERS

A. Sizes 3”, 4”, and 6”:

1. Meters in these sizes shall be single body compound type conforming to AWWA C702, latest revision.

2. Main casings shall be of a copper alloy containing not less than 75% copper, or lead-free bronze alloy.

3. Measuring cages or chambers shall be made of a copper alloy containing not less than 85% copper or lead-free bronze-alloy.

4. Meters are to have strainers.

5. All 3”, 4”and 6” meters shall be furnished with flanged ends. Laying length shall be as follows for Badger Meter and Neptune Technology Group meters (meter size = laying length):

   a. 3’’ = 17’’

   b. 4’’ = 20’’

   c. 6” = 24”

6. Meters in 3”, 4” and 6” sizes shall test 100% ± 1.5% at the following flows in gallons per minute (GPM):

   a. Badger Meter:

      1) 3” = 0.50 to 450 GPM

      2) 4” = 0.75 to 1000 GPM

      3) 6” = 0.75 to 2000 GPM

   b. Neptune Technology Group:

      1) 3” = 0.50 to 450 GPM

      2) 4” = 1.00 to 1000 GPM

      3) 6” = 1.50 to 2000 GPM

7. Only compound meters manufactured by Badger Meter and Neptune Technology Group are acceptable.

8. All meters must have submersible Absolute Encoded register with neutral trial gear combinations. The Contractor must furnish Charlotte Water a certificate, which unconditionally guarantees the registers for a minimum of 15 years against defects in material or workmanship.

9. Placement of the bypass piping must be quickly and easily changeable by Charlotte Water employees when needed at the time of meter installation.

10. Only the following models are acceptable:

    a. Badger Meter Recordall® Compound Series (3”, 4”, 6”)

    b. Neptune Technology Group, TRU/FLO® Compound Meter (3”, 4”, 6”)

2.7 COMBINED FIRE AND DOMESTIC SERVICE METERS (FMCT)

A. Sizes 4”, 6”, 8”, 10", and 12":

1. Meters shall comply with AWWA C703, latest revision.

2. Meters must be approved for fireline service by Underwriters Laboratories or National Fire Protection Association.

3. Meters are to have stop and check valves on the by-pass meter.

4. Measuring cages, chambers, or turbines shall be made of a copper alloy containing not less than 85% copper, or lead-free bronze alloy or stainless steel.

5. Main casing for by-pass meters shall be of a copper alloy containing not less than 75% copper, or lead-free bronze alloy.

6. Casing for main line meters shall be of either copper alloy containing not less than 75% copper, cast iron protected by a corrosion-resistant coating or other anti-corrosion treatment, or epoxy coated steel or stainless steel.

7. Small bypass meters shall be positive displacement meters as specified.

8. Laying length of meters shall be as follows (meter size = laying length):

   a. 4" = 33"

   b. 6" = 45"

   c. 8" = 53"

   d. 10" = 68"

   e. 12" = 68"

9. Meters are to have strainers.

10. All meters must have submersible automated registers with neutral trial gear combinations. The Contractor must furnish Charlotte Water with a certificate from the manufacturer which unconditionally guarantees the registers for a minimum period of 15 years against defects in material or workmanship.

11. Six-inch meters must have a bypass meter no larger than 2".

12. Only the following models will be acceptable:

    a. Badger Meter Recordall® Fire Series Assemblies (FSAA):

       1) 4" – 10": With Disc Bypass Meter

       2) 12": With Turbo Bypass Meter

    b. Neptune Technology Group High Performance (HP) PROTECTUS® III Stainless Steel (S) Fire Service Meter (4", 6", 8", 10")

2.8 TIME TRANSIT ULTRASONIC METERS

A. Meters shall comply with AWWA C-750.

B. Companion flanges, gaskets, bolts, and nuts shall not be provided.

C. Casing shall be of stainless steel or copper alloy containing not less than 75% copper or galvanized zinc treated cast iron.

D. The Contractor must furnish Charlotte Water with a certificate from the manufacturer which guarantees a minimum warranty period of 10 years against defects in material or workmanship. The warranty must also provide full replacement within a 10-year period.

E. Only the following makes and models are acceptable:

1. Badger Meter:

   a. 5/8" – 8": E-Series®

2. Master Meter:

   a. 1.5" – 12": Octave®

3. Neptune Technology Group:

a. 1.5” – 12”: Mach 10®

2.9 TURBINE WATER METERS: 3-INCH AND 4-INCH (ONLY WHEN SPECIFIED)

A. Meters shall conform to AWWA C701, latest revision.

B. Meters shall only be used when approved by Charlotte Water on a project-specific basis.

C. Main casings shall be of a copper alloy containing not less than 75% copper.

D. Measuring cages or chambers shall be made of a copper alloy containing not less than 85% copper or a suitable synthetic polymer.

E. Meters are to have strainers.

F. Meters in 3” and 4” sizes shall test 100% ± 1.5% at the following flows in gallons per minute (GPM):

1. 3” = 3 to 350 GPM

2. 4” = 4 to 650 GPM

G. All meters must have submersible Absolute Encoded register with neutral trial gear combinations. The Contractor must furnish Charlotte Water a certificate that unconditionally guarantees the registers for a minimum period of 15 years against defects in material or workmanship.

H. Placement of the bypass piping must be quickly and easily changeable by Charlotte Water employees when needed at the time of meter installation.

I. Only the following models are acceptable:

1. Badger Meter Recordall® Turbo Series Model 450 (3”), Model 1000 (4”)

2. Neptune Technology Group High Performance (HP) Turbine Meter (3” and 4”)

2.10 SEPARATE IRRIGATION METERS

A. Effective July 1, 2009, a new state law requires a separate irrigation meter for all new in-ground irrigation systems connected to the public water supply. The intent of this legislation, House Bill 2499, is to reduce water systems’ vulnerability to drought and allow Charlotte Water a quicker response to water shortages.

B. Charlotte Water has approved two methods for installing a separate irrigation meter:

1. Single Split Service: an irrigation service line and meter are tied on an existing domestic service by installing a tee just before the domestic meter on the domestic line.

2. Dedicated Irrigation Service: a separate tap and a separate line run to each meter box.

C. ¾-inch and 1-inch irrigation service tubing shall be Type K copper (ONLY).

D. ¾-inch single split irrigation services shall match the existing ¾-inch service tubing materials – copper split off copper or HDPE (SDR-9 tubing) split off HDPE.

1. Occasionally, IPS diameter HDPE service tube may be encountered on existing services. The Contractor shall furnish an IPS x IPS x CTS brass tee to complete the split irrigation service.

2.11 METER BOXES AND LIDS

A. General

1. Service boxes and lids for 3/4-inch and 1-inch water services shall be plastic, unless otherwise approved or directed by the Engineer.
2. Mouse holes shall not be present in meter boxes.
3. All lids shall have a recess suitable for installation of automatic meter reading endpoint / meter communication device. Charlotte Water shall be imprinted/cast into the lid. The solid HD lid shall have a rare earth magnet cast in the plastic. Lids with magnets shall be identified on the underside of the lid with bold letter “M”.

B. Domestic Service

1. 3/4” / 1” domestic water meter boxes and lids shall be as manufactured by:
   a. Southeastern Distributors
   b. DFW Plastics
   c. Sigma Co.
2. Color shall be “Charlotte Gray” (Color - Pantone No. TBD) unless otherwise stated.

C. Irrigation Service

1. 3/4” / 1” irrigation water meter boxes and lids shall be as manufactured by:
   a. Southeastern Distributors
   b. DFW Plastics
   c. Sigma Co.
2. Color shall be “Charlotte Green” (Color - Pantone No. 355C) unless otherwise stated. “Irrigation” shall be imprinted/cast into the lid for irrigation services.

D. Concrete Meter Boxes (For meter installation in sidewalk only)

1. The Contractor shall use the approved 1-inch standard concrete box with plastic lid when directed by the Engineer.
2. Concrete meter boxes shall conform to the Standard Details and be made of concrete mix, 1-2-1, one part cement, two parts granite screenings, and one-part 3/8" granite stone. The meter boxes shall be concrete machine made and tamped with pneumatic tamps to insure the proper density. All concrete items shall be steam cured 24 hours and yard cured for two weeks. Cracked or broken boxes will be rejected at final inspection and must be replaced.
3. Concrete boxes for 5/8-inch (3/4-inch services) shall be as manufactured by:
   a. Southern Meter Box Company
   b. Approved equal
4. Concrete boxes for 1-inch meters shall be as manufactured by:

a. Southern Meter Box Company
   1) Series 65H
b. Approved equal

2.12 METER VAULT ACCESS DOORS

A. 1.5-inch and 2-inch Services

1. 2 ft. x 3 ft. access doors shall be steel single leaf cast in place or recessed steel single leaf cast in place per the design requirements of the Charlotte Water Water and Sewer Design and Construction Standards. Meter vault access doors shall be H-20 traffic rated where required. H-20 traffic rated meter vault access doors shall not be used with brick vaults.
2. Charlotte Water shall be imprinted/cut into cover.
3. Steel access doors shall be as manufactured by USF Fabrication or EJ Co. only.

B. Large Water Services

1. 3 ft. x 3 ft., 3 ft. x 4 ft., 3 ft. x 5 ft., 3 ft. x 6 ft. single leaf manifold vault access doors, 4 ft. x 5 ft., 4 ft. x 6 ft., 5 ft. x 5 ft. and 5 ft. x 6 ft. double leaf access doors shall meet the general requirements of the Charlotte Water Water and Sewer Design and Construction Standards. Steel double leaf H-20 traffic rated meter vault access doors shall be used where required. H-20 traffic rated meter vault access doors shall not be used with brick vaults.
2. All 1,000 PSF double leaf access doors and all double leaf H-20 traffic rated access doors shall be steel that complies with the requirements of the Charlotte Water Water and Sewer Design and Construction Standards.
3. Steel access doors shall be as manufactured by USF Fabrication or EJ Co. only.

C. Identification

1. Lid: Premise numbers shall be clearly indicated on lid via an etched, adhesive or fastened tag, on the endpoint transmitter shelf bracket. See the Charlotte Water Water and Sewer Design and Construction Standards for requirements.
2. Manifolds: Premise numbers shall be clearly indicated on lid via an etched, adhesive or fastened tag, on the endpoint transmitter shelf bracket. Numbers shall be laid out using a ≥ 1.25-inch high stencil and lettering. See the Charlotte Water Water and Sewer Design and Construction Standards for requirements.

2.13 BRICKWORK FOR VAULTS

A. When brickwork (curbing) is required by the Standard Details, the interior and exterior faces of all brickwork shall be surfaced with a minimum of ½-inch cement mortar plaster. Mortar mix shall be (1) one part Portland cement and (2) parts clean sand. Mortar joints shall be a minimum of 3/8-inch. The brick shall be NCDOT pink solid concrete cap block for the brick curbing, creating an 8-inch minimum width brick.

B. In lieu of brickwork, reinforced precast concrete with finished mortar joints inside and out or reinforced cast in place concrete curbing may be used. The minimum width shall be 6-inches and the minimum height shall be 8-inches.

C. Submit curbing details for review and approval.

D. All brickwork installed inside vaults shall be NCDOT pink solid concrete cap block.

E. H-20 traffic rated meter vault access doors shall not be used with brick vaults.

2.14 PIPE SUPPORTS FOR VAULT PIPING

A. Pipe supports shall conform to MSS (Manufactures Standardization Society of the Valve and Fittings Industry) SP-58 – Pipe Hangers and Supports – Materials, Design, Manufacturer, Selection, Application, and Installation.

B. Supports shall provide means of vertical adjustment after erection.

C. Pipe sizes 1/2 to 1-1/2 in (13 to 38 mm): ASTM A240 (A240M), Type 316 Stainless Steel, adjustable swivel, split ring.

D. Pipe Sizes 2-inch (50 mm) and larger: ASTM A240 (A240M), Type 316 Stainless Steel, adjustable, clevis.

E. Vertical support shall be riser clamp.

F. Floor supports shall be adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or stainless-steel support.

PART 3 - EXECUTION

3.1 TEMPORARY UTILITIES

A. Contractor shall provide and pay for all electrical, gas, and water required for construction and maintenance activities until Acceptance.

3.2 CONSTRUCTION LAYOUT

A. Construction Staking: Contractor is responsible for staking water main alignments, water main appurtenance structures, easements, rights-of-way, limits of disturbance, tree protection fence line, wetland boundaries, buffers, Project Control Points and other horizontal control reference points and benchmarks for the work shown on the Drawings. Charlotte Water will provide a drawing and/or staking plan files in electronic format to Contractor. Contractor shall confirm all drawing dimensions and elevations and establish elevations, lines, and levels from reference points, utilizing recognized engineering survey practices. During construction, Contractor shall provide competent helpers for checking elevations, lines, and levels deemed necessary by Charlotte Water. Contractor to establish horizontal and vertical control benchmarks and reference points on the site located in prominent and protected places as agreed upon by Contractor and Charlotte Water.

B. See Chapter 10, Water Distribution Piping Specifications, of the Charlotte Water Water and Sewer Design and Construction Standards for all additional requirements.

3.3 INSTALLATION AND ASSEMBLY, GENERAL

A. Proper implements, tools, and facilities satisfactory to the Engineer shall be provided and used by the Contractor for the safe and convenient prosecution of the work. All pipe, fittings, valves and hydrants shall be carefully lowered into the trench piece by piece by means of a backhoe or other suitable means, in such a manner as to prevent damage

to protective coatings and linings. Under no circumstances shall water main materials be dropped or dumped into the trench. A tracer wire system shall be installed for all piping based on the Standard Details and Specifications.

1. Inspection of Material: The pipe and fittings shall be inspected for defects.

2. Cleaning Pipe and Fittings: All lumps, blisters and excess coatings shall be removed from the bell and spigot ends of each pipe, and the outside of the spigot and the inside of the bell shall be wire- brushed and wiped clean and dry and free from oil and grease before the pipe is laid.

B. See Chapter 10, Water Distribution Piping Specifications, of the Charlotte Water Water and Sewer Design and Construction Standards for all additional requirements.

3.4 PIPING INSTALLATION GENERAL

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

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

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

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

E. See Chapter 10, Water Distribution Piping Specifications, of the Charlotte Water Water and Sewer Design and Construction Standards for all additional requirements.

3.5 WATER SERVICES

A. Services shall be installed prior to testing the proposed main. Services shall be installed in a location determined by Charlotte Water after consultation with the Contractor (with Inspector present) and applicants. The water meter (only) will be furnished by the Charlotte Water and will be installed by the Contractor at the time of activation. All other materials required for water services will be furnished and installed by the Contractor.

B. Where single split irrigation services are to be installed, the Contractor shall freeze the existing water service to allow the existing service tubing to be cut for the installation of the brass tee. The Contractor may also choose to excavate to the corporation stop on existing services that are not under hardscape. The corporation stop may then be used to allow the existing service tubing to be cut for the installation of the brass tee. Under no circumstances shall the existing service tubing (copper or HDPE) be crimped to allow the existing service tubing to be cut for the installation of the brass tee.

C. Backflow Prevention devices shall be installed in accordance with Article V of Chapter 23 in the Charlotte City Code.

3.6 CHARLOTTE DEPARTMENT OF TRANSPORTATION (CDOT) REQUIREMENTS

A. Pull boxes, hand holes, manholes, and vaults, if permitted to be in pedestrian/non-motorized areas, shall have lids identifying the utility owner with a skid resistant surface. Lids shall have a minimum vertical load capacity of 20,000 lbs. in accordance with ANSI/SCTE 77 and ANSI Tier 15 test provisions.

3.7 PROTECTION OF ADVANCED METERING INFRASTRUCTURE (AMI)

A. While working in or around meter boxes, the Contractor shall protect in place all Advanced Metering Infrastructure (AMI) devices attached to the water meter or located in or near water meter boxes, coffins, or vaults in accordance with the Contract Documents. This includes any antenna installed through the meter box lid.

B. Contractor shall avoid damaging the antenna, cable, and endpoints when removing the meter box lid and when disconnecting AMI endpoints from the register on top of the water meter.

C. If meters or AMI devices need to be removed or relocated, the AMI endpoints shall be reinstalled with the Endpoint/Transmitter pointing upwards.

D. Because the AMI equipment is uniquely matched to each service location and to specific meter serial numbers, any AMI devices that are removed or disconnected shall be reinstalled on the same service lateral as well as to the same meter serial number it was attached to originally.

E. Do not change or modify the lid if the lid has an antenna drilled through it.

F. If damaged, disconnected, buried, or broken AMI endpoints, cables between the registers, antennae, lids, or are encountered, notify the Engineer within 24 hours.

G. Any AMI equipment damaged by the Contractor shall be repaired or replaced by Charlotte Water at Contractor's expense.

3.8 REPAIRS

A. The Contractor shall make any needed repairs to newly installed unactivated mains and shall notify the Owner and Engineer of the repairs. A representative of the Owner shall be on site during repairs. Repairs to existing and/or activated mains will be made by Charlotte Water unless the Contractor is otherwise directed by the Engineer.

1. Repairs to New mains: Repairs shall be made by cutting out and removing the damaged/defective section and replacing those with new pipe using long pattern solid sleeves to connect plain ends. Bell clamps will not be allowed to repair newly installed.

2. Repairs to Existing Mains: The Contractor will not be required to repair existing mains unless specifically directed by the Engineer or specified elsewhere in these specifications. Repair methods will be considered on a case-by-case basis.

B. See Chapter 10, Water Distribution Piping Specifications, of the Charlotte Water Water and Sewer Design and Construction Standards for all additional requirements.

3.9 FINAL INSPECTION

A. See Chapter 10, Water Distribution Piping Specifications, of the Charlotte Water Water and Sewer Design and Construction Standards for final inspection requirements.

List of Approved Water Meter Manufacturers and Models

Approved Water Meters			
Meter Type	**Size**	**Manufacturer**	**Model**
Displacement			
	5/8”	Badger Meter	Recordall® Model 25
	5/8”	Neptune Technology Group	Model T-10®
	1”	Badger Meter	Recordall® Model 70
	1”	Neptune Technology Group	Model T-10®
	1 ½”	Badger Meter	Recordall® Model 120
	1 ½”	Neptune Technology Group	Model T-10®
	2”	Badger Meter	Recordall® Model 170
	2”	Neptune Technology Group	Model T-10®
Compound			
	3” – 6”	Badger Meter	Recordall® Compound Series
	3” – 6”	Neptune Technology Group	TRU/FLO® Compound Meter Series
FMCT			
	4” – 10”	Badger Meter	Recordall® Fire Series Assemblies (FSAA) with Disc Bypass Meter
	4” – 10”	Neptune Technology Group	HP PROTECTUS® III S Fire Service
	12”	Badger Meter	Recordall® Fire Series Assemblies (FSAA) with Turbo Bypass Meter
Ultrasonic			
	5/8” – 8”	Badger Meter	E-Series®
	1.5” – 12”	Master Meter	Octave®
	1.5” – 12”	Neptune Technology Group	Mach 10®
Turbine			
	3”, 4”	Badger Meter	Recordall® Turbo Series
	3”, 4”	Neptune Technology Group	HP Turbine Meter

END OF SECTION

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WATER METERS DETAILS
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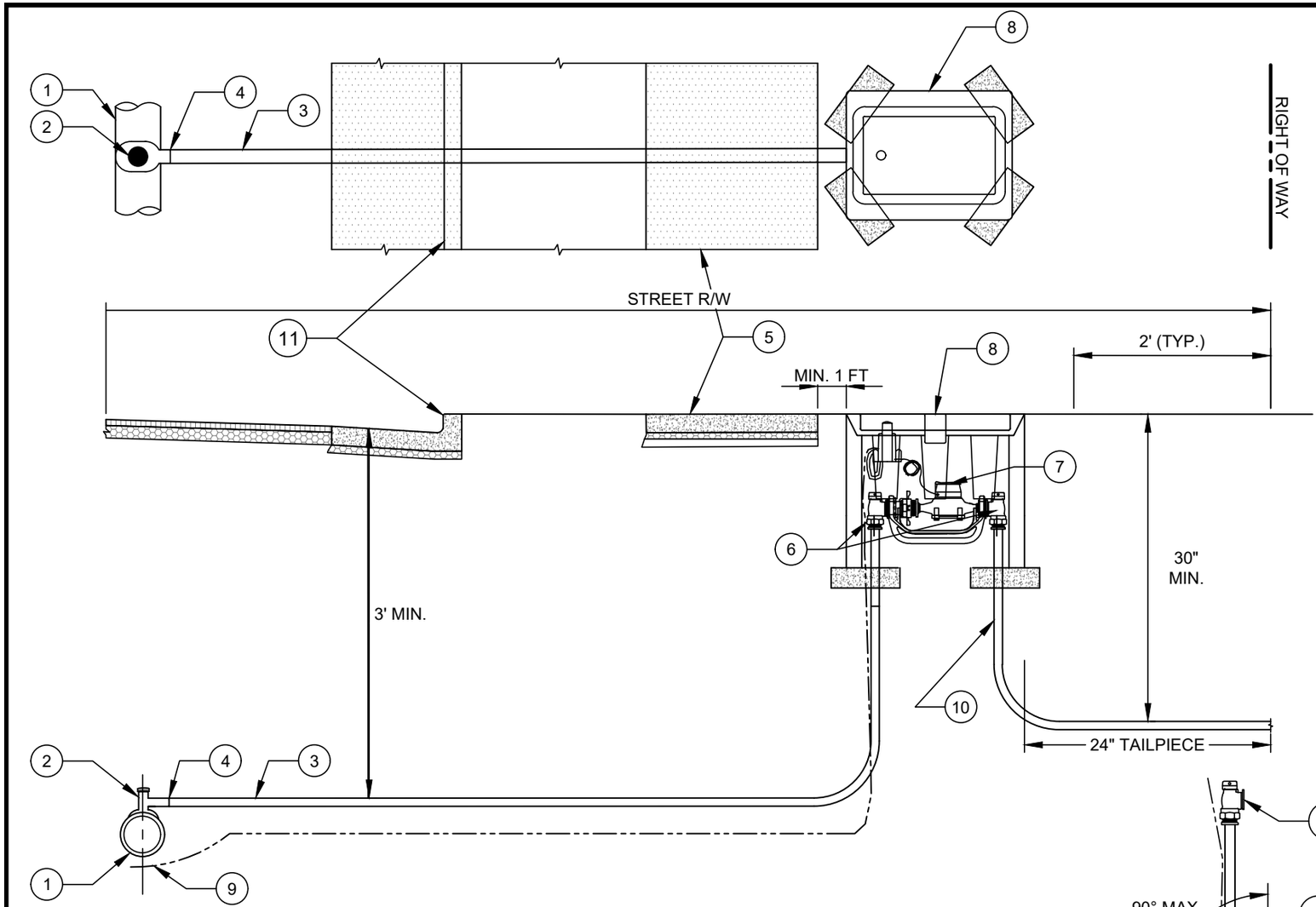
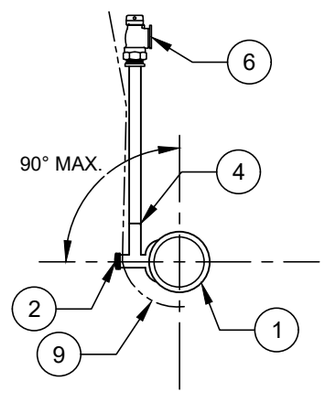


TAPPING SADDLE WITH CAP AND CUTTER



OPTION - ANGLED TAPPING SADDLE WITH METER ABOVE MAIN

NO.	DESCRIPTION:
1.	HDPE WATER MAIN.
2.	HDPE SERVICE TAPPING SADDLE WITH CAP AND CUTTER.
3.	HDPE WATER TUBING (SDR-9 CTS).
4.	ELECTROFUSION COUPLING.
5.	FINISHED GRADE OF SIDEWALK.
6.	5/8" X 3/4" ANGLE BALL VALVE WITH LOCK WINGS, YOKE STAR NUT X CTS COMPRESSION.
7.	WATER METER WITH TRANSMITTER.
8.	METER BOX ASSEMBLY. SEE STANDARD DETAIL.
9.	TRACER WIRE - CONTINUOUS AWG #12 GAUGE SOLID COPPER TRACER WIRE WITH 30 MILS THICK BLUE HDPE INSULATION.
10.	TYPE K COPPER TUBING OR HDPE SDR-9 (CTS) TUBING WITH INSERT STIFFENERS.
11.	CURB AND GUTTER.

NOTES:

A. METER LOCATION WHERE SIDEWALK AND CURB ARE INTEGRAL IS AT BACK OF SIDEWALK INSTEAD OF BACK OF CURB AS SHOWN.

B. ANGLED OPTION IS ONLY ALLOWED WITH CLTW APPROVAL.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

HDPE SERVICE CONNECTION TAP ON HDPE PIPE (3/4-INCH TO 1-INCH)

NO SCALE

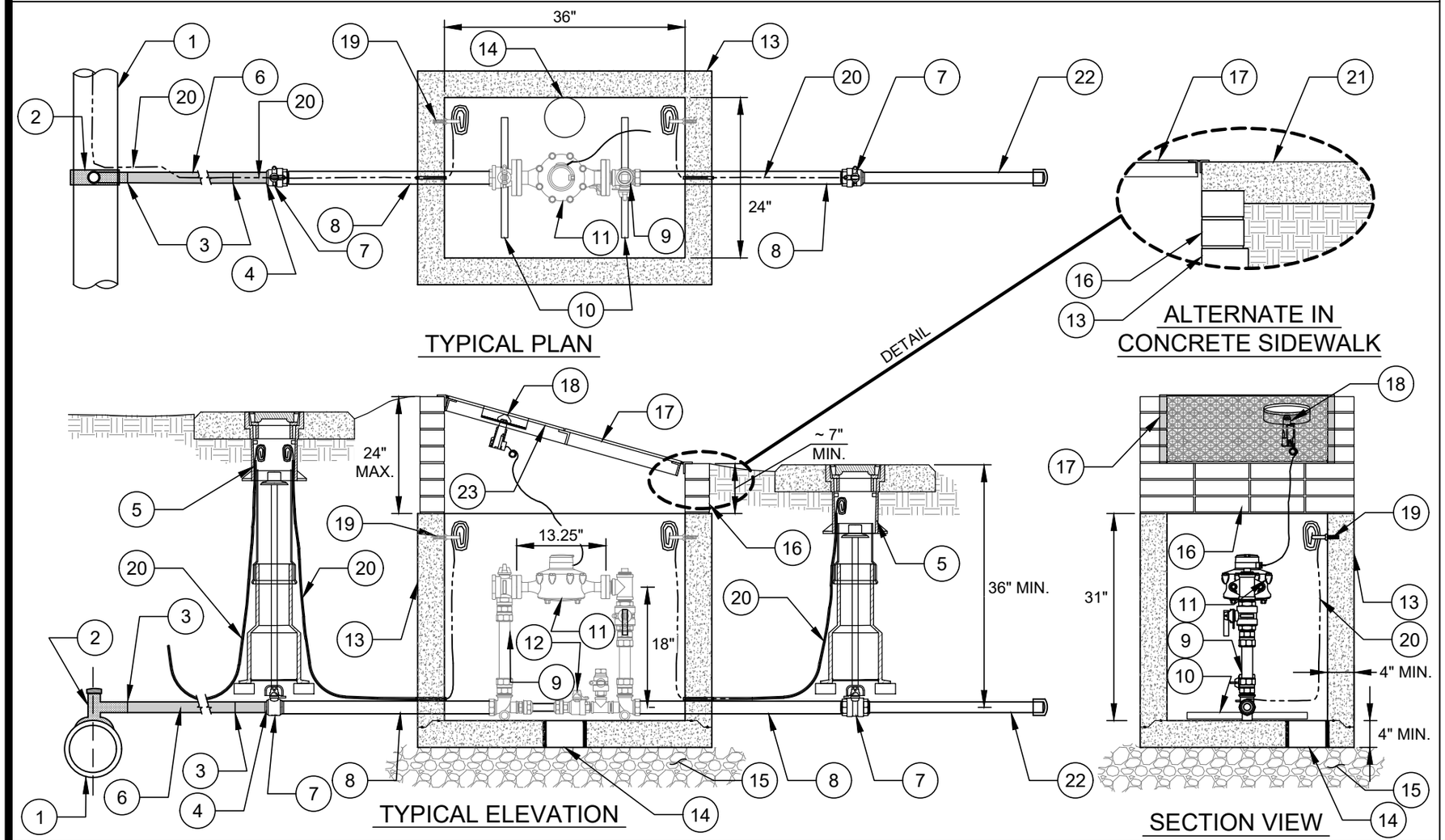
VERSION 2.0

DATE 01/2025

DETAIL 15.1.1

NOTES:

A. ALL FLANGE HARDWARE (BOLT/WASHER/NUT) SHALL BE STAINLESS STEEL - TYPE 304 WITH ANTI-SEIZE COMPOUND.
B. ALL PIPE SHALL BE RESTRAINED FROM TAP TO PROPERTY LINE VALVE.
C. VAULT SHALL BE RATED FOR NCDOT HS-20 LOADING - SUBMIT SHOP DRAWINGS / P.E. SEALED FOR REVIEW.
D. ALL CONCRETE SHALL BE MINIMUM 3,600 PSI COMPRESSIVE STRENGTH.
E. DESIGN SHALL CONFORM TO ASTM C858 - SPECIFICATIONS FOR "UNDERGROUND PRECAST CONCRETE UTILITY STRUCTURE".
F. STEEL REINFORCING DESIGN SHALL CONFORM TO ASTM C857.
G. REBARS SHALL BE GRADE 60 PER ASTM A615.
H. WELDED WIRE FABRIC SHALL CONFORM TO ASTM A185.
I. DIAGONAL REINFORCING SHALL BE ADDED AT ALL OPENINGS.
J. PIPE PENETRATIONS SHALL BE SEALED WITH FLEXIBLE CONNECTERS (MANHOLE BOOTS) OR WITH 4" OF BRICK & MORTAR (AND 1/2-INCH THICK CONSTRUCTION EXPANSION MATERIAL AROUND THE PIPE).
K. FRAME TO BE FLUSH WITH GROUND OR CONCRETE SIDEWALK, GROUND SHALL SLOPE AWAY FROM VAULT.
L. ALL JOINTS SHALL BE MADE WATERTIGHT USING 2 RINGS OF BUTYL RUBBER JOINT MASTIC.
M. ALTERNATE TO BRICK USE CRETEX PRORING 36x24 POLYPROPYLENE ADJUSTMENT RING(S). MUST USE MANUFACTURER APPROVED M-1 OR RAPID SET ADHESIVE.



NO.	DESCRIPTION:
1.	HDPE WATER MAIN.
2.	HDPE SERVICE TAPPING SADDLE WITH T-HEAD OPERATING NUT, AND CAP AND CUTTER.
3.	HDPE BUTT FUSION JOINT.
4.	BUTT FUSION X THREADED (MNPT) ADAPTER.
5.	STANDARD VALVE BOX ASSEMBLY (TYP.) - ALL VALVES (OMIT AT CORPORATION STOP ON SHORT SIDE SERVICE).
6.	1 1/2" SDR-9 IPS HDPE PIPE.
7.	1 1/2" BRASS BALL VALVE (FNPT X FNPT).
8.	1 1/2" RED BRASS PIPE NIPPLE (L = 30").
9.	1 1/2" BRASS METER SETTER ASSEMBLY - NO SOLDER JOINTS PERMITTED. SEE TECHNICAL SPECIFICATIONS.
10.	1" SCH 40 RED BRASS NIPPLE (L = 18") X 2 EACH.
11.	1 1/2" WATER METER ASSEMBLY WITH AMR TRANSMITTER (BY CONTRACTOR).
12.	BY PASS BALL VALVE WITH LOCK WINGS - LOCK VALVE IN CLOSED POSITION (SERIAL NUMBERED STUD LOCK - FURNISHED BY CLTW).
13.	PRECAST CONCRETE SERVICE VAULT (36" X 24" X 31").
14.	6" DIAMETER SUMP HOLE.
15.	6" COMPACTED #57 WASHED STONE.
16.	MINIMUM OF (3) STANDARD SOLID CONCRETE BRICK COURSES UNDER ACCESS DOOR FRAME, MAXIMUM 2'. SEE NOTE M.
17.	24" X 36" ACCESS DOOR - SEE STANDARD DETAIL.
18.	AMR TRANSMITTER.
19.	3/8" DIAMETER GALV. STEEL EYE BOLT (ADHESIVE ANCHOR) - TYPICAL.
20.	AWG #12 GAUGE SOLID COPPER TRACER WIRE 30 MILS BLUE HDPE INSTALLATION - TERMINATE WITH 24" EXCESS WIRE (COILED) AT EYE BOLT AND VALVE BOX (TYP.).
21.	CAST IN PLACE CONCRETE SIDEWALK - BRICK WORK SHALL NOT EXTEND TO SURFACE, ACCESS DOOR SHALL REST ON SIDEWALK.
22.	1 1/2" TYPE K COPPER TUBING TAIL PIECE - L = 24" MIN. - BRASS OR PVC CAP END.
23.	ATTACH ENGRAVED LABEL, WITH PREMISE NUMBER, TO UNDERSIDE OF DOOR, NEAR THE LIFTING HANDLE.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

1.5" HDPE SERVICE CONNECTION AND VAULT ON HDPE WATER MAIN

NO SCALE

VERSION 2.0

DATE 01/2026

DETAIL 15.1.2

NOTES:

A. ALL FLANGE HARDWARE (BOLT/WASHER/NUT) SHALL BE STAINLESS STEEL - TYPE 304 WITH ANTI-SEIZE COMPOUND.
B. ALL PIPE SHALL BE RESTRAINED FROM TAP TO PROPERTY LINE VALVE.
C. VAULT SHALL BE RATED FOR NCDOT HS-20 LOADING - SUBMIT SHOP DRAWINGS / P.E. SEALED FOR REVIEW.
D. ALL CONCRETE SHALL BE MINIMUM 3,600 PSI COMPRESSIVE STRENGTH.
E. DESIGN SHALL CONFORM TO ASTM C858 - SPECIFICATIONS FOR "UNDERGROUND PRECAST CONCRETE UTILITY STRUCTURE".
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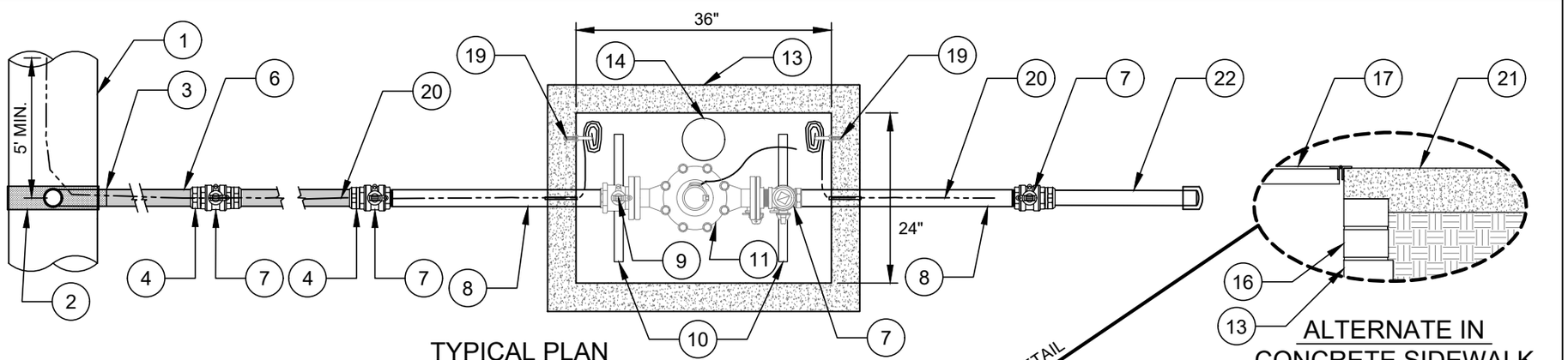
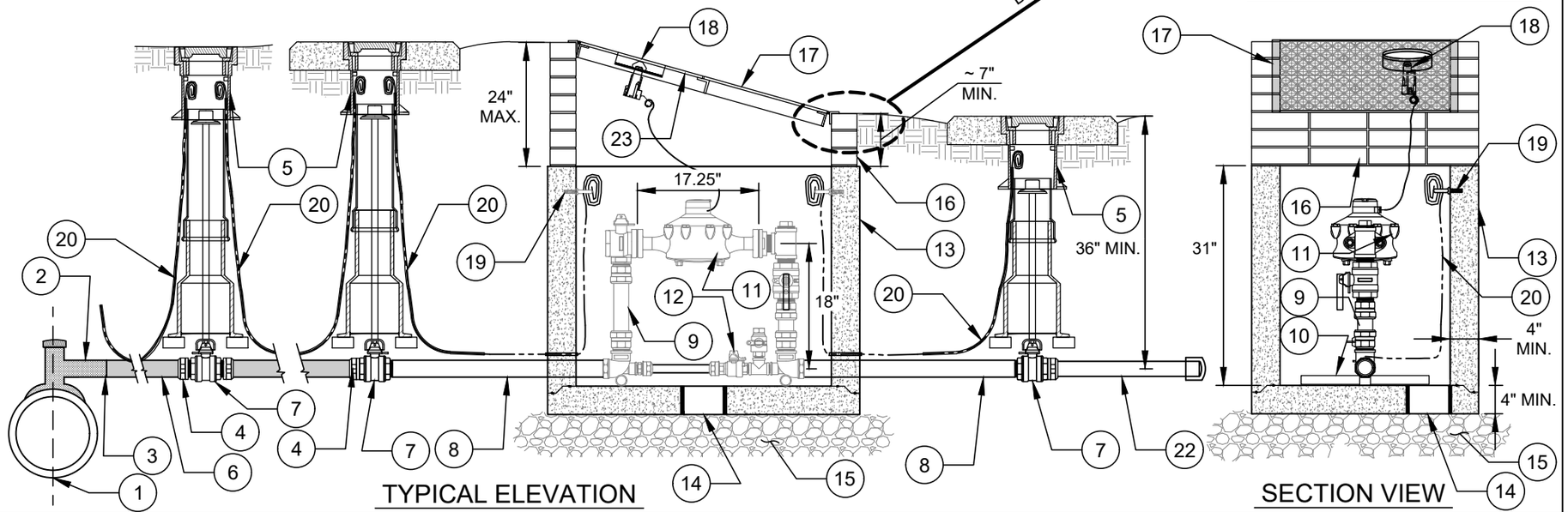
G. REBARS SHALL BE GRADE 60 PER ASTM A615.
H. WELDED WIRE FABRIC SHALL CONFORM TO ASTM A185.
I. DIAGONAL REINFORCING SHALL BE ADDED AT ALL OPENINGS.
J. PIPE PENETRATIONS SHALL BE SEALED WITH FLEXIBLE CONNECTERS (MANHOLE BOOTS) OR WITH 4" OF BRICK & MORTAR (AND 1/2-INCH THICK CONSTRUCTION EXPANSION MATERIAL AROUND THE PIPE).
K. FRAME TO BE FLUSH WITH GROUND OR CONCRETE SIDEWALK, GROUND SHALL SLOPE AWAY FROM VAULT.
L. ALL JOINTS SHALL BE MADE WATERTIGHT USING 2 RINGS OF BUTYL RUBBER JOINT MASTIC.
M. ALTERNATE TO BRICK USE CRETEX PRORING 36x24 POLYPROPYLENE ADJUSTMENT RING(S). MUST USE MANUFACTURER APPROVED M-1 OR RAPID SET ADHESIVE.



TYPICAL PLAN

ALTERNATE IN CONCRETE SIDEWALK



TYPICAL ELEVATION

SECTION VIEW

NO.	DESCRIPTION:
1.	HDPE WATER MAIN.
2.	HDPE SERVICE TAPPING SADDLE WITH CAP AND CUTTER.
3.	HDPE BUTT FUSION JOINT.
4.	BUTT FUSION X THREADED (MNPT) ADAPTER.
5.	STANDARD VALVE BOX ASSEMBLY (TYP.) - ALL VALVES (OMIT AT CORPORATION STOP ON SHORT SIDE SERVICE).
6.	2" SDR-9 IPS HDPE PIPE.
7.	2" BRASS BALL VALVE (FNPT X FNPT).
8.	2" RED BRASS PIPE NIPPLE (L = 30").
9.	2" BRASS METER SETTER ASSEMBLY - NO SOLDER JOINTS PERMITTED. SEE TECHNICAL SPECIFICATIONS.
10.	1" SCH 40 RED BRASS NIPPLE (L = 18") X 2 EACH.
11.	2" WATER METER ASSEMBLY WITH AMR TRANSMITTER (BY CONTRACTOR).
12.	BY PASS BALL VALVE WITH LOCK WINGS - LOCK VALVE IN CLOSED POSITION (SERIAL NUMBERED STUD LOCK - FURNISHED BY CLTW).
13.	PRECAST CONCRETE SERVICE VAULT (36" X 24" X 31").
14.	6" DIAMETER SUMP HOLE.
15.	6" COMPACTED #57 WASHED STONE.
16.	MINIMUM OF (3) STANDARD SOLID CONCRETE BRICK COURSES UNDER ACCESS DOOR FRAME, MAXIMUM 2'. SEE NOTE A.
17.	24" X 36" ACCESS DOOR - SEE STANDARD DETAIL.
18.	AMR TRANSMITTER.
19.	3/8" DIAMETER GALV. STEEL EYE BOLT (ADHESIVE ANCHOR) - TYPICAL.
20.	AWG #12 GAUGE SOLID COPPER TRACER WIRE 30 MILS BLUE HDPE - TERMINATE WITH 24" EXCESS WIRE (COILED) AT EYE BOLT AND VALVE BOX (TYP.).
21.	CAST IN PLACE CONCRETE SIDEWALK - BRICK WORK SHALL NOT EXTEND TO SURFACE, ACCESS DOOR SHALL REST ON SIDEWALK.
22.	2" TYPE K COPPER TUBING TAIL PIECE - L = 24" MIN. - BRASS OR PVC CAP END.
23.	ATTACH ENGRAVED LABEL, WITH PREMISE NUMBER, TO UNDERSIDE OF DOOR, NEAR THE LIFTING HANDLE.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

HDPE SERVICE CONNECTION TAP ON HDPE PIPE (2-INCH)

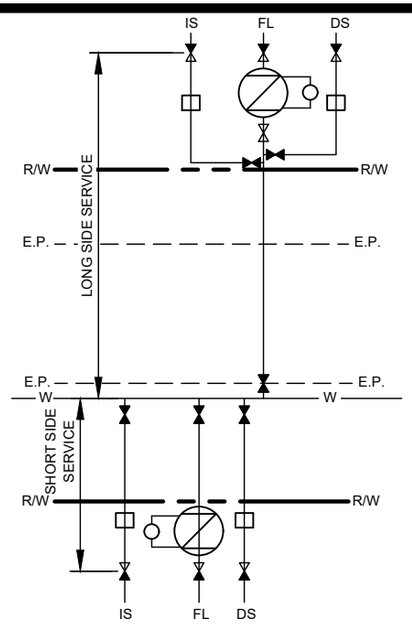
NO SCALE

VERSION 2.0

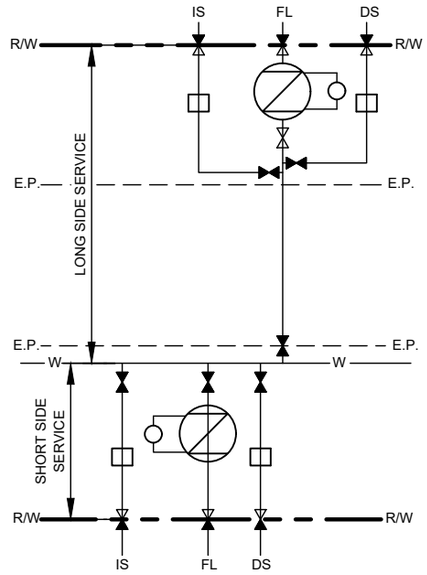
DATE 01/2026

DETAIL 15.1.3

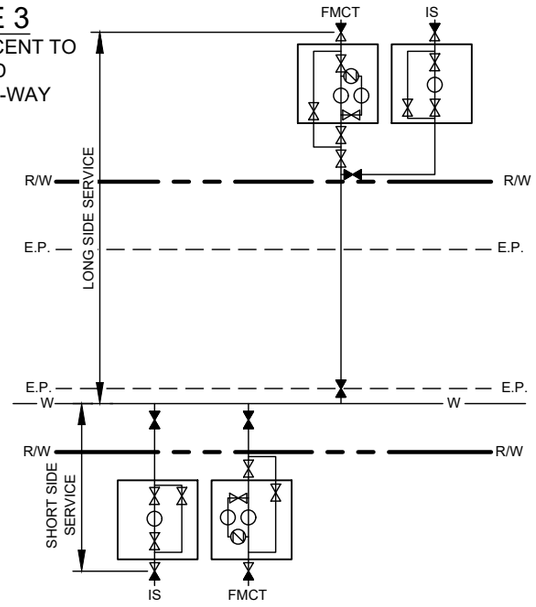
TYPE 1
METERS ADJACENT TO ROAD RIGHT-OF-WAY



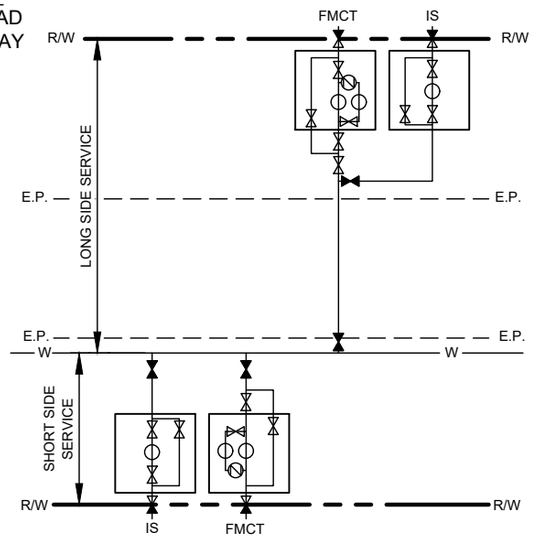
TYPE 2
METERS IN ROAD RIGHT-OF-WAY



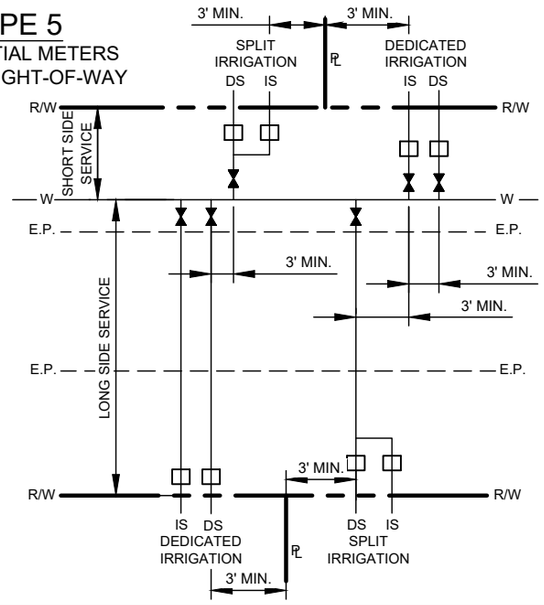
TYPE 3
FMCT ADJACENT TO ROAD RIGHT-OF-WAY



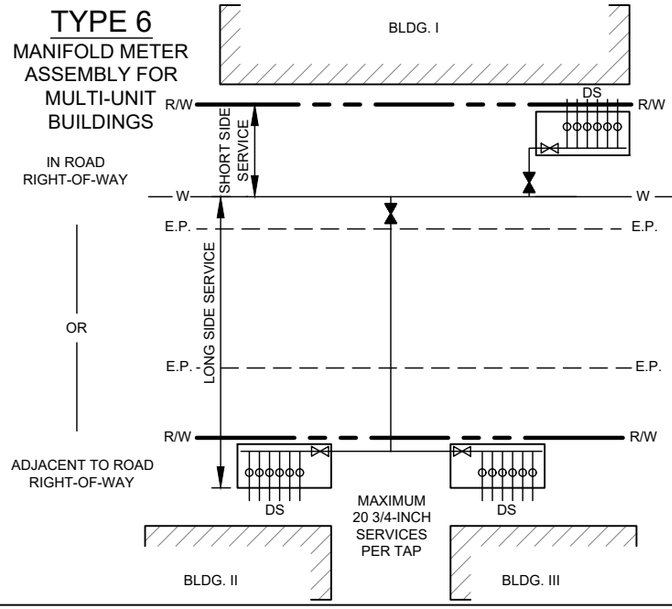
TYPE 4
FMCT IN ROAD RIGHT-OF-WAY



TYPE 5
RESIDENTIAL METERS IN ROAD RIGHT-OF-WAY



TYPE 6
MANIFOLD METER ASSEMBLY FOR MULTI-UNIT BUILDINGS



LEGEND / NOTE:

IS = LAWN IRRIGATION SERVICE
DS = DOMESTIC POTABLE WATER SERVICE
FL = FIRE LINE SERVICE WITH DETECTOR METER
FMCT = FACTORY MUTUAL COMPOUND TYPE / FIRE MAIN COMPOUND TYPE OR ULTRASONIC METER TYPE.

⋈ = FOR 3/4"-2" SERVICE - TAPPING SADDLE AND BALL CORPORATION STOP - CC (TAPER) THREAD.
⋈ = FOR 3"-12" SERVICE - TAPPING SLEEVE AND TAPPING GATE VALVE (FL X MJ) FOR EXISTING WATER MAINS OR MJ TEE, FOSTER ADAPTOR, SERVICE GATE VALVE, (RESTRAINED) FOR NEW MAINS.
⋈ = GATE VALVE OR BALL VALVE - SEE METER DETAILS

⋈ = PROPERTY LINE VALVE - FOR 3/4"-1" - NOT REQUIRED, FOR 1 1/2"-2" - BALL VALVE CURB STOP, OR FOR 3"-12" - OPEN LEFT MJ GATE VALVE (RESTRAINED).

ALL PIPE SHALL BE RESTRAINED FROM MAIN TO PROPERTY LINE VALVE - 3/4"-2" SHALL BE TYPE K COPPER OR SDR 9 HDPE (NO JOINTS PERMITTED BETWEEN WATER MAIN AND METER), 3"-12" SHALL BE RESTRAINED JOINT DUCTILE IRON. SEE INDIVIDUAL METER DETAILS FOR SPECIFIC COMPONENT REQUIREMENTS.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

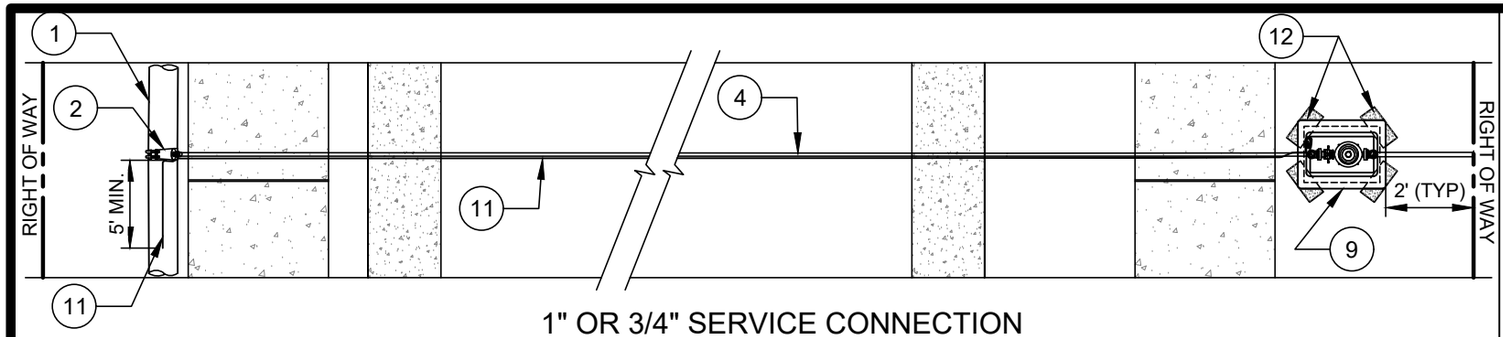
MULTIPLE WATER SERVICES - SCHEMATIC

NO SCALE

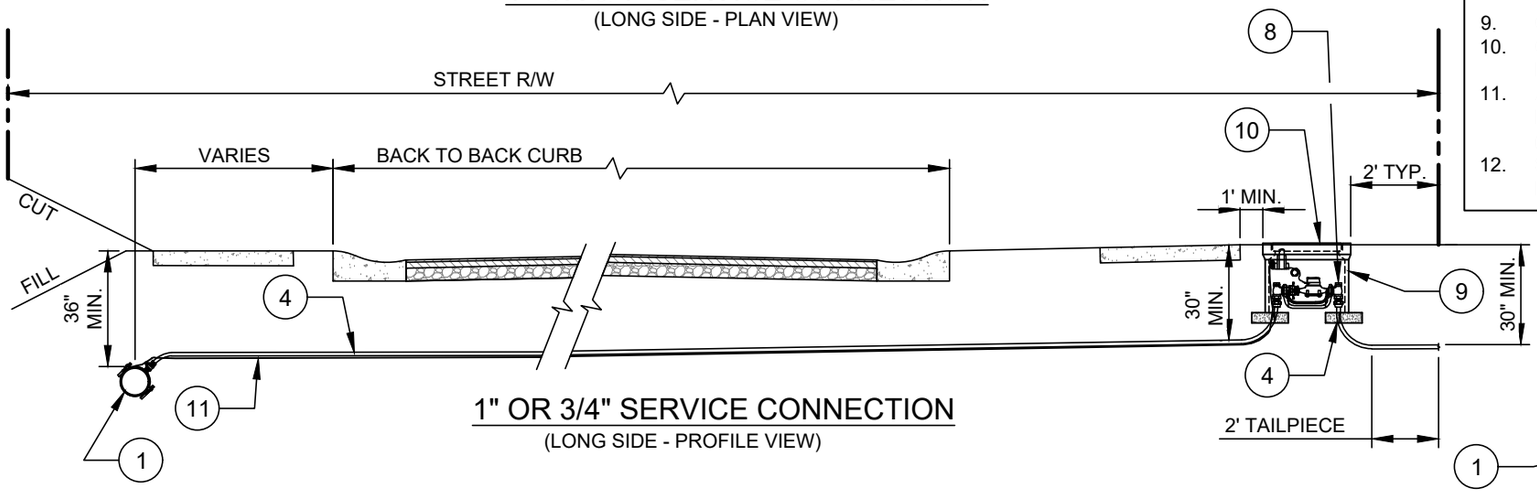
VERSION 1.0

DATE 04/2024

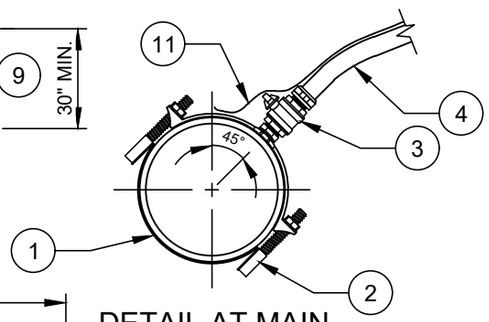
DETAIL 15.1.4



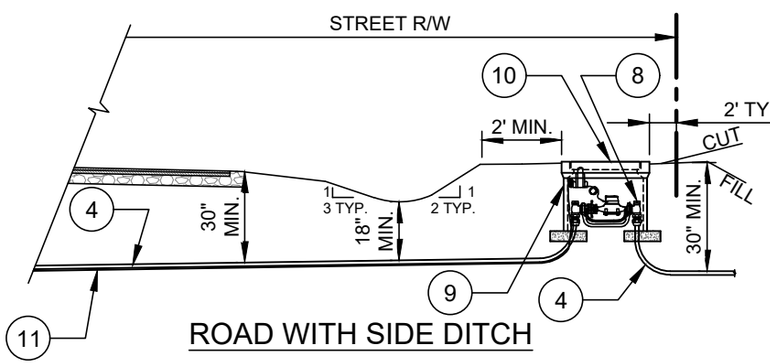
1" OR 3/4" SERVICE CONNECTION
(LONG SIDE - PLAN VIEW)



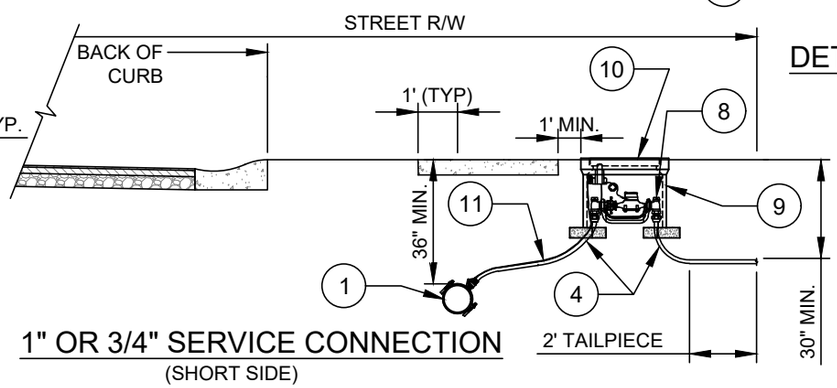
1" OR 3/4" SERVICE CONNECTION
(LONG SIDE - PROFILE VIEW)



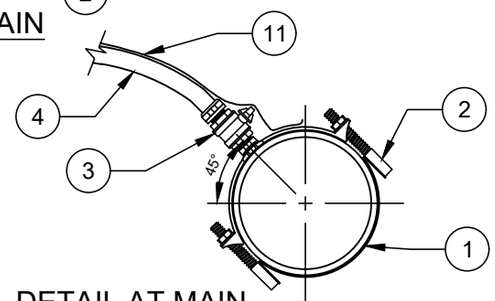
DETAIL AT MAIN
(LONG SIDE)



ROAD WITH SIDE DITCH



1" OR 3/4" SERVICE CONNECTION
(SHORT SIDE)



DETAIL AT MAIN
(SHORT SIDE)

NO.	DESCRIPTION:
1.	WATER MAIN.
2.	S.S. DOUBLE STRAP SERVICE SADDLE - CC (TAPER) THREAD OUTLET.
3.	BALL CORPORATION STOP WITH BRASS TEE HEAD OPERATING NUT- CC (TAPER) THREAD X CTS COMPRESSION.
4.	TYPE K COPPER TUBING OR SDR9 HDPE (POLY) TUBING WITH INSERT STIFFENERS - CONTINUOUS ONE PIECE (NO FITTING ALLOWED).
5.	5/8" X 3/4" ANGLE BALL VALVE WITH LOCK WINGS - CTS COMPRESSION X YOKE STAR NUT.
6.	5/8" DUCTILE IRON YOKE BAR.
7.	5/8" METER ASSEMBLY (BY CLTW) WITH AMR TRANSMITTER.
8.	CUSTOMER PROPERTY LINE 5/8" X 3/4" ANGLE BALL VALVE WITH LOCK WINGS - CTS COMPRESSION X YOKE STAR NUT.
9.	GRAY HDPE PLASTIC METER BOX - SEE STD. DETAILS.
10.	GRAY HDPE METER BOX LID WITH AMR TRANSMITTER - SEE STD. DETAILS.
11.	AWG #12 GAUGE SOLID COPPER TRACER WIRE - WITH 30 MILS BLUE INSULATION HDPE - TERMINATE IN METER BOX WITH 24" EXCESS WIRE (COILED).
12.	SOLID STANDARD CONCRETE BRICKS - DIAGONAL AT CORNERS - 4 EACH.

NOTES:

A. MIN. DISTANCE CENTER TO CENTER ON SERVICES OR TO BELLS OR SPIGOTS SHALL BE 3' AS MEASURED ALONG THE MAIN.
B. CENTER ANGLE BALL VALVES AND METER (NO. 5 - NO. 7) IN METER BOX.
C. SHOWN AS 3/4" SERVICE, USE 1" COMPONENTS FOR 1" DOMESTIC WATER SERVICE.
D. TRACER WIRE REQUIRED FOR ALL SERVICES REGARDLESS OF PIPE TYPE.
E. WHEN METER BOX MUST BE PLACED IN CONCRETE, IT SHALL BE COMPLETELY IN, AND CENTERED IN CONCRETE PANEL, PER CDOT / NCDOT REQUIREMENTS.
F. CLTW MAINTENANCE ENDS WITH THE CUSTOMER PROPERTY LINE ANGLE BALL VALVE (NO. 8).
G. METER SHALL SERVE PROPERTY IT FRONTS.
H. SERVICE LINE SHALL RUN PERPENDICULAR TO THE ROAD/ROW IF THE MAIN IS ON A SKEW.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

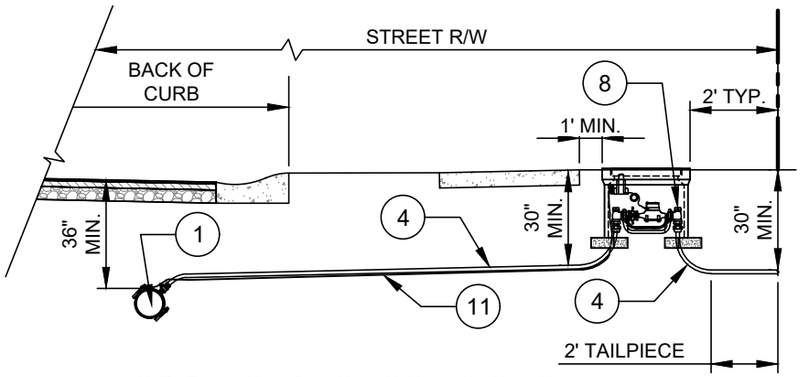
3/4" AND 1" DOMESTIC WATER SERVICE CONNECTION

NO SCALE

VERSION 2.0

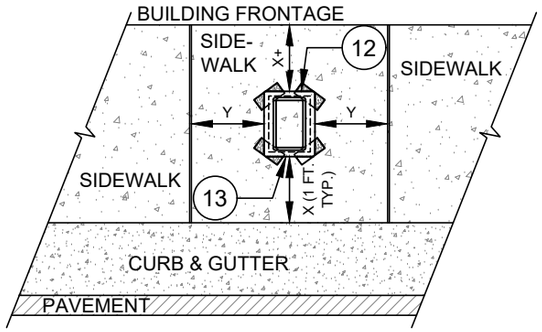
DATE 01/2025

DETAIL 15.1.5



1" OR 3/4" SERVICE CONNECTION

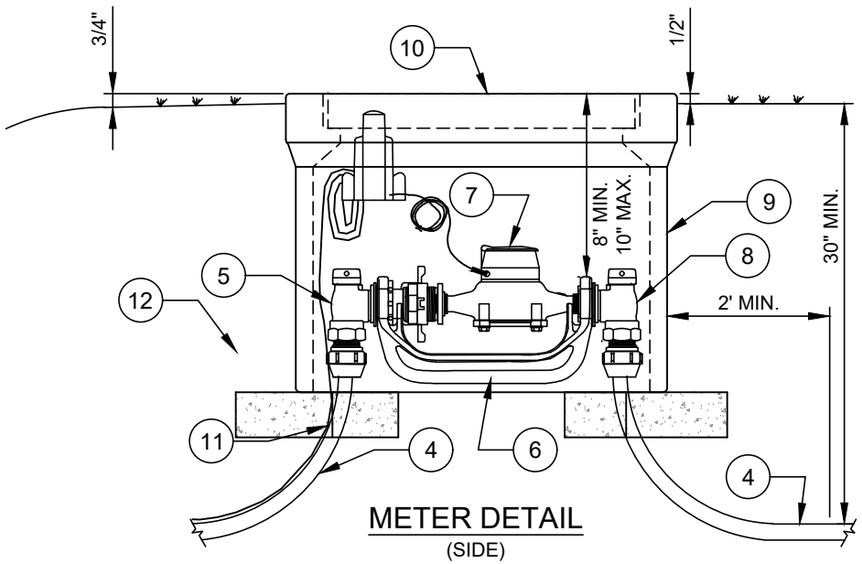
(SHORT SIDE - IN PAVEMENT)



METER BOX IN SIDEWALK

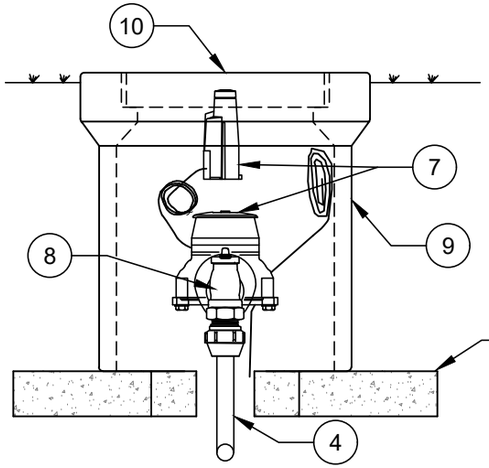
(REQUIRES PRIOR CLTW APPROVAL)

NO.	DESCRIPTION:
1.	WATER MAIN.
2.	S.S. DOUBLE STRAP SERVICE SADDLE - CC (TAPER) THREAD OUTLET.
3.	BALL CORPORATION STOP WITH BRASS TEE HEAD OPERATING NUT- CC (TAPER) THREAD x CTS COMPRESSION.
4.	TYPE K COPPER TUBING OR SDR9 HDPE (POLY) TUBING WITH INSERT STIFFENERS - CONTINUOUS ONE PIECE (NO FITTING ALLOWED).
5.	5/8" x 3/4" ANGLE BALL VALVE WITH LOCK WINGS - CTS COMPRESSION x YOKE STAR NUT.
6.	5/8" DUCTILE IRON YOKE BAR.
7.	5/8" METER ASSEMBLY (BY CLTW) WITH AMR TRANSMITTER.
8.	CUSTOMER PROPERTY LINE 5/8" X 3/4" ANGLE BALL VALVE WITH LOCK WINGS - CTS COMPRESSION X YOKE STAR NUT.
9.	GRAY HDPE PLASTIC METER BOX - SEE STD. DETAILS.
10.	GRAY HDPE METER BOX LID WITH AMR TRANSMITTER - SEE STD. DETAILS.
11.	AWG #12 GAUGE SOLID COPPER TRACER WIRE - WITH 30 MILS BLUE INSULATION HDPE - TERMINATE IN METER BOX WITH 24" EXCESS WIRE (COILED).
12.	SOLID STANDARD CONCRETE BRICKS - DIAGONAL AT CORNERS - 4 EACH.
13.	USE CONCRETE METER BOX WHEN IN SIDEWALK.



METER DETAIL

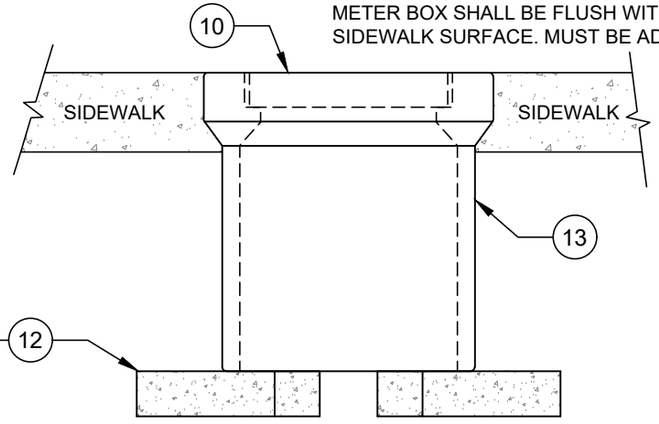
(SIDE)



METER DETAIL

(END)

NOTE:
METER BOX SHALL BE FLUSH WITH THE SIDEWALK SURFACE. MUST BE ADA COMPLIANT.



METER BOX IN SIDEWALK DETAIL

(REQUIRES PRIOR CLTW APPROVAL)
(BOX SHALL BE CONCRETE BOX WITH PLASTIC LID, AND SUPPORTED BY CONCRETE SIDEWALK - AS SHOWN)

NOTES:

A. MIN. DISTANCE CENTER TO CENTER ON SERVICES OR TO BELLS OR SPIGOTS SHALL BE 3' AS MEASURED ALONG THE MAIN.
B. CENTER ANGLE BALL VALVES AND METER (NO. 5 - NO.7) IN METER BOX.
C. SHOWN AS 3/4" SERVICE, USE 1" COMPONENTS FOR 1" DOMESTIC WATER SERVICE.
D. TRACER WIRE REQUIRED FOR ALL SERVICES REGARDLESS OF PIPE TYPE.
E. WHEN METER BOX MUST BE PLACED IN CONCRETE, IT SHALL BE COMPLETELY IN, AND CENTERED IN CONCRETE PANEL, PER CDOT / NCDOT REQUIREMENTS.
F. CLTW MAINTENANCE ENDS WITH THE CUSTOMER PROPERTY LINE ANGLE BALL VALVE (NO. 8).
G. METER SHALL SERVE PROPERTY IT FRONTS.
H. SERVICE LINE SHALL RUN PERPENDICULAR TO THE ROAD/ROW IF THE MAIN IS ON A SKEW.
I. METER BOX IS NOT ALLOWED IN DRIVEWAY.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

3/4" AND 1" DOMESTIC WATER SERVICE CONNECTION

NO SCALE

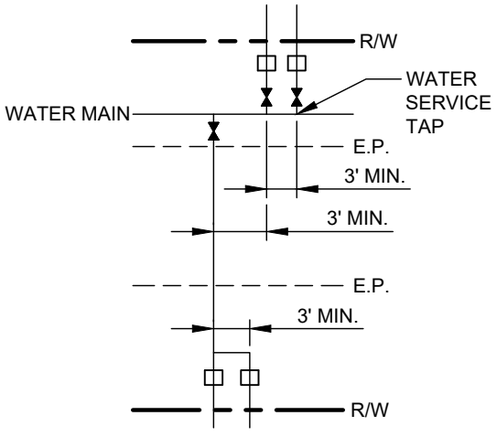
VERSION 2.0

DATE 01/2025

DETAIL 15.1.6

REQUIREMENT 1

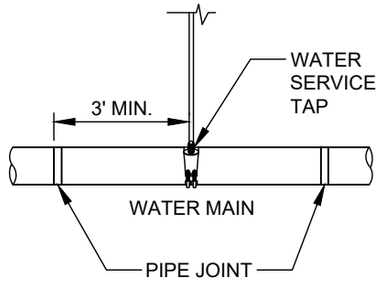
MINIMUM SPACING BETWEEN WATER TAPS: 3 FT



PLAN VIEW
(HORIZONTAL SEPARATION)

REQUIREMENT 2

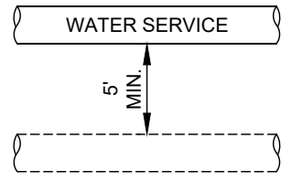
MINIMUM CLEARANCE OF WATER TAP TO PIPE JOINTS OR FITTINGS: 3 FT



PLAN VIEW
(HORIZONTAL SEPARATION)

REQUIREMENT 3

MINIMUM SPACING BETWEEN WATER SERVICES AND PARALLEL STORM PIPES/CATCH BASINS: 5 FT

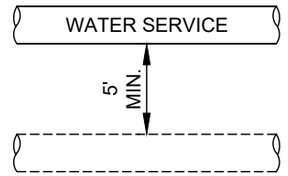


STORM SEWER, STORM WATER FORCE MAIN, STORM CATCH BASIN

PLAN VIEW
(HORIZONTAL SEPARATION)

REQUIREMENT 4

MINIMUM SPACING BETWEEN WATER SERVICES AND SEWER SERVICES: 5 FT

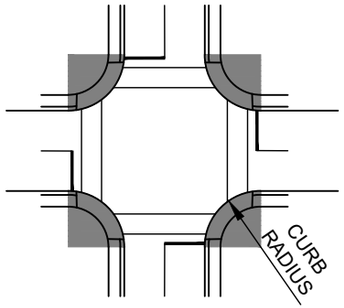


GRAVITY SANITARY SEWER, SANITARY SEWER FORCE MAIN

PLAN VIEW
(HORIZONTAL SEPARATION)

REQUIREMENT 5

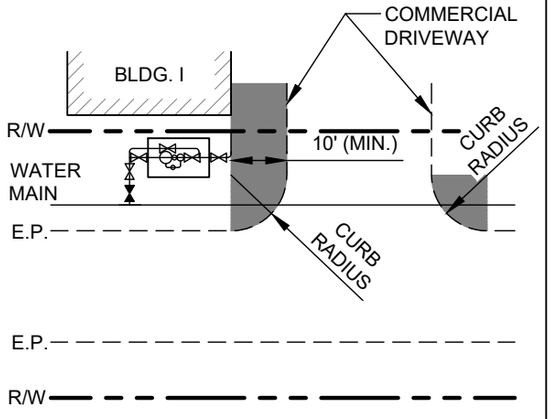
WATER SERVICES PROHIBITED INSIDE CURB RADIUS POINT OF PUBLIC AND PRIVATE ROAD INTERSECTIONS



PLAN VIEW

REQUIREMENT 6

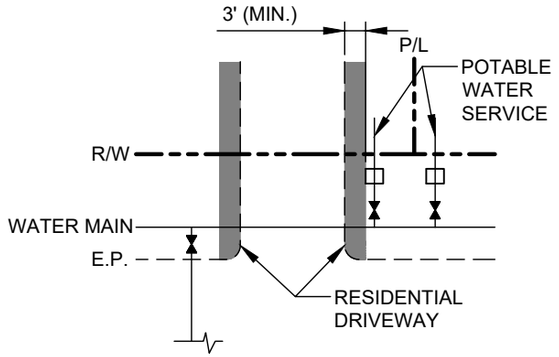
WATER SERVICE VAULTS PROHIBITED WITHIN 10 FT OF COMMERCIAL DRIVEWAYS OR WITHIN THE CURB RADIUS POINT, WHICHEVER IS GREATER



PLAN VIEW
(HORIZONTAL SEPARATION)

REQUIREMENT 7

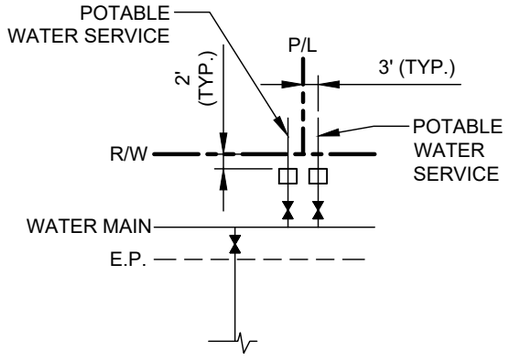
WATER SERVICE METER BOXES PROHIBITED WITHIN 3 FT OF RESIDENTIAL DRIVEWAYS



PLAN VIEW
(HORIZONTAL SEPARATION)

REQUIREMENT 8

MINIMUM CLEARANCE BETWEEN PROPERTY LINE AND WATER SERVICE/VAULT: 3 FT



PLAN VIEW
(HORIZONTAL SEPARATION)

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

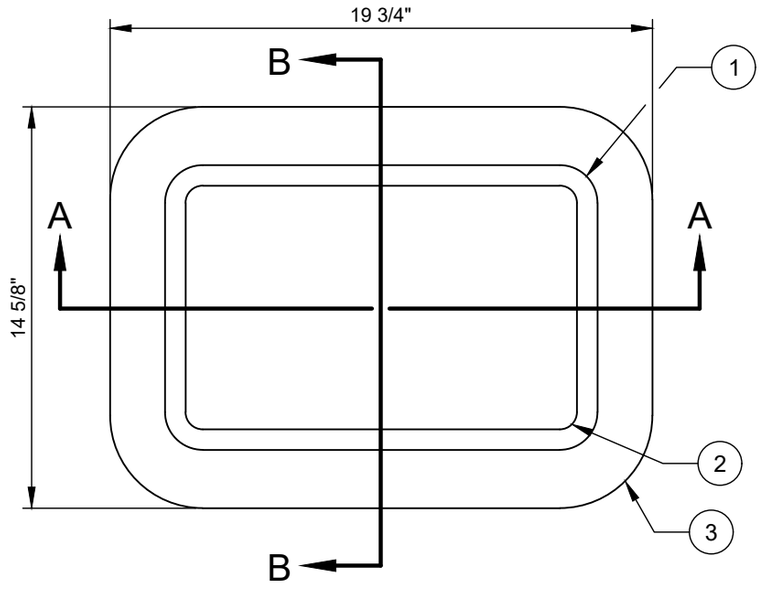
WATER SERVICES - SCHEMATIC

NO SCALE

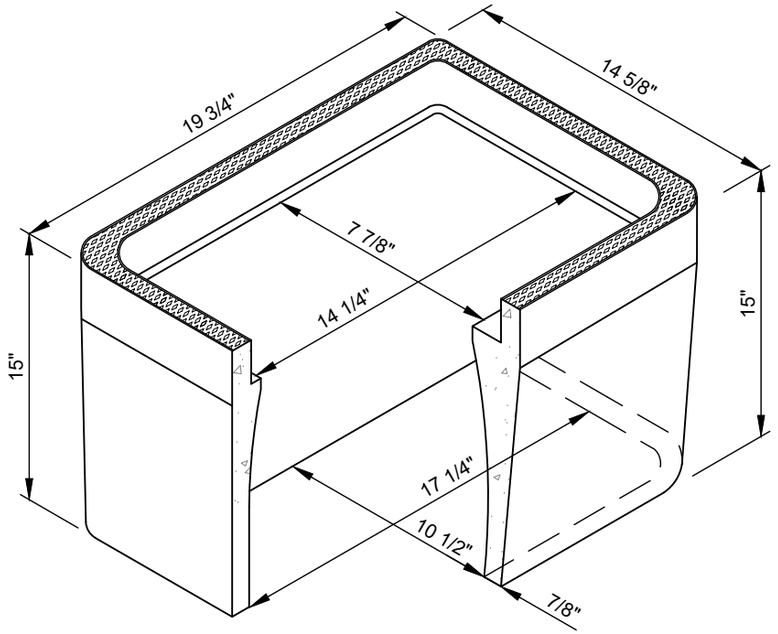
VERSION
1.0

DATE
04/2024

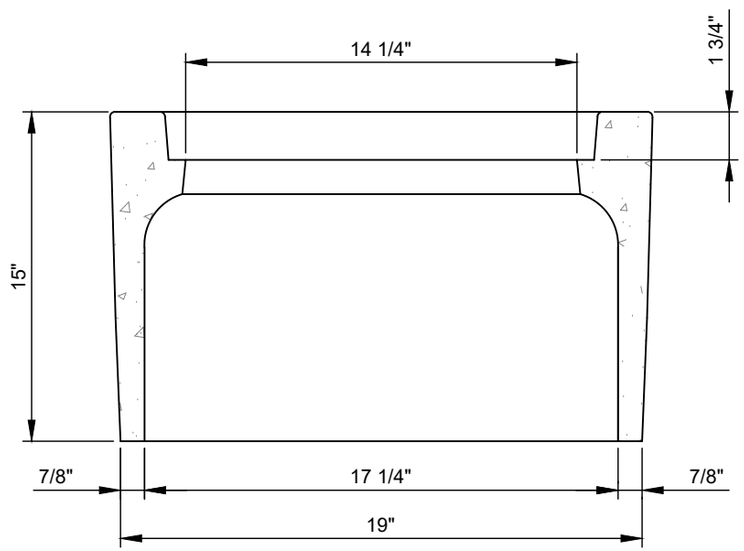
DETAIL
15.1.7



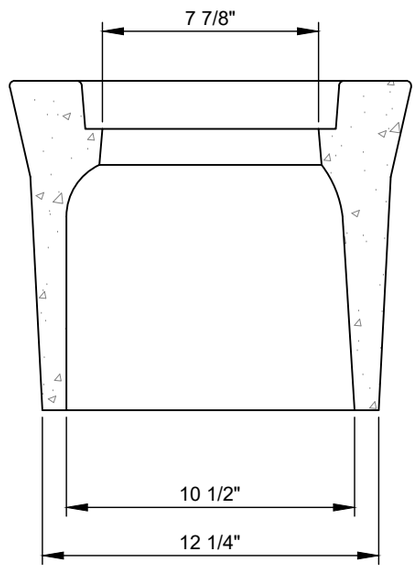
PLAN VIEW



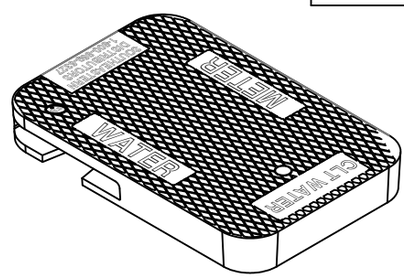
BODY



SECTION VIEW A - A



SECTION VIEW B - B



PLASTIC LID

NO.	DESCRIPTION:
1.	1 3/8" RADIUS.
2.	5/8" RADIUS.
3.	3 3/8" RADIUS.

NOTES:

A. METER BOX SHALL ACCOMMODATE COMPANION PLASTIC METER BOX LID - SEE STANDARD DETAIL.

B. MINOR DIMENSION VARIATIONS ARE PERMITTED, BASED ON MANUFACTURER'S PRODUCT LINES, PROVIDED THE CLTW STANDARD PLASTIC LID FITS PROPERLY.

C. CONCRETE SHALL BE MINIMUM f'c = 4,000 PSI COMPRESSIVE STRENGTH.

D. DESIGN SHALL CONFORM TO ASTM C858-SPECIFICATIONS FOR "UNDERGROUND PRECAST CONCRETE UTILITY STRUCTURE".

E. STEEL REINFORCING DESIGN SHALL CONFORM TO ASTM C857.

F. WELDED WIRE FABRIC SHALL CONFORM TO ASTM A185 AND A82.

G. WHEN METER HAS TO BE IN SIDEWALK, USE THIS DETAIL ONLY (CONCRETE BOX).

MANUFACTURERS:

SOUTHERN METER C.H. 5/8" x 3/4" METER BOX BODY

BOX BODY WEIGHT - 88 LB

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

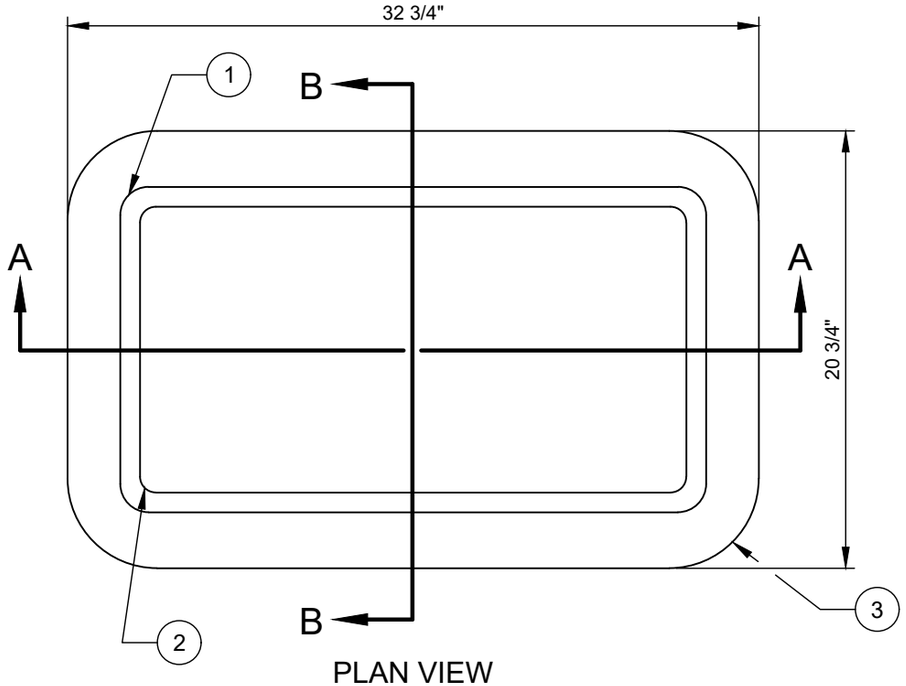
PRECAST CONC. METER BOX FOR 3/4-INCH DOMESTIC WATER SERVICE

NO SCALE

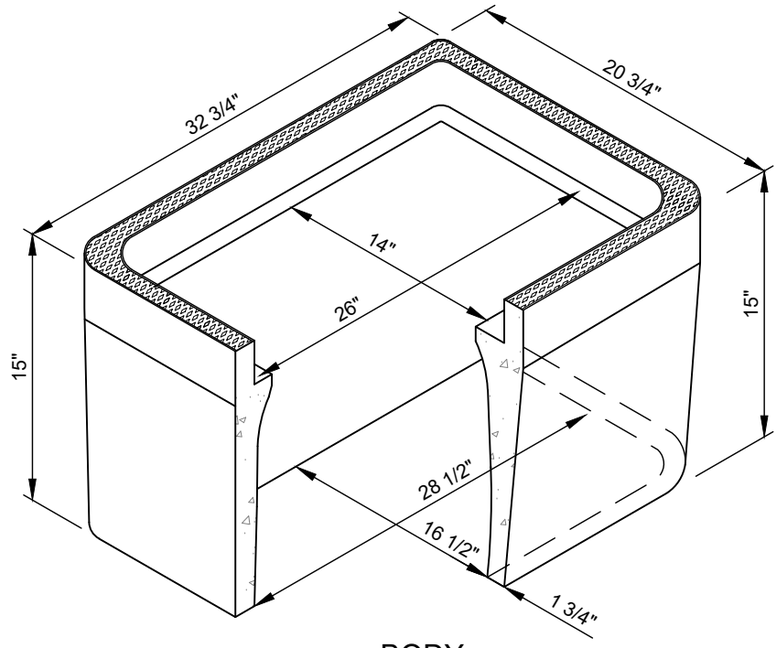
VERSION 1.0

DATE 04/2024

DETAIL 15.2.1



PLAN VIEW



BODY

NO.	DESCRIPTION:
1.	1 11/32" RADIUS.
2.	3/4" RADIUS.
3.	4 1/4" RADIUS.

NOTES:

A. METER BOX SHALL ACCOMMODATE COMPANION PLASTIC METER BOX LID - SEE STANDARD DETAIL.

B. MINOR DIMENSION VARIATIONS ARE PERMITTED, BASED ON MANUFACTURER'S PRODUCT LINES, PROVIDED THE CLTW STANDARD PLASTIC LID FITS PROPERLY.

C. CONCRETE SHALL BE MINIMUM f'c = 4,000 PSI COMPRESSIVE STRENGTH.

D. DESIGN SHALL CONFORM TO ASTM C858-SPECIFICATIONS FOR "UNDERGROUND PRECAST CONCRETE UTILITY".

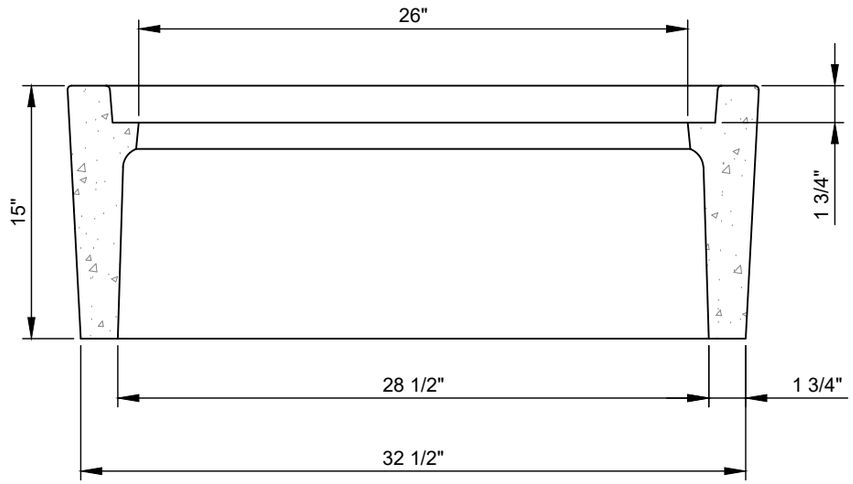
E. STEEL REINFORCING DESIGN SHALL CONFORM TO ASTM C857.

F. WELDED WIRE FABRIC SHALL CONFORM TO ASTM A185 AND A82.

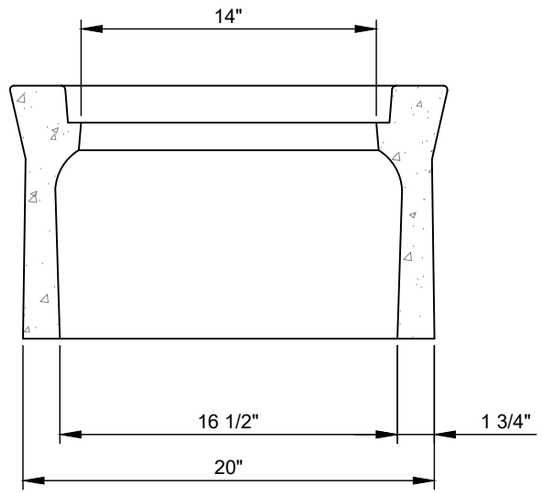
G. WHEN METER HAS TO BE IN SIDEWALK, USE THIS DETAIL ONLY (CONCRETE BOX).

MANUFACTURERS:

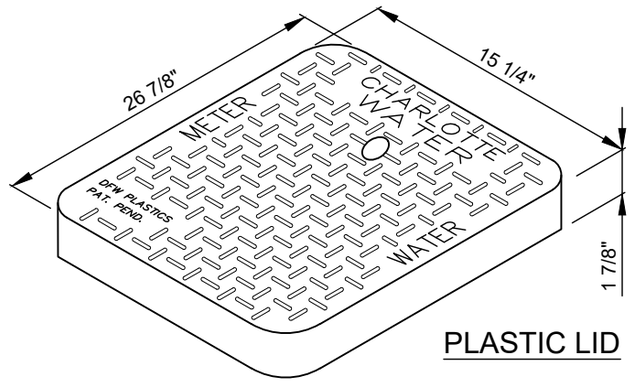
SOUTHERN METER #C.H. 2 METER BOX BODY



SECTION VIEW A - A



SECTION VIEW B - B



PLASTIC LID

BOX BODY WEIGHT - 191 LB

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

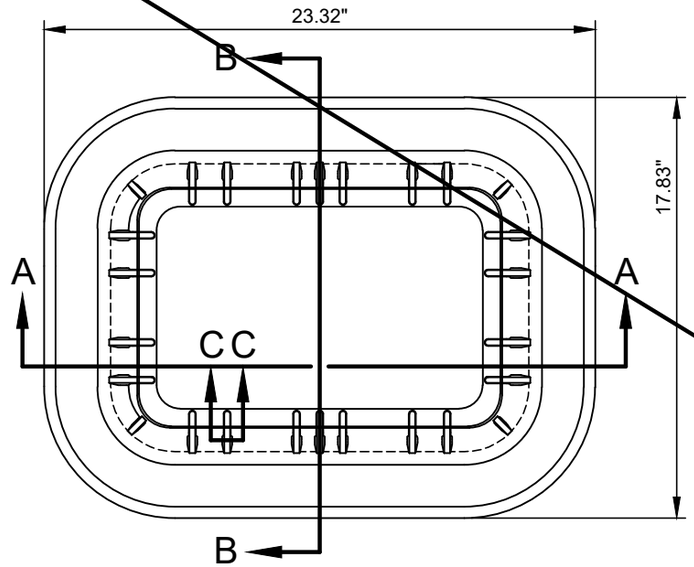
PRECAST CONCRETE METER BOX FOR 1-INCH WATER SERVICE

NO SCALE

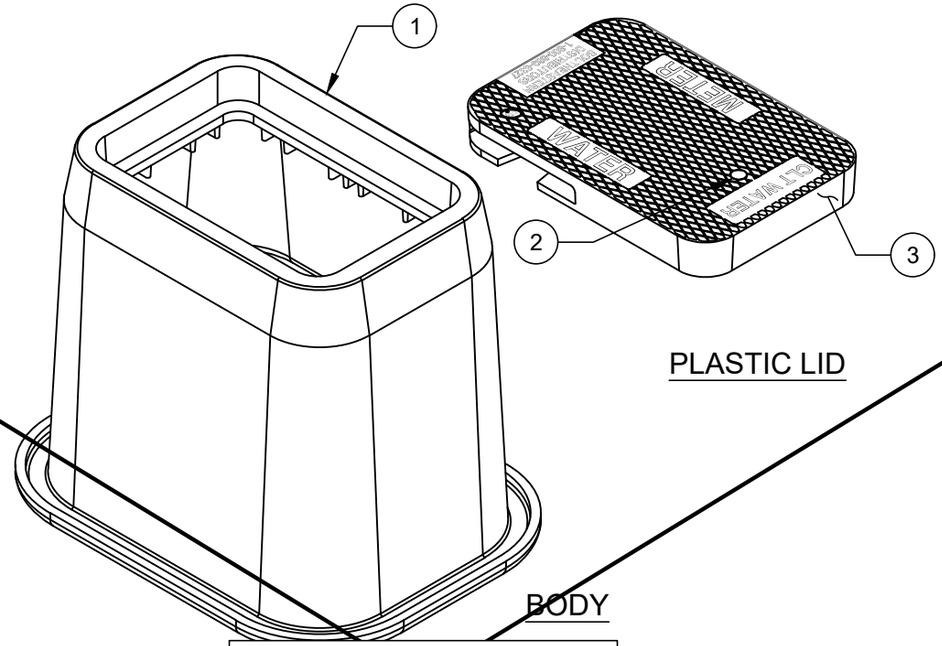
VERSION 1.0

DATE 04/2024

DETAIL 15.2.2



PLAN VIEW



PLASTIC LID

BODY

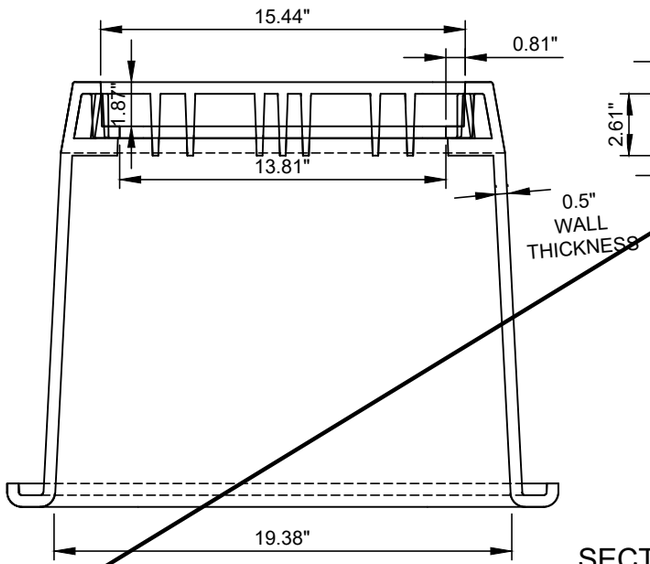
NO LONGER IN USE - SEE STANDARD DETAIL 15.2.4

NO. DESCRIPTION:

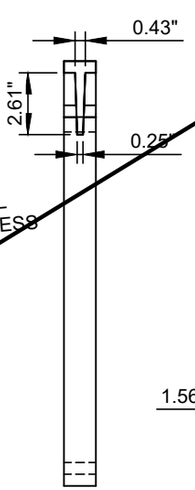
1. MATERIAL SHALL BE HIGH DENSITY POLYETHYLENE.
2. 0.69" DIAMETER PICK HOLE.
3. CHARLOTTE GRAY PLASTIC LID.
4. ITRON 40W MOUNT.
5. 1/8" X Ø3/4" RARE EARTH MAGNET.
6. IMPRINTED "M" UNDER MAGNET.

NOTES:

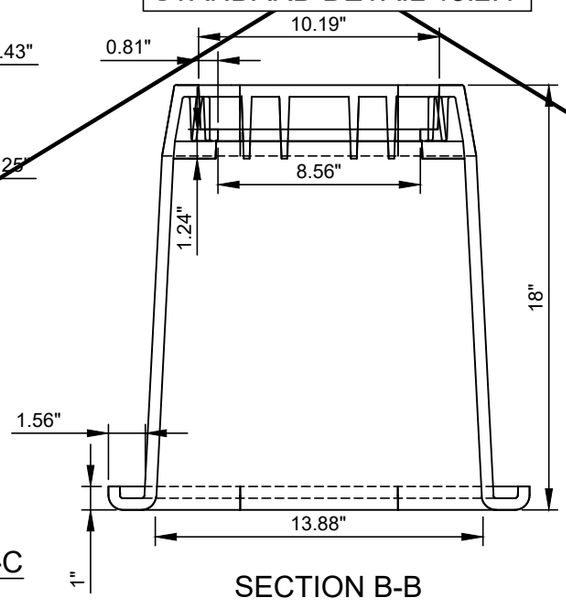
A. MATERIAL SHALL BE HIGH DENSITY POLYETHYLENE.
B. LOAD RATING = HS20.
C. COLOR SHALL BE CHARLOTTE GRAY.
D. SUPPLIER/MANUFACTURER: SOUTHEASTERN DISTRIBUTORS MODEL MB 16 - HD (ADDED HEIGHT).



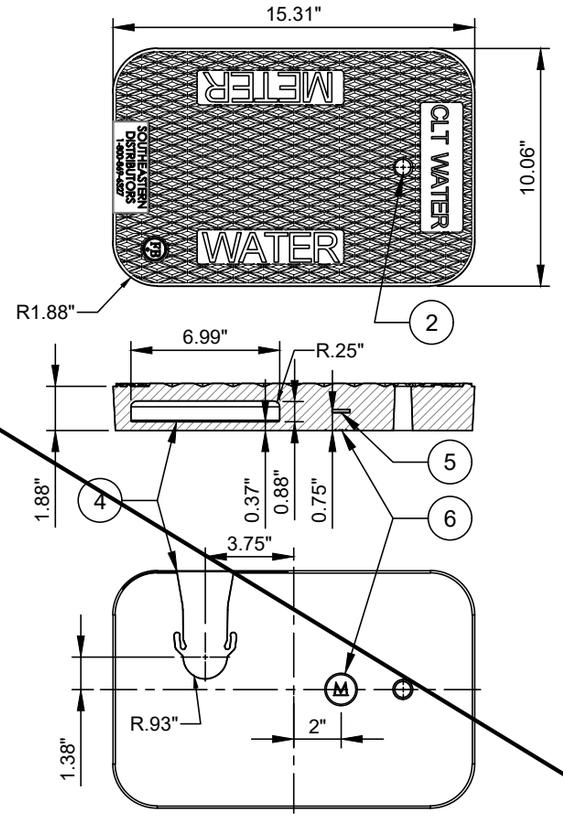
SECTION A-A



SECTION C-C
RIB DETAIL



SECTION B-B



BOTTOM VIEW

METER BOX BODY WEIGHT= 16-18 LBS.

LID WEIGHT - INCLUDING MAGNET - 6 LBS.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

PLASTIC METER BOX AND LID
FOR 3/4-INCH DOMESTIC WATER SERVICE

NO SCALE

VERSION 3.0

DATE 01/2026

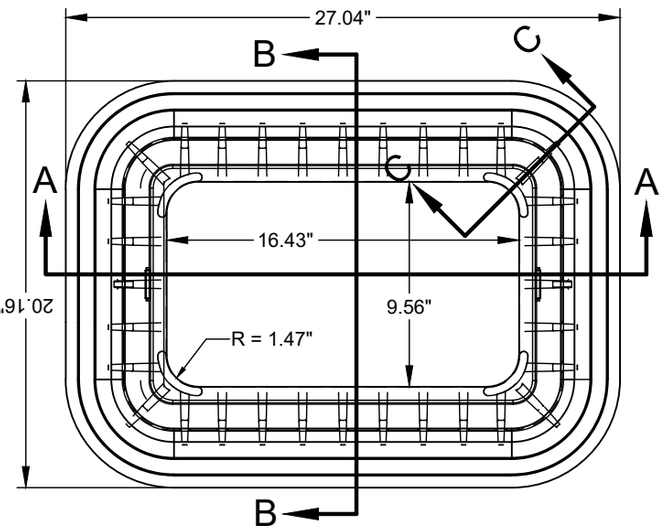
DETAIL 15.2.3

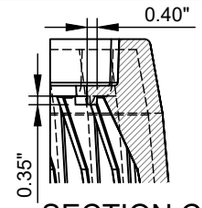
NO. DESCRIPTION:

1. ENDPOINT TRANSMITTER SUPPORT SHELF.
2. 1 INCH DIAMETER PICK HOLE.
3. 1/8" X Ø3/4" RARE EARTH MAGNET.
4. IMPRINTED "M" LOCATER MARK UNDER MAGNET.
5. MANUFACTURER NAME.

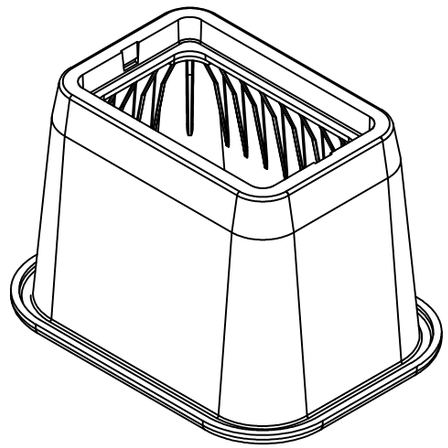
NOTES:

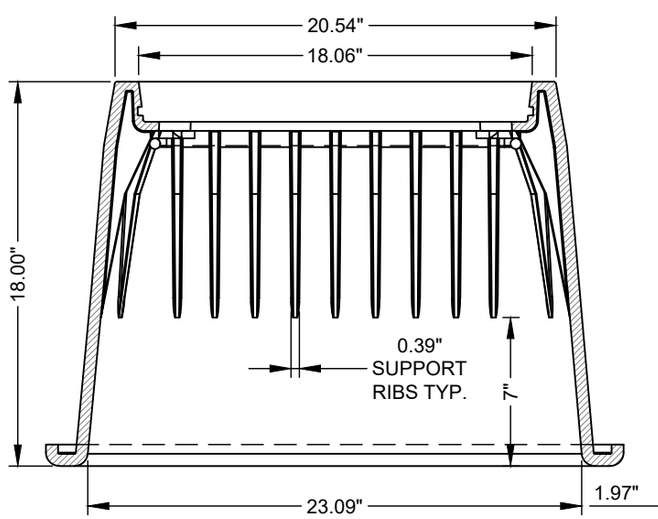
A. MATERIAL SHALL BE HIGH DENSITY POLYETHYLENE.
B. LOAD RATING = HS20 HEAVY DUTY.
C. COLOR SHALL BE CHARLOTTE GRAY.
D. MANUFACTURERS; SOUTHEASTERN, DFW AND SIGMA.



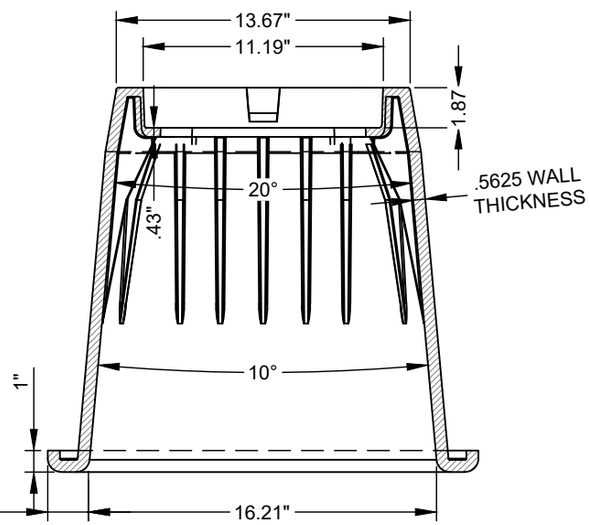


SECTION C-C

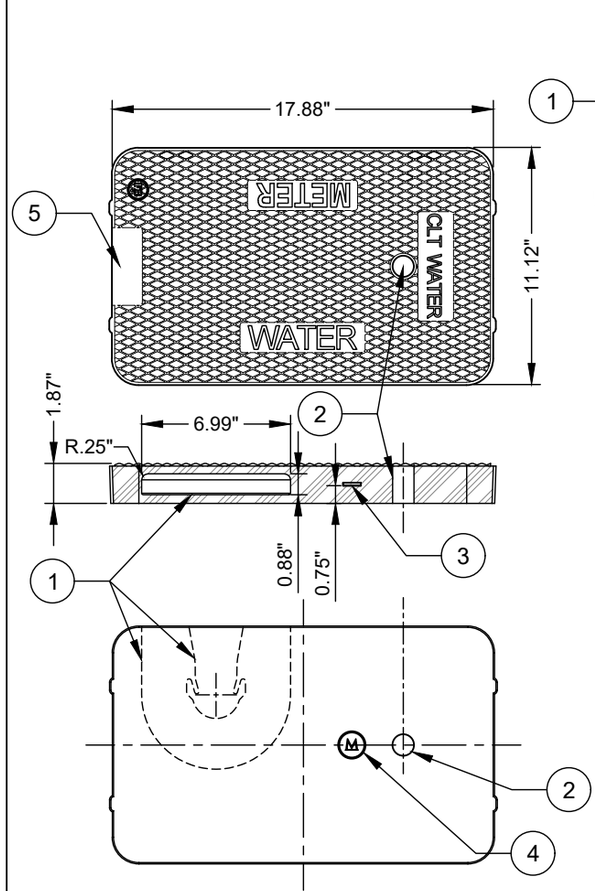




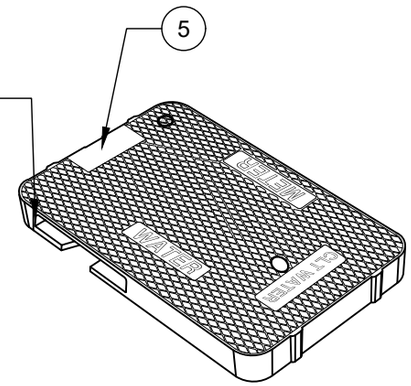
SECTION A-A

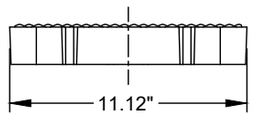


SECTION B-B



BOTTOM VIEW





METER BOX BODY WEIGHT = APPROX. 20 - 24 LBS. LID WEIGHT = APPROX. 8 - 14 LBS.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

PLASTIC METER BOX AND LID FOR 3/4-INCH AND 1-INCH DOMESTIC WATER SERVICE

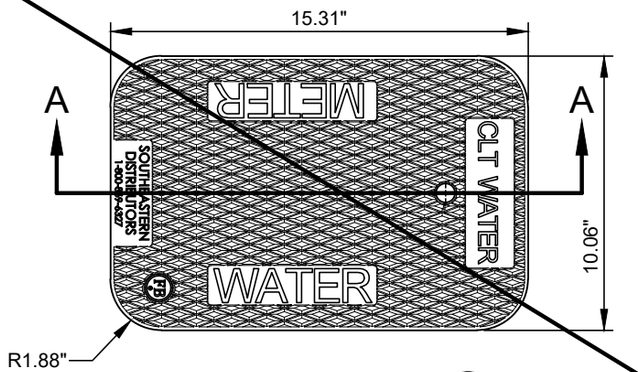
NO SCALE

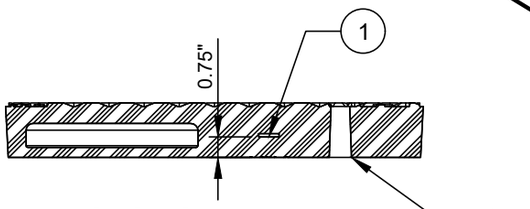
VERSION 2.0

DATE 01/2026

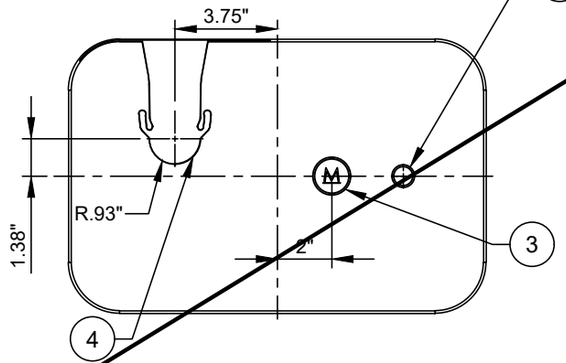
DETAIL 15.2.4

3/4-INCH SERVICE LID





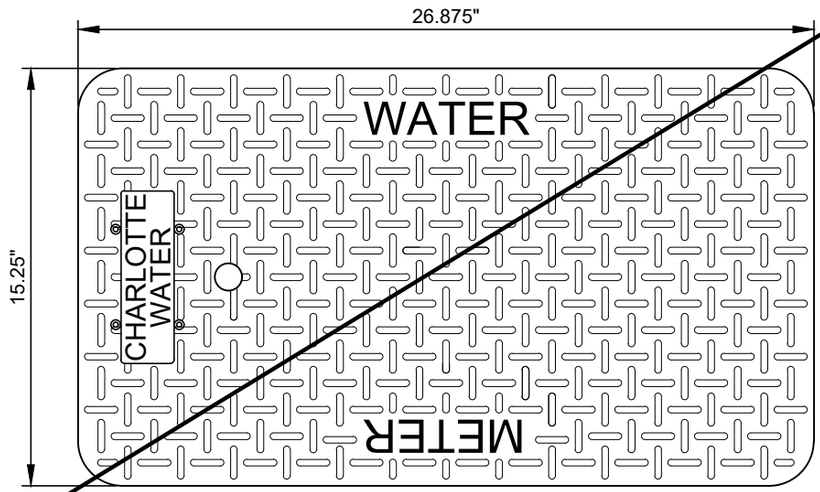
SECTION VIEW A-A

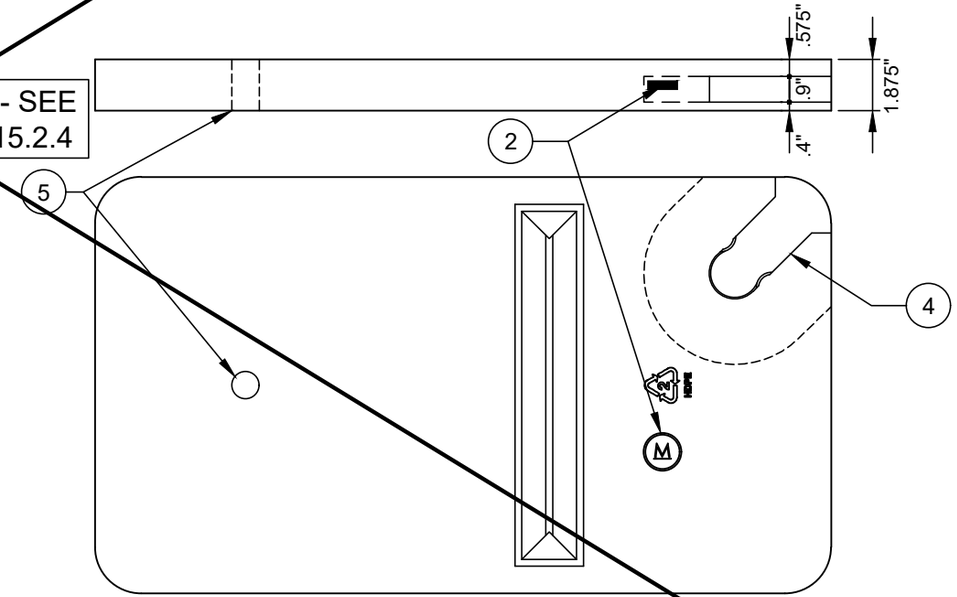


SOUTHEASTERN DISTRIBUTORS - MB16 HD - LID WEIGHT - INCLUDING MAGNET - 6 LBS.

NO LONGER IN USE - SEE STANDARD DETAIL 15.2.4

1-INCH SERVICE LID





DFW 65C - RSGSM - LID WEIGHT - LBS.

NO.	DESCRIPTION:
1.	1/8" X Ø3/4" DIA. RARE EARTH MAGNET (MOLDED IN RARE EARTH MAGNET, MINIMUM 1.4 TESLA MAGNET STRENGTH).
2.	0.69" DIAMETER PICK HOLE.
3.	MAGNET LOCATION MARKER.
4.	ITRON 40W MOUNT.
5.	1" DIAMETER PICK HOLE.

NOTES:

A. MATERIAL - HIGH DENSITY POLYETHYLENE (HDPE) - RECYCLED.
B. COLOR - CHARLOTTE GREY.
C. LOAD RATING - HEAVY DUTY.
D. MANUFACTURER - SOUTHEASTERN DISTRIBUTORS, INC., DFW PLASTICS INC. OR APPROVED EQUAL.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

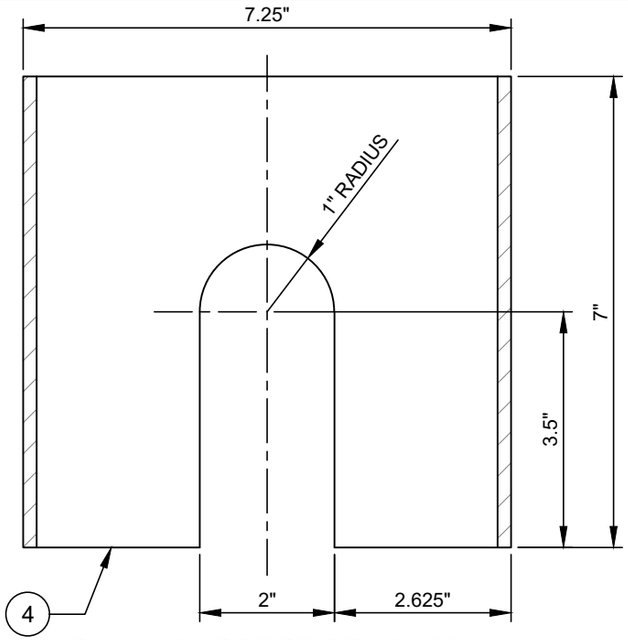
WATER METER BOX - PLASTIC LID FOR 3/4-INCH AND 1-INCH WATER SERVICES

NO SCALE

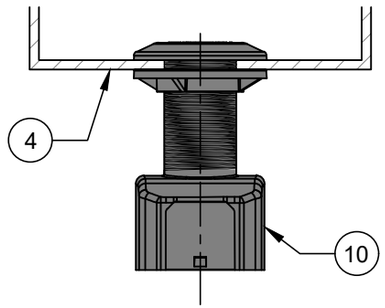
VERSION 2.0

DATE 01/2026

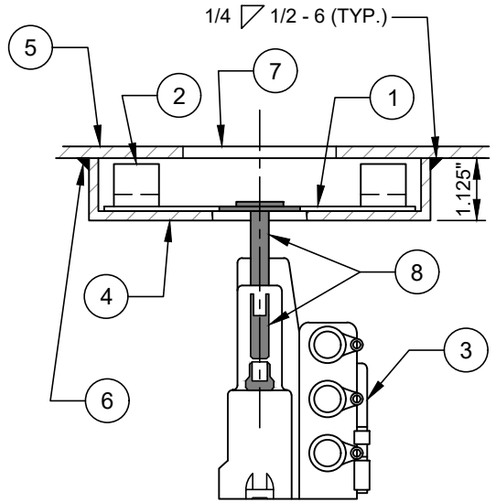
DETAIL 15.2.5



PLAN - SUPPORT BRACKET



BADGER ORION CELLULAR ENDPOINT WITH MOUNT ADAPTER

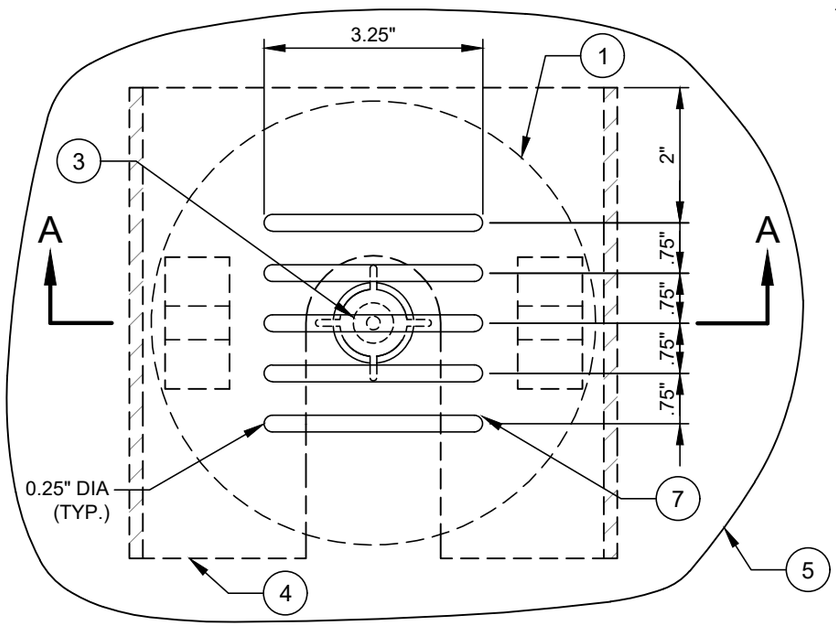


SECTION "A-A" - SUPPORT BRACKET WITH ITRON ERT AND DISC

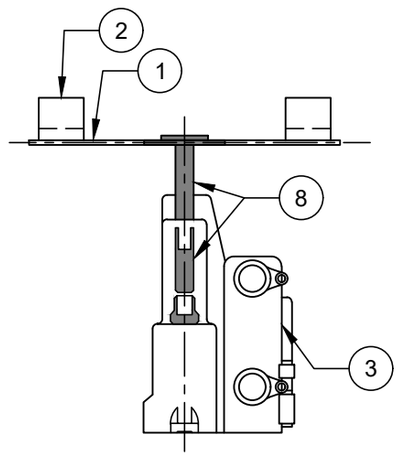
NO.	DESCRIPTION:
1.	ITRON 6.7" DIAMETER SHELF MOUNT DISC WITH FOAM SPACERS.
2.	FOAM SPACERS 2 EACH (TYPICAL).
3.	ITRON END POINT TRANSMITTER.
4.	SUPPORT BRACKET (1/4" STEEL PLATE).
5.	DIAMOND PLATE DOOR LEAF.
6.	FILLET WELD SUPPORT BRACKET AT CORNERS.
7.	TRANSMITTER SLOTS - 5 EA. AS SHOWN.
8.	ITRON SHELF DISC ADAPTER.
9.	ITRON MOUNT ADAPTER.
10.	BADGER ORION CELLULAR ENDPOINT WITH LOCKNUTS FOR BRACKET MOUNT.

NOTES:

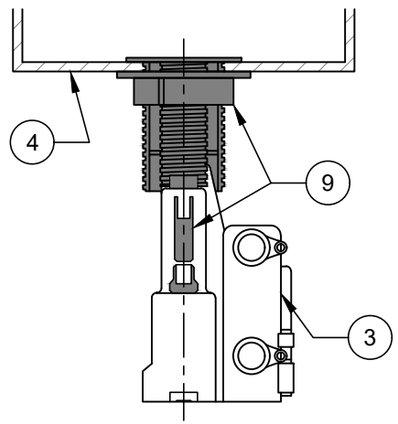
A. ONE SUPPORT BRACKET REQUIRED FOR EACH METER IN VAULT.
B. ITRON 100W ADAPTER SHALL BE SNAPPED INTO SHELF MOUNT DISC AND ITRON 100W ERT TRANSMITTER. ITRON 500W ADAPTER SHALL BE TIGHTLY ATTACHED TO THE SUPPORT BRACKET SLOT AND ITRON 100W TRANSMITTER.
C. TRANSMITTER/MOUNT ADAPTER SHALL BE INSERTED INTO SUPPORT BRACKET AS SHOWN.
D. DOOR LEAF AND SUPPORT BRACKET SHALL BE OF LIKE MATERIALS.
E. SEE ACCESS DOOR STANDARD DETAILS FOR SUPPORT BRACKET LOCATIONS.



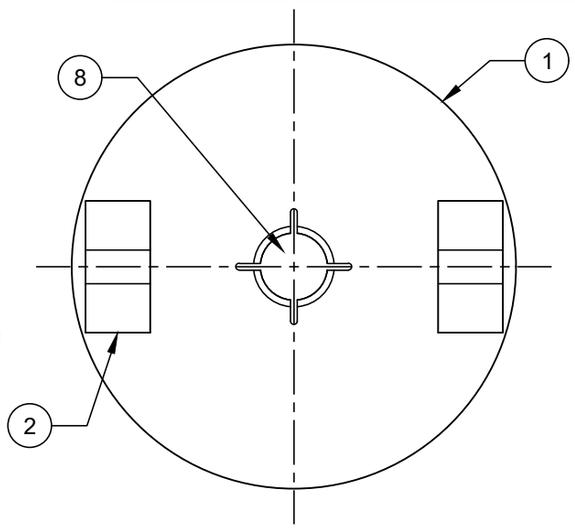
PLAN - TRANSMITTER SLOT DETAIL



ITRON WITH DISC ADAPTER



ITRON WITH MOUNT ADAPTER



ITRON SHELF MOUNT DISC

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

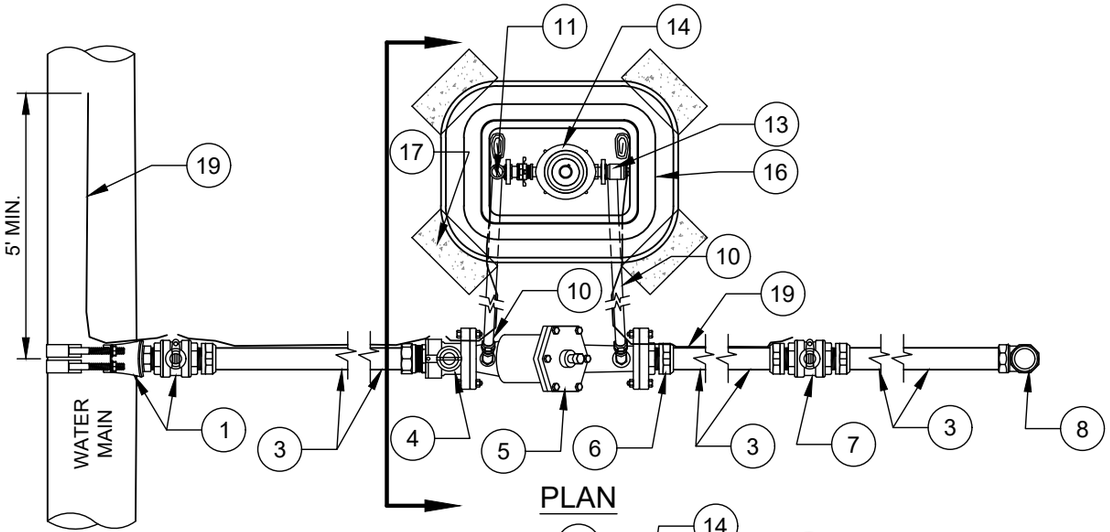
END POINT TRANSMITTER SUPPORT BRACKET & END POINT SHELF - MOUNT ADAPTER

NO SCALE

VERSION 2.0

DATE 01/2026

DETAIL 15.2.6

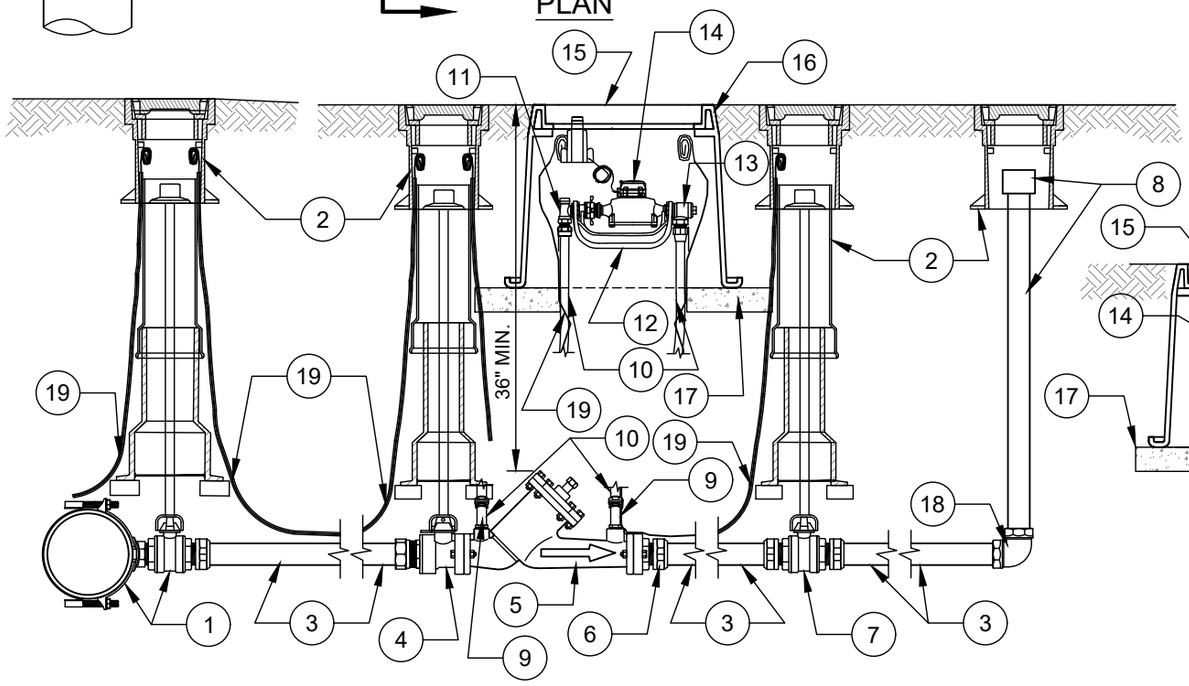


PLAN

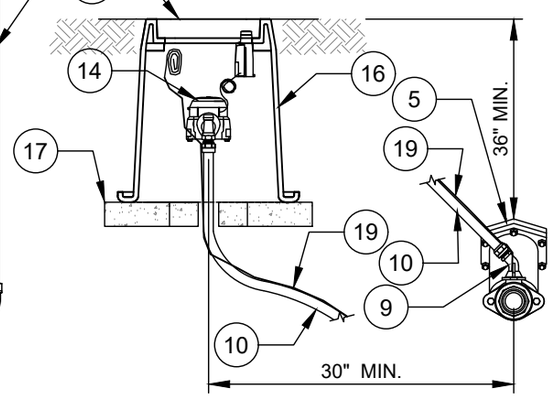
NOTES:

A. CENTER ANGLE BALL VALVE NO. 11 AND SINGLE ANGLE CHECK VALVE NO. 13 IN METER BOX.
B. LOCK ANGLE BALL VALVE NO. 11 IN OPEN POSITION. PERMANENT LOCK (WITH CLTW SERIAL #) SHALL BE FURNISHED BY CLTW.
C. METER BOX TO BE FLUSH WITH GROUND OR CONCRETE SIDEWALK, GROUND SHALL SLOPE AWAY FROM METER BOX.
D. 5/8-INCH METER SHALL BE INSTALLED IN STANDARD METER BOX PER STD. DETAIL.

FIRE SERVICE SIZE	DETECTOR METER SIZE
2"	5/8"



ELEVATION



SIDE ELEVATION

NO. DESCRIPTION:

1. TAPPING SADDLE & 2" BALL CORPORATION STOP WITH BRASS TEE HEAD OPERATING NUT (CC TAPER THREAD X CTS COMPRESSION).
2. STANDARD VALVE BOX ASSEMBLY (TYP.) - ALL VALVES (OMIT AT CORPORATION STOP ON SHORT SIDE SERVICE).
3. 2" TYPE K COPPER TUBING CONTINUOUS ONE PIECE (NO FITTINGS ALLOWED) .
4. BALL STRAIGHT METER VALVE - (2 BOLT METER FL X CTS COMPRESSION), MUELLER #B-24335 OR APPROVED EQUAL.
5. DETECTOR CHECK VALVE - (2 BOLT METER FL X 2 BOLT METER FL), FEBCO SERIES 406, OR APPROVED EQUAL.
6. STRAIGHT METER COUPLING - (2 BOLT METER FL X CTS COMPRESSION), FORD #CF34-77, OR APPROVED EQUAL.
7. PROPERTY LINE BALL CURB VALVE - (ALL CTS COMPRESSION), MUELLER #B-25209, FORD #B44-777, OR APPROVED EQUAL.
8. TEMPORARY 2" BLOW-OFF ASSEMBLY - GALV. STEEL PIPE WITH THREADED COUPLING.
9. 3/4-INCH 45° COUPLING (MIP TREAD X CTS COMPRESSION), MUELLER #H15529, OR APPROVED EQUAL.
10. 3/4-INCH TYPE K COPPER.
11. 5/8-INCH X 3/4-INCH ANGLE BALL VALVE WITH LOCK WINGS (LOCK OPEN) (CTS COMPRESSION X YOKE STAR NUT).
12. 5/8-INCH METER YOKE BAR.
13. 5/8-INCH X 3/4 INCH SINGLE ANGLE CHECK VALVE (YOKE STAR NUT X CTS COMPRESSION).
14. 3/4-INCH METER ASSEMBLY WITH AMR TRANSMITTER (BY CLTW).
15. SOLID POLYETHYLENE (HDPE) METER BOX LID.
16. STANDARD 3/4-INCH PLASTIC METER BOX PER STANDARD DETAIL. USE CONCRETE METER BOX ONLY WHEN METER IS IN SIDEWALK.
17. SOLID STANDARD CONCRETE BRICKS - DIAGONAL AT CORNERS - 4 EACH.
18. 90° BEND (CTS COMPRESSION X FNPT).
19. AWG #12 GAUGE SOLID COPPER TRACER WIRE WITH 30 MILS BLUE INSULATION, TERMINATE WITH 24" EXCESS WIRE (COILED) AT METER BOX AND VALVE BOX (TYP).

ALTERNATE DESCRIPTION:

WHEN USING HDPE (IPS) POLY IN PLACE OF COPPER TUBING - USE THE FOLLOWING PRODUCTS:

1. 2" BALL CORPORATION STOP (CC TAPER THREAD X FNPT).
3. 2" SDR9 HDPE (IPS) POLY WITH STAINLESS STEEL, BRASS, OR BRONZE MNPT ENDS CONTINUOUS ONE PIECE (NO FITTINGS ALLOWED).
4. BALL STRAIGHT METER VALVE (2 BOLT METER FLANGE X FNPT) MUELLER #B-24337 OR APPROVED EQUAL.
6. STRAIGHT METER COUPLING - (2 BOLT METER FL X FNPT) FORD #CF31-77, OR APPROVED EQUAL.
7. BALL CURB VALVE (FNPT X FNPT).
18. 90° BEND (FNPT X FNPT).

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

2" FIRE LINE SPRINKLER SERVICE WITH DETECTOR METER ASSEMBLY

NO SCALE

VERSION 1.0

DATE 04/2024

DETAIL 15.3.1

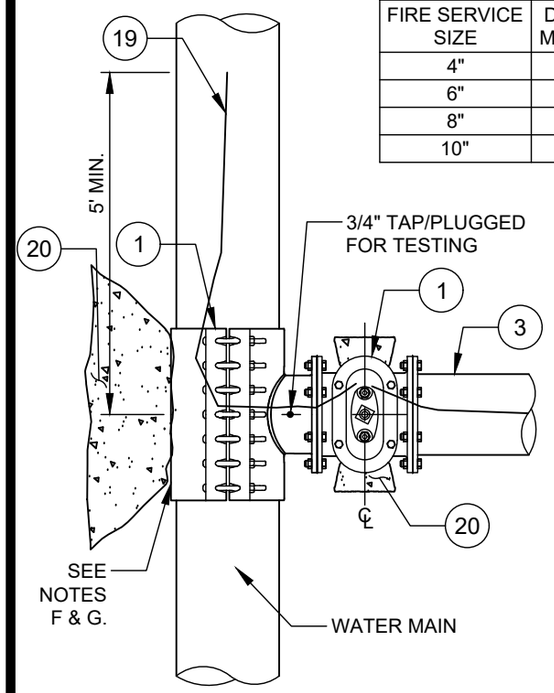
FIRE SERVICE SIZE	DETECTOR METER SIZE
4"	1"
6"	1"
8"	1"
10"	1"

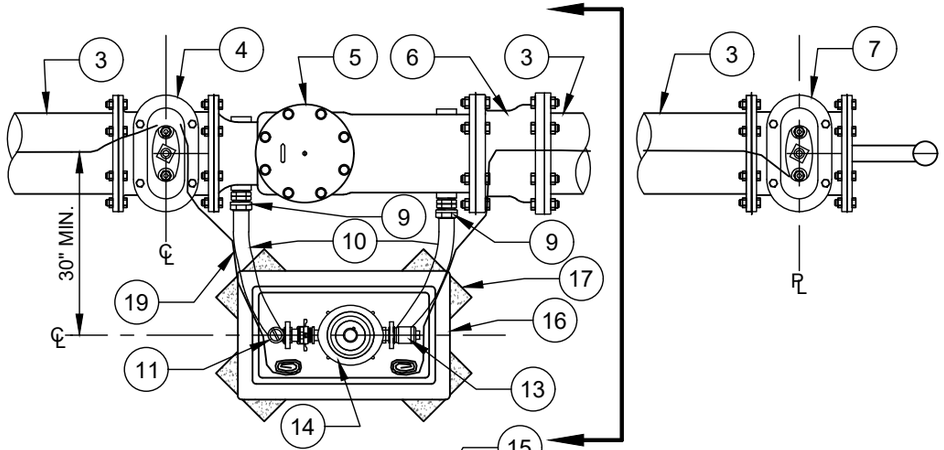
NOTES:

A. ALL FLANGE HARDWARE (BOLT/WASHER/NUT) SHALL BE STAINLESS STEEL - TYPE 304 WITH ANTI-SEIZE COMPOUND.
B. ALL PIPE SHALL BE RESTRAINED JOINT DUCTILE IRON FROM TAP TO PROPERTY LINE VALVE.
C. METER BOX TO BE FLUSH WITH GROUND OR CONCRETE SIDEWALK, GROUND SHALL SLOPE AWAY FROM METER BOX.
D. ALL VALVES SHALL BE OPEN RIGHT - CLOCKWISE, EXCEPT NO. 7.
E. ONE INCH METER SHALL BE INSTALLED IN STANDARD METER BOX PER STD. DETAIL.
F. WRAP TAPPING SLEEVE WITH 2 LAYERS HDPE PLASTIC FILM (HDCLPE PER AWWA C-105) - 4 MILS EACH LAYER - EXTEND HDPE 2' EACH WAY FROM SLEEVE - DUCT TAPE OR ZIP LOCK TIE ENDS.
G. CONCRETE THRUST BLOCKING REQUIRED AT TAPPING SLEEVE.
H. ANGLE BALL VALVE NO. 11 PERMANENT LOCK (WITH CLTW SERIAL #) SHALL BE FURNISHED BY CLTW.

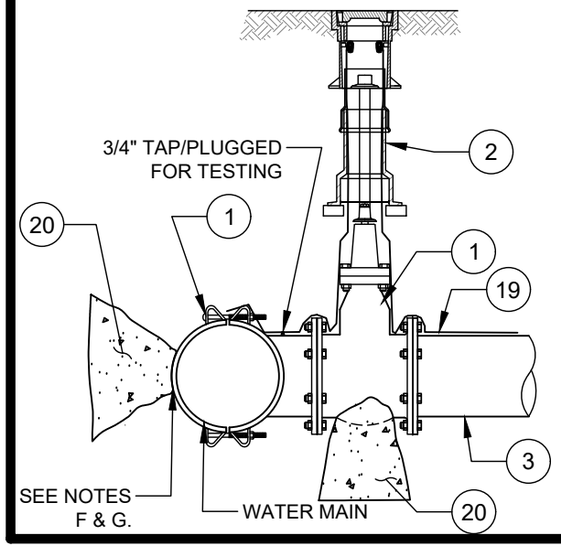
NO. DESCRIPTION:

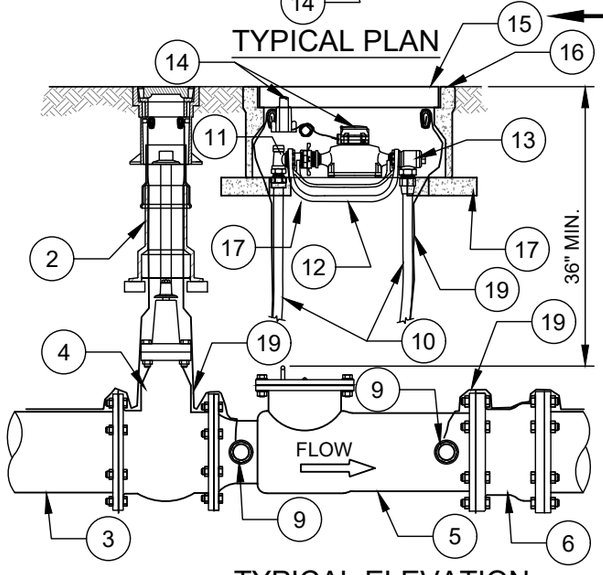
1. TAPPING SLEEVE & FL X MJ TAPPING VALVE ON EXISTING MAIN. MJ TEE, FOSTER ADAPTOR, AND MJ GATE VALVE ON NEW MAIN.
2. STANDARD VALVE BOX ASSEMBLY (TYP.) - ALL VALVES.
3. RESTRAINED JOINT DUCTILE IRON PIPE.
4. FLANGE X MJ GATE VALVE ON LONG SIDE SERVICES. FLANGE X FL ADAPTER ON SHORT SIDE SERVICE (NOT SHOWN).
5. DETECTOR CHECK VALVE (FLANGE X FLANGE).
6. FLANGE X MJ ADAPTOR (OMIT WHEN PROPERTY LINE VALVE NO. 7 IS BOLTED DIRECTLY TO DETECTOR CHECK VALVE NO. 5).
7. MJ GATE VALVE (RESTRAINED, OPEN LEFT) AT PROPERTY LINE. (FL X MJ GATE VALVE BOLTED DIRECTLY TO DETECTOR CHECK VALVE NO. 5 - WHEN APPROVED).
8. TEMP. 2" PIPE GALV. STEEL (SCH 80) WITH THREADED COUPLING.
9. CTS X MNPT BRASS STRAIGHT COUPLING (WITH BRASS HEX REDUCING BUSHING - AS REQUIRED).
10. 1" COPPER TUBE - TYPE K.
11. 1" ANGLE BALL VALVE WITH LOCK WINGS (LOCK OPEN WITH LOCK FURNISHED BY CLTW) (CTS COMPRESSION X YOKE STAR NUT).
12. 1" METER YOKE BAR.
13. 1" SINGLE ANGLE CHECK VALVE (YOKE STAR NUT X CTS COMPRESSION).
14. 1" METER ASSEMBLY WITH AMR TRANSMITTER (BY CLTW).
15. GRAY SOLID POLYETHYLENE (HDPE) METER BOX LID PER STD. DETAIL.
16. GRAY STANDARD 1-INCH PLASTIC METER BOX PER STANDARD DETAIL. USE CONCRETE METER BOX ONLY WHEN METER IS IN SIDEWALK.
17. SOLID STANDARD CONCRETE BRICKS - DIAGONAL AT CORNERS - 4 EACH.
18. TEMP. MALLEABLE IRON (GALV.) 90° BEND (FNPT X FNPT).
19. AWG #12 GAUGE SOLID COPPER HDPE INSTALLATION TRACER WIRE WITH 30 MILS BLUE INSULATION, TERMINATE WITH 24" EXCESS WIRE (COILED) AT METER BOX AND VALVE BOX (TYP.).
20. CONCRETE THRUST BLOCKING - 3,600 PSI.



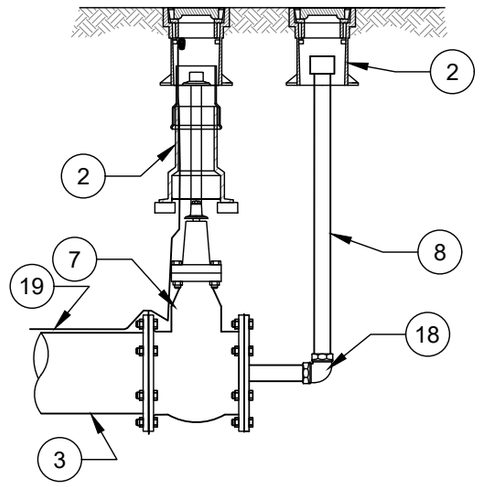


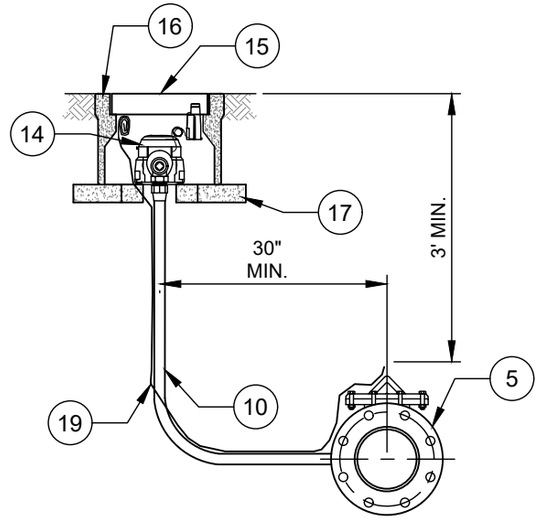
TYPICAL PLAN





TYPICAL ELEVATION





SIDE ELEVATION

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

4" - 10" FIRE LINE SERVICE WITH DETECTOR METER ASSEMBLY

NO SCALE

VERSION 1.0

DATE 04/2024

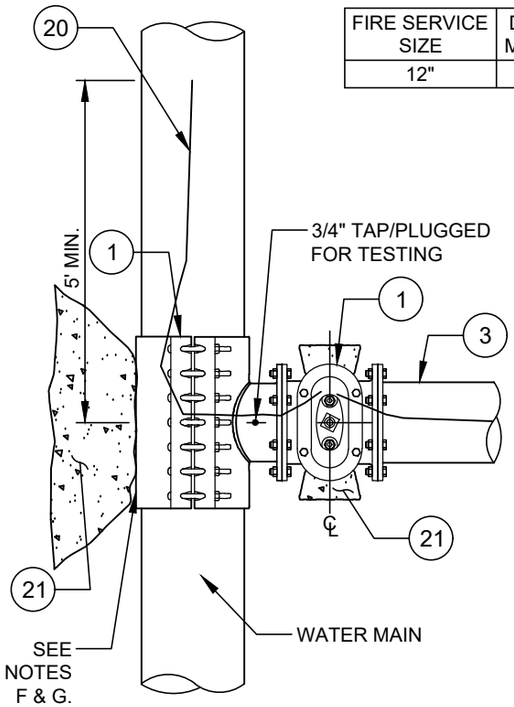
DETAIL 15.3.2

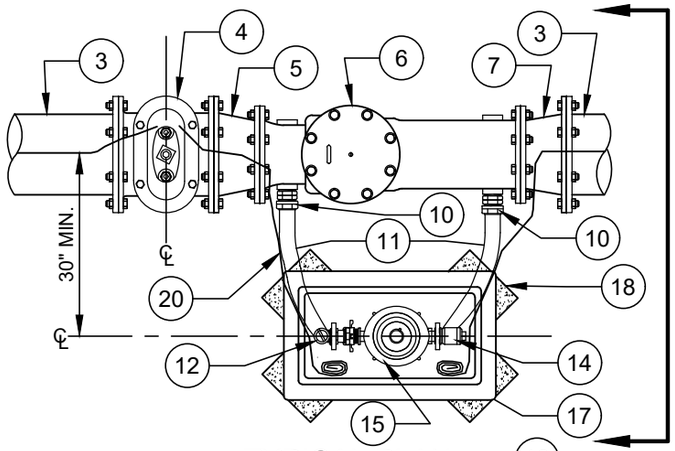
FIRE SERVICE SIZE	DETECTOR METER SIZE
12"	1"

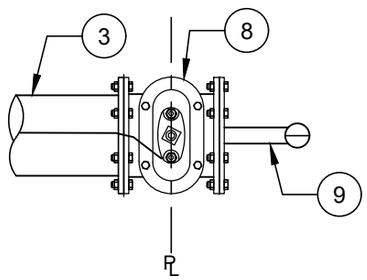
NOTES:

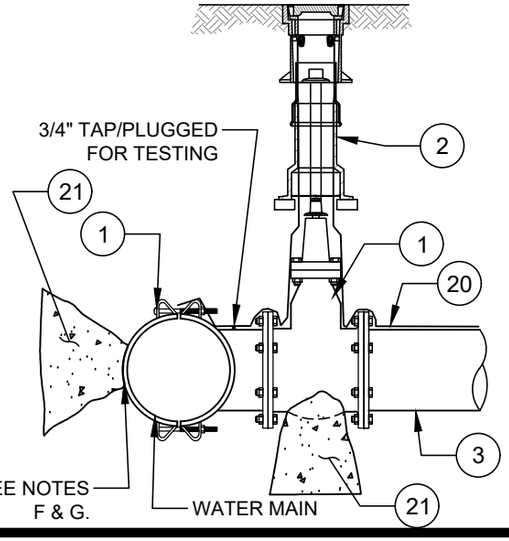
A. ALL FLANGE HARDWARE (BOLT/WASHER/NUT) SHALL BE STAINLESS STEEL - TYPE 304 WITH ANTI-SEIZE COMPOUND.
B. ALL PIPE SHALL BE RESTRAINED JOINT DUCTILE IRON FROM TAP TO PROPERTY LINE VALVE.
C. METER BOX TO BE FLUSH WITH GROUND OR CONCRETE SIDEWALK, GROUND SHALL SLOPE AWAY FROM METER BOX.
D. ALL VALVES SHALL BE OPEN RIGHT - CLOCKWISE, EXCEPT NO. 8.
E. ONE INCH METER SHALL BE INSTALLED IN STANDARD METER BOX PER STD. DETAIL.
F. WRAP TAPPING SLEEVE WITH 2 LAYERS HDPE PLASTIC FILM (HDCLPE PER AWWA C-105) - 4 MILS EACH LAYER - EXTEND HDPE 2' EACH WAY FROM SLEEVE - DUCT TAPE OR ZIP LOCK TIE ENDS.
G. CONCRETE THRUST BLOCKING REQUIRED AT TAPPING SLEEVE.
H. ANGLE BALL VALVE NO. 12 PERMANENT LOCK (WITH CLTW SERIAL #) SHALL BE FURNISHED BY CLTW.

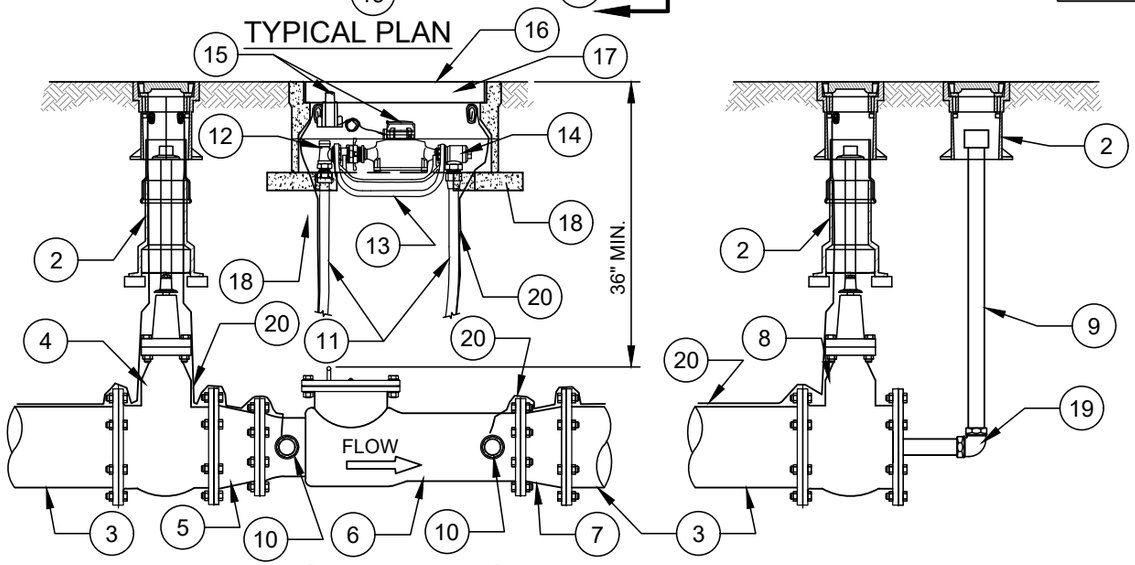
NO.	DESCRIPTION:
1.	TAPPING SLEEVE & FL X MJ 12" TAPPING VALVE ON EXISTING MAIN. MJ TEE, FOSTER ADAPTER AND MJ 12" GATE VALVE ON NEW MAIN.
2.	STANDARD VALVE BOX ASSEMBLY (TYP.) - ALL VALVES.
3.	RESTRAINED JOINT DUCTILE IRON PIPE - 12" DIAMETER.
4.	12" MJ GATE VALVE ON LONG SIDE SERVICES. OMIT ON SHORT SIDE SERVICE (NOT SHOWN).
5.	12" X 10" REDUCER - MJ X FLANGE.
6.	10" DETECTOR CHECK VALVE (FLANGE X FLANGE).
7.	10" X 12" REDUCER - FLANGE X MJ.
8.	MJ GATE VALVE (RESTRAINED, OPEN LEFT) AT PROPERTY LINE. (FL X MJ GATE VALVE BOLTED DIRECTLY TO 10" X 12" REDUCER NO. 7 - WHEN APPROVED).
9.	TEMP. 2" PIPE GALV. STEEL (SCH 80) WITH THREADED COUPLING.
10.	CTS X MNPT BRASS STRAIGHT COUPLING (WITH BRASS HEX REDUCING BUSHING - AS REQUIRED).
11.	1" COPPER TUBE - TYPE K.
12.	1" ANGLE BALL VALVE WITH LOCK WINGS (LOCK OPEN WITH LOCK FURNISHED BY CLTW) (CTS COMPRESSION X YOKE STAR NUT).
13.	1" METER YOKE BAR.
14.	1" SINGLE ANGLE CHECK VALVE (YOKE STAR NUT X CTS COMPRESSION).
15.	1" METER ASSEMBLY WITH AMR TRANSMITTER (BY CLTW).
16.	GRAY SOLID POLYETHYLENE (HDPE) METER BOX LID PER STD. DETAIL.
17.	GRAY STANDARD 1-INCH PLASTIC METER BOX PER STANDARD DETAIL. USE CONCRETE METER BOX ONLY WHEN METER IS IN SIDEWALK.
18.	SOLID STANDARD CONCRETE BRICKS - DIAGONAL AT CORNERS - 4 EACH.
19.	TEMP. MALLEABLE IRON (GALV.) 90° BEND (FNPT X FNPT).
20.	AWG #12 GAUGE SOLID COPPER HDPE INSTALLATION TRACER WIRE WITH 30 MILS BLUE INSULATION, TERMINATE WITH 24" EXCESS WIRE (COILED) AT METER BOX AND VALVE BOX (TYP.).
21.	CONCRETE THRUST BLOCKING - 3,600 PSI.

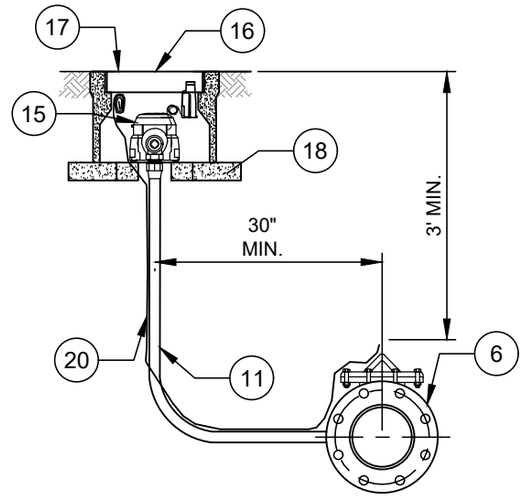












CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

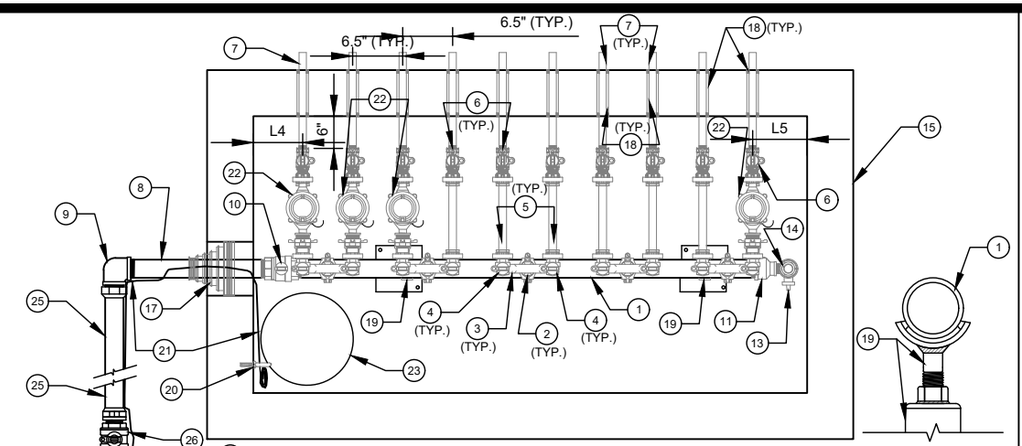
12" FIRE LINE SERVICE WITH DETECTOR METER ASSEMBLY

NO SCALE

VERSION 1.0

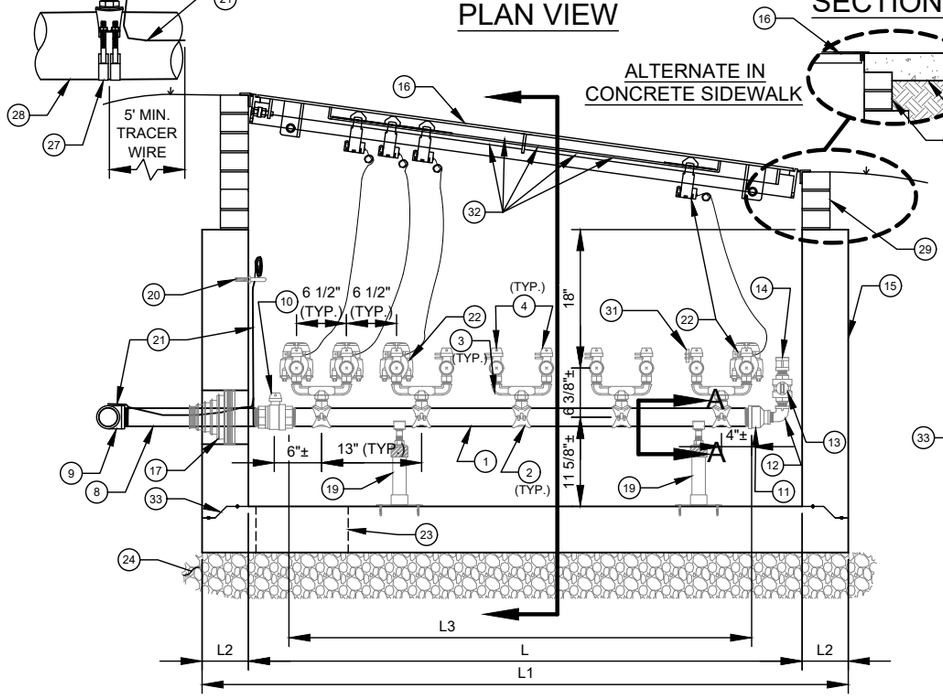
DATE 04/2024

DETAIL 15.3.3

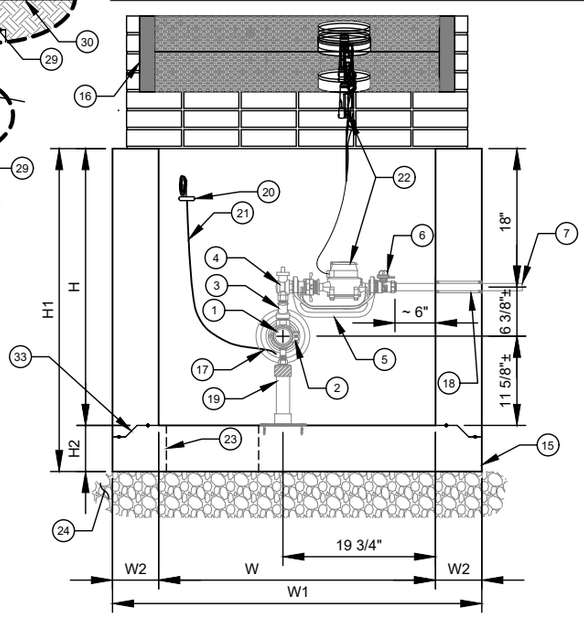


PLAN VIEW

SECTION A-A



ELEVATION VIEW



SIDE ELEVATION VIEW

NO. ALTERNATE DESCRIPTION:

WHEN USING SDR9 HDPE (IPS) WITH STAINLESS STEEL, BRASS, OR BRONZE MNPT ENDS, USE THE FOLLOWING PRODUCTS:

9. 2" - 90° SCH. 40 BRASS OR S.S. BEND - FNPT X FNPT.
25. 2" SDR9 HDPE (POLY) IPS PIPE (MNPT X MNPT) - LENGTH AS REQUIRED (NO JOINTS PERMITTED).
26. FOR EXISTING MAINS - 2" BALL CORPORATION STOP W/ TEE HEAD OPERATING NUT - CC (TAPER THREAD) X FNPT (W/ STD. VALVE BOX ASSEMBLY) OR; FOR NEW MAINS - MJ TEE, MJ PLUG - TAP - 2", 2" X 6" SCH 40 RED BRASS NIPPLE, 2" GATE VALVE W/ TEE HEAD OPERATING NUT (FNPT) (WITH STANDARD VALVE BOX ASSEMBLY).

NOTES:

A. ACCESS DOOR SHALL BE ANCHORED TO VAULT OR SIDEWALK PER ACCESS DOOR STANDARD DETAIL.
B. ACCESS DOOR SHALL BE FLUSH WITH GROUND OR SIDEWALK, AND GROUND SHALL SLOPE AWAY FROM VAULT.
C. SEE MULTIPLE WATER SERVICES - SCHEMATIC STANDARD DETAIL FOR ADDITIONAL LAYOUT REQUIREMENTS AND OPTIONS.
D. ASSEMBLY MAY BE FLIPPED 180° TO MEET SITE REQUIREMENTS.

NO. DESCRIPTION:

1. 2" SCH. 40 RED BRASS PIPE MNPT (LENGTH = L3).
2. 2" X 1" BRASS SERVICE SADDLE - FNPT OUTLET.
3. 1" X 3/4" X 3/4" BRASS U-BRANCH - MNPT.
4. 5/8" X 3/4" ANGLE BALL VALVE WITH LOCK WINGS - FNPT X YOKE STAR NUT.
5. 5/8" DUCTILE IRON METER YOKE BAR.
6. 5/8" STRAIGHT BALL VALVE (YOKE STAR NUT X FNPT).
7. 3/4" RED BRASS NIPPLE WITH THREADED END (L = 18").
8. 2" SCH. 40 RED BRASS PIPE MNPT (L = 24").
9. 2" - 90° BRASS BEND - FNPT X CTS COMPRESSION.
10. 2" BALL VALVE CURB STOP W/ TEE HEAD OPERATING NUT - FNPT X FNPT.
11. 2" X 1" BRASS REDUCER - FNPT X FNPT.
12. 1" BRASS 90° STREET ELBOW - MNPT X FNPT.
13. 1" BALL VALVE CURB STOP - MNPT X MNPT WITH LOCK WINGS (LOCK CLOSED WITH PERMANENT BLUE PAD LOCK FURNISHED BY CLTW).
14. 1" RED BRASS THREADED COUPLING - FNPT X FNPT.
15. PRECAST CONCRETE METER VAULT - SEE CHART FOR SIZE.
16. MANIFOLD HOT DIP GALV. STEEL ACCESS DOOR - SEE DETAIL.
17. 2" FLEXIBLE PIPE CONNECTOR BOOT **(DO NOT FILL WITH MORTAR).**
18. 1 1/2"Ø - SCH 40 PVC SLEEVE (WITH RUBBER ISOLATION BUSHING AT EACH FACE OF VAULT WALL) OR FOAM RUBBER PIPE INSULATION THROUGH SLEEVE.
19. GALV. STEEL OR S.S. ADJUSTABLE SADDLE PIPE SUPPORT (NUMBER REQ'D = N1) WITH 1/4"± THICK NEOPRENE LINER (WITH STAINLESS STEEL EPOXY ANCHORS).
20. 3/8" DIAMETER STAINLESS STEEL EYE BOLT (EPOXY ANCHOR).
21. AWG #12 GAUGE COPPER TRACER WIRE - WITH BLUE INSULATION (30 MILS HDPE) - TERMINATE WITH 24" EXCESS WIRE (COILED) @ EYE BOLT AND VALVE BOX (TYPICAL).
22. 5/8" WATER METER WITH AMR TRANSMITTER (FURNISHED BY CLTW).
23. 12" DIAMETER SUMP HOLE.
24. 6" #57 WASHED STONE.
25. 2" TYPE K COPPER (NO JOINTS PERMITTED).
26. FOR EXISTING MAINS - 2" BALL CORPORATION STOP - WITH T-HEAD OPERATING NUT - CC (TAPER TREAD) X CTS COMPRESSION (WITH STANDARD VALVE BOX ASSEMBLY), OR; FOR NEW MAINS - MJ TEE, MJ PLUG - TAP - 2", 2" X 6" SCH 40 RED BRASS NIPPLE, 2" GATE VALVE W/ TEE HEAD OPERATING NUT (FNPT) (WITH STANDARD VALVE BOX ASSEMBLY), BRASS STRAIGHT CONNECTOR (MNPT X CTS COMPRESSION) MUELLER #H-15428, FORD #C84-77GJ, McDONALD #24753T.
27. SERVICE SADDLE - CC (TAPER THREAD OUTLET).
28. 6" OR LARGER WATER MAIN.
29. PRECAST CONC. RISER OR BRICKWORK MAY BE REQUIRED FOR GRADE ADJUSTMENTS. MAX HEIGHT SHALL BE 12".
30. CAST IN PLACE CONCRETE SIDEWALK - BRICK WORK SHALL NOT EXTEND TO SURFACE, ACCESS DOOR SHALL REST ON SIDEWALK.
31. UNUSED SERVICES SHALL BE LOCKED (LOCK (BLUE SERIAL NO.) FURNISHED BY CLTW) IN CLOSED POSITION.
32. FOR EACH WATER METER, ATTACH AN ENGRAVED LABEL DIRECTLY ABOVE THE METER/ALIGNED WITH THE TRANSMITTER, INCLUDING THE PREMISE NUMBER, STREET NUMBER/UNIT NUMBER AND STREET NAME, TO UNDERSIDE OF DOOR.
33. TWO ROWS OF JOINT SEALANT AS SHOWN IF TWO PIECE CONSTRUCTION. MONOLITHIC CONSTRUCTION IS ACCEPTABLE.

DESIGN REQUIREMENTS:

a. VAULT SHALL BE RATED FOR NCDOT HS-20 LOADING - SUBMIT SHOP DRAWING / CALCULATIONS / P.E. SEALED FOR REVIEW.
b. ALL CONCRETE SHALL BE MINIMUM 4,000 PSI COMPRESSIVE STRENGTH.
c. DESIGN SHALL CONFORM TO ASTM C858 - SPECIFICATIONS FOR "UNDERGROUND PRECAST CONCRETE UTILITY STRUCTURE."
d. STEEL REINFORCING DESIGN SHALL CONFORM TO ASTM C857.
e. REBARS SHALL BE GRADE 60 PER ASTM A615.
f. WELDED WIRE FABRIC SHALL CONFORM TO ASTM A185.
g. PIPE PENETRATIONS SHALL BE ISOLATED FROM PIPE WITH FLEXIBLE CONNECTERS (MANHOLE BOOTS) OR WITH RUBBER ISOLATION BUSHINGS.
h. PRECAST VAULT COMPONENTS SHALL HAVE MARKINGS PER ASTM C478 REQUIREMENTS.

DIMENSIONS (INCHES)

VAULT (INSIDE)			VAULT (OVERALL-MIN.)			WALL THICKNESS (MIN.)	FLOOR THICKNESS (MIN.)	NUMBER OF METERS (MAX.)	L3 2" RED BRASS PIPE LENGTH NO. 1	N1 REQ'D NO. OF PIPE SUPPORTS NO. 19		
L	W	H	L1	W1	H1	W2 / L2	H2				L4	L5
72	36	36	84	48	42	6	6	10	60	2	6.5	7
60	36	36	72	48	42	6	6	8	48	2	7	7.5
48	36	36	60	48	42	6	6	6	36	2	7.5	8
36	36	36	44	44	40	4	4	4	24	1	8	8.5

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

3/4-INCH MANIFOLD WATER METER ASSEMBLY AND PRECAST CONCRETE VAULT

NO SCALE

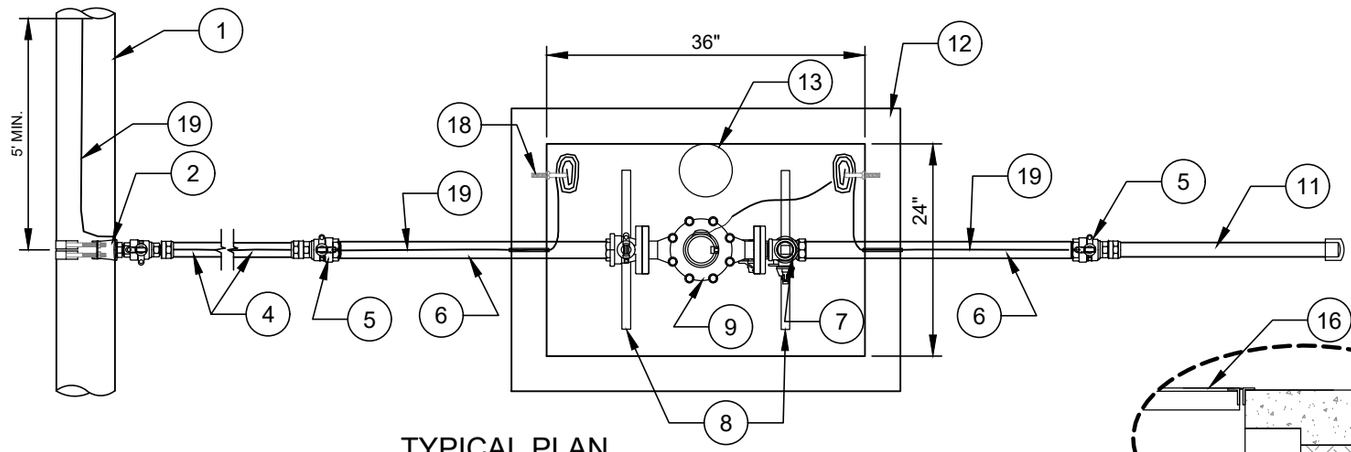
VERSION 3.0

DATE 01/2026

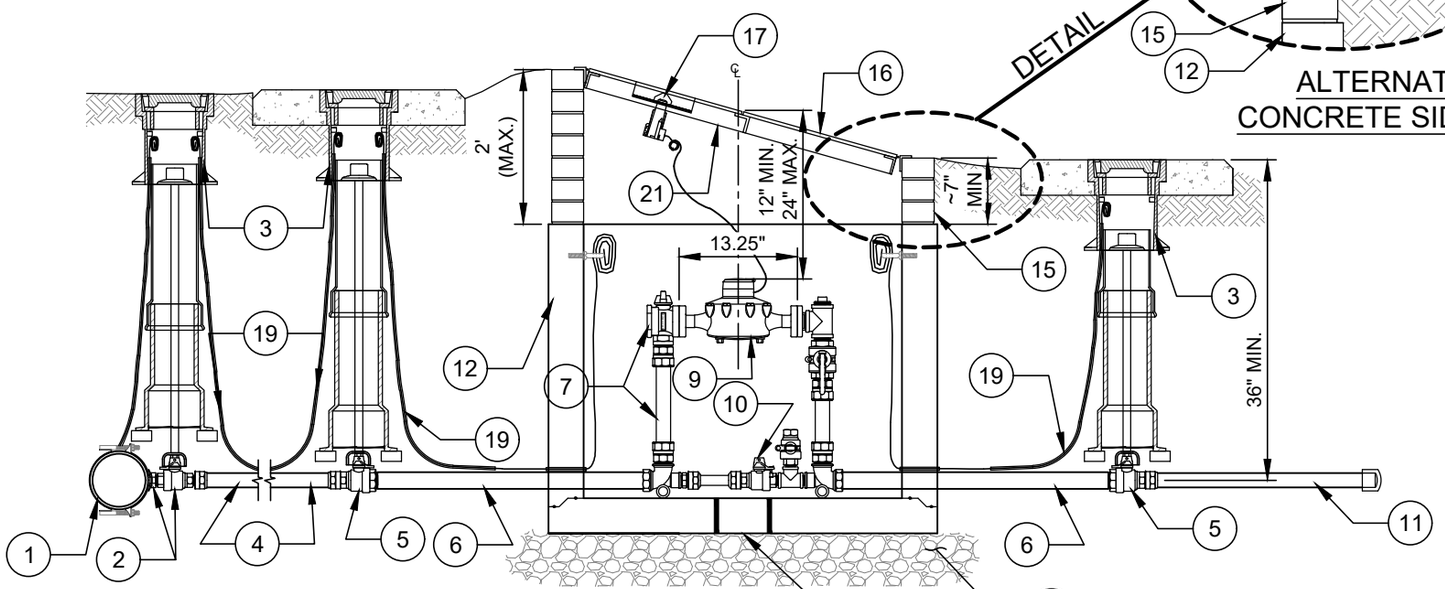
DETAIL 15.4.1

NOTES:

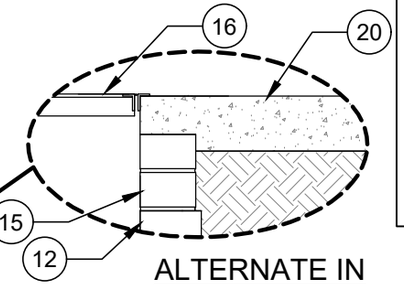
A. ALL FLANGE HARDWARE (BOLT/WASHER/NUT) SHALL BE STAINLESS STEEL - TYPE 304 WITH ANTI-SEIZE COMPOUND.
B. ALL PIPE SHALL BE RESTRAINED FROM TAP TO PROPERTY LINE VALVE.
C. VAULT SHALL BE RATED FOR NCDOT HS-20 LOADING - SUBMIT SHOP DRAWINGS / P.E. SEALED FOR REVIEW.
D. ALL CONCRETE SHALL BE MINIMUM 4000 PSI COMPRESSIVE STRENGTH.
E. DESIGN SHALL CONFORM TO ASTM C858 - SPECIFICATIONS FOR "UNDERGROUND PRECAST CONCRETE UTILITY STRUCTURE".
F. STEEL REINFORCING DESIGN SHALL CONFORM TO ASTM C857.
G. REBARS SHALL BE GRADE 60 PER ASTM A615.
H. WELDED WIRE FABRIC SHALL CONFORM TO ASTM A185.
I. DIAGONAL REINFORCING SHALL BE ADDED AT ALL OPENINGS.
J. PIPE PENETRATIONS SHALL BE SEALED WITH FLEXIBLE CONNECTERS (MANHOLE BOOTS) OR WITH 4-INCHES OF BRICK & MORTAR (AND 1/2 INCH THICK CONSTRUCTION EXPANSION MATERIAL).
K. FRAME TO BE FLUSH WITH GROUND OR CONCRETE SIDEWALK, GROUND SHALL SLOPE AWAY FROM VAULT.
L. ALL JOINTS SHALL BE MADE WATERTIGHT USING 2 RINGS OF BUTYL RUBBER JOINT MASTIC.
M. PRECAST VAULT COMPONENTS SHALL HAVE MARKINGS PER ASTM C478 REQUIREMENTS.
N. ALTERNATE TO BRICK USE CRETEX PRORING 36X24 POLYPROPYLENE ADJUSTMENT RING(S). MUST USE MANUFACTURER APPROVED M-1 OR RAPID SET ADHESIVE.



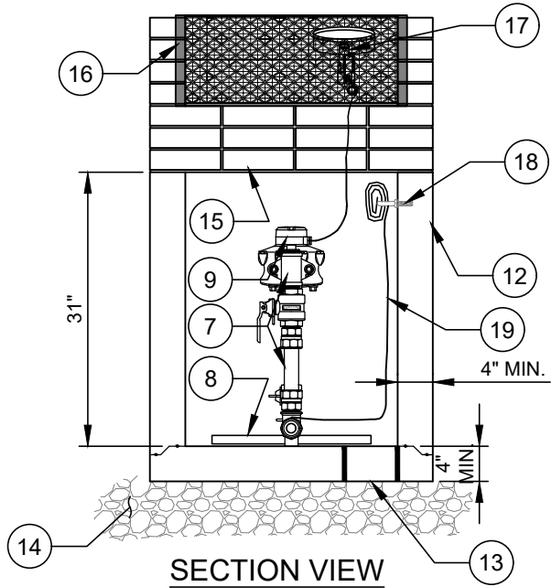
TYPICAL PLAN



TYPICAL ELEVATION



ALTERNATE IN CONCRETE SIDEWALK



SECTION VIEW

NO. DESCRIPTION:

1. EXISTING OR PROPOSED WATER MAIN.
2. TAPPING SADDLE AND 1 1/2" BALL CORPORATION STOP WITH T-HEAD OPERATING NUT (CC TAPER THREAD X CTS COMPRESSION).
3. STANDARD VALVE BOX ASSEMBLY (TYP) - ALL VALVES (OMIT AT CORPORATION STOP ON SHORT SIDE SERVICE OR WHEN IN THE PAVEMENT).
4. 1 1/2" TYPE K COPPER TUBING.
5. 1 1/2" BALL VALVE (CTS COMPRESSION X FNPT).
6. 1 1/2" RED BRASS PIPE NIPPLE (L = 30" OR 36").
7. 1 1/2" BRASS METER SETTER ASSEMBLY - FORD #VB-76-95311-05, MUELLER #098B 242343, CAMBRIDGE #6020-718F6F6-UUBS OR MCDONALD #720B618WTFF, NO SOLDER JOINTS PERMITTED.
8. 1" SCH 40 RED BRASS NIPPLE (L = 18") X 2 EACH.
9. 1 1/2" WATER METER ASSEMBLY WITH AMR TRANSMITTER (BY CONTRACTOR).
10. BYPASS BALL VALVE WITH LOCK WINGS - LOCK VALVE IN CLOSED POSITION (SERIAL NUMBERED STUD LOCK - FURNISHED BY CLTW).
11. 1 1/2" TYPE K COPPER TUBING TAIL PIECE - L = 24" MIN. - BASS OR PVC TEMP. CAP.
12. PRECAST CONCRETE SERVICE VAULT (36" X 24" X 31").
13. 6" DIAMETER SUMP HOLE.
14. 6" COMPACTED #57 WASHED STONE.
15. MINIMUM OF (3) STANDARD SOLID CONCRETE BRICK COURSES UNDER ACCESS DOOR FRAME, MAXIMUM 2'. SEE NOTE N.
16. 24" X 36" ACCESS DOOR - SEE STANDARD DETAIL.
17. AMR TRANSMITTER.
18. 3/8" DIAMETER GALV. STEEL EYE BOLT (ADHESIVE ANCHOR) - TYPICAL.
19. AWG #12 GAUGE SOLID COPPER HDPE INSTALLATION TRACER WIRE - WITH 30 MILS BLUE INSULATION TERMINATE WITH 24" EXCESS WIRE (COILED) AT EYE BOLT AND VALVE BOX (TYP).
20. CAST IN PLACE CONCRETE SIDEWALK - BRICK WORK SHALL NOT EXTEND TO SURFACE, ACCESS DOOR SHALL REST ON SIDEWALK.
21. ATTACH ENGRAVED LABEL, WITH PREMISE NUMBER, TO UNDERSIDE OF DOOR, NEAR THE LIFTING HANDLE.

NO. ALTERNATE DESCRIPTION:

WHEN USING SDR9 HDPE (IPS) WITH STAINLESS STEEL, BRASS, OR BRONZE MNPT ENDS, USE THE FOLLOWING PRODUCTS:

2. 1 1/2" BALL CORPORATION STOP (CC TAPER THREAD X FNPT).
4. 1 1/2" SDR9 HDPE (POLY) - IPS PIPE (MNPT X MNPT).
5. 1 1/2" BALL VALVE (FNPT X FNPT).
11. 1 1/2" SDR9 HDPE (POLY) - IPS PIPE (MNPT X MNPT) - BASS OR PVC TEMP. CAP.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

1 1/2-INCH WATER METER SERVICE CONNECTION AND VAULT

NO SCALE

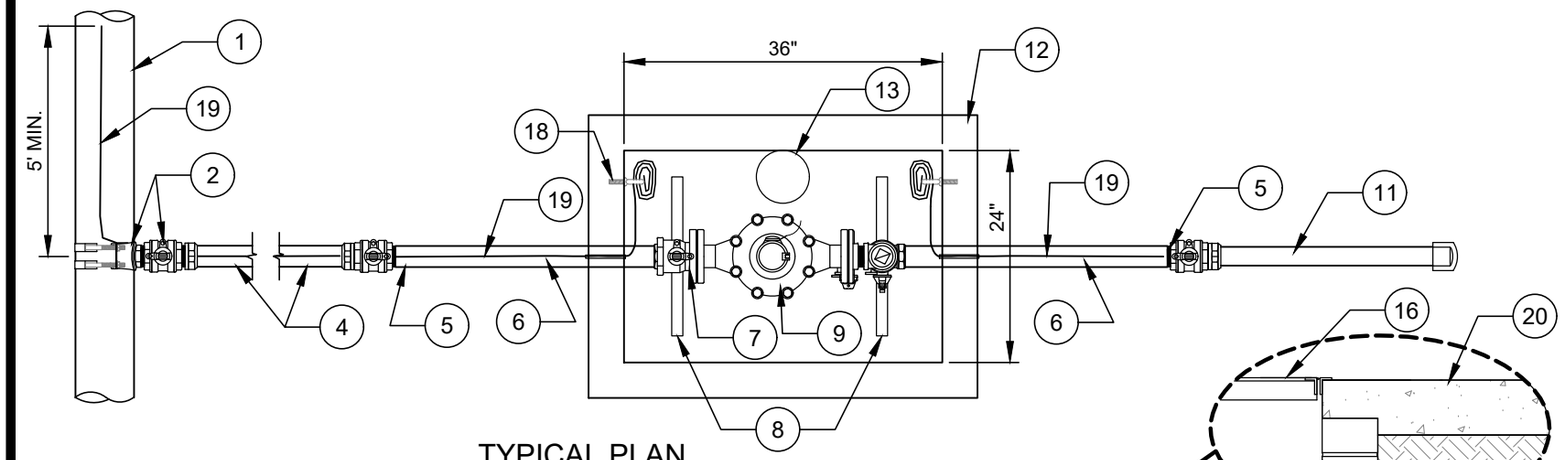
VERSION 2.0

DATE 01/2026

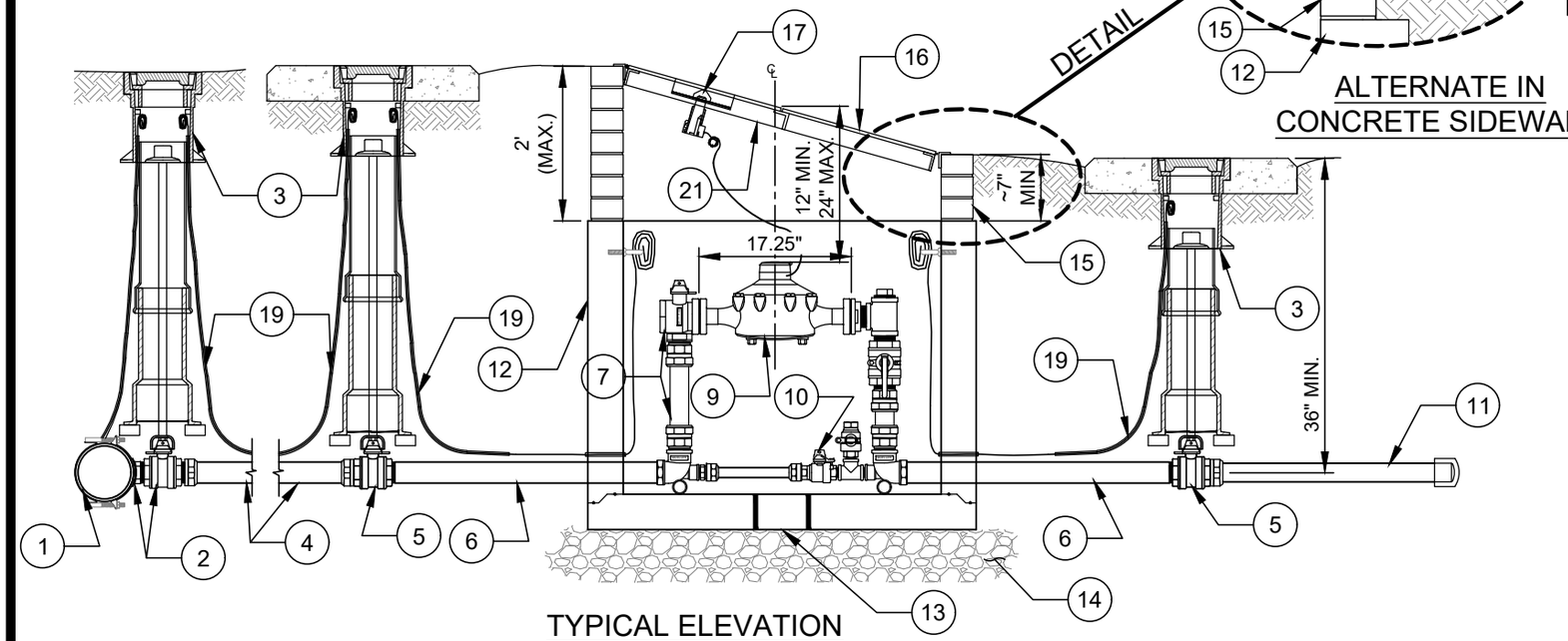
DETAIL 15.4.2

NOTES:

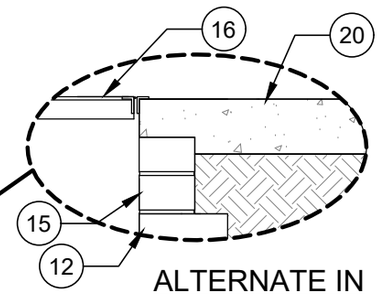
A. ALL FLANGE HARDWARE (BOLT/WASHER/NUT) SHALL BE STAINLESS STEEL - TYPE 304 WITH ANTI-SEIZE COMPOUND.
B. ALL PIPE SHALL BE RESTRAINED JOINT DUCTILE IRON FROM TAP TO PROPERTY LINE VALVE.
C. VAULT SHALL BE RATED FOR NCDOT HS-20 LOADING - SUBMIT SHOP DRAWINGS / P.E. SEALED FOR REVIEW.
D. ALL CONCRETE SHALL BE MINIMUM 4,000 PSI COMPRESSIVE STRENGTH.
E. DESIGN SHALL CONFORM TO ASTM C858 - SPECIFICATIONS FOR "UNDERGROUND PRECAST CONCRETE UTILITY STRUCTURE".
F. STEEL REINFORCING DESIGN SHALL CONFORM TO ASTM C857.
G. REBARS SHALL BE GRADE 60 PER ASTM A615.
H. WELDED WIRE FABRIC SHALL CONFORM TO ASTM A185.
I. DIAGONAL REINFORCING SHALL BE ADDED AT ALL OPENINGS.
J. PIPE PENETRATIONS SHALL BE SEALED WITH FLEXIBLE CONNECTORS (MANHOLE BOOTS) OR WITH 8" OF BRICK & MORTAR (AND 1/2-INCH THICK CONSTRUCTION EXPANSION MATERIAL).
K. FRAME TO BE FLUSH WITH GROUND OR CONCRETE SIDEWALK, GROUND SHALL SLOPE AWAY FROM VAULT.
L. ALL JOINTS SHALL BE MADE WATERTIGHT USING 2 RINGS OF BUTYL RUBBER JOINT MASTIC.
M. PRECAST VAULT COMPONENTS SHALL HAVE MARKINGS PER ASTM C478 REQUIREMENTS.
N. ALTERNATE TO BRICK USE CRETEX PRORING 36X24 POLYPROPYLENE ADJUSTMENT RING(S). MUST USE MANUFACTURER APPROVED M-1 OR RAPID SET ADHESIVE.



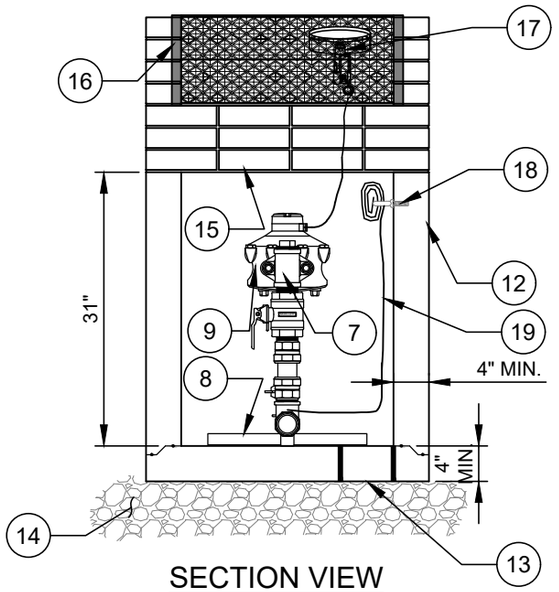
TYPICAL PLAN



TYPICAL ELEVATION



ALTERNATE IN CONCRETE SIDEWALK



SECTION VIEW

NO. DESCRIPTION:

1. EXISTING OR PROPOSED WATER MAIN.
2. TAPPING SADDLE AND 2" BALL CORPORATION STOP WITH T-HEAD OPERATING NUT (CC TAPER THREAD X CTS COMPRESSION).
3. STANDARD VALVE BOX ASSEMBLY (TYP) - ALL VALVES (OMIT AT CORPORATION STOP ON SHORT SIDE SERVICE OR WHEN IN THE PAVEMENT).
4. 2" TYPE K COPPER TUBING.
5. 2" BALL VALVE (CTS COMPRESSION X FNPT).
6. 2" RED BRASS PIPE NIPPLE (L = 30" OR 36").
7. 2" BRASS METER SETTER ASSEMBLY - FORD #VB-77-95311-02, MUELLER #106B 242343, CAMBRIDGE #6020-718F7F7-UUBS OR MCDONALD #720B718WTFF, NO SOLDER JOINTS PERMITTED.
8. 1" SCH 40 RED BRASS NIPPLE (L=18") X 2 EACH.
9. 2" WATER METER ASSEMBLY WITH AMR TRANSMITTER (BY CONTRACTOR).
10. 1" BYPASS BALL VALVE WITH LOCK WINGS - LOCK VALVE IN CLOSED POSITION (PERMANENT STUD LOCK - FURNISHED BY CLTW).
11. 2" TYPE K COPPER TUBING TAIL PIECE - L = 24" MIN. - BASS OR PVC TEMP. CAP.
12. PRECAST CONCRETE SERVICE VAULT (36" X 24" X 31").
13. 6" DIAMETER SUMP HOLE.
14. 6" COMPACTED #57 WASHED STONE.
15. MINIMUM OF (3) STANDARD SOLID CONCRETE BRICK COURSES UNDER ACCESS DOOR FRAME, MAXIMUM 2'. SEE NOTE N.
16. 24" X 36" ACCESS DOOR - SEE STANDARD DETAIL.
17. AMR TRANSMITTER.
18. 3/8" DIAMETER GALV. STEEL EYE BOLT (ADHESIVE ANCHOR) - TYPICAL.
19. AWG #12 GAUGE SOLID COPPER HDPE INSTALLATION TRACER WIRE - WITH 30 MILS BLUE INSULATION TERMINATE WITH 24" EXCESS WIRE (COILED) AT EYE BOLT AND VALVE BOX (TYP).
20. CAST IN PLACE CONCRETE SIDEWALK - BRICK WORK SHALL NOT EXTEND TO SURFACE, ACCESS DOOR SHALL REST ON SIDEWALK.
21. ATTACH ENGRAVED LABEL, WITH PREMISE NUMBER, TO UNDERSIDE OF DOOR, NEAR THE LIFTING HANDLE.

NO. ALTERNATE DESCRIPTION:

WHEN USING SDR9 HDPE (IPS) WITH STAINLESS STEEL, BRASS, OR BRONZE MNPT ENDS, USE THE FOLLOWING PRODUCTS:

2. 2" BALL CORPORATION STOP (CC TAPER THREAD X FNPT).
4. 2" SDR9 HDPE (POLY) - IPS PIPE (MNPT X MNPT).
5. 2" BALL VALVE (FNPT X FNPT).

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

2-INCH WATER METER SERVICE CONNECTION AND VAULT

NO SCALE

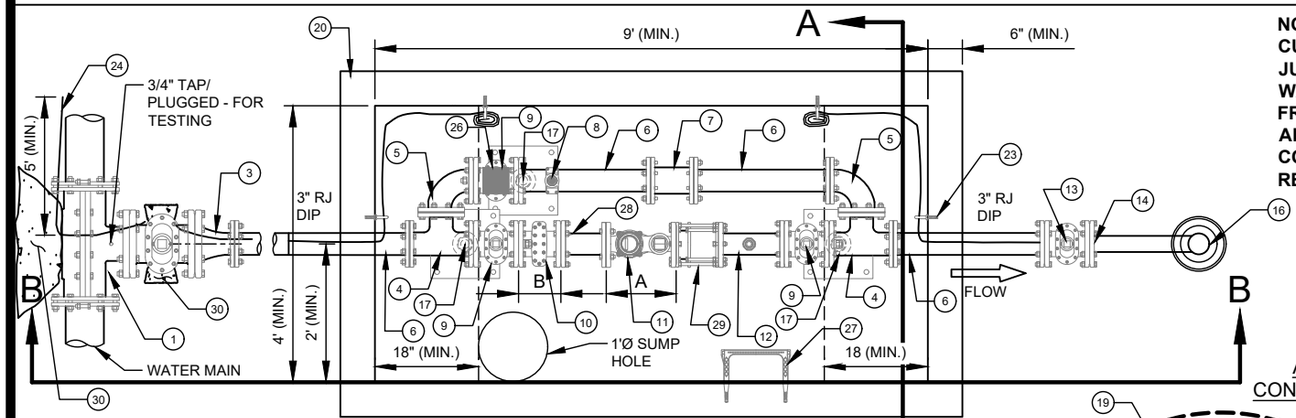
VERSION 2.0

DATE 01/2026

DETAIL 15.4.3

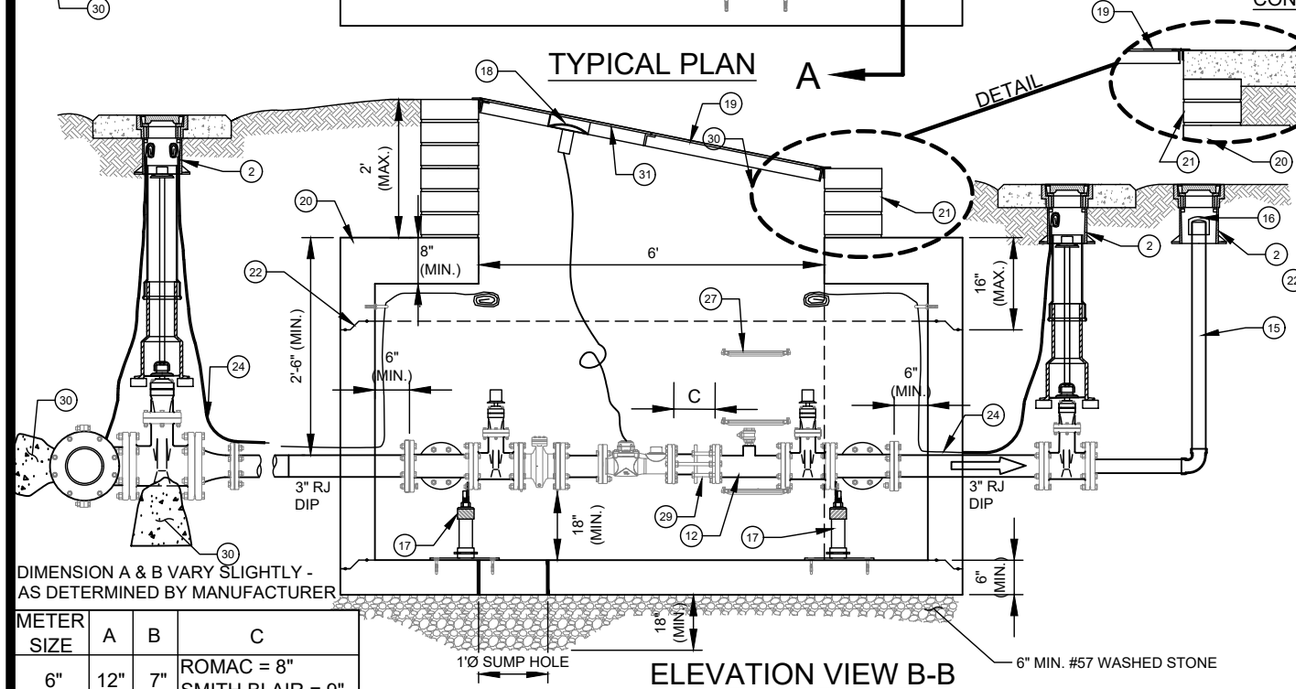
NOTES:

A. ALL FLANGE HARDWARE (BOLT/WASHER/NUT) SHALL BE STAINLESS STEEL - TYPE 304 WITH ANTI-SEIZE COMPOUND.
B. ALL PIPE SHALL BE RESTRAINED JOINT DUCTILE IRON FROM TAP TO PROPERTY LINE VALVE.
C. METER CONFIGURATION AND LENGTH MAY VARY DUE TO BRAND - VERIFY LENGTH TO DETERMINE MINIMUM VAULT LENGTH.
D. VAULT SHALL BE SIZED AS NEEDED FOR PIPE (8' X 4' MINIMUM) AND RATED FOR NCDOT HS-20 LOADING - SUBMIT SHOP DRAWINGS / P.E. SEALED FOR REVIEW.
E. ALL CONCRETE SHALL BE MINIMUM 4,000 PSI COMPRESSIVE STRENGTH.
F. DESIGN SHALL CONFORM TO ASTM C858 - SPECIFICATIONS FOR "UNDERGROUND PRECAST CONCRETE UTILITY STRUCTURE".
G. STEEL REINFORCING DESIGN SHALL CONFORM TO ASTM C857.
H. REBARS SHALL BE GRADE 60 PER ASTM A615.
I. WELDED WIRE FABRIC SHALL CONFORM TO ASTM A185.
J. DIAGONAL REINFORCING SHALL BE ADDED AT ALL OPENINGS.
K. PIPE PENETRATIONS SHALL BE SEALED WITH FLEXIBLE CONNECTORS (MANHOLE BOOTS) OR WITH 8" OF BRICK AND MORTAR (AND 1/2-INCH THICK CONSTRUCTION EXPANSION MATERIAL AROUND THE PIPE).
L. FRAME TO BE FLUSH WITH GROUND OR CONCRETE SIDEWALK. GROUND SHALL SLOPE AWAY FROM VAULT.
M. ALL JOINTS SHALL BE MADE WATERTIGHT USING 2 RINGS OF BUTYL RUBBER JOINT MASTIC.
N. ALL VALVES SHALL BE OPEN RIGHT - CLOCKWISE, EXCEPT NO. 13.
O. SERVICE AND VAULT MAY BE ROTATED 90° WHEN NEEDED, DUE TO LIMITED SITE / SPACE RESTRICTIONS.
P. WRAP TAPPING SLEEVE WITH 2 LAYERS HDPE PLASTIC FILM (HDCLPE PER AWWA C-105) - 4 MILS EACH LAYER - EXTEND HDPE 2' EACH WAY FROM SLEEVE - DUCT TAPE OR ZIP LOCK TIE ENDS.
Q. CONCRETE THRUST BLOCKING REQUIRED AT TAPPING SLEEVE.
R. PRECAST VAULT COMPONENTS SHALL HAVE MARKINGS PER ASTM C478 REQUIREMENTS.



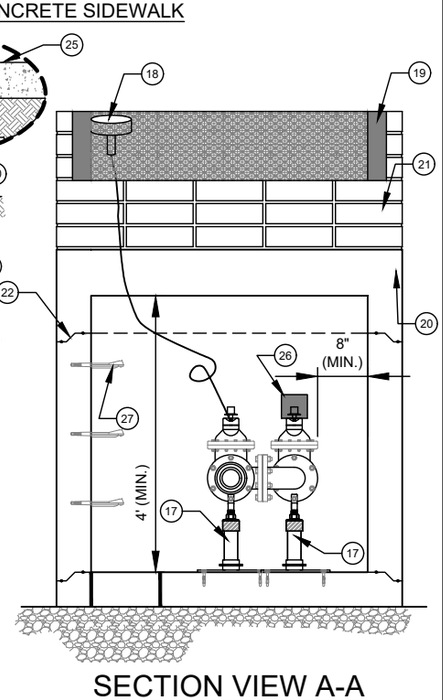
TYPICAL PLAN

NOTE:
CUSTOMER / APPLICANT MUST PROVIDE JUSTIFICATION WHEN REQUESTING A TURBINE WATER METER. PRIOR APPROVAL IS REQUIRED FROM THE CUSTOMER SERVICE MANAGER FOR ALL TURBINE METERS. OTHERWISE, A COMPOUND OR ULTRASONIC METER IS REQUIRED.



METER SIZE	A	B	C
6"	12"	7"	ROMAC = 8" SMITH BLAIR = 9"

ELEVATION VIEW B-B



SECTION VIEW A-A

NO. DESCRIPTION:

1. 4" TAPPING SLEEVE AND 4" FLANGE X MJ TAPPING VALVE ON EXISTING MAIN. 3" MJ TEE, 3" FOSTER ADAPTOR AND 3" MJ GATE VALVE ON NEW MAIN.
2. STANDARD VALVE BOX ASSEMBLY (TYP.) - ALL VALVES.
3. 4" X 3" REDUCER (RJ) REQUIRED ON EXISTING MAIN INSTALLATIONS. (REDUCER NOT REQUIRED ON NEW MAIN INSTALLATIONS)
4. FLANGE DUCTILE IRON TEE WITH ADJUSTABLE FLANGE SUPPORT.
5. FLANGE DUCTILE IRON 90°-BEND.
6. FLANGE X PLAIN END DUCTILE IRON PIPE - LL = 63" (MIN. SPECIAL CLASS 53).
7. MJ LONG PATTERN SOLID SLEEVE WITH RESTRAINED JOINTS.
8. 3/4" BALL CORPORATION STOP WITH TAPPING SADDLE.
9. FLANGE GATE VALVE; WITH 2" OPERATING NUT - OPEN RIGHT AND WITH ADJUSTABLE FLANGE SUPPORT ON BYPASS VALVE.
10. PLATE STRAINER - FL X FL.
11. FLANGE TURBINE METER ASSEMBLY W/AMR TRANSMITTERS. METER CONFIGURATION MAY VARY DUE TO BRAND SUPPLIED.
12. 3" EPOXY COATED/LINED STEEL FL X FL SPOOL WITH 2" FNPT TEST OUTLET - LL = 12" (MARS CO.) AND 2" BALL CORPORATION STOP WITH T-HEAD OPERATING NUT - MNPT X FNPT.
13. MECHANICAL JOINT (RJ) GATE VALVE - 2" OPERATING NUT - OPEN LEFT @ PROPERTY LINE.
14. MECHANICAL JOINT PLUG WITH 2" TAP.
15. TEMP 2" PIPE GALVANIZED STEEL (SCH 80) WITH STANDARD VALVE BOX/CONCRETE PAD.
16. TEMP 2" THREADED COUPLING (SCH 80 - G.S.F.).
17. ADJUSTABLE FLANGE PIPE SUPPORTS (3 REQUIRED).
18. AMR TRANSMITTERS.
19. 4' X 5' DOUBLE-LEAF ACCESS DOOR. SEE STANDARD DETAIL.
20. PRECAST REINFORCED CONCRETE VAULT - 8' X 4' X 4' (MIN.).
21. MINIMUM OF (3) STANDARD SOLID CONCRETE BRICK COURSES UNDER ACCESS DOOR FRAME, MAXIMUM 2'.
22. JOINT REQUIRED AT FLAT TOP SECTION.
23. 3/8" DIA. GALVANIZED STEEL EYE BOLT (ADHESIVE ANCHOR) - TYPICAL.
24. AWG #12 GAUGE SOLID COPPER TRACER WIRE - WITH BLUE INSULATION (30 MILS HDPE) - TERMINATE WITH 24" EXCESS WIRE (COILED) @ EYE BOLT AND VALVE BOX (TYPICAL).
25. CAST IN PLACE CONCRETE SIDEWALK - BRICKWORK SHALL NOT EXTEND TO SURFACE. ACCESS DOOR FRAME SHALL REST ON SIDEWALK.
26. VALVE LOCK (FURNISHED BY CLTW) - LOCK VALVE CLOSED.
27. PLASTIC STEP - 12" VERTICAL SPACING.
28. DUCTILE IRON PIPE SPOOL (FL X FL) - L = 15" (SPECIAL CLASS 53).
29. DISMANTLING JOINT - FL X FL - (L = 10" OR 9" - EXTENDED) SMITH BLAIR #975 (SET TO 9") OR ROMAC #DJ400 (SET TO 8") WITH STAINLESS STEEL TIE RODS/HARDWARE.
30. CONCRETE THRUST BLOCKING - 3,600 PSI.
31. ATTACH ENGRAVED LABEL, WITH PREMISE NUMBER, TO UNDERSIDE OF DOOR, NEAR THE LIFTING HANDLE.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

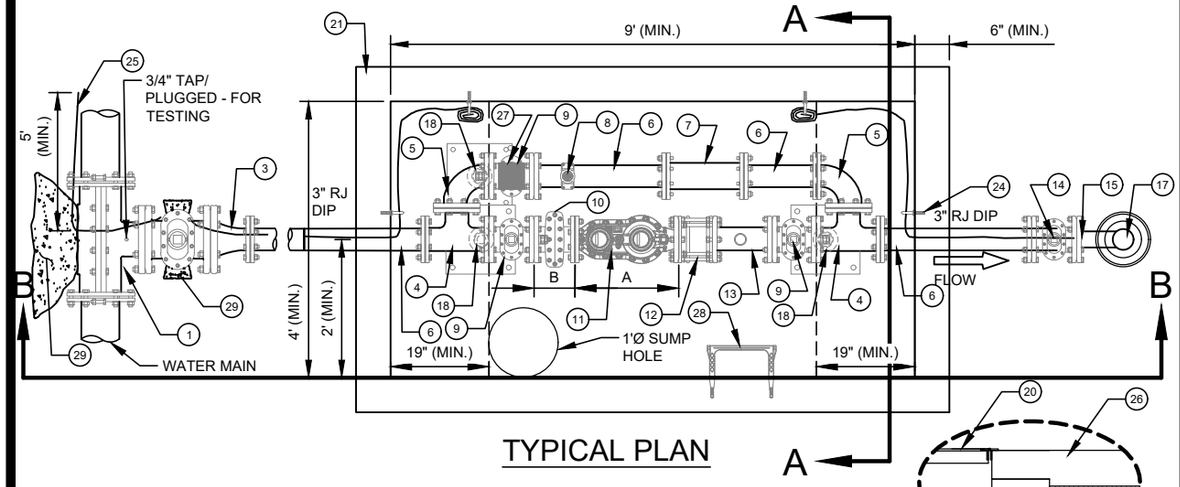
3-INCH TURBINE WATER METER AND PRECAST CONCRETE VAULT

NO SCALE

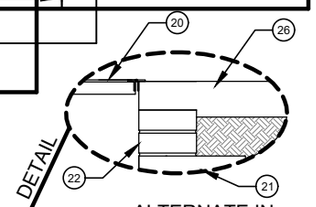
VERSION 1.0

DATE 04/2024

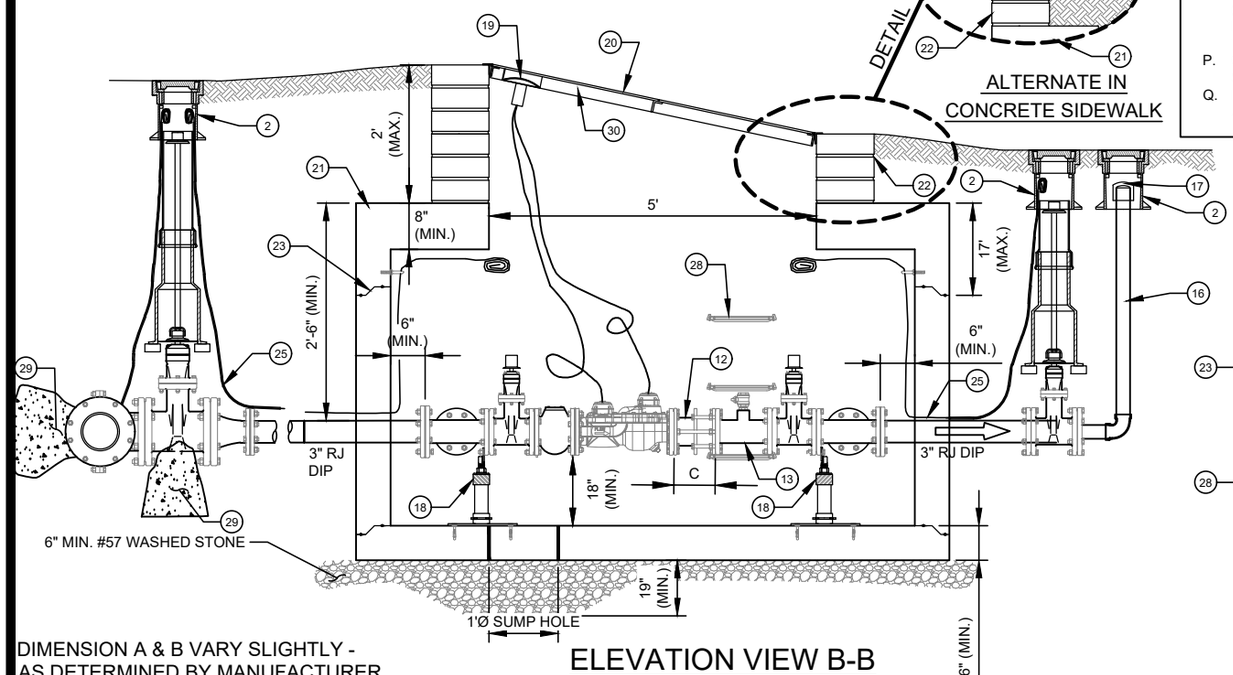
DETAIL 15.4.4



TYPICAL PLAN



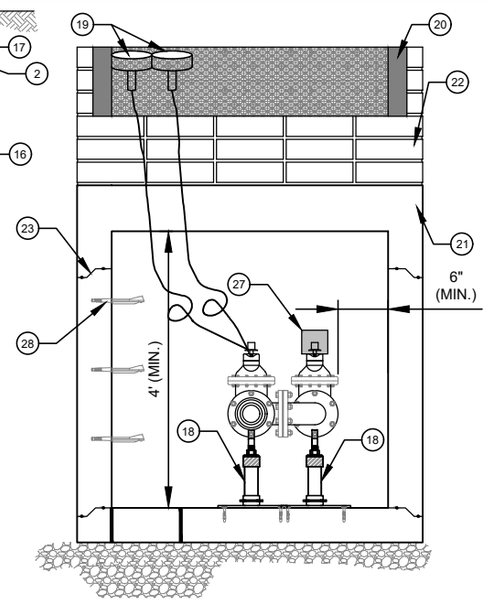
ALTERNATE IN
CONCRETE SIDEWALK



ELEVATION VIEW B-B

DIMENSION A & B VARY SLIGHTLY -
AS DETERMINED BY MANUFACTURER

METER SIZE	A	B	C
6"	18"	7"	ROMAC = 8" SMITH BLAIR = 9"



SECTION VIEW A-A

NOTES:

A. ALL FLANGE HARDWARE (BOLT/WASHER/NUT) SHALL BE STAINLESS STEEL - TYPE 315 WITH ANTI-SEIZE COMPOUND.
B. ALL PIPE SHALL BE RESTRAINED JOINT DUCTILE IRON FROM TAP TP PROPERTY LINE VALVE.
C. METER CONFIGURATION AND LENGTH MAY VARY DUE TO BRAND - VERIFY LENGTH TO DETERMINE MINIMUM VAULT LENGTH.
D. VAULT SHALL BE SIZED AS NEEDED FOR MINIMUM CLEARANCE AS SHOWN AND RATED FOR NCDOT HS-20 LOADING - SUBMIT SHOP DRAWINGS / P.E. SEALED FOR REVIEW.
E. ALL CONCRETE SHALL BE MINIMUM 4,000 PSI COMPRESSIVE STRENGTH.
F. DESIGN SHALL CONFORM TO ASTM C858 - SPECIFICATION FOR "UNDERGROUND PRECAST CONCRETE UTILITY STRUCTURE".
G. STEEL REINFORCING DESIGN SHALL CONFORM TO ASTM C857.
H. REBARS SHALL BE GRADE 60 PER ASTM A615.
I. WELDED WIRE FABRIC SHALL CONFORM TO ASTM A195.
J. DIAGONAL REINFORCING SHALL BE ADDED AT ALL OPENINGS.
K. PIPE PENETRATIONS SHALL BE SEALED WITH FLEXIBLE CONNECTORS (MANHOLE BOOTS) OR WITH 8" OF BRICK AND MORTAR (AND 1/2-INCH THICK CONSTRUCTION EXPANSION MATERIAL).
L. FRAME TO BE FLUSH WITH GROUND OR CONCRETE SIDEWALK. GROUND SHALL SLOPE AWAY FROM VAULT.
M. ALL JOINTS SHALL BE MADE WATERTIGHT USING 2 RINGS OF BUTYL RUBBER JOINT MASTIC.
N. ALL VALVES SHALL BE OPEN RIGHT - CLOCKWISE, EXCEPT NO. 14.
O. WRAP TAPPING SLEEVE WITH 2 LAYERS HDPE PLASTIC FILM (HDCLPE PER AWWA C-105) - 4 MILS EACH LAYER - EXTEND HDPE 2' EACH WAY FROM SLEEVE - DUCT TAPE OR ZIP LOCK TIE ENDS.
P. CONCRETE THRUST BLOCKING REQUIRED AT TAPPING SLEEVE.
Q. PRECAST VAULT COMPONENTS SHALL HAVE MARKINGS PER ASTM C478 REQUIREMENTS.

NO. DESCRIPTION:

1. 4" TAPPING SLEEVE AND 4" FLANGE x MJ TAPPING VALVE ON EXISTING MAIN. 3" MJ TEE, 3" FOSTER ADAPTER, AND 3" MJ GATE VALVE ON NEW MAIN.
2. STANDARD VALVE BOX ASSEMBLY (TYP.) - ALL VALVES.
3. 4" x 3" REDUCER (RJ) REQUIRED ON EXISTING MAIN INSTALLATIONS.
4. FLANGE DUCTILE TEE WITH ADJUSTABLE FLANGE SUPPORT. (REDUCER NOT REQUIRED ON NEW MAIN INSTALLATIONS).
5. FLANGE DUCTILE IRON 90°-BEND.
6. FLANGE x PLAIN END DUCTILE IRON PIPE 2 EA. - LL = 49" (MIN.) (SPECIAL CLASS 53).
7. MJ LONG PATTERN SOLID SLEEVE WITH RESTRAINED JOINTS.
8. 3/4" BALL CORPORATION STOP (CC TAPER THREAD) AND S.S. SERVICE SADDLE.
9. FLANGE GATE VALVE; WITH 2" OPERATING NUT - OPEN RIGHT AND WITH ADJUSTABLE FLANGE SUPPORT ON BYPASS VALVE.
10. FLANGE STRAINER.
11. FLANGE COMPOUND METER ASSEMBLY W/AMR TRANSMITTERS. METER CONFIGURATION MAY VARY DUE TO BRAND SUPPLIED.
12. 3" DISMANTLING JOINT (RESTRAINED) - ROMAC DJ400 - LL = 7" TO 9", SET TO 8", OR SMITH-BLAIR #975 - 8" TO 10", SET TO 9". - FL x FL - (L = 10" OR 9" - EXTENDED) SMITH BLAIR #975 OR ROMAC #DJ400 WITH STAINLESS STEEL TIE RODS/HARDWARE.
13. 3" EPOXY COATED/LINED STEEL FL x FL SPOOL WITH 2" FNPT TEST OUTLET - LL = 12" (MARS CO.) AND 2" BALL CORPORATION STOP WITH T-HEAD OPERATING NUT - MNPT x FNPT.
14. MECHANICAL JOINT (RJ) GATE VALVE - 2" OPERATING NUT - OPEN LEFT AT PROPERTY LINE.
15. MECHANICAL JOINT PLUG WITH 2" TAP.
16. TEMP. 2" PIPE GALVANIZED STEEL (SCH 80) WITH STANDARD VALVE BOX/CONCRETE PAD.
17. TEMP. 2" THREADED COUPLING.
18. ADJUSTABLE FLANGE PIPE SUPPORTS (3 REQUIRED).
19. AMR TRANSMITTERS.
20. 4' x 5' DOUBLE-LEAF ACCESS DOOR. SEE STANDARD DETAIL.
21. PRECAST REINFORCED CONCRETE VAULT.
22. MINIMUM OF (3) STANDARD SOLID CONCRETE BRICK COURSES UNDER ACCESS DOOR FRAME, MAXIMUM 2'.
23. JOINT REQUIRED AT FLAT TOP SECTION.
24. 3/8" DIA. GALVANIZED STEEL EYE BOLT (ADHESIVE ANCHOR) - TYPICAL.
25. AWG #12 GAUGE SOLID COPPER HDPE INSTALLATION TRACER WIRE - WITH 30 MILS BLUE INSULATION - TERMINATE WITH 24" EXCESS WIRE (COILED) AT EYE BOLT AND VALVE BOX (TYPICAL).
26. CAST IN PLACE CONCRETE SIDEWALK - BRICKWORK SHALL NOT EXTEND TO SURFACE. ACCESS DOOR FRAME SHALL REST ON SIDEWALK.
27. VALVE LOCK AND WARNING TAG (FURNISHED BY CLTW) - LOCK VALVE CLOSED.
28. PLASTIC STEP - 12" O.C. VERTICAL SPACING.
29. CONCRETE THRUST BLOCKING - 3,600 PSI.
30. ATTACH ENGRAVED LABEL, WITH PREMISE NUMBER, TO UNDERSIDE OF DOOR, NEAR THE LIFTING HANDLE.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

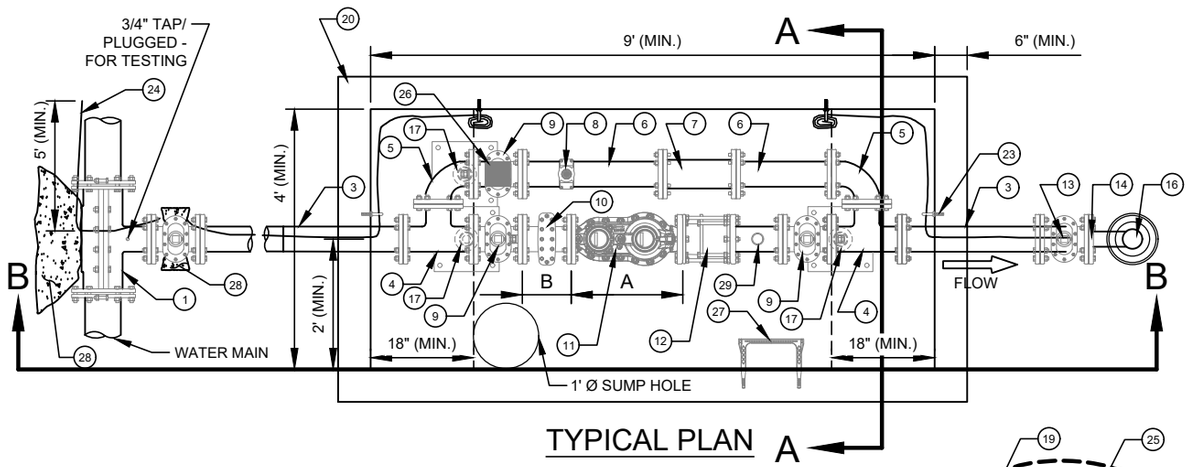
3-INCH COMPOUND WATER METER AND PRECAST CONCRETE VAULT

NO SCALE

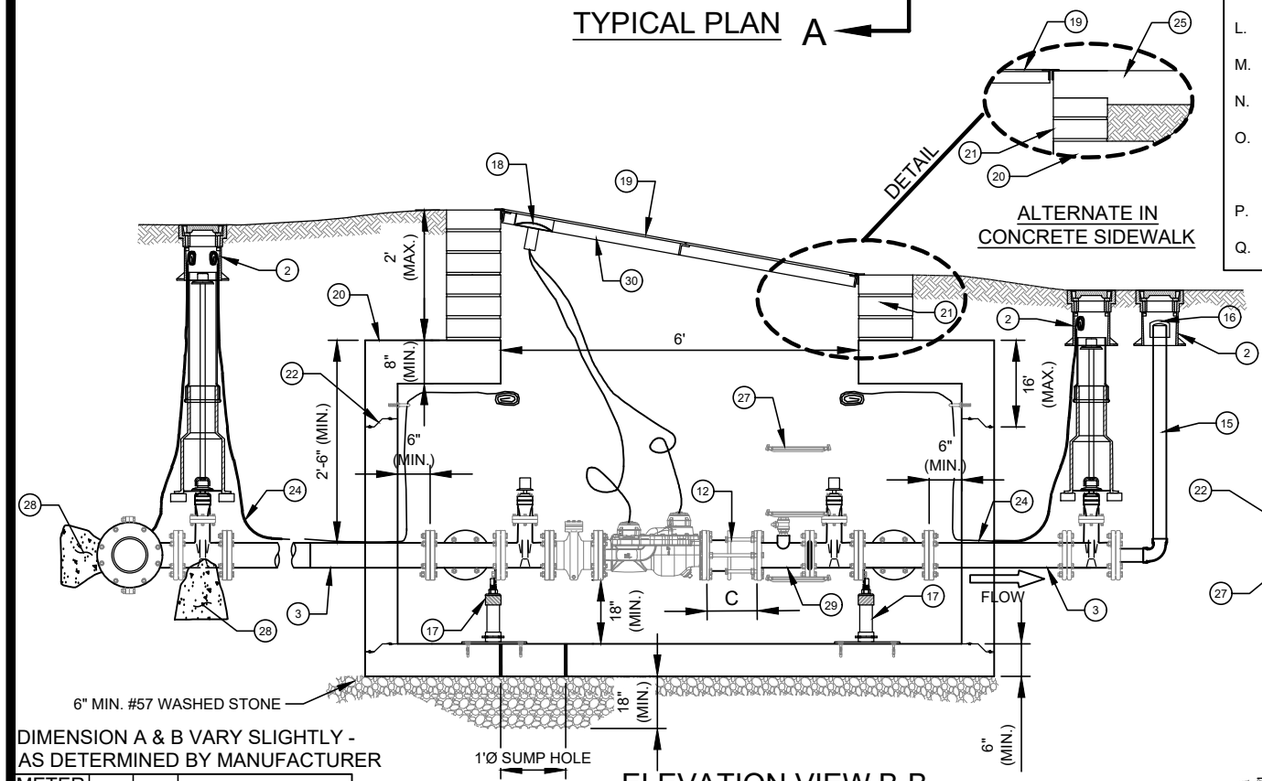
VERSION 2.0

DATE 01/2026

DETAIL 15.4.5



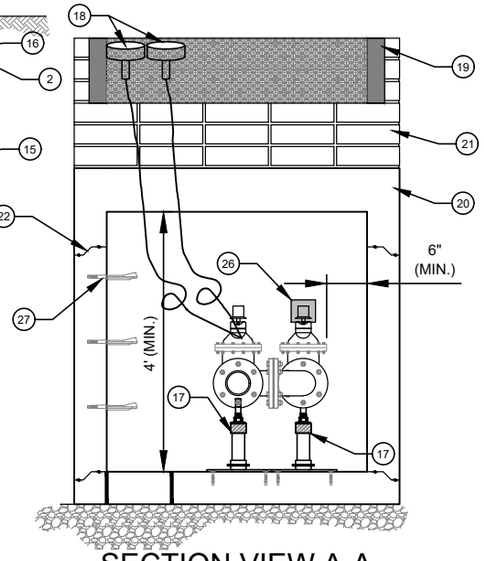
TYPICAL PLAN



ELEVATION VIEW B-B

DIMENSION A & B VARY SLIGHTLY -
AS DETERMINED BY MANUFACTURER

METER SIZE	A	B	C
4"	20"	9"	ROMAC = 8" SMITH BLAIR = 9"



SECTION VIEW A-A

NOTES:

A. ALL FLANGE HARDWARE (BOLT/WASHER/NUT) SHALL BE STAINLESS STEEL - TYPE 304 WITH ANTI-SEIZE COMPOUND.
B. ALL PIPE SHALL BE RESTRAINED JOINT DUCTILE IRON FROM TAP TO PROPERTY LINE VALVE.
C. METER CONFIGURATION AND LENGTH MAY VARY DUE TO BRAND -VERIFY LENGTH TO DETERMINE MINIMUM VAULT LENGTH.
D. VAULT SHALL BE SIZED AS NEEDED FOR MINIMUM CLEARANCE AS SHOWN AND RATED FOR NCDOT HS-20 LOADING - SUBMIT SHOP DRAWINGS / P.E. SEALED FOR REVIEW.
E. ALL CONCRETE SHALL BE MINIMUM 4,000 PSI COMPRESSIVE STRENGTH.
F. DESIGN SHALL CONFORM TO ASTM C858 - SPECIFICATIONS FOR "UNDERGROUND PRECAST CONCRETE UTILITY STRUCTURE".
G. STEEL REINFORCING DESIGN SHALL CONFORM TO ASTM C857.
H. REBARS SHALL BE GRADE 60 PER ASTM A615.
I. WELDED WIRE FABRIC SHALL CONFORM TO ASTM A185.
J. DIAGONAL REINFORCING SHALL BE ADDED AT ALL OPENINGS.
K. PIPE PENETRATIONS SHALL BE SEALED WITH FLEXIBLE CONNECTORS (MANHOLE BOOTS) OR WITH 8" OF BRICK & MORTAR (AND 1/2-INCH THICK CONSTRUCTION EXPANSION MATERIAL).
L. FRAME TO BE FLUSH WITH GROUND OR CONCRETE SIDEWALK, GROUND SHALL SLOPE AWAY FROM VAULT.
M. ALL JOINTS SHALL BE MADE WATERTIGHT USING 2 RINGS OF BUTYL RUBBER JOINT MASTIC.
N. ALL VALVES SHALL BE OPEN RIGHT - CLOCKWISE, EXCEPT NO. 13.
O. WRAP TAPPING SLEEVE WITH 2 LAYERS HDPE PLASTIC FILM (HDCLPE PER AWWA C-105) - 4 MILS EACH LAYER - EXTEND HDPE 2' EACH WAY FROM SLEEVE - DUCT TAPE OR ZIP LOCK TIE ENDS.
P. CONCRETE THRUST BLOCKING REQUIRED AT TAPPING SLEEVE.
Q. PRECAST VAULT COMPONENTS SHALL HAVE SCRIPTION PER ASTM C478 REQUIREMENTS.

NO.	DESCRIPTION
1.	4" TAPPING SLEEVE AND 4" FLANGE X MJ TAPPING VALVE ON EXISTING MAIN. 4" MJ TEE, 4" FOSTER ADAPTOR, AND 4" MJ GATE VALVE ON NEW MAIN.
2.	STANDARD VALVE BOX ASSEMBLY (TYP.) - ALL VALVES.
3.	FLANGE X PLAIN END DUCTILE IRON PIPE - L = 30" (MIN.) (SPECIAL CLASS 53).
4.	FLANGE DUCTILE IRON TEE WITH ADJUSTABLE FLANGE SUPPORT.
5.	FLANGE DUCTILE IRON 90° - BEND.
6.	FLANGE X PLAIN END DUCTILE IRON PIPE 2 EA. - LL = 62" (MIN. SPECIAL CLASS 53).
7.	MJ LONG PATTERN SOLID SLEEVE WITH RESTRAINED JOINTS.
8.	3/4" BALL CORPORATION STOP WITH TAPPING SADDLE.
9.	FLANGE GATE VALVE; WITH 2" OPERATING NUT - OPEN RIGHT AND WITH ADJUSTABLE FLANGE SUPPORT ON BYPASS VALVE.
10.	FLANGE STRAINER.
11.	FLANGE COMPOUND METER ASSEMBLY W/AMR TRANSMITTERS. METER CONFIGURATION MAY VARY DUE TO BRAND SUPPLIED.
12.	4" DISMANTLING JOINT (RESTRAINED) - ROMAC DJ400 - LL = 7" TO 9", SET TO 8", OR SMITH-BLAIR #975 - 8" TO 10", SET TO 9". - FL X FL - (L = 10" OR 9" - EXTENDED) SMITH BLAIR #975 OR ROMAC #DJ400 WITH STAINLESS STEEL TIE RODS/HARDWARE.
13.	MECHANICAL JOINT (RJ) GATE VALVE - 2" OPERATING NUT - OPEN LEFT AT PROPERTY LINE.
14.	MECHANICAL JOINT PLUG WITH 2" TAP.
15.	TEMP. 2" PIPE GALVANIZED STEEL (SCH 80) WITH STANDARD VALVE BOX/CONCRETE PAD.
16.	TEMP. 2" THREADED COUPLING.
17.	ADJUSTABLE FLANGE PIPE SUPPORTS (3 REQUIRED).
18.	AMR TRANSMITTERS.
19.	4' X 6' DOUBLE-LEAF ACCESS DOOR. SEE STANDARD DETAIL.
20.	PRECAST REINFORCED CONCRETE VAULT.
21.	MINIMUM OF (3) STANDARD SOLID CONCRETE BRICK COURSES UNDER ACCESS DOOR FRAME, MAXIMUM 2'.
22.	JOINT REQUIRED AT FLAT TOP SECTION.
23.	3/8" DIA. GALV. STEEL EYE BOLT (ADHESIVE ANCHOR) - TYPICAL.
24.	AWG #12 GAUGE SOLID COPPER TRACER WIRE - WITH 30 MILS BLUE HDPE INSULATION -TERMINATE WITH 24" EXCESS WIRE (COILED) AT EYE BOLT AND VALVE BOX (TYPICAL).
25.	CAST IN PLACE CONCRETE SIDEWALK - BRICKWORK SHALL NOT EXTEND TO SURFACE. ACCESS DOOR FRAME SHALL REST ON SIDEWALK.
26.	VALVE LOCK AND WARNING TAG (FURNISHED BY CLTW) - LOCK VALVE CLOSED.
27.	PLASTIC STEP - 12" VERTICAL SPACING.
28.	CONC. THRUST BLOCKING - 3,600 PSI.
29.	4" EPOXY COATED/LINED STEEL FL X FL SPOOL WITH 2" FNPT TEST OUTLET - LL = 12" (MARS CO) AND 2" BALL CORPORATION STOP WITH T-HEAD OPERATING NUT - MNPT X FNPT.
30.	ATTACH ENGRAVED LABEL, WITH PREMISE NUMBER, TO UNDERSIDE OF DOOR, NEAR THE LIFTING HANDLE.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

4-INCH COMPOUND WATER METER AND PRECAST CONCRETE VAULT

NO SCALE

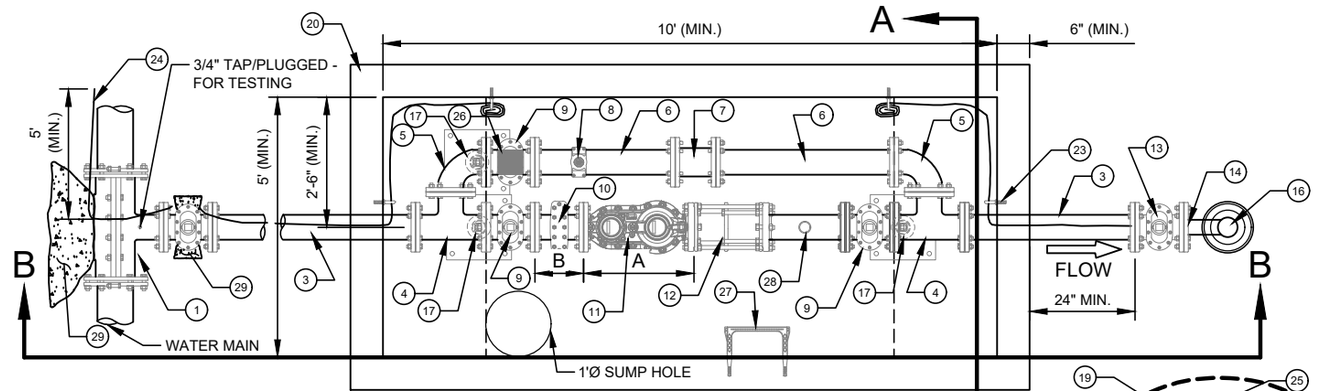
VERSION 2.0

DATE 01/2026

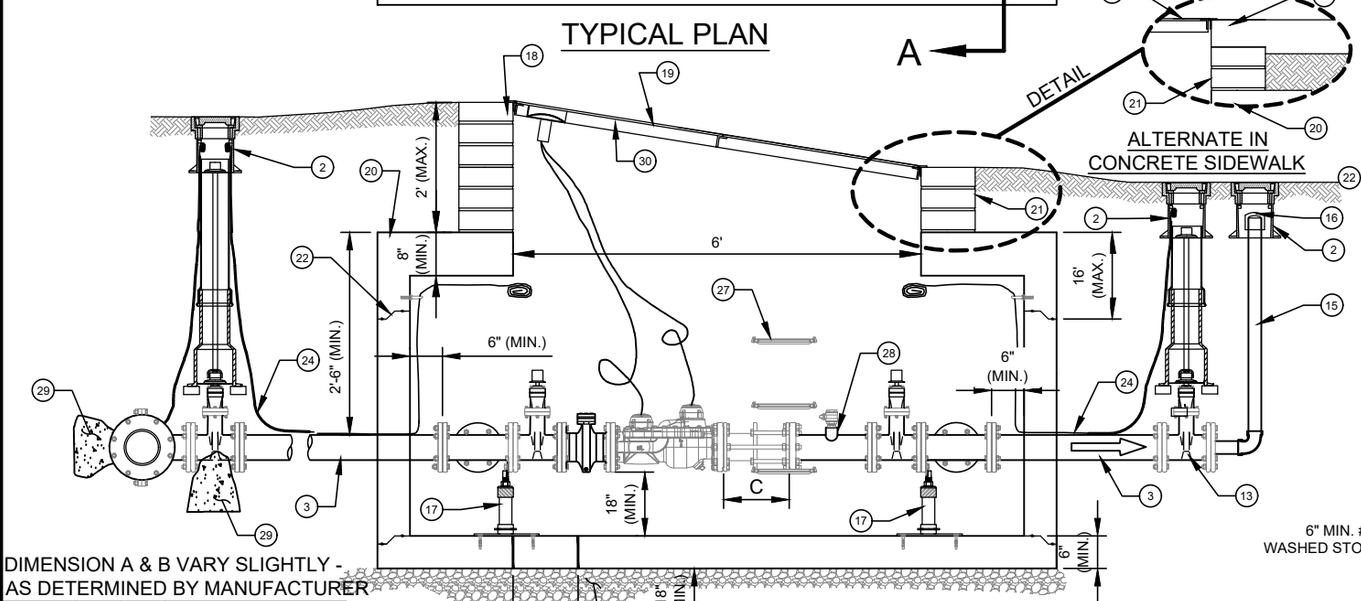
DETAIL 15.4.6

NOTES:

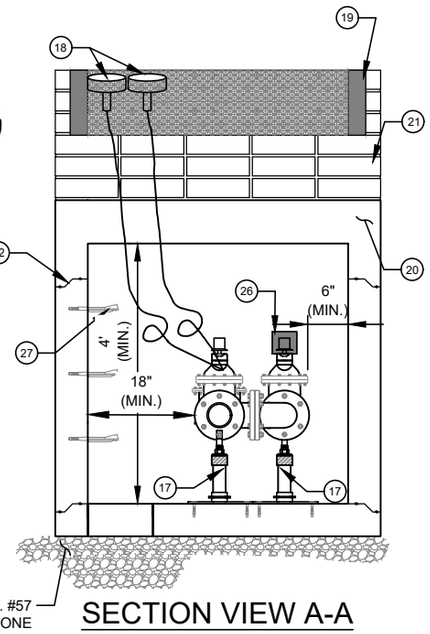
A. ALL FLANGE HARDWARE (BOLT/WASHER/NUT) SHALL BE STAINLESS STEEL - TYPE 304 WITH ANTI-SEIZE COMPOUND.
B. ALL PIPE SHALL BE RESTRAINED JOINT DUCTILE IRON FROM TAP TO PROPERTY LINE VALVE.
C. METER CONFIGURATION AND LENGTH / WIDTH MAY VARY DUE TO BRAND - VERIFY LENGTH TO DETERMINE MINIMUM VAULT LENGTH.
D. VAULT SHALL BE SIZED AS NEEDED FOR PIPE (8.5' X 4' MINIMUM) AND RATED FOR NCDOT HS-20 LOADING - SUBMIT SHOP DRAWINGS / P.E. SEALED FOR REVIEW.
E. ALL CONCRETE SHALL BE MINIMUM 4,000 PSI COMPRESSIVE STRENGTH.
F. DESIGN SHALL CONFORM TO ASTM C858 - SPECIFICATIONS FOR "UNDERGROUND PRECAST CONCRETE UTILITY STRUCTURE".
G. STEEL REINFORCING DESIGN SHALL CONFORM TO ASTM C857.
H. REBARS SHALL BE GRADE 60 PER ASTM A615.
I. WELDED WIRE FABRIC SHALL CONFORM TO ASTM A185.
J. DIAGONAL REINFORCING SHALL BE ADDED AT ALL OPENINGS.
K. PIPE PENETRATIONS SHALL BE SEALED WITH FLEXIBLE CONNECTORS (MANHOLE BOOTS) OR WITH 8" OF BRICK & MORTAR (AND 1/2-INCH THICK CONSTRUCTION EXPANSION MATERIAL).
L. FRAME TO BE FLUSH WITH GROUND OR CONCRETE SIDEWALK, GROUND SHALL SLOPE AWAY FROM VAULT.
M. ALL JOINTS SHALL BE MADE WATERTIGHT USING 2 RINGS OF BUTYL RUBBER JOINT MASTIC.
N. ALL VALVES SHALL BE OPEN RIGHT - CLOCKWISE, EXCEPT NO. 13.
O. WRAP TAPPING SLEEVE WITH 2 LAYERS HDPE PLASTIC FILM (HDCLPE PER AWWA C-105) - 4 MILS EACH LAYER - EXTEND HDPE 2' EACH WAY FROM SLEEVE - DUCT TAPE OR ZIP LOCK TIE ENDS.
P. CONCRETE THRUST BLOCKING REQUIRED AT TAPPING SLEEVE.
Q. PRECAST VAULT COMPONENTS SHALL HAVE MARKINGS PER ASTM C478 REQUIREMENTS.



TYPICAL PLAN



ELEVATION VIEW B-B



SECTION VIEW A-A

DIMENSION A & B VARY SLIGHTLY - AS DETERMINED BY MANUFACTURER

METER SIZE	A	B	C
6"	24"	9"	ROMAC = 8" SMITH BLAIR = 9"

NO. DESCRIPTION:

1. 6" TAPPING SLEEVE AND 6" FLANGE X MJ TAPPING VALVE ON EXISTING MAIN. 6" MJ TEE, 6" FOSTER ADAPTOR AND 6" MJ GATE VALVE ON NEW MAIN.
2. STANDARD VALVE BOX ASSEMBLY (TYP.) - ALL VALVES.
3. 6" DUCTILE IRON PIPE - FLANGE X PE - L = 30" OR 36" (SPECIAL CLASS 53).
4. FLANGE DUCTILE IRON TEE WITH ADJUSTABLE FLANGE SUPPORT.
5. FLANGE DUCTILE IRON 90° - BEND.
6. FLANGE X PLAIN END DUCTILE IRON PIPE 2 EA. - LL = 66" (MIN. SPECIAL CLASS 53).
7. MJ LONG PATTERN SOLID SLEEVE WITH RESTRAINED JOINTS.
8. 2" BALL CORPORATION STOP (THREADED OUTLET) WITH TAPPING SADDLE.
9. FLANGE GATE VALVE; WITH 2" OPERATING NUT - OPEN RIGHT AND WITH ADJUSTABLE FLANGE SUPPORT ON BYPASS VALVE.
10. FLANGE STRAINER.
11. FLANGE COMPOUND METER ASSEMBLY W/AMR TRANSMITTERS. METER CONFIGURATION MAY VARY DUE TO BRAND SUPPLIED.
12. 6" DISMANTLING JOINT (RESTRAINED) - ROMAC DJ400 - LL = 7" TO 9", SET TO 8", OR SMITH-BLAIR #975 - 8" TO 10", SET TO 9". - FL X FL - (L = 8" OR 9" - EXTENDED) SMITH BLAIR #975 OR ROMAC #DJ400 WITH STAINLESS STEEL TIE RODS/HARDWARE.
13. MECHANICAL JOINT (RJ) GATE VALVE - 2" OPERATING NUT - OPEN LEFT @ PROPERTY LINE.
14. MECHANICAL JOINT PLUG WITH 2" TAP.
15. TEMP. 2" PIPE GALVANIZED STEEL (SCH 80) WITH STANDARD VALVE BOX/CONCRETE PAD.
16. TEMP. 2" THREADED COUPLING.
17. ADJUSTABLE FLANGE PIPE SUPPORTS (3 REQUIRED).
18. AMR TRANSMITTERS.
19. 5' X 6' DOUBLE-LEAF ACCESS DOOR. SEE STANDARD DETAIL.
20. PRECAST REINFORCED CONCRETE VAULT.
21. MINIMUM OF (3) SOLID CONCRETE CAP BLOCK COURSES UNDER ACCESS DOOR FRAME, MAXIMUM 2'.
22. JOINT REQUIRED AT FLAT TOP SECTION.
23. 3/8" DIAMETER GALV. STEEL EYE BOLT (ADHESIVE ANCHOR) - TYPICAL.
24. AWG #12 GAUGE SOLID COPPER TRACER WIRE - WITH BLUE INSULATION (30 MILS HDPE) - TERMINATE WITH 24" EXCESS WIRE (COILED) @ EYE BOLT AND VALVE BOX (TYPICAL).
25. CAST IN PLACE CONCRETE SIDEWALK - BRICKWORK SHALL NOT EXTEND TO SURFACE. ACCESS DOOR FRAME SHALL REST ON SIDEWALK.
26. VALVE LOCK AND WARNING TAG (FURNISHED BY CLTW) - LOCK VALVE CLOSED.
27. PLASTIC STEP - 12" O.C. VERTICAL SPACING.
28. 6" EPOXY COATED/LINED STEEL FL X FL SPOOL WITH 2" FNPT TEST OUTLET - LL = 12" (MARS CO) AND 2" BALL CORPORATION STOP WITH T-HEAD OPERATING NUT - MNPT X FNPT.
29. CONCRETE THRUST BLOCKING - 3,600 PSI.
30. ATTACH ENGRAVED LABEL, WITH PREMISE NUMBER, TO UNDERSIDE OF DOOR, NEAR THE LIFTING HANDLE.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

6-INCH COMPOUND WATER METER AND PRECAST CONCRETE VAULT

NO SCALE

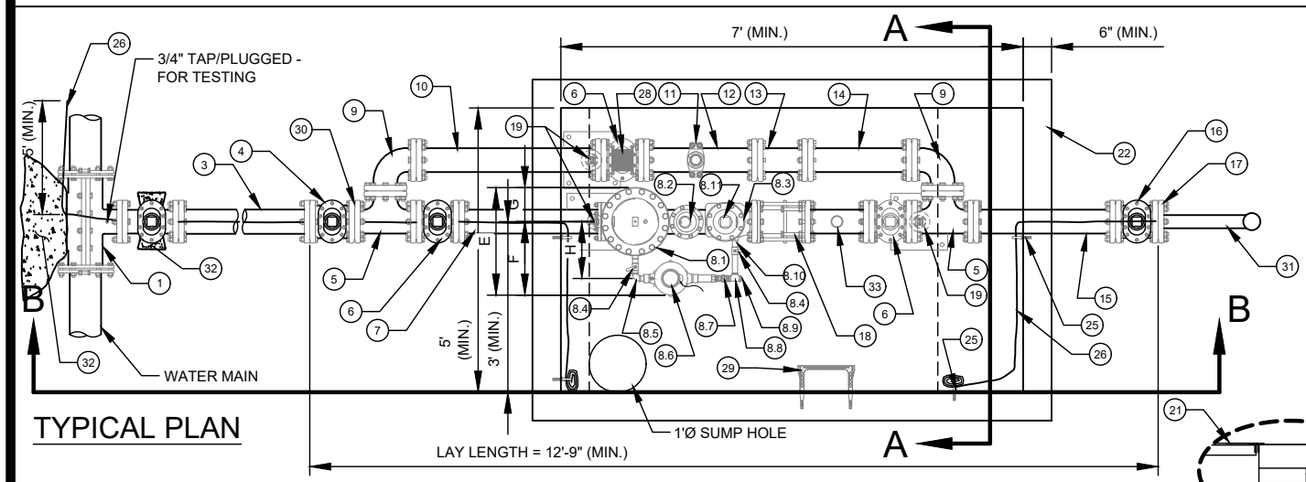
VERSION 2.0

DATE 01/2026

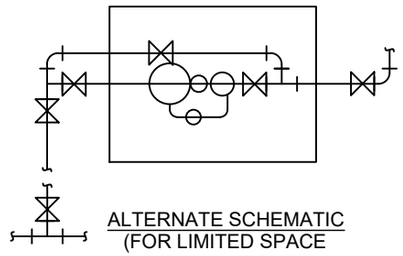
DETAIL 15.4.7

NOTES:

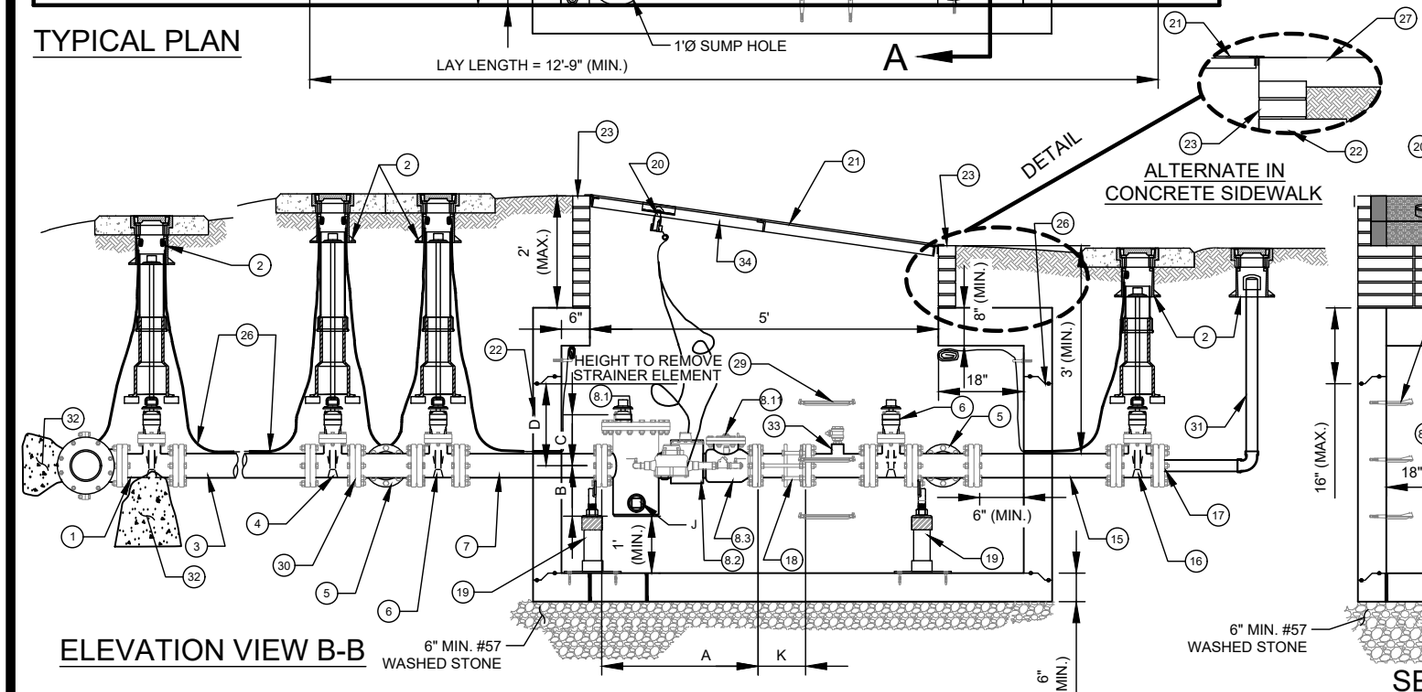
A. ALL FLANGE HARDWARE (BOLT/WASHER/NUT) SHALL BE SERIES 300 STAINLESS STEEL (ASTM F 593 / F 594) - WITH ANTI-SEIZE COMPOUND.
B. ALL PIPE SHALL BE RESTRAINED JOINT DUCTILE IRON FROM TAP TO PROPERTY LINE VALVE.
C. METER CONFIGURATION AND LENGTH / WIDTH MAY VARY DUE TO BRAND - VERIFY DIMENSIONS TO DETERMINE MINIMUM VAULT SIZE.
D. VAULT SHALL BE SIZED AS NEEDED FOR MINIMUM CLEARANCE AS SHOWN AND RATED FOR NCDOT HS-20 LOADING - SUBMIT SHOP DRAWINGS/P.E. SEALED FOR REVIEW.
E. ALL CONCRETE SHALL BE MINIMUM 4,000 PSI COMPRESSIVE STRENGTH.
F. DESIGN SHALL CONFORM TO ASTM C858 - SPECIFICATIONS FOR "UNDERGROUND PRECAST CONCRETE UTILITY STRUCTURE".
G. STEEL REINFORCING DESIGN SHALL CONFORM TO ASTM C857.
H. REBARS SHALL BE GRADE 60 PER ASTM A615.
I. WELDED WIRE FABRIC SHALL CONFORM TO ASTM A185.
J. DIAGONAL REINFORCING SHALL BE ADDED AT ALL OPENINGS.
K. PIPE PENETRATIONS SHALL BE SEALED WITH FLEXIBLE CONNECTORS (MANHOLE BOOTS) OR WITH 8" OF BRICK & MORTAR (AND 1/2-INCH THICK CONSTRUCTION EXPANSION MATERIAL).
L. FRAME TO BE FLUSH WITH GROUND OR CONCRETE SIDEWALK, GROUND SHALL SLOPE AWAY FROM VAULT.
M. ALL JOINTS SHALL BE MADE WATERTIGHT USING 2 RINGS OF BUTYL RUBBER JOINT MASTIC.
N. ALL VALVES SHALL BE OPEN RIGHT - CLOCKWISE, EXCEPT NO. 16.
O. PRECAST VAULT COMPONENTS SHALL HAVE MARKINGS PER ASTM C478 REQUIREMENTS.



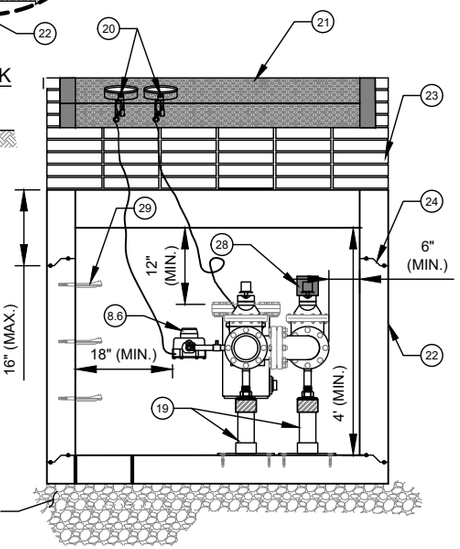
TYPICAL PLAN



ALTERNATE SCHEMATIC (FOR LIMITED SPACE INSTALLATIONS)



ELEVATION VIEW B-B



SECTION VIEW A-A

DIMENSION B - H VARY SLIGHTLY - AS DETERMINED BY MANUFACTURER.

METER SIZE	A	B	C	D	E	F	G	H	J	K
4"	33"	10 5/8"	10 3/4"	17 1/2"	22"	15 1/4"	6 3/4"	12"	2"	SMITH-BLAIR = 9" ROMAC = 8"

34. ATTACH ENGRAVED LABEL WITH PREMISE NUMBER, TO UNDERSIDE OF DOOR, NEAR THE LIFTING HANDLE

NO. DESCRIPTION:

1. 4" - TAPPING SLEEVE AND 4" FL X MJ TAPPING VALVE ON EXISTING MAIN. 4" MJ OUTLET TEE, 4" FOSTER ADAPTOR, AND 4" MJ GATE VALVE ON NEW MAIN.
2. STANDARD VALVE BOX ASSEMBLY (TYPICAL) - ALL VALVES.
3. 4" DUCTILE IRON PIPE - RESTRAINED.
4. 4" MJ X FL DUCTILE IRON ADAPTER ON SHORT SIDE SERVICE (NOT SHOWN), 4" MJ X FL GATE VALVE ON LONG SIDE SERVICE (SHOWN).
5. 4" ALL FLANGE DUCTILE IRON TEE.
6. 4" ALL FLANGE GATE VALVE.
7. 4" ALL FLANGE DUCTILE IRON PIPE SPOOL - L = 30" (MIN.) (SPECIAL CLASS 53).
8. 4" FMCT METER ASSEMBLY (FLANGE X FLANGE) - 4" X 1"
   - 8.1. STRAINER.
   - 8.2. METER WITH AMR TRANSMITTER.
   - 8.3. CHECK VALVE.
   - 8.4. 1" BRASS BALL VALVE WITH HANDLE (FNPT X FNPT).
   - 8.5. 1" BRASS 90° BEND (FNPT X FNPT).
   - 8.6. 1" METER WITH AMR TRANSMITTER.
   - 8.7. 1" BRONZE CHECK VALVE (FNPT X FNPT).
   - 8.8. 1" BRONZE TEE (FNPT X FNPT X FNPT).
   - 8.9. 1" BRONZE PLUG (MNPT).
   - 8.10. 1" RED BRASS PIPE NIPPLES (TYP. - AS REQUIRED) - (MNPT X MNPT).
   - 8.11. 2" (MIN.) SQUARE HEAD BRASS PLUG (MNPT).
9. 4" DUCTILE IRON 90° BEND FLANGE X FLANGE.
10. 4" DUCTILE IRON PIPE - FLANGE X FLANGE SPOOL - L = 39" (MIN.) (SPECIAL CLASS 53).
11. 4" X 1" SERVICE SADDLE WITH 1" BALL CORPORATION STOP - CC - TAPER THREAD.
12. 4" DUCTILE IRON PIPE - FLANGE X PE - L = 22" (MIN.) (SPECIAL CLASS 53).
13. 4" MECHANICAL JOINT DUCTILE IRON LONG PATTERN SOLID SLEEVE WITH RESTRAINED JOINTS.
14. 4" DUCTILE IRON PIPE - FLANGE X PE - L = 20" (MIN.) (SPECIAL CLASS 53).
15. 4" DUCTILE IRON PIPE - FLANGE X PE - L = 30" (MIN.) (SPECIAL CLASS 53).
16. 4" MECHANICAL JOINT (RJ) GATE VALVE - OPEN LEFT AT PROPERTY LINE.
17. 4" MECHANICAL JOINT PLUG WITH 2" TAP (FNPT).
18. 4" DISMANTLING JOINT (RESTRAINED) - ROMAC DJ400 - LL = 7" TO 9", SET TO 8", OR SMITH-BLAIR #975 - 8" TO 10", SET TO 9". - FL X FL - (L = 8" OR 9" - EXTENDED) SMITH BLAIR #975 OR ROMAC #DJ400 WITH STAINLESS STEEL TIE RODS/HARDWARE.
19. GALV. STEEL OR S.S. ADJUSTABLE FLANGE PIPE SUPPORTS (NUMBER REQUIRED = 3) (WITH STAINLESS STEEL ADHESIVE ANCHORS).
20. AMR TRANSMITTERS.
21. 5' X 5' ACCESS DOOR - SEE STD. DETAIL.
22. PRECAST REINFORCED CONCRETE VAULT - 8' X 5' X 4' (MIN.). SEE NOTES C AND D.
23. MINIMUM OF THREE STD. SOLID CONCRETE BRICK COURSES UNDER ACCESS DOOR FRAME - MAX. 2'.
24. JOINT REQUIRED AT FLAT TOP SECTION.
25. 3/8" DIA. GALV. STEEL EYE BOLT (EPOXY ADHESIVE ANCHOR) - TYPICAL.
26. AWG #12 GAUGE SOLID COPPER TRACER WIRE - WITH BLUE INSULATION (30 MILS HDPE) TERMINATE WITH 24" EXCESS WIRE (COILED) AT EYE BOLT AND VALVE BOX (TYPICAL).
27. CAST IN PLACE CONCRETE SIDEWALK - BRICKWORK SHALL NOT EXTEND TO SURFACE. ACCESS DOOR FRAME SHALL REST ON SIDEWALK.
28. VALVE LOCK AND WARNING TAG (FURNISHED BY CLTW) - LOCK VALVE CLOSED.
29. PLASTIC STEP - 12" O.C. VERTICAL SPACING.
30. ISOLATION FLANGE KIT REQUIRED WITH ALL CATHODIC PROTECTED MAINS, AND ALL MAINS 30-INCH AND LARGER.
31. 2" TEMPORARY BLOW OFF ASSEMBLY (GALV. STEEL (SCH 80)).
32. CONCRETE THRUST BLOCKING - 3,600 PSI.
33. 4" EPOXY COATED/LINED STEEL FL X FL SPOOL WITH 2" FNPT TEST OUTLET - LL = 12" (MARS CO.) AND 2" BALL CORPORATION STOP WITH T-HEAD OPERATING NUT - MNPT X FNPT.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

4-INCH FIRE METER COMPOUND TYPE (FMCT) WATER METER AND PRECAST CONCRETE VAULT

NO SCALE

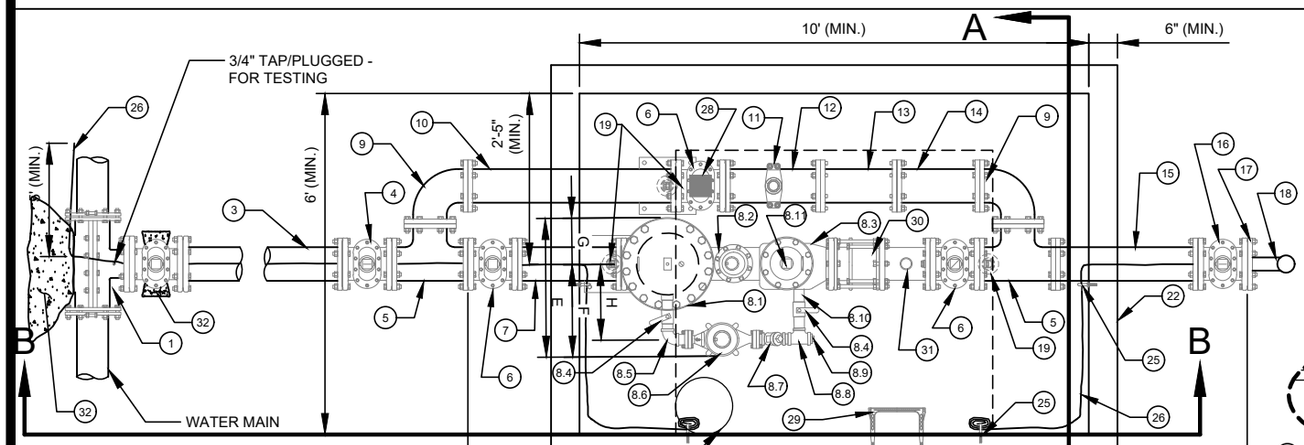
VERSION 1.0

DATE 04/2024

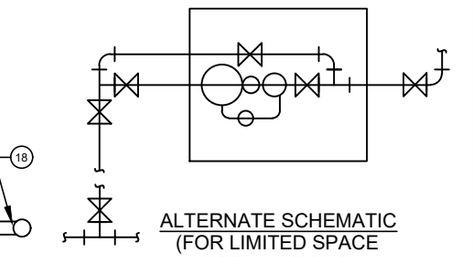
DETAIL 15.4.8

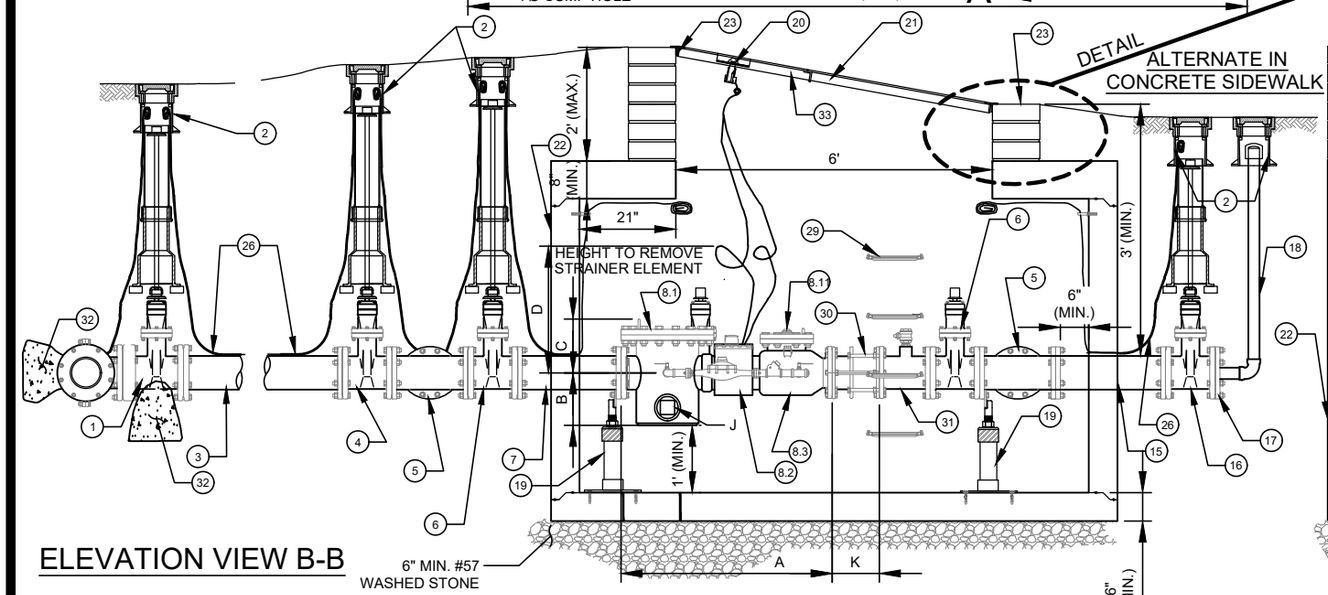
NOTES:

A. ALL FLANGE HARDWARE (BOLT/WASHER/NUT) SHALL BE STAINLESS STEEL - TYPE 304 WITH ANTI-SEIZE COMPOUND.
B. ALL PIPE SHALL BE RESTRAINED JOINT DUCTILE IRON FROM TAP TO PROPERTY LINE VALVE.
C. METER CONFIGURATION AND LENGTH / WIDTH MAY VARY DUE TO BRAND - VERIFY DIMENSIONS TO DETERMINE MINIMUM VAULT SIZE.
D. VAULT SHALL BE SIZED AS NEEDED FOR MINIMUM CLEARANCE AS SHOWN AND RATED FOR NCDOT HS-20 LOADING - SUBMIT SHOP DRAWINGS / P.E. SEALED FOR REVIEW.
E. ALL CONCRETE SHALL BE MINIMUM 4,000 PSI COMPRESSIVE STRENGTH.
F. DESIGN SHALL CONFORM TO ASTM C858 - SPECIFICATIONS FOR "UNDERGROUND PRECAST CONCRETE UTILITY STRUCTURE".
G. STEEL REINFORCING DESIGN SHALL CONFORM TO ASTM C857.
H. REBARS SHALL BE GRADE 60 PER ASTM A615.
I. WELDED WIRE FABRIC SHALL CONFORM TO ASTM A185.
J. DIAGONAL REINFORCING SHALL BE ADDED AT ALL OPENINGS.
K. PIPE PENETRATIONS SHALL BE SEALED WITH FLEXIBLE CONNECTORS (MANHOLE BOOTS) OR WITH 8" OF BRICK & MORTAR (AND 1/2-INCH THICK CONSTRUCTION EXPANSION MATERIAL).
L. FRAME TO BE FLUSH WITH GROUND OR CONCRETE SIDEWALK, GROUND SHALL SLOPE AWAY FROM VAULT.
M. ALL JOINTS SHALL BE MADE WATERTIGHT USING 2 RINGS OF BUTYL RUBBER JOINT MASTIC.
N. ALL VALVES SHALL BE OPEN RIGHT - CLOCKWISE, EXCEPT NO. 16.
O. PRECAST VAULT COMPONENTS SHALL HAVE MARKINGS PER ASTM C478 REQUIREMENTS.

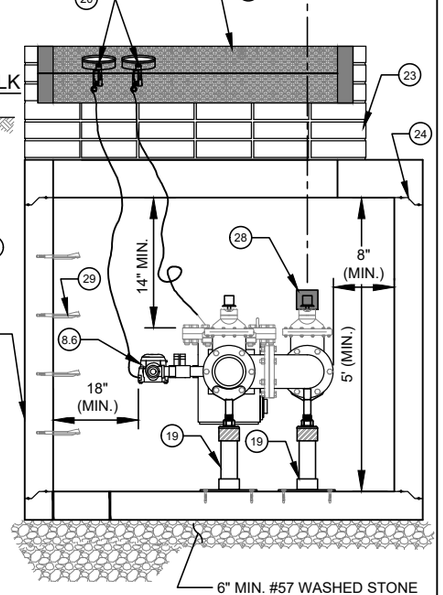


TYPICAL PLAN





ELEVATION VIEW B-B



SECTION VIEW A-A

DIMENSION B - H VARY SLIGHTLY - AS DETERMINED BY MANUFACTURER.

METER SIZE	A	B	C	D	E	F	G	H	J	K
6"	45"	11 1/16"	11 3/8"	21 1/4"	29"	19 1/2"	9 1/2"	16"	3"	SMITH-BLAIR = 9" ROMAC = 9"

NO. DESCRIPTION:

1. 6" - TAPPING SLEEVE AND 6" FL X MJ TAPPING VALVE ON EXISTING MAIN. 6" MJ OUTLET TEE, 6" FOSTER ADAPTOR, (OR SWIVEL TEE) AND 6" MJ GATE VALVE ON NEW MAIN.
2. STANDARD VALVE BOX ASSEMBLY (TYPICAL) - ALL VALVES.
3. 6" DUCTILE IRON PIPE - RESTRAINED.
4. 6" MJ X FL DUCTILE IRON ADAPTER ON SHORT SIDE SERVICE (NOT SHOWN), 6" MJ X FL GATE VALVE ON LONG SIDE SERVICE (SHOWN).
5. 6" ALL FLANGE DUCTILE IRON TEE.
6. 6" ALL FLANGE GATE VALVE.
7. 6" ALL FLANGE DUCTILE IRON PIPE SPOOL - L = 30" (MIN.) (SPECIAL CLASS 53).
8. 6" FMCT METER ASSEMBLY (FLANGE X FLANGE) - SHOWN AS 6" X 2", MAY ALSO BE 6" X 1 1/2" - AS DETERMINED BY MANUFACTURER.
   - 8.1. STRAINER.
   - 8.2. METER WITH AMR TRANSMITTER.
   - 8.3. CHECK VALVE.
   - 8.4. 2" BRASS BALL VALVE WITH HANDLE (FNPT X FNPT).
   - 8.5. 2" BRASS 90° BEND (FNPT X FNPT).
   - 8.6. 2" METER (2 BOLT METER FL - EACH END) WITH TRANSMITTER.
   - 8.7. 2" BRONZE CHECK VALVE (FNPT X FNPT).
   - 8.8. 2" BRONZE TEE (FNPT X FNPT X FNPT).
   - 8.9. 2" BRONZE PLUG (MNPT).
   - 8.10. 2" RED BRASS PIPE NIPPLES (TYP. - AS REQUIRED) - (MNPT X MNPT).
   - 8.11. 2" (MIN.) SQUARE HEAD BRASS PLUG (MNPT).
9. 6" DUCTILE IRON 90° BEND FLANGE X FLANGE.
10. 6" DUCTILE IRON PIPE - FLANGE X FLANGE SPOOL - L = 64.5" (MIN.) (SPECIAL CLASS 53).
11. 6" X 1 1/2" SERVICE SADDLE WITH 1 1/2" BALL CORPORATION STOP - CC - TAPER THREAD.
12. 6" DUCTILE IRON PIPE - FLANGE X PE - L = 24" (MIN.) (SPECIAL CLASS 53).
13. 6" MECHANICAL JOINT DUCTILE IRON LONG PATTERN SOLID SLEEVE WITH RESTRAINED JOINT.
14. 6" DUCTILE IRON PIPE - FLANGE X PE - L = 18" (MIN.) (SPECIAL CLASS 53).
15. 6" DUCTILE IRON PIPE - FLANGE X PE - L = 30" (MIN.) (SPECIAL CLASS 53).
16. 6" MECHANICAL JOINT (RJ) GATE VALVE - OPEN LEFT AT PROPERTY LINE.
17. 6" MECHANICAL JOINT PLUG WITH 2" TAP (FNPT).
18. 2" TEMPORARY BLOW OFF ASSEMBLY (GALV. STEEL (SCH 80), RED BRASS (SCH 40), HDPE (DR9) OR DIP - END WITH THREADED COUPLING).
19. GALV. STEEL OR S.S. ADJUSTABLE FLANGE PIPE SUPPORTS (NUMBER REQUIRED = 3) (WITH STAINLESS STEEL ADHESIVE ANCHORS).
20. AMR TRANSMITTERS.
21. 6' X 5' ACCESS DOOR - SEE STD. DETAIL.
22. PRECAST REINFORCED CONCRETE VAULT - 9.5' X 6' X 5' (MIN.). SEE NOTES C AND D.
23. MINIMUM OF THREE STD. SOLID CONCRETE BRICK COURSES UNDER ACCESS DOOR FRAME - MAX. 2'.
24. JOINT REQUIRED AT FLAT TOP SECTION.
25. 3/8" DIA. GALV. STEEL EYE BOLT (EPOXY ADHESIVE ANCHOR) - TYPICAL.
26. AWG #12 GAUGE SOLID COPPER TRACER WIRE - WITH BLUE INSULATION (30 MILS HDPE) TERMINATE WITH 24" EXCESS WIRE (COILED) AT EYE BOLT AND VALVE BOX (TYPICAL).
27. CAST IN PLACE CONCRETE SIDEWALK - BRICKWORK SHALL NOT EXTEND TO SURFACE. ACCESS DOOR FRAME SHALL REST ON SIDEWALK.
28. VALVE LOCK AND WARNING TAG (FURNISHED BY CLTW) - LOCK VALVE CLOSED.
29. PLASTIC STEP - 12" O.C. VERTICAL SPACING.
30. 6" DISMANTLING JOINT (RESTRAINED) - ROMAC DJ400 - LL = 7.38" TO 9.38", SET TO 9" OR SMITH-BLAIR #975 - LL = 8" TO 10", SET TO 9". ALL HARDWARE, BOLTS, NUTS, AND TIE RODS SHALL BE 304 S.S.
31. 6" EPOXY COATED/LINED STEEL FL X FL SPOOL WITH 2" FNPT TEST OUTLET - LL = 12" (MARS CO.) AND 2" BALL CORPORATION STOP WITH T-HEAD OPERATING NUT - MNPT X FNPT.
32. CONCRETE THRUST BLOCKING - 3,600 PSI.
33. ATTACH ENGRAVED LABEL, WITH PREMISE NUMBER, TO UNDERSIDE OF DOOR, NEAR THE LIFTING HANDLE.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

6-INCH FIRE METER COMPOUND TYPE (FMCT) WATER METER AND PRECAST CONCRETE VAULT

NO SCALE

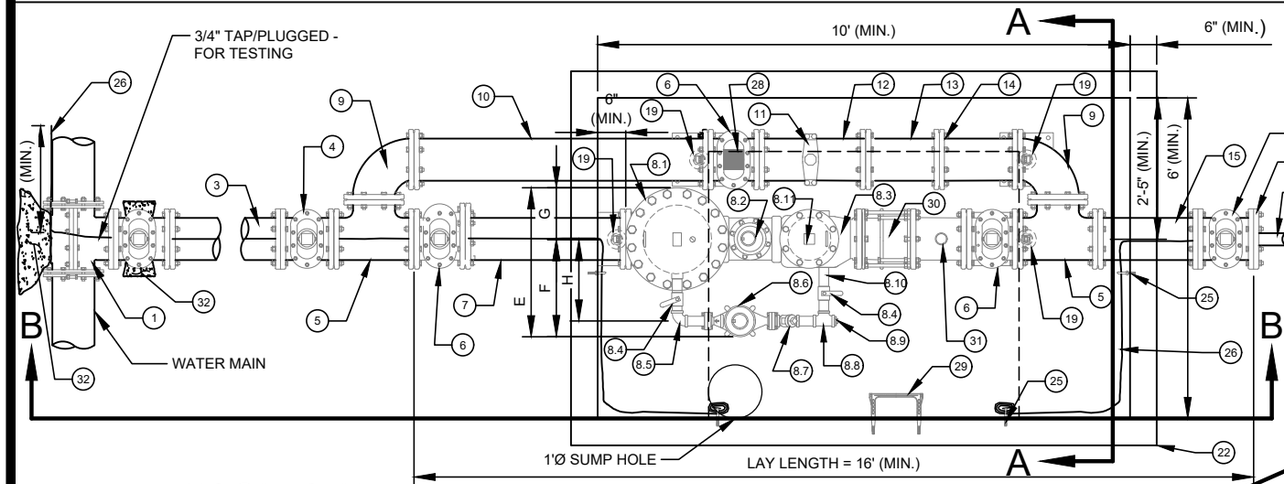
VERSION 2.0

DATE 01/2026

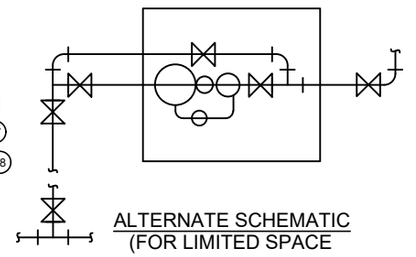
DETAIL 15.4.9

NOTES:

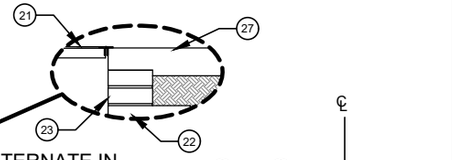
A. ALL FLANGE HARDWARE (BOLT/WASHER/NUT) SHALL BE STAINLESS STEEL - TYPE 304 WITH ANTI-SEIZE COMPOUND.
B. ALL PIPE SHALL BE RESTRAINED JOINT DUCTILE IRON FROM TAP TO PROPERTY LINE VALVE.
C. METER CONFIGURATION AND LENGTH / WIDTH MAY VARY DUE TO BRAND - VERIFY DIMENSIONS TO DETERMINE MINIMUM VAULT SIZE.
D. VAULT SHALL BE SIZED AS NEEDED FOR MINIMUM CLEARANCE AS SHOWN AND RATED FOR NCDOT HS-20 LOADING - SUBMIT SHOP DRAWINGS / P.E. SEALED FOR REVIEW.
E. ALL CONCRETE SHALL BE MINIMUM 4,000 PSI COMPRESSIVE STRENGTH.
F. DESIGN SHALL CONFORM TO ASTM C858 - SPECIFICATIONS FOR "UNDERGROUND PRECAST CONCRETE UTILITY STRUCTURE".
G. STEEL REINFORCING DESIGN SHALL CONFORM TO ASTM C857.
H. REBARS SHALL BE GRADE 60 PER ASTM A615.
I. WELDED WIRE FABRIC SHALL CONFORM TO ASTM A185.
J. DIAGONAL REINFORCING SHALL BE ADDED AT ALL OPENINGS.
K. PIPE PENETRATIONS SHALL BE SEALED WITH FLEXIBLE CONNECTORS (MANHOLE BOOTS) OR WITH 8" OF BRICK & MORTAR (AND 1/2-INCH THICK CONSTRUCTION EXPANSION MATERIAL).
L. FRAME TO BE FLUSH WITH GROUND OR CONCRETE SIDEWALK, GROUND SHALL SLOPE AWAY FROM VAULT.
M. ALL JOINTS SHALL BE MADE WATERTIGHT USING 2 RINGS OF BUTYL RUBBER JOINT MASTIC.
N. ALL VALVES SHALL BE OPEN RIGHT - CLOCKWISE, EXCEPT NO. 16.
O. PRECAST VAULT COMPONENTS SHALL HAVE MARKINGS PER ASTM C478 REQUIREMENTS.



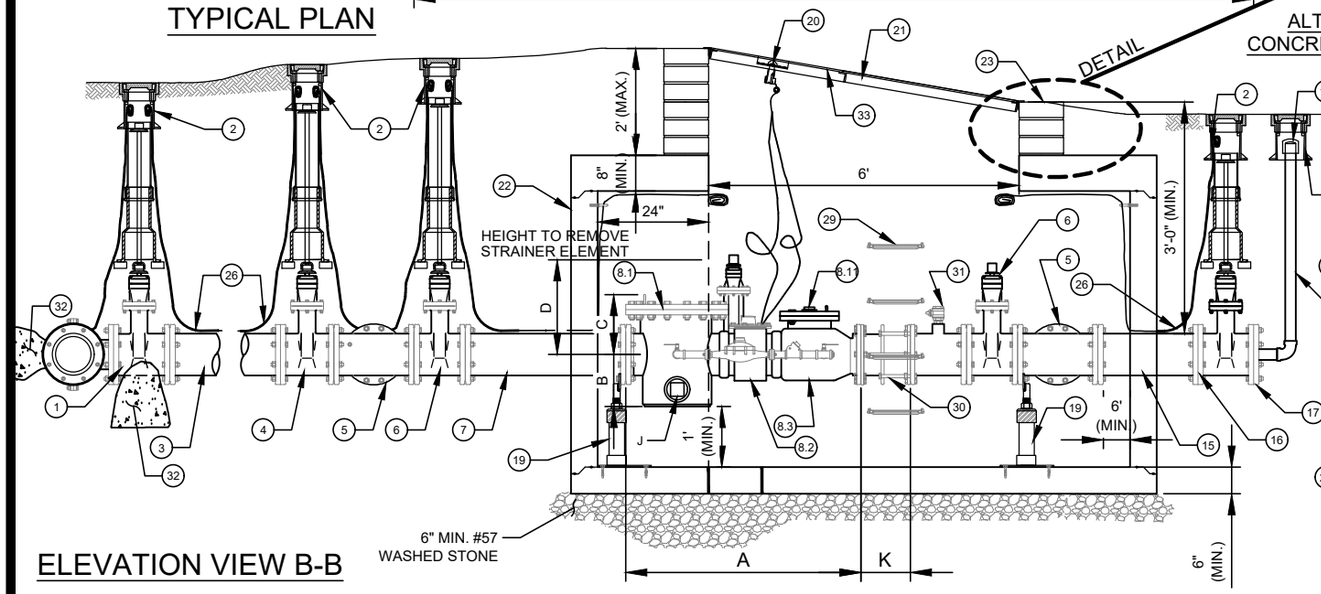
TYPICAL PLAN



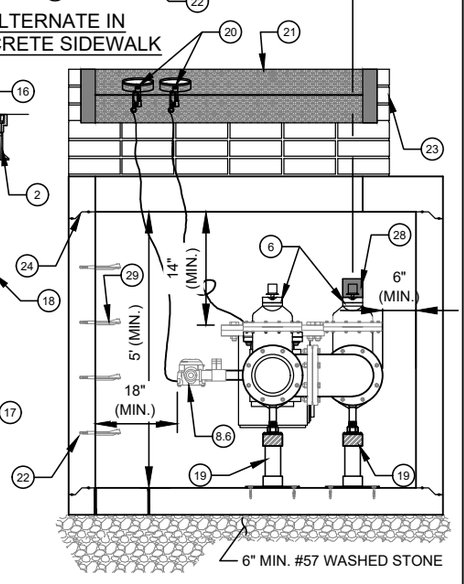
ALTERNATE SCHEMATIC (FOR LIMITED SPACE INSTALLATIONS)



ALTERNATE IN CONCRETE SIDEWALK



ELEVATION VIEW B-B



SECTION VIEW A-A

DIMENSION B - H VARY SLIGHTLY - AS DETERMINED BY MANUFACTURER.

METER SIZE	A	B	C	D	E	F	G	H	J	K
8"	53"	11 13/16"	13 29/64"	25 7/8"	34 1/4"	21 3/4"	12 1/2"	17"	3"	SMITH-BLAIR = 9" ROMAC = 9"

NO. DESCRIPTION:

1. 8" OUTLET TAPPING SLEEVE AND 8" FL X MJ TAPPING VALVE ON EXISTING MAIN. 8" MJ OUTLET TEE, 8" FOSTER ADAPTOR AND 8" MJ GATE VALVE ON NEW MAIN.
2. STANDARD VALVE BOX ASSEMBLY (TYPICAL) - ALL VALVES.
3. 8" DUCTILE IRON PIPE - RESTRAINED.
4. 8" MJ X FL DUCTILE IRON ADAPTER ON SHORT SIDE SERVICE (NOT SHOWN), 8" MJ X FL GATE VALVE ON LONG SIDE SERVICE (SHOWN).
5. 8" ALL FLANGE DUCTILE IRON TEE.
6. 8" ALL FLANGE GATE VALVE.
7. 8" ALL FLANGE DUCTILE IRON PIPE SPOOL - L = 36" (MIN.) (SPECIAL CLASS 53).
8. 8" FMCT METER ASSEMBLY (FLANGE X FLANGE)
   - 8.1. STRAINER.
   - 8.2. METER WITH AMR TRANSMITTER.
   - 8.3. CHECK VALVE.
   - 8.4. 2" BRASS BALL VALVE WITH HANDLE (FNPT X FNPT).
   - 8.5. 2" BRASS 90° BEND (FNPT X FNPT).
   - 8.6. 2" METER (2 BOLT METER FL - EACH END) WITH TRANSMITTER.
   - 8.7. 2" BRONZE CHECK VALVE (FNPT X FNPT).
   - 8.8. 2" BRONZE TEE (FNPT X FNPT X FNPT).
   - 8.9. 2" BRONZE PLUG (MNPT).
   - 8.10. 2" RED BRASS PIPE NIPPLES (TYP. - AS REQUIRED) - (MNPT X MNPT).
   - 8.11. 2" (MIN.) SQUARE HEAD BRASS PLUG (MNPT).
9. 8" DUCTILE IRON 90° BEND FLANGE X FLANGE.
10. 8" DUCTILE IRON PIPE - FLANGE X FLANGE SPOOL - L = 87.5" (MIN.) (SPECIAL CLASS 53).
11. 8" X 1 1/2" SERVICE SADDLE WITH 1 1/2" BALL CORPORATION STOP - CC - TAPER THREAD.
12. 8" DUCTILE IRON PIPE - FLANGE X PE - L = 20" (MIN.) (SPECIAL CLASS 53).
13. 8" MECHANICAL JOINT DUCTILE IRON LONG PATTERN SOLID SLEEVE WITH RESTRAINED JOINT.
14. 8" DUCTILE IRON PIPE - FLANGE X PE - L = 14" (MIN.) (SPECIAL CLASS 53).
15. 8" DUCTILE IRON PIPE - FLANGE X PE - L = 30" (MIN.) (SPECIAL CLASS 53).
16. 8" MECHANICAL JOINT (RJ) GATE VALVE - OPEN LEFT AT PROPERTY LINE.
17. 8" MECHANICAL JOINT PLUG WITH 2" TAP (FNPT).
18. 2" TEMPORARY BLOW OFF ASSEMBLY (GALV. STEEL (SCH 80) - END WITH THREADED COUPLING).
19. GALV. STEEL OR S.S. ADJUSTABLE FLANGE PIPE SUPPORTS (NUMBER REQUIRED = 4) (WITH STAINLESS STEEL ADHESIVE ANCHORS).
20. AMR TRANSMITTERS.
21. 5' X 6' ACCESS DOOR - SEE STD. DETAIL.
22. PRECAST REINFORCED CONCRETE VAULT - 10' X 6' X 5' (MIN.). SEE NOTES C AND D.
23. MINIMUM OF THREE STD. SOLID CONCRETE BRICK COURSES UNDER ACCESS DOOR FRAME - MAX. 2'.
24. JOINT REQUIRED AT FLAT TOP SECTION.
25. 3/8" DIAMETER GALV. STEEL EYE BOLT (EPOXY ADHESIVE ANCHOR) - TYPICAL.
26. AWG #12 GAUGE SOLID COPPER TRACER WIRE - WITH BLUE INSULATION (30 MILS HDPE) TERMINATE WITH 24" EXCESS WIRE (COILED) AT EYE BOLT AND VALVE BOX (TYPICAL).
27. CAST IN PLACE CONCRETE SIDEWALK - BRICKWORK SHALL NOT EXTEND TO SURFACE. ACCESS DOOR FRAME SHALL REST ON SIDEWALK.
28. VALVE LOCK AND WARNING TAG (FURNISHED BY CLTW) - LOCK VALVE CLOSED.
29. PLASTIC STEP - 12" O.C. VERTICAL SPACING.
30. 8" DISMANTLING JOINT (RESTRAINED) - ROMAC DJ400 - LL = 7.38" TO 9.38", SET TO 9" OR SMITH-BLAIR #975 - LL = 8" TO 10", SET TO 9". ALL HARDWARE, BOLTS, NUTS AND TIE RODS SHALL BE 304 S.S.
31. 8" EPOXY COATED/LINED STEEL FL X FL SPOOL WITH 2" FNPT TEST OUTLET - LL = 12" (MARS CO.) AND 2" BALL CORPORATION STOP WITH T-HEAD OPERATING NUT - MNPT X FNPT.
32. CONCRETE THRUST BLOCKING - 3,600 PSI.
33. ATTACH ENGRAVED LABEL, WITH PREMISE NUMBER, TO UNDERSIDE OF DOOR, NEAR THE LIFTING HANDLE.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

8-INCH FIRE METER COMPOUND TYPE (FMCT)
WATER METER AND PRECAST CONCRETE VAULT

NO SCALE

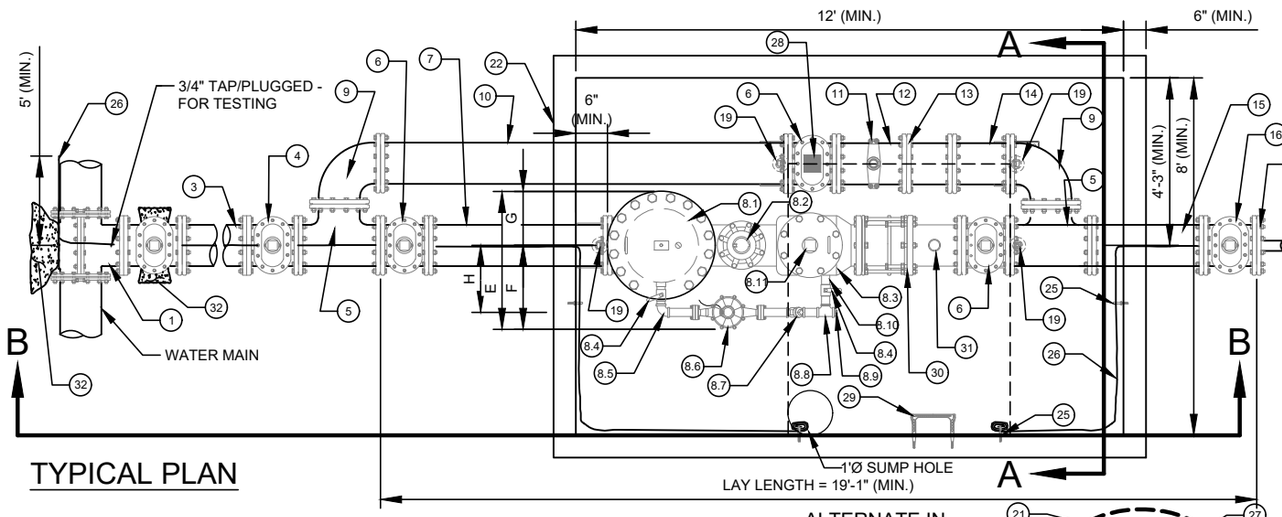
VERSION 2.0

DATE 01/2026

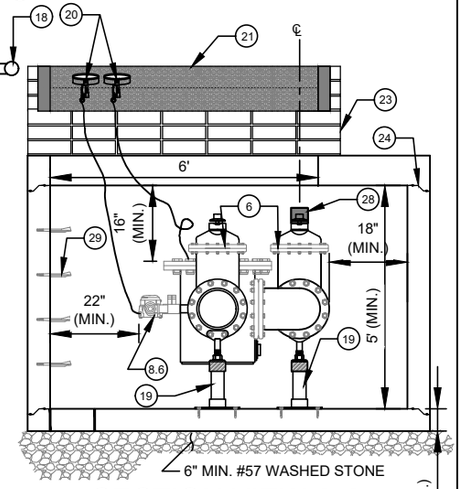
DETAIL 15.4.10

NOTES:

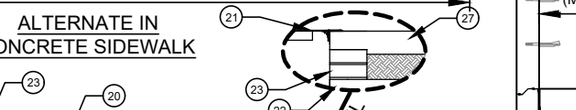
A. ALL FLANGE HARDWARE (BOLT/WASHER/NUT) SHALL BE STAINLESS STEEL - TYPE 304 WITH ANTI-SEIZE COMPOUND.
B. ALL PIPE SHALL BE RESTRAINED JOINT DUCTILE IRON FROM TAP TO PROPERTY LINE VALVE.
C. METER CONFIGURATION AND LENGTH / WIDTH MAY VARY DUE TO BRAND - VERIFY DIMENSIONS TO DETERMINE MINIMUM VAULT SIZE.
D. VAULT SHALL BE SIZED AS NEEDED FOR MINIMUM CLEARANCE AS SHOWN AND RATED FOR NCDOT HS-20 LOADING - SUBMIT SHOP DRAWINGS / P.E. SEALED FOR REVIEW.
E. ALL CONCRETE SHALL BE MINIMUM 4,000 PSI COMPRESSIVE STRENGTH.
F. DESIGN SHALL CONFORM TO ASTM C858 - SPECIFICATIONS FOR "UNDERGROUND PRECAST CONCRETE UTILITY STRUCTURE".
G. STEEL REINFORCING DESIGN SHALL CONFORM TO ASTM C857.
H. REBARS SHALL BE GRADE 60 PER ASTM A615.
I. WELDED WIRE FABRIC SHALL CONFORM TO ASTM A185.
J. DIAGONAL REINFORCING SHALL BE ADDED AT ALL OPENINGS.
K. PIPE PENETRATIONS SHALL BE SEALED WITH FLEXIBLE CONNECTORS (MANHOLE BOOTS) OR WITH 8" OF BRICK & MORTAR (AND 1/2-INCH THICK CONSTRUCTION EXPANSION MATERIAL).
L. FRAME TO BE FLUSH WITH GROUND OR CONCRETE SIDEWALK, GROUND SHALL SLOPE AWAY FROM VAULT.
M. ALL JOINTS SHALL BE MADE WATERTIGHT USING 2 RINGS OF BUTYL RUBBER JOINT MASTIC.
N. ALL VALVES SHALL BE OPEN RIGHT - CLOCKWISE, EXCEPT NO. 16.
O. PRECAST VAULT COMPONENTS SHALL HAVE MARKINGS PER ASTM C478 REQUIREMENTS.

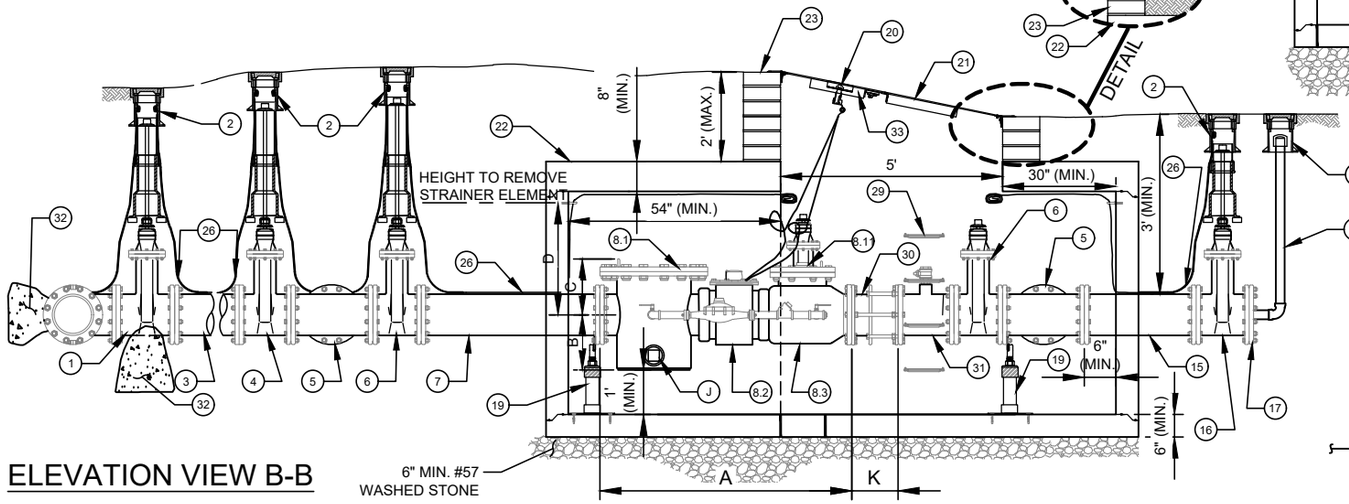


TYPICAL PLAN

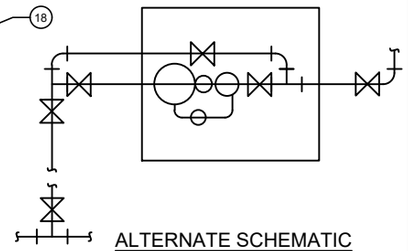


SECTION VIEW A-A





ELEVATION VIEW B-B



ALTERNATE SCHEMATIC (FOR LIMITED SPACE INSTALLATIONS)

DIMENSION B - H VARY SLIGHTLY - AS DETERMINED BY MANUFACTURER.

METER SIZE	A	B	C	D	E	F	G	H	J	K
10"	68"	14 13/16"	15"	30 1/16"	36 1/4"	22 1/2"	13 3/4"	18"	3"	SMITH-BLAIR = 10" ROMAC = 10.5"

NO. DESCRIPTION:

1. 10" OUTLET TAPPING SLEEVE AND 10" FL X MJ TAPPING VALVE ON EXISTING MAIN. 10" MJ OUTLET TEE, 10" FOSTER ADAPTOR AND 10" MJ GATE VALVE ON NEW MAIN AND FOSTER ADAPTER.
2. STANDARD VALVE BOX ASSEMBLY (TYPICAL) - ALL VALVES.
3. 10" DUCTILE IRON PIPE - RESTRAINED.
4. 10" MJ X FL DUCTILE IRON ADAPTER ON SHORT SIDE SERVICE (NOT SHOWN), 10" MJ X FL GATE VALVE ON LONG SIDE SERVICE (SHOWN).
5. 10" ALL FLANGE DUCTILE IRON TEE.
6. 10" ALL FLANGE GATE VALVE.
7. 10" ALL FLANGE DUCTILE IRON PIPE SPOOL - L = 48" (MIN.) (SPECIAL CLASS 53).
8. 10" FMCT METER ASSEMBLY (FLANGE X FLANGE)
   - 8.1. STRAINER.
   - 8.2. METER WITH AMR TRANSMITTER.
   - 8.3. CHECK VALVE.
   - 8.4. 2" BRASS BALL VALVE WITH HANDLE (FNPT X FNPT).
   - 8.5. 2" BRASS 90° BEND (FNPT X FNPT).
   - 8.6. 2" METER (2 BOLT METER FL - EACH END) WITH AMR TRANSMITTER.
   - 8.7. 2" BRONZE CHECK VALVE (FNPT X FNPT).
   - 8.8. 2" BRONZE TEE (FNPT X FNPT X FNPT).
   - 8.9. 2" SQUARE HEAD BRONZE PLUG (MNPT).
   - 8.10. 2" RED BRASS PIPE NIPPLES (TYP. - AS REQUIRED) - (MNPT X MNPT).
   - 8.11. 2" (MIN.) SQUARE HEAD BRASS PLUG (MNPT).
9. 10" DUCTILE IRON 90° BEND FLANGE X FLANGE.
10. 10" DUCTILE IRON PIPE - FLANGE X FLANGE SPOOL - L = 117.5" (MIN.) (SPECIAL CLASS 53).
11. 10" X 1 1/2" SERVICE SADDLE WITH 1 1/2" BALL CORPORATION STOP - CC - TAPER THREAD.
12. 10" DUCTILE IRON PIPE - FLANGE X PE - L = 20" (MIN.) (SPECIAL CLASS 53).
13. 10" MECHANICAL JOINT DUCTILE IRON LONG PATTERN SOLID SLEEVE WITH RESTRAINED JOINT.
14. 10" DUCTILE IRON PIPE - FLANGE X PE - L = 14" (MIN.) (SPECIAL CLASS 53).
15. 10" DUCTILE IRON PIPE - FLANGE X PE - L = 30" (MIN.) (SPECIAL CLASS 53).
16. 10" MECHANICAL JOINT (RJ) GATE VALVE - OPEN LEFT AT PROPERTY LINE.
17. 10" MECHANICAL JOINT PLUG WITH 2" TAP (FNPT).
18. 2" TEMPORARY BLOW OFF ASSEMBLY (GALV. STEEL (SCH 80) - END WITH THREADED COUPLING).
19. GALV. STEEL OR S.S. ADJUSTABLE FLANGE PIPE SUPPORTS (NUMBER REQUIRED = 4) (WITH STAINLESS STEEL ADHESIVE ANCHORS).
20. AMR TRANSMITTERS.
21. 5' X 6' ACCESS DOOR - SEE STD. DETAIL.
22. PRECAST REINFORCED CONCRETE VAULT - 12' X 8' X 5' (MIN.). SEE NOTES C AND D.
23. MINIMUM OF THREE STD. SOLID CONCRETE BRICK COURSES UNDER ACCESS DOOR FRAME - MAX. 2'.
24. JOINT REQUIRED AT FLAT TOP SECTION.
25. 3/8" DIA. GALV. STEEL EYE BOLT (EPOXY ADHESIVE ANCHOR) - TYPICAL.
26. AWG #12 GAUGE SOLID COPPER TRACER WIRE - WITH BLUE INSULATION (30 MILS HDPE) TERMINATE WITH 24" EXCESS WIRE (COILED) AT EYE BOLT AND VALVE BOX (TYPICAL).
27. CAST IN PLACE CONCRETE SIDEWALK - BRICKWORK SHALL NOT EXTEND TO SURFACE. ACCESS DOOR FRAME SHALL REST ON SIDEWALK.
28. VALVE LOCK AND WARNING TAG (FURNISHED BY CLTW) - LOCK VALVE CLOSED.
29. PLASTIC STEP - 12" O.C. VERTICAL SPACING.
30. 10" DISMANTLING JOINT (RESTRAINED) - ROMAC DJ400 - LL = 9.5" TO 11.5", SET TO 10.5" OR SMITH-BLAIR #975 - LL = 9" TO 11", SET TO 10". ALL HARDWARE, BOLTS, NUTS AND TIE RODS SHALL BE 304 S.S.
31. 10" EPOXY COATED/LINED STEEL FL X FL SPOOL WITH 2" FNPT TEST OUTLET - LL = 12" (MARS CO.) AND 2" BALL CORPORATION STOP WITH T-HEAD OPERATING NUT - MNPT X FNPT.
32. CONCRETE THRUST BLOCKING - 3,600 PSI.
33. ATTACH ENGRAVED LABEL, WITH PREMISE NUMBER, TO UNDERSIDE OF DOOR, NEAR THE LIFTING HANDLE.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

10-INCH FIRE METER COMPOUND TYPE (FMCT)
WATER METER AND PRECAST CONCRETE VAULT)

NO SCALE

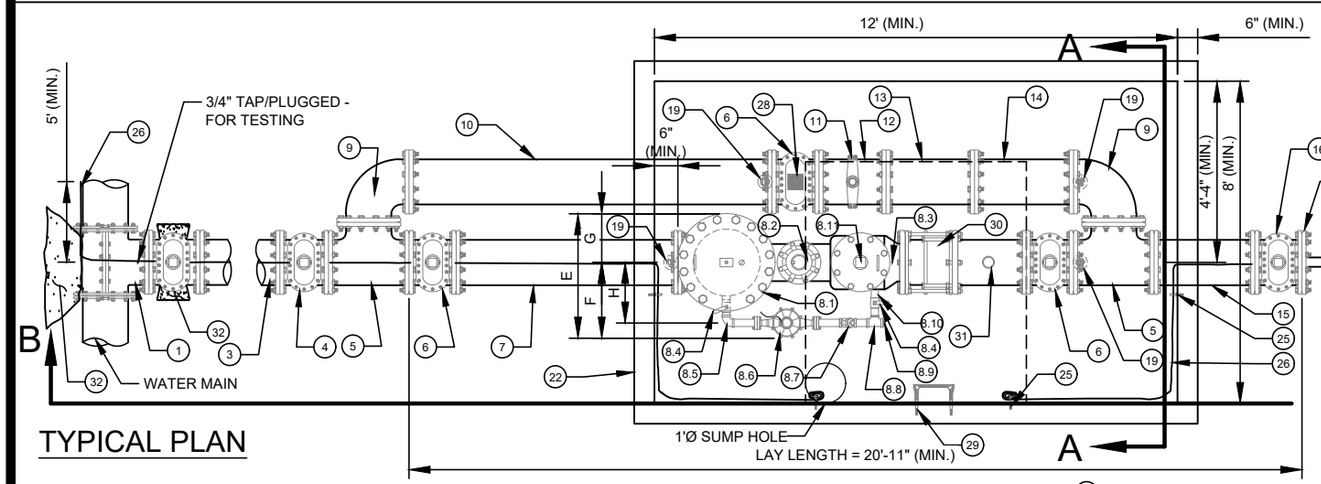
VERSION 2.0

DATE 01/2026

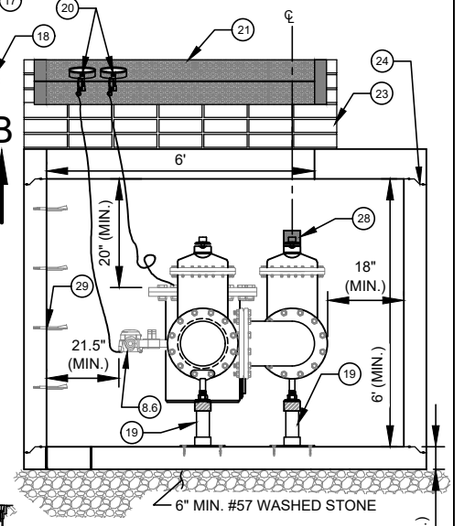
DETAIL 15.4.11

NOTES:

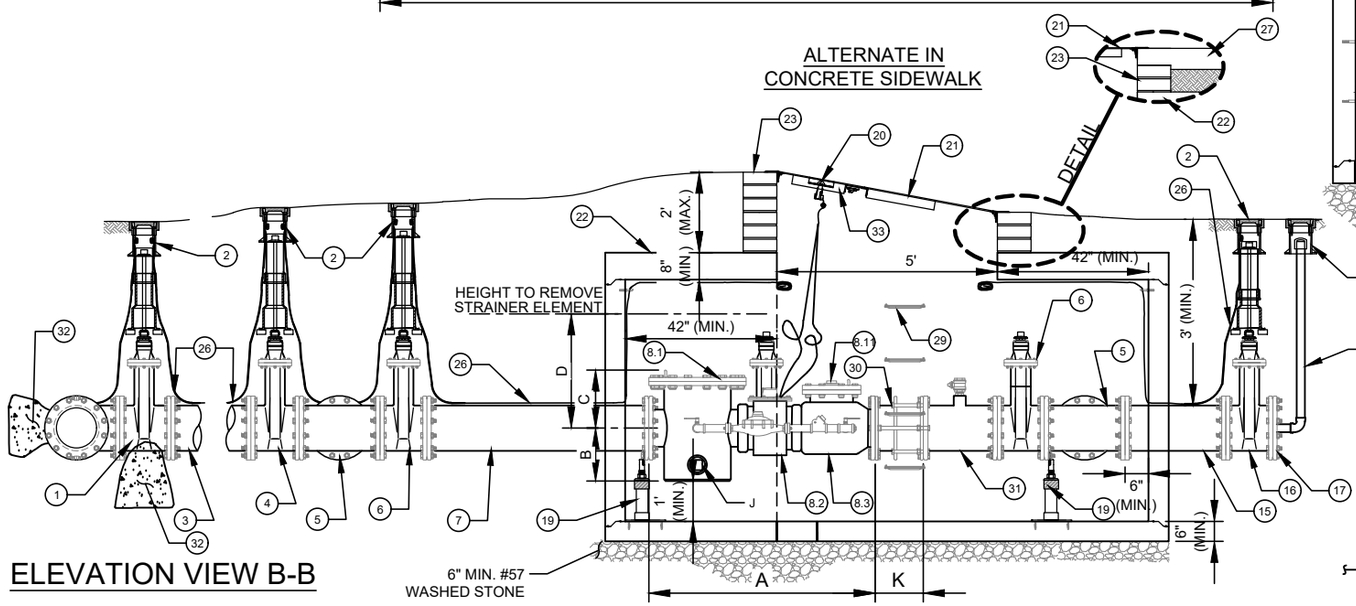
A. ALL FLANGE HARDWARE (BOLT/WASHER/NUT) SHALL BE STAINLESS STEEL - TYPE 304 WITH ANTI-SEIZE COMPOUND.
B. ALL PIPE SHALL BE RESTRAINED JOINT DUCTILE IRON FROM TAP TO PROPERTY LINE VALVE.
C. METER CONFIGURATION AND LENGTH / WIDTH MAY VARY DUE TO BRAND - VERIFY DIMENSIONS TO DETERMINE MINIMUM VAULT SIZE.
D. VAULT SHALL BE SIZED AS NEEDED FOR MINIMUM CLEARANCE AS SHOWN AND RATED FOR NCDOT HS-20 LOADING - SUBMIT SHOP DRAWINGS / P.E. SEALED FOR REVIEW.
E. ALL CONCRETE SHALL BE MINIMUM 4,000 PSI COMPRESSIVE STRENGTH.
F. DESIGN SHALL CONFORM TO ASTM C858 - SPECIFICATIONS FOR "UNDERGROUND PRECAST CONCRETE UTILITY STRUCTURE".
G. STEEL REINFORCING DESIGN SHALL CONFORM TO ASTM C857.
H. REBARS SHALL BE GRADE 60 PER ASTM A615.
I. WELDED WIRE FABRIC SHALL CONFORM TO ASTM A185.
J. DIAGONAL REINFORCING SHALL BE ADDED AT ALL OPENINGS.
K. PIPE PENETRATIONS SHALL BE SEALED WITH FLEXIBLE CONNECTORS (MANHOLE BOOTS) OR WITH 8" OF BRICK & MORTAR (AND 1/2-INCH THICK CONSTRUCTION EXPANSION MATERIAL).
L. FRAME TO BE FLUSH WITH GROUND OR CONCRETE SIDEWALK, GROUND SHALL SLOPE AWAY FROM VAULT.
M. ALL JOINTS SHALL BE MADE WATERTIGHT USING 2 RINGS OF BUTYL RUBBER JOINT MASTIC.
N. ALL VALVES SHALL BE OPEN RIGHT - CLOCKWISE, EXCEPT NO. 16.
O. PRECAST VAULT COMPONENTS SHALL HAVE MARKINGS PER ASTM C478 REQUIREMENTS.



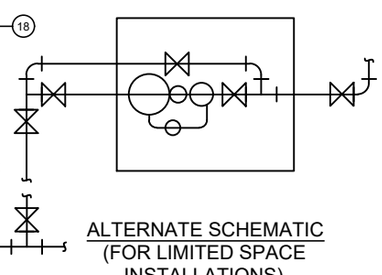
TYPICAL PLAN



SECTION VIEW A-A



ELEVATION VIEW B-B



ALTERNATE SCHEMATIC (FOR LIMITED SPACE INSTALLATIONS)

DIMENSION B - H VARY SLIGHTLY - AS DETERMINED BY MANUFACTURER.

METER SIZE	A	B	C	D	E	F	G	H	J	K
12"	68"	15 3/4"	17 1/4"	34 1/16"	36 1/4"	22 1/2"	13 3/4"	18"	3"	SMITH-BLAIR = 10" ROMAC = 10.5"

NO. DESCRIPTION:

1. 12" OUTLET TAPPING SLEEVE AND 12" FL X MJ TAPPING VALVE ON EXISTING MAIN. 12" MJ OUTLET TEE, 10" FOSTER ADAPTOR AND 10" MJ GATE VALVE ON NEW MAIN.
2. STANDARD VALVE BOX ASSEMBLY (TYPICAL) - ALL VALVES.
3. 12" DUCTILE IRON PIPE - RESTRAINED.
4. 12" MJ X FL DUCTILE IRON ADAPTER ON SHORT SIDE SERVICE (NOT SHOWN), 12" MJ X FL GATE VALVE ON LONG SIDE SERVICE (SHOWN).
5. 12" ALL FLANGE DUCTILE IRON TEE.
6. 12" ALL FLANGE GATE VALVE.
7. 12" ALL FLANGE DUCTILE IRON PIPE SPOOL - L = 66" (MIN.) (SPECIAL CLASS 53).
8. 12" FMCT METER ASSEMBLY (FLANGE X FLANGE)
   - 8.1. STRAINER.
   - 8.2. METER WITH AMR TRANSMITTER.
   - 8.3. CHECK VALVE.
   - 8.4. 2" BRASS BALL VALVE WITH HANDLE (FNPT X FNPT).
   - 8.5. 2" BRASS 90° BEND (FNPT X FNPT).
   - 8.6. 2" METER (2 BOLT METER FL - EACH END) WITH AMR TRANSMITTER.
   - 8.7. 2" BRONZE CHECK VALVE (FNPT X FNPT).
   - 8.8. 2" BRONZE TEE (FNPT X FNPT X FNPT).
   - 8.9. 2" SQUARE HEAD BRONZE PLUG (MNPT).
   - 8.10. 2" RED BRASS PIPE NIPPLES (TYP. - AS REQUIRED) - (MNPT X MNPT).
   - 8.11. 2" (MIN.) SQUARE HEAD BRASS PLUG (MNPT).
9. 12" DUCTILE IRON 90° BEND FLANGE X FLANGE.
10. 12" DUCTILE IRON PIPE - FLANGE X FLANGE SPOOL - L = 132.5" (MIN.) (SPECIAL CLASS 53).
11. 12" X 1 1/2" SERVICE SADDLE WITH 1 1/2" BALL CORPORATION STOP - CC - TAPER THREAD.
12. 12" DUCTILE IRON PIPE - FLANGE X PE - L = 24" (MIN.) (SPECIAL CLASS 53).
13. 12" MECHANICAL JOINT DUCTILE IRON LONG PATTERN SOLID SLEEVE WITH RESTRAINED JOINT.
14. 12" DUCTILE IRON PIPE - FLANGE X PE - L = 14" (MIN.) (SPECIAL CLASS 53).
15. 12" DUCTILE IRON PIPE - FLANGE X PE - L = 30" (MIN.) (SPECIAL CLASS 53).
16. 12" MECHANICAL JOINT (RJ) GATE VALVE - OPEN LEFT AT PROPERTY LINE.
17. 12" MECHANICAL JOINT PLUG WITH 2" TAP (FNPT).
18. 2" TEMPORARY BLOW OFF ASSEMBLY (GALV. STEEL (SCH 80) - END WITH THREADED COUPLING).
19. GALV. STEEL OR S.S. ADJUSTABLE FLANGE PIPE SUPPORT (NUMBER REQUIRED = 4) (WITH STAINLESS STEEL ADHESIVE ANCHORS).
20. AMR TRANSMITTERS.
21. 5' X 6' ACCESS DOOR - SEE STD. DETAIL.
22. PRECAST REINFORCED CONCRETE VAULT - 12' X 8' X 6' (MIN.). SEE NOTES C AND D.
23. MINIMUM OF THREE STD. SOLID CONCRETE BRICK COURSES UNDER ACCESS DOOR FRAME - MAX. 2'.
24. JOINT REQUIRED AT FLAT TOP SECTION.
25. 3/8" DIAMETER GALV. STEEL EYE BOLT (EPOXY ADHESIVE ANCHOR) - TYPICAL.
26. AWG #12 GAUGE SOLID COPPER TRACER WIRE - WITH BLUE INSULATION (30 MILS HDPE) TERMINATE WITH 24" EXCESS WIRE (COILED) AT EYE BOLT AND VALVE BOX (TYPICAL).
27. CAST IN PLACE CONCRETE SIDEWALK - BRICKWORK SHALL NOT EXTEND TO SURFACE. ACCESS DOOR FRAME SHALL REST ON SIDEWALK.
28. VALVE LOCK AND WARNING TAG (FURNISHED BY CLTW) - LOCK VALVE CLOSED.
29. PLASTIC STEP - 12" O.C. VERTICAL SPACING.
30. 12" DISMANTLING JOINT (RESTRAINED) - ROMAC DJ400 - LL = 9.5" TO 11.5", SET TO 10.5" OR SMITH-BLAIR #975 - LL = 9" TO 11", SET TO 10". ALL HARDWARE, BOLTS, NUTS AND TIE RODS SHALL BE 304 S.S.
31. 12" EPOXY COATED/LINED STEEL FL X FL SPOOL WITH 2" FNPT TEST OUTLET - LL = 12" (MARS CO.) AND 2" BALL CORPORATION STOP WITH T-HEAD OPERATING NUT - MNPT X FNPT.
32. CONCRETE THRUST BLOCKING - 3,600 PSI.
33. ATTACH ENGRAVED LABEL, WITH PREMISE NUMBER, TO UNDERSIDE OF DOOR, NEAR THE LIFTING HANDLE.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

12-INCH FIRE METER COMPOUND TYPE (FMCT) WATER METER AND PRECAST CONCRETE VAULT

NO SCALE

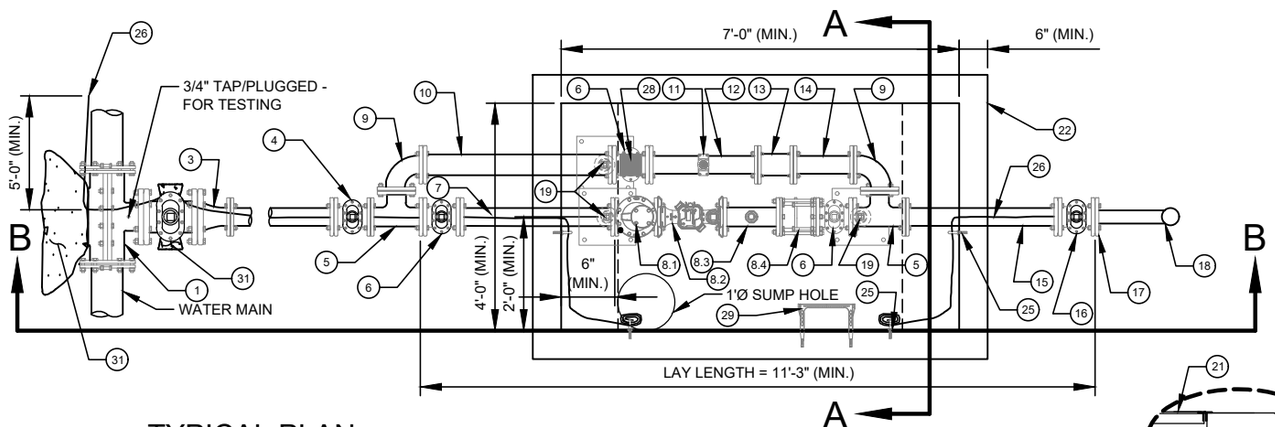
VERSION 2.0

DATE 01/2026

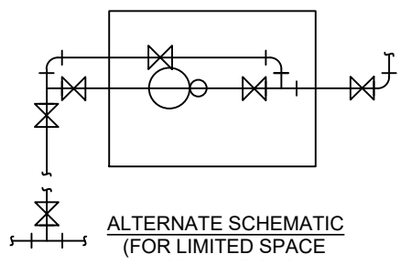
DETAIL 15.4.12

NOTES:

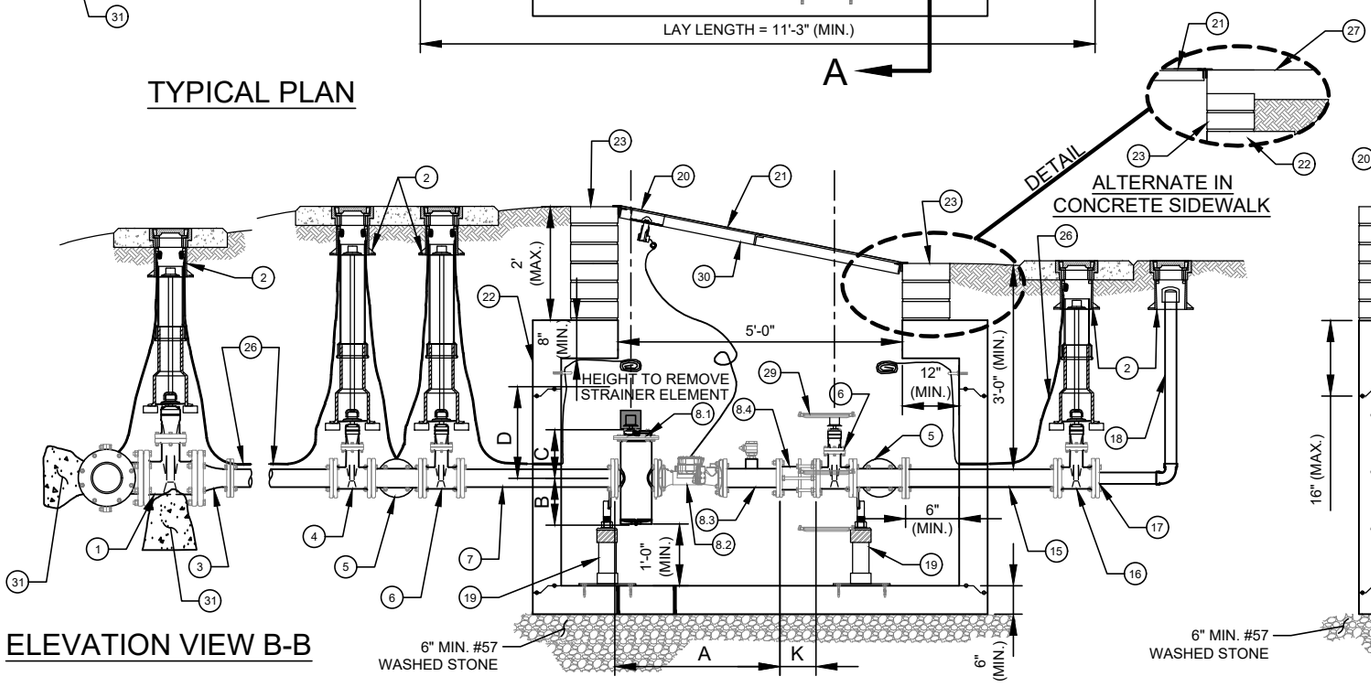
A. ALL FLANGE HARDWARE (BOLT/WASHER/NUT) SHALL BE STAINLESS STEEL - TYPE 304 WITH ANTI-SEIZE COMPOUND.
B. ALL PIPE SHALL BE RESTRAINED JOINT DUCTILE IRON FROM TAP TO PROPERTY LINE VALVE.
C. METER CONFIGURATION AND LENGTH / WIDTH MAY VARY DUE TO BRAND - VERIFY DIMENSIONS TO DETERMINE MINIMUM VAULT SIZE.
D. VAULT SHALL BE SIZED AS NEEDED FOR MINIMUM CLEARANCE AS SHOWN AND RATED FOR NCDOT HS-20 LOADING - SUBMIT SHOP DRAWINGS / P.E. SEALED FOR REVIEW.
E. ALL CONCRETE SHALL BE MINIMUM 4,000 PSI COMPRESSIVE STRENGTH.
F. DESIGN SHALL CONFORM TO ASTM C858 - SPECIFICATIONS FOR "UNDERGROUND PRECAST CONCRETE UTILITY STRUCTURE".
G. STEEL REINFORCING DESIGN SHALL CONFORM TO ASTM C857.
H. REBARS SHALL BE GRADE 60 PER ASTM A615.
I. WELDED WIRE FABRIC SHALL CONFORM TO ASTM A185.
J. DIAGONAL REINFORCING SHALL BE ADDED AT ALL OPENINGS.
K. PIPE PENETRATIONS SHALL BE SEALED WITH FLEXIBLE CONNECTORS (MANHOLE BOOTS) OR WITH 8" OF BRICK & MORTAR (AND 1/2-INCH THICK CONSTRUCTION EXPANSION MATERIAL).
L. FRAME TO BE FLUSH WITH GROUND OR CONCRETE SIDEWALK, GROUND SHALL SLOPE AWAY FROM VAULT.
M. ALL JOINTS SHALL BE MADE WATERTIGHT USING 2 RINGS OF BUTYL RUBBER JOINT MASTIC.
N. ALL VALVES SHALL BE OPEN RIGHT - CLOCKWISE, EXCEPT NO. 16.
O. PRECAST VAULT COMPONENTS SHALL HAVE MARKINGS PER ASTM C478 REQUIREMENTS.



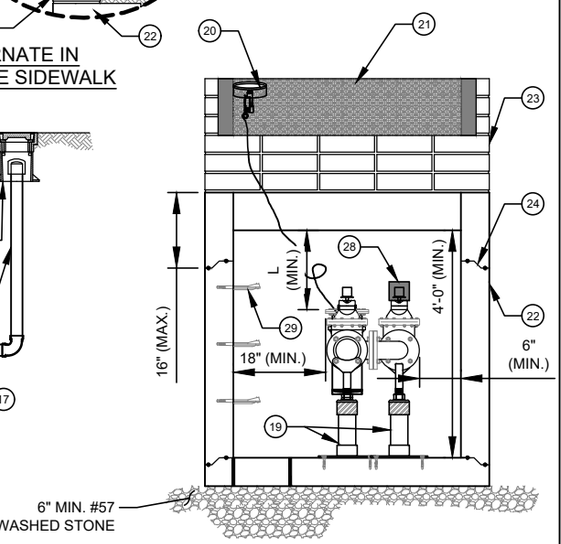
TYPICAL PLAN



ALTERNATE SCHEMATIC (FOR LIMITED SPACE INSTALLATIONS)



ELEVATION VIEW B-B



SECTION VIEW A-A

METER SIZE	A	B	C	D	K	L
3"	BERMAD = 33.8" BADGER = 38.25"	BERMAD = 6.3" BADGER = 10"	BERMAD = 5.9" BADGER = 10.625"	BERMAD = 23.1" BADGER = 31.25"	SMITH-BLAIR = 9" ROMAC = 8"	BERMAD = 20" BADGER = 14"

NO. DESCRIPTION:

1. 4" TAPPING SLEEVE AND 4" FL X MJ TAPPING VALVE ON EXISTING MAIN. 3" MJ OUTLET TEE, 3" FOSTER ADAPTOR, AND 3" MJ GATE VALVE ON NEW MAIN. WHEN THE NEW MAIN IS LARGER THAN 12", USE A 6" SWIVEL TEE, 6" MJ GATE VALVE, 6" FOSTER ADAPTOR, AND 6" X 3" MJ REDUCER.
2. STANDARD VALVE BOX ASSEMBLY (TYPICAL) - ALL VALVES.
3. 4" FOSTER ADAPTOR, 4" X 3" REDUCER (RMJ) REQUIRED ON EXISTING MAIN INSTALLATIONS.
4. 3" MJ X FL DUCTILE IRON ADAPTER ON SHORT SIDE SERVICE (NOT SHOWN), 3" MJ X FL GATE VALVE ON LONG SIDE SERVICE (SHOWN).
5. 3" ALL FLANGE DUCTILE IRON TEE.
6. 3" ALL FLANGE GATE VALVE.
7. 3" ALL FLANGE DUCTILE IRON PIPE SPOOL - L = 30" (MIN.) (SPECIAL CLASS 53).
8. 3" ULTRASONIC WATER METER ASSEMBLY (FLANGE X FLANGE).
   - 8.1. BERMAD OR BADGER FIRE RATED BASKET STRAINER (FL X FL) - LL = 9.8" (BERMAD MODEL FP-60F-D) OR LL = 14.25" (BADGER MODEL 7000 AFSS FIRE SERVICE STRAINER).
   - 8.2. 3" MASTER METER OCTAVE OR BADGER E-SERIES OR NEPTUNE MACH10 ULTRASONIC WATER METER WITH ITRON W100 TRANSMITTER - LL = 12".
   - 8.3. 3" EPOXY COATED/LINED STEEL FL X FL SPOOL WITH 2" FNPT TEST OUTLET - LL = 12" (MARS CO.) AND 2" BALL CORPORATION STOP WITH T-HEAD OPERATING NUT - MNPT X FNPT.
   - 8.4. ROMAC D J400 DISMANTLING JOINT - LL = 7" TO 9", SET TO 8" OR SMITH-BLAIR MODEL 975 DISMANTLING JOINT (RESTRAINED) - LL = 8" TO 10", SET TO 9". ALL HARDWARE BOLTS, NUTS AND TIE RODS SHALL BE 304 S.S.
9. 3" DUCTILE IRON 90° BEND FLANGE X FLANGE.
10. 3" DUCTILE IRON PIPE - FLANGE X FLANGE SPOOL (SPECIAL CLASS 53) - L = 43.5" (MIN.) (WHEN USING BERMAD STRAINER) OR L = 39" (MIN.) (WHEN USING BADGER STRAINER).
11. 3" X 1.5" SERVICE SADDLE WITH 1.5" BALL CORPORATION STOP WITH T-HEAD OPERATING NUT - CC - TAPER THREAD X FNPT.
12. 3" DUCTILE IRON PIPE - FLANGE X PE - L = 24" (MIN.) (SPECIAL CLASS 53).
13. 3" MECHANICAL JOINT DUCTILE IRON LONG PATTERN SOLID SLEEVE WITH RESTRAINED JOINTS.
14. 3" DUCTILE IRON PIPE - FLANGE X PE - L = 12" (MIN.) (SPECIAL CLASS 53).
15. 3" DUCTILE IRON PIPE - FLANGE X PE - L = 30" (MIN.) (SPECIAL CLASS 53).
16. 3" MECHANICAL JOINT (RJ) GATE VALVE - OPEN LEFT AT PROPERTY LINE.
17. 3" MECHANICAL JOINT PLUG WITH 2" TAP (FNPT).
18. 2" TEMPORARY BLOW OFF ASSEMBLY (GALV. STEEL (SCH 80) OR RED BRASS (SCH 40) - END WITH THREADED COUPLING).
19. GALV. STEEL OR S.S. ADJUSTABLE FLANGE PIPE SUPPORTS (NUMBER REQUIRED = 3) (WITH STAINLESS STEEL ADHESIVE ANCHORS).
20. AMR TRANSMITTER.
21. 4' X 5' ACCESS DOOR - SEE STD. DETAIL.
22. PRECAST REINFORCED CONCRETE VAULT - 7' X 4' X 4' (MIN.) (L X W X D). SEE NOTES C AND D.
23. MINIMUM OF THREE STD. SOLID CONCRETE BRICK COURSES (OR PRECAST RISER) UNDER ACCESS DOOR FRAME - MAX. 2'.
24. JOINT REQUIRED AT FLAT TOP SECTION.
25. 3/8" DIAMETER GALV. STEEL EYE BOLT (EPOXY ADHESIVE ANCHOR) - TYPICAL.
26. AWG #12 GAUGE SOLID COPPER TRACER WIRE - WITH BLUE INSULATION (30 MILS HDPE) TERMINATE WITH 24" EXCESS WIRE (COILED) AT EYE BOLT AND VALVE BOX (TYPICAL).
27. CAST IN PLACE CONCRETE SIDEWALK - BRICKWORK SHALL NOT EXTEND TO SURFACE. ACCESS DOOR FRAME SHALL REST ON SIDEWALK.
28. VALVE LOCK (FURNISHED BY CLTW) - LOCK VALVE CLOSED.
29. PLASTIC STEP - 12" O.C. VERTICAL SPACING.
30. ATTACH ENGRAVED LABEL, WITH PREMISE NUMBER, TO UNDERSIDE OF DOOR, NEAR THE LIFTING HANDLE.
31. CONCRETE THRUST BLOCKING - 3,600 PSI.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

3-INCH ULTRASONIC WATER METER (COMBINED FIRE AND DOMESTIC) SERVICE AND PRECAST CONCRETE VAULT

NO SCALE

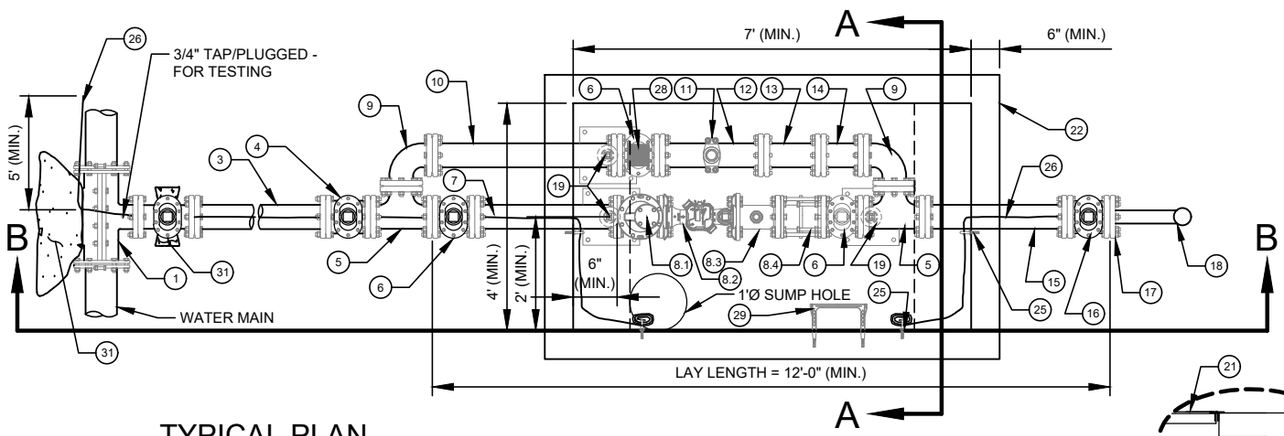
VERSION 2.0

DATE 01/2026

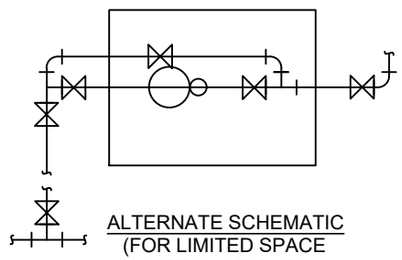
DETAIL 15.5.1

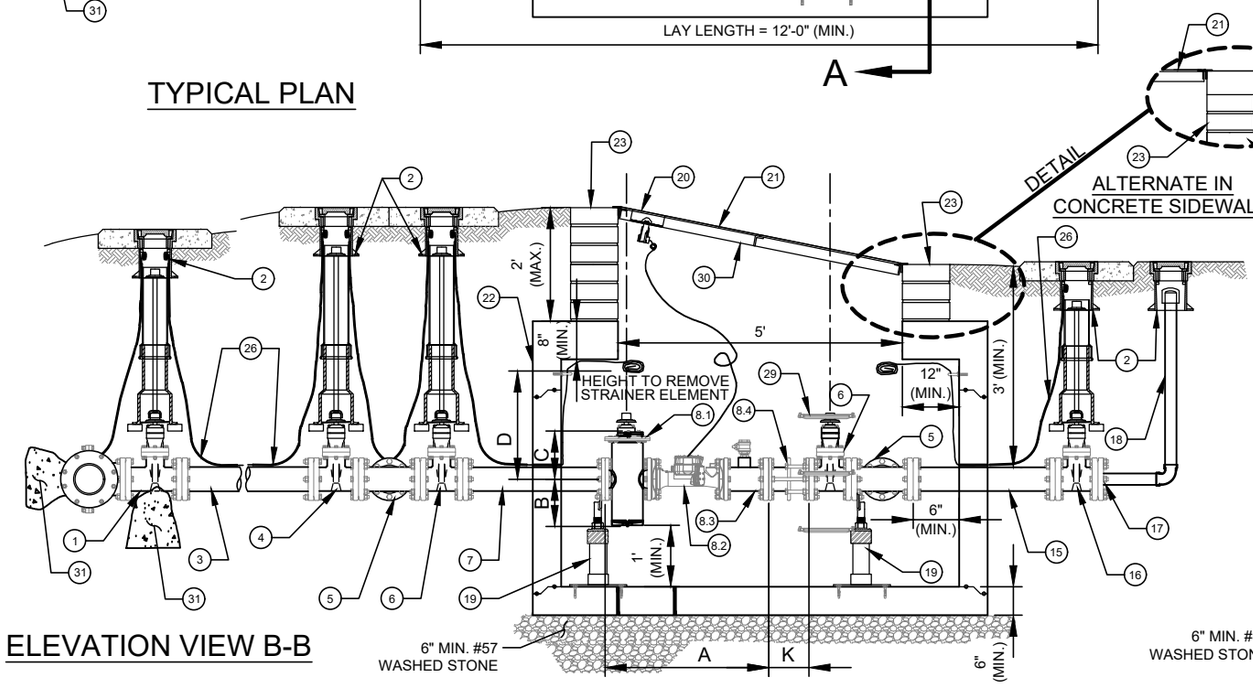
NOTES:

A. ALL FLANGE HARDWARE (BOLT/WASHER/NUT) SHALL BE STAINLESS STEEL - TYPE 304 WITH ANTI-SEIZE COMPOUND.
B. ALL PIPE SHALL BE RESTRAINED JOINT DUCTILE IRON FROM TAP TO PROPERTY LINE VALVE.
C. METER CONFIGURATION AND LENGTH / WIDTH MAY VARY DUE TO BRAND - VERIFY DIMENSIONS TO DETERMINE MINIMUM VAULT SIZE.
D. VAULT SHALL BE SIZED AS NEEDED FOR MINIMUM CLEARANCE AS SHOWN AND RATED FOR NCDOT HS-20 LOADING - SUBMIT SHOP DRAWINGS / P.E. SEALED FOR REVIEW.
E. ALL CONCRETE SHALL BE MINIMUM 4,000 PSI COMPRESSIVE STRENGTH.
F. DESIGN SHALL CONFORM TO ASTM C858 - SPECIFICATIONS FOR "UNDERGROUND PRECAST CONCRETE UTILITY STRUCTURE".
G. STEEL REINFORCING DESIGN SHALL CONFORM TO ASTM C857.
H. REBARS SHALL BE GRADE 60 PER ASTM A615.
I. WELDED WIRE FABRIC SHALL CONFORM TO ASTM A185.
J. DIAGONAL REINFORCING SHALL BE ADDED AT ALL OPENINGS.
K. PIPE PENETRATIONS SHALL BE SEALED WITH FLEXIBLE CONNECTORS (MANHOLE BOOTS) OR WITH 8" OF BRICK & MORTAR (AND 1/2-INCH THICK CONSTRUCTION EXPANSION MATERIAL).
L. FRAME TO BE FLUSH WITH GROUND OR CONCRETE SIDEWALK, GROUND SHALL SLOPE AWAY FROM VAULT.
M. ALL JOINTS SHALL BE MADE WATERTIGHT USING 2 RINGS OF BUTYL RUBBER JOINT MASTIC.
N. ALL VALVES SHALL BE OPEN RIGHT - CLOCKWISE, EXCEPT NO. 16.
O. PRECAST VAULT COMPONENTS SHALL HAVE MARKINGS PER ASTM C478 REQUIREMENTS.

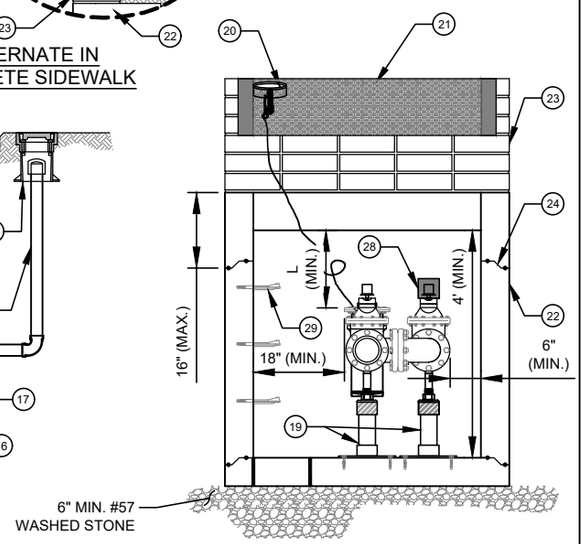


TYPICAL PLAN





ELEVATION VIEW B-B



SECTION VIEW A-A

METER SIZE	A	B	C	D	K	L
4"	BERMAD = 37.5" BADGER = 37.375"	BERMAD = 8.4" BADGER = 10"	BERMAD = 7.7" BADGER = 10.625"	BERMAD = 28.8" BADGER = 31.25"	SMITH-BLAIR = 9" ROMAC = 8"	BERMAD = 18" BADGER = 14"

NO. DESCRIPTION:

1. 4" TAPPING SLEEVE AND 4" FL X MJ TAPPING VALVE ON EXISTING MAIN. 4" MJ OUTLET TEE, 4" FOSTER ADAPTOR, AND 4" MJ GATE VALVE ON NEW MAIN. WHEN THE NEW MAIN IS LARGER THAN 12", USE A 6" SWIVEL TEE, 6" MJ GATE VALVE, 6" FOSTER ADAPTOR, AND 6" X 4" MJ REDUCER.
2. STANDARD VALVE BOX ASSEMBLY (TYPICAL) - ALL VALVES.
3. 4" DUCTILE IRON PIPE - RESTRAINED.
4. 4" MJ X FL DUCTILE IRON ADAPTER ON SHORT SIDE SERVICE (NOT SHOWN), 4" MJ X FL GATE VALVE ON LONG SIDE SERVICE (SHOWN).
5. 4" ALL FLANGE DUCTILE IRON TEE.
6. 4" ALL FLANGE GATE VALVE.
7. 4" ALL FLANGE DUCTILE IRON PIPE SPOOL - L = 30" (MIN.) (SPECIAL CLASS 53).
8. 4" ULTRASONIC WATER METER ASSEMBLY (FLANGE X FLANGE).
   - 8.1. BERMAD OR BADGER FIRE RATED BASKET STRAINER (FL X FL) - LL = 11.5" (BERMAD MODEL FP-60F-D) OR LL = 11.375" (BADGER MODEL 7000 AFSS FIRE SERVICE STRAINER).
   - 8.2. 4-INCH MASTER METER OCTAVE OR BADGER E-SERIES OR NEPTUNE MACH10 ULTRASONIC WATER METER WITH ITRON W100 TRANSMITTER - LL = 14".
   - 8.3. 4" EPOXY COATED/LINED STEEL FL X FL SPOOL WITH 2" FNPT TEST OUTLET - LL = 12" (MARS CO.) AND 2" BALL CORPORATION STOP WITH T-HEAD OPERATING NUT - MNPT X FNPT.
   - 8.4. ROMAC D J400 DISMANTLING JOINT - LL = 7" TO 9", SET TO 8" OR SMITH-BLAIR MODEL 975 DISMANTLING JOINT (RESTRAINED) - LL = 8" TO 10", SET TO 9". ALL HARDWARE BOLTS, NUTS AND TIE RODS SHALL BE 304 S.S.
9. 4" DUCTILE IRON 90° BEND FLANGE X FLANGE.
10. 4" DUCTILE IRON PIPE - FLANGE X FLANGE SPOOL - L = 48" (MIN.) (SPECIAL CLASS 53).
11. 4" X 1.5" SERVICE SADDLE WITH 1.5" BALL CORPORATION STOP WITH T-HEAD OPERATING NUT - CC - TAPER THREAD X FNPT.
12. 4" DUCTILE IRON PIPE - FLANGE X PE - L = 24" (MIN.) (SPECIAL CLASS 53).
13. 4" MECHANICAL JOINT DUCTILE IRON LONG PATTERN SOLID SLEEVE WITH RESTRAINED JOINTS.
14. 4" DUCTILE IRON PIPE - FLANGE X PE - L = 12" (MIN.) (SPECIAL CLASS 53).
15. 4" DUCTILE IRON PIPE - FLANGE X PE - L = 30" (MIN.) (SPECIAL CLASS 53).
16. 4" MECHANICAL JOINT (RJ) GATE VALVE - OPEN LEFT AT PROPERTY LINE.
17. 4" MECHANICAL JOINT PLUG WITH 2" TAP (FNPT).
18. 2" TEMPORARY BLOW OFF ASSEMBLY (GALV. STEEL (SCH 80) OR RED BRASS (SCH 40) - END WITH THREADED COUPLING).
19. GALV. STEEL OR S.S. ADJUSTABLE FLANGE PIPE SUPPORTS (NUMBER REQUIRED = 3) (WITH STAINLESS STEEL ADHESIVE ANCHORS).
20. AMR TRANSMITTER.
21. 4' X 5' ACCESS DOOR - SEE STD. DETAIL.
22. PRECAST REINFORCED CONCRETE VAULT - 7' X 4' X 4' (MIN.) (L X W X D). SEE NOTES C AND D.
23. MINIMUM OF THREE STD. SOLID CONCRETE BRICK COURSES (OR PRECAST RISER) UNDER ACCESS DOOR FRAME - MAX. 2'.
24. JOINT REQUIRED AT FLAT TOP SECTION.
25. 3/8" DIA. GALV. STEEL EYE BOLT (EPOXY ADHESIVE ANCHOR) - TYPICAL.
26. AWG #12 GAUGE SOLID COPPER TRACER WIRE - WITH BLUE INSULATION (30 MILS HDPE) TERMINATE WITH 24" EXCESS WIRE (COILED) AT EYE BOLT AND VALVE BOX (TYPICAL).
27. CAST IN PLACE CONCRETE SIDEWALK - BRICKWORK SHALL NOT EXTEND TO SURFACE. ACCESS DOOR FRAME SHALL REST ON SIDEWALK.
28. VALVE LOCK (FURNISHED BY CLTW) - LOCK VALVE CLOSED.
29. PLASTIC STEP - 12" O.C. VERTICAL SPACING.
30. ATTACH ENGRAVED LABEL, WITH PREMISE NUMBER, TO UNDERSIDE OF DOOR, NEAR THE LIFTING HANDLE.
31. CONCRETE THRUST BLOCKING - 3,600 PSI.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

4-INCH ULTRASONIC WATER METER (COMBINED FIRE AND DOMESTIC) SERVICE AND PRECAST CONCRETE VAULT

NO SCALE

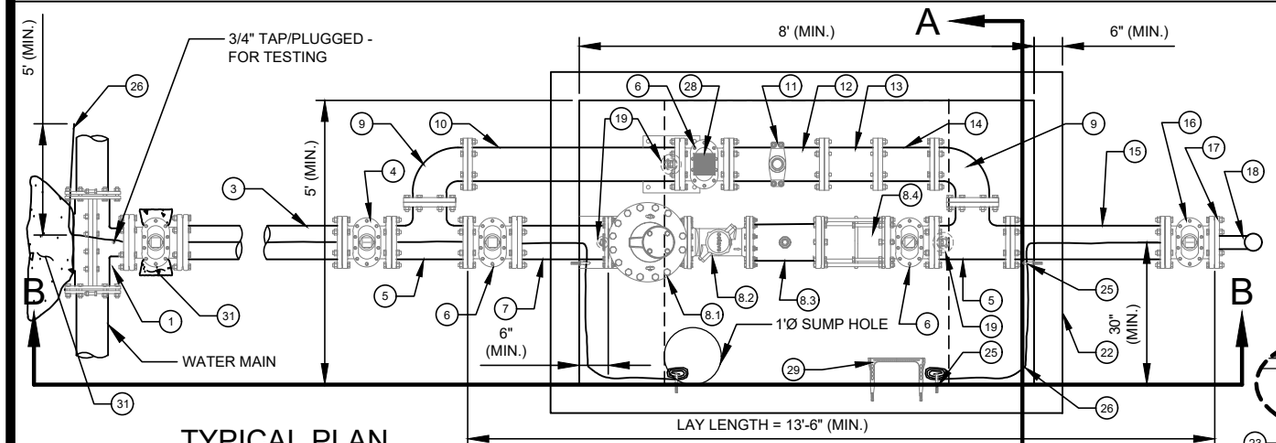
VERSION 2.0

DATE 01/2026

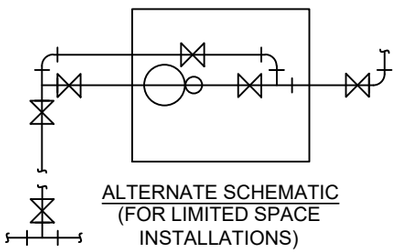
DETAIL 15.5.2

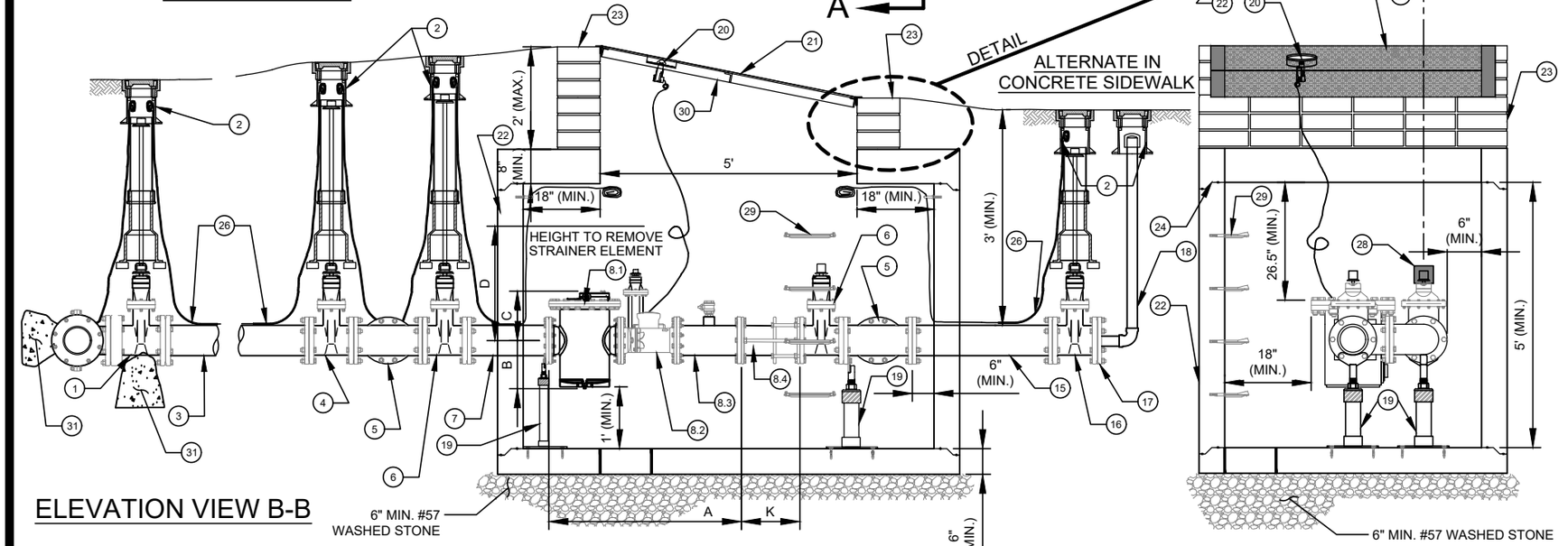
NOTES:

A. ALL FLANGE HARDWARE (BOLT/WASHER/NUT) SHALL BE STAINLESS STEEL - TYPE 304 WITH ANTI-SEIZE COMPOUND.
B. ALL PIPE SHALL BE RESTRAINED JOINT DUCTILE IRON FROM TAP TO PROPERTY LINE VALVE.
C. METER CONFIGURATION AND LENGTH / WIDTH MAY VARY DUE TO BRAND - VERIFY DIMENSIONS TO DETERMINE MINIMUM VAULT SIZE.
D. VAULT SHALL BE SIZED AS NEEDED FOR MINIMUM CLEARANCE AS SHOWN AND RATED FOR NCDOT HS-20 LOADING - SUBMIT SHOP DRAWINGS / P.E. SEALED FOR REVIEW.
E. ALL CONCRETE SHALL BE MINIMUM 4,000 PSI COMPRESSIVE STRENGTH.
F. DESIGN SHALL CONFORM TO ASTM C858 - SPECIFICATIONS FOR "UNDERGROUND PRECAST CONCRETE UTILITY STRUCTURE".
G. STEEL REINFORCING DESIGN SHALL CONFORM TO ASTM C857.
H. REBAR SHALL BE GRADE 60 PER ASTM A615.
I. WELDED WIRE FABRIC SHALL CONFORM TO ASTM A185.
J. DIAGONAL REINFORCING SHALL BE ADDED AT ALL OPENINGS.
K. PIPE PENETRATIONS SHALL BE SEALED WITH FLEXIBLE CONNECTORS (MANHOLE BOOTS) OR WITH 8" OF BRICK & MORTAR (AND 1/2-INCH THICK CONSTRUCTION EXPANSION MATERIAL).
L. FRAME TO BE FLUSH WITH GROUND OR CONCRETE SIDEWALK, GROUND SHALL SLOPE AWAY FROM VAULT.
M. ALL JOINTS SHALL BE MADE WATERTIGHT USING 2 RINGS OF BUTYL RUBBER JOINT MASTIC.
N. ALL VALVES SHALL BE OPEN RIGHT - CLOCKWISE, EXCEPT NO. 16.
O. PRECAST VAULT COMPONENTS SHALL HAVE MARKINGS PAR ASTM C478 REQUIREMENTS.



TYPICAL PLAN





ELEVATION VIEW B-B

SECTION VIEW A-A

METER SIZE	A	B	C	D	K
6"	44.9"	10.7"	10.8"	37.3"	SMITH-BLAIR = 9" ROMAC = 9"

NO. DESCRIPTION:

1. 6" TAPPING SLEEVE AND 6" FL X MJ TAPPING VALVE ON EXISTING MAIN. 6" MECHANICAL JOINT OUTLET TEE, 6" FOSTER ADAPTOR, (OR SWIVEL TEE) AND 6" MJ GATE VALVE ON NEW MAIN.
2. STANDARD VALVE BOX ASSEMBLY (TYPICAL) - ALL VALVES.
3. 6" DUCTILE IRON PIPE - RESTRAINED.
4. 6" MJ X FL DUCTILE IRON ADAPTER ON SHORT SIDE SERVICE (NOT SHOWN), 6" MJ X FL GATE VALVE ON LONG SIDE SERVICE (SHOWN).
5. 6" ALL FLANGE DUCTILE IRON TEE.
6. 6" ALL FLANGE GATE VALVE.
7. 6" ALL FLANGE DUCTILE IRON PIPE SPOOL - L = 30" (MIN.) (SPECIAL CLASS 53).
8. 6" ULTRASONIC WATER METER ASSEMBLY (FLANGE X FLANGE).
   - 8.1. BERMAD MODEL FP-60F-D FIRE RATED BASKET STRAINER (FL X FL). LL = 14.9"
   - 8.2. 6-INCH MASTER METER OCTAVE OR BADGER E-SERIES OR NEPTUNE MACH 10 WITH ITRON W100 TRANSMITTER - LL = 18".
   - 8.3. 6" EPOXY COATED/LINED STEEL FLANGE X FLANGE SPOOL WITH 2" FNPT TEST OUTLET - LL = 12" (MARS CO.) AND 2" BALL CORPORATION STOP WITH T-HEAD OPERATING NUT - MNPT X FNPT.
   - 8.4. ROMAC D J400 DISMANTLING JOINT - LL = 7.38" TO 9.38", SET TO 9" OR SMITH-BLAIR MODEL 975 DISMANTLING JOINT (RESTRAINED) - LL = 8" TO 10", SET TO 9". ALL HARDWARE BOLTS, NUTS AND TIE RODS SHALL BE 304 S.S.
9. 6" DUCTILE IRON 90° BEND FLANGE X FLANGE.
10. 6" DUCTILE IRON PIPE - FLANGE X FLANGE SPOOL - L = 58.5" (MIN.) (SPECIAL CLASS 53).
11. 6" X1 1/2" SERVICE SADDLE WITH 1 1/2" BALL CORPORATION STOP WITH T-HEAD OPERATING NUT - CC - TAPER THREAD X FNPT.
12. 6" DUCTILE IRON PIPE - FLANGE X PE - L = 24" (MIN.) (SPECIAL CLASS 53).
13. 6" MECHANICAL JOINT DUCTILE IRON LONG PATTERN SOLID SLEEVE WITH RESTRAINED JOINT.
14. 6" DUCTILE IRON PIPE - FLANGE X PE - L = 12" (MIN.) (SPECIAL CLASS 53).
15. 6" DUCTILE IRON PIPE - FLANGE X PE - L = 30" (MIN.) (SPECIAL CLASS 53).
16. 6" MECHANICAL JOINT (RJ) GATE VALVE - OPEN LEFT AT PROPERTY LINE.
17. 6" MECHANICAL JOINT PLUG WITH 2" TAP (FNPT).
18. 2" TEMPORARY BLOW OFF ASSEMBLY (GALV. STEEL (SCH 80) OR RED BRASS (SCH 40) - END WITH THREADED COUPLING).
19. GALV. STEEL OR S.S. ADJUSTABLE FLANGE PIPE SUPPORTS (NUMBER REQUIRED = 3) (WITH STAINLESS STEEL ADHESIVE ANCHORS).
20. AMR TRANSMITTER.
21. 5' X 5' ACCESS DOOR - SEE STD. DETAIL.
22. PRECAST REINFORCED CONCRETE VAULT - 8' X 5' X 5' (MIN.) (L X W X D). SEE NOTES C AND D.
23. MINIMUM OF THREE STD. SOLID CONCRETE BRICK COURSES (OR PRECAST RISER) UNDER ACCESS DOOR FRAME - MAX. 2'.
24. JOINT REQUIRED AT FLAT TOP SECTION.
25. 3/8" DIAMETER GALV. STEEL EYE BOLT (EPOXY ADHESIVE ANCHOR) - TYPICAL.
26. AWG #12 GAUGE SOLID COPPER TRACER WIRE - WITH BLUE INSULATION (30 MILS HDPE) TERMINATE WITH 24" EXCESS WIRE (COILED) AT EYE BOLT AND VALVE BOX (TYPICAL).
27. CAST IN PLACE CONCRETE SIDEWALK - BRICKWORK SHALL NOT EXTEND TO SURFACE. ACCESS DOOR FRAME SHALL REST ON SIDEWALK.
28. VALVE LOCK (FURNISHED BY CLTW) - LOCK VALVE CLOSED.
29. PLASTIC STEP - 12" O.C. VERTICAL SPACING.
30. ATTACH ENGRAVED LABEL, WITH PREMISE NUMBER, TO UNDERSIDE OF DOOR, NEAR THE LIFTING HANDLE.
31. CONCRETE THRUST BLOCKING - 3,600 PSI.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

6-INCH ULTRASONIC WATER METER (COMBINED FIRE AND DOMESTIC) SERVICE AND PRECAST CONCRETE VAULT

NO SCALE

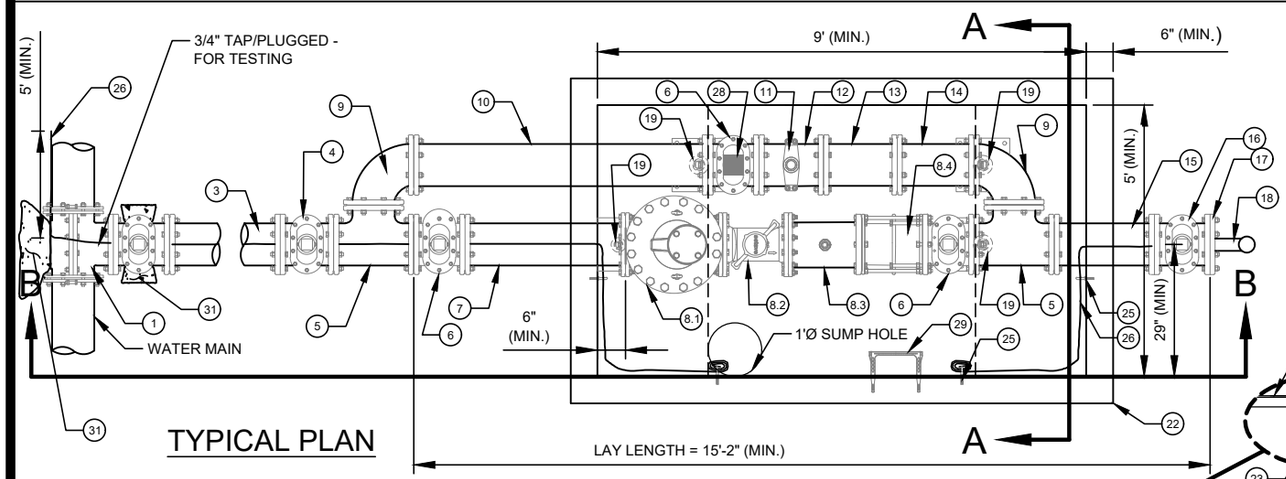
VERSION 2.0

DATE 01/2026

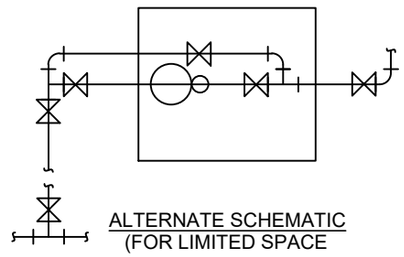
DETAIL 15.5.3

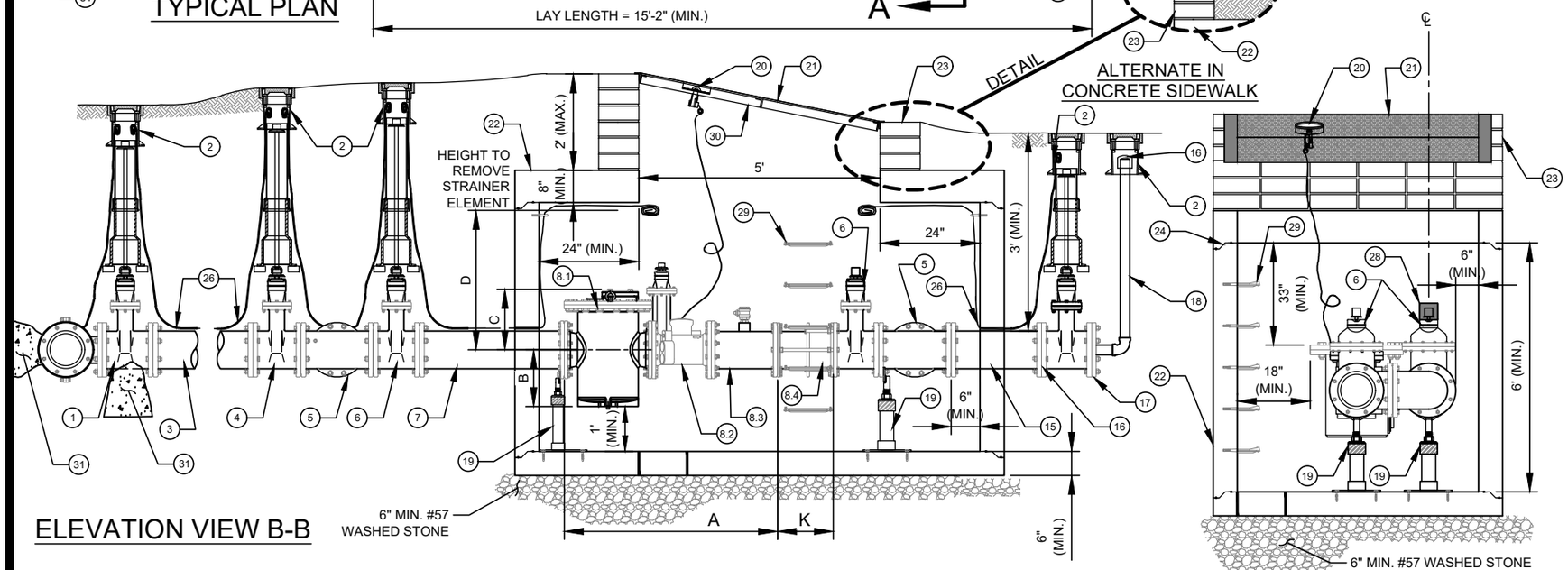
NOTES:

A. ALL FLANGE HARDWARE (BOLT/WASHER/NUT) SHALL BE STAINLESS STEEL - TYPE 304 WITH ANTI-SEIZE COMPOUND.
B. ALL PIPE SHALL BE RESTRAINED JOINT DUCTILE IRON FROM TAP TO PROPERTY LINE VALVE.
C. METER CONFIGURATION AND LENGTH / WIDTH MAY VARY DUE TO BRAND - VERIFY DIMENSIONS TO DETERMINE MINIMUM VAULT SIZE.
D. VAULT SHALL BE SIZED AS NEEDED FOR MINIMUM CLEARANCE AS SHOWN AND RATED FOR NCDOT HS-20 LOADING - SUBMIT SHOP DRAWINGS / P.E. SEALED FOR REVIEW.
E. ALL CONCRETE SHALL BE MINIMUM 4,000 PSI COMPRESSIVE STRENGTH.
F. DESIGN SHALL CONFORM TO ASTM C858 - SPECIFICATIONS FOR "UNDERGROUND PRECAST CONCRETE UTILITY STRUCTURE".
G. STEEL REINFORCING DESIGN SHALL CONFORM TO ASTM C857.
H. REBAR SHALL BE GRADE 60 PER ASTM A615.
I. WELDED WIRE FABRIC SHALL CONFORM TO ASTM A185.
J. DIAGONAL REINFORCING SHALL BE ADDED AT ALL OPENINGS.
K. PIPE PENETRATIONS SHALL BE SEALED WITH FLEXIBLE CONNECTORS (MANHOLE BOOTS) OR WITH 8" OF BRICK & MORTAR (AND 1/2-INCH THICK CONSTRUCTION EXPANSION MATERIAL).
L. FRAME TO BE FLUSH WITH GROUND OR CONCRETE SIDEWALK, GROUND SHALL SLOPE AWAY FROM VAULT.
M. ALL JOINTS SHALL BE MADE WATERTIGHT USING 2 RINGS OF BUTYL RUBBER JOINT MASTIC.
N. ALL VALVES SHALL BE OPEN RIGHT - CLOCKWISE, EXCEPT NO. 16.
O. PRECAST VAULT COMPONENTS SHALL HAVE MARKING PER ASTM C478.



TYPICAL PLAN





ELEVATION VIEW B-B

SECTION VIEW A-A

METER SIZE	A	B	C	D	K
8"	50.7"	14.8"	12.2"	44.2"	SMITH-BLAIR = 9" ROMAC = 9"

NO. DESCRIPTION:

1. 8" OUTLET TAPPING SLEEVE AND 8" FL X MJ TAPPING VALVE ON EXISTING MAIN. 8" MJ OUTLET TEE, 8" FOSTER ADAPTOR AND 8" MJ GATE VALVE ON NEW MAIN.
2. STANDARD VALVE BOX ASSEMBLY (TYPICAL) - ALL VALVES.
3. 8" DUCTILE IRON PIPE - RESTRAINED.
4. 8" MJ X FL DUCTILE IRON ADAPTER ON SHORT SIDE SERVICE (NOT SHOWN), 8" MJ X FL GATE VALVE ON LONG SIDE SERVICE (SHOWN).
5. 8" ALL FLANGE DUCTILE IRON TEE.
6. 8" ALL FLANGE GATE VALVE.
7. 8" ALL FLANGE DUCTILE IRON PIPE SPOOL - L = 40" (MIN.) (SPECIAL CLASS 53).
8. 8" ULTRASONIC WATER METER ASSEMBLY (FLANGE X FLANGE).
   - 8.1. BERMAD MODEL FP-60F-D FIRE RATED BASKET STRAINER (FL X FL). LL = 18.7"
   - 8.2. 8-INCH MASTER METER OCTAVE OR BADGER E-SERIES OR NEPTUNE MACH10 WITH ITRON W100 TRANSMITTER - LL = 20".
   - 8.3. 8" EPOXY COATED/LINED STEEL FLANGE X FLANGE SPOOL WITH 2" FNPT TEST OUTLET - LL = 12" (MARS CO.) AND 2" BALL CORPORATION STOP WITH T-HEAD OPERATING NUT - MNPT X FNPT.
   - 8.4. ROMAC D J400 DISMANTLING JOINT - LL = 7.38" TO 9.38", SET TO 9" OR SMITH-BLAIR MODEL 975 DISMANTLING JOINT (RESTRAINED) - LL = 8" 10", SET TO 9". ALL HARDWARE BOLTS, NUTS AND TIE RODS SHALL BE 304 S.S.
9. 8" DUCTILE IRON 90° BEND FLANGE X FLANGE.
10. 8" DUCTILE IRON PIPE - FLANGE X FLANGE SPOOL - L = 75.5" (MIN.) (SPECIAL CLASS 53).
11. 8" X 1 1/2" SERVICE SADDLE WITH 1 1/2" BALL CORPORATION STOP WITH T-HEAD OPERATING NUT - CC - TAPER THREAD X FNPT.
12. 8" DUCTILE IRON PIPE - FLANGE X PE - L = 24" (MIN.) (SPECIAL CLASS 53).
13. 8" MECHANICAL JOINT DUCTILE IRON LONG PATTERN SOLID SLEEVE WITH RESTRAINED JOINT.
14. 8" DUCTILE IRON PIPE - FLANGE X PE - L = 12" (MIN.) (SPECIAL CLASS 53).
15. 8" DUCTILE IRON PIPE - FLANGE X PE - L = 30" (MIN.) (SPECIAL CLASS 53).
16. 8" MECHANICAL JOINT (RJ) GATE VALVE - OPEN LEFT AT PROPERTY LINE.
17. 8" MECHANICAL JOINT PLUG WITH 2" TAP (FNPT).
18. 2" TEMPORARY BLOW OFF ASSEMBLY (GALV. STEEL (SCH 80) OR RED BRASS (SCH 40) - END WITH THREADED COUPLING).
19. GALV. STEEL OR S.S. ADJUSTABLE FLANGE PIPE SUPPORTS (NUMBER REQUIRED = 4) (WITH STAINLESS STEEL ADHESIVE ANCHORS).
20. AMR TRANSMITTER.
21. 5' X 5' ACCESS DOOR - SEE STD. DETAIL.
22. PRECAST REINFORCED CONCRETE VAULT - 9' X 5' X 6' (MIN.) (L X W X D). SEE NOTES C AND D.
23. MINIMUM OF THREE STD. SOLID CONCRETE BRICK COURSES (OR PRECAST RISER) UNDER ACCESS DOOR FRAME - MAX. 2'.
24. JOINT REQUIRED AT FLAT TOP SECTION.
25. 3/8" DIAMETER GALV. STEEL EYE BOLT (EPOXY ADHESIVE ANCHOR) - TYPICAL.
26. AWG #12 GAUGE SOLID COPPER TRACER WIRE - WITH BLUE INSULATION (30 MILS HDPE) TERMINATE WITH 24" EXCESS WIRE (COILED) AT EYE BOLT AND VALVE BOX (TYPICAL).
27. CAST IN PLACE CONCRETE SIDEWALK - BRICKWORK SHALL NOT EXTEND TO SURFACE. ACCESS DOOR FRAME SHALL REST ON SIDEWALK.
28. VALVE LOCK (FURNISHED BY CLTW) - LOCK VALVE CLOSED.
29. PLASTIC STEP - 12" O.C. VERTICAL SPACING.
30. ATTACH ENGRAVED LABEL, WITH PREMISE NUMBER, TO UNDERSIDE OF DOOR, NEAR THE LIFTING HANDLE.
31. CONCRETE THRUST BLOCKING - 3,600 PSI.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

8-INCH ULTRASONIC WATER METER
(COMBINED FIRE AND DOMESTIC) SERVICE
AND PRECAST CONCRETE VAULT

NO SCALE

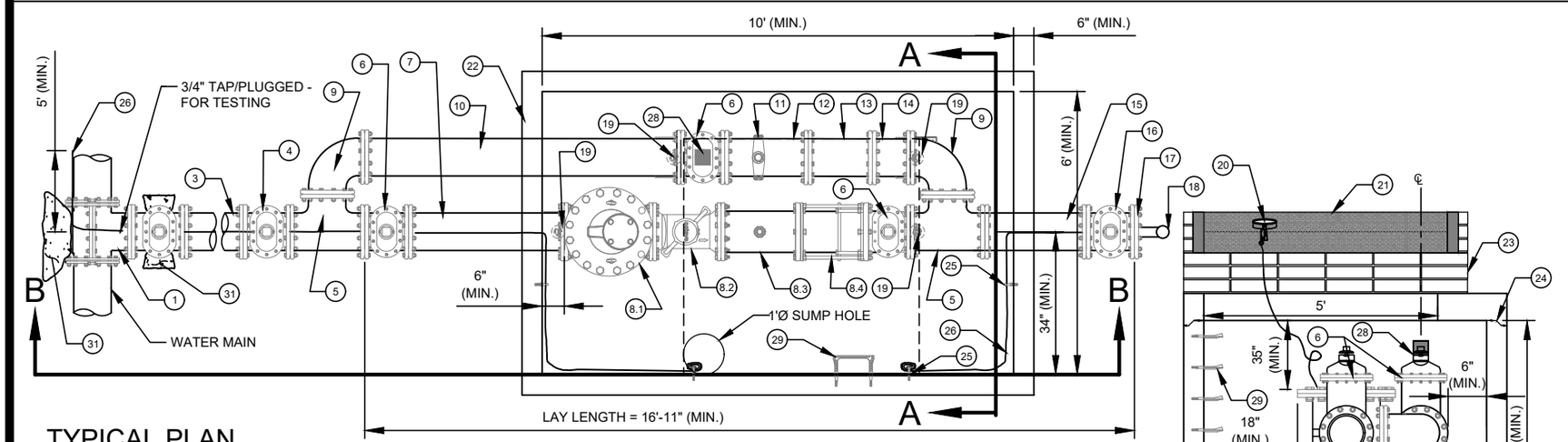
VERSION
2.0

DATE
01/2026

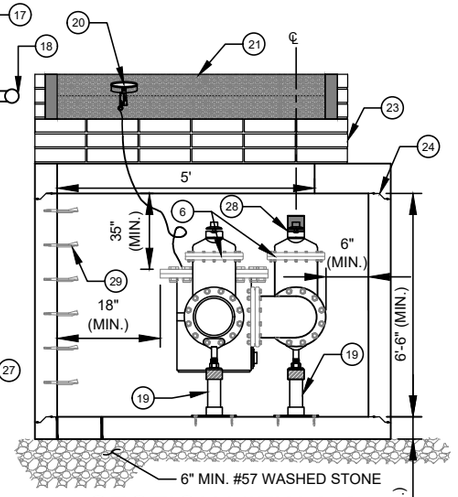
DETAIL
15.5.4

NOTES:

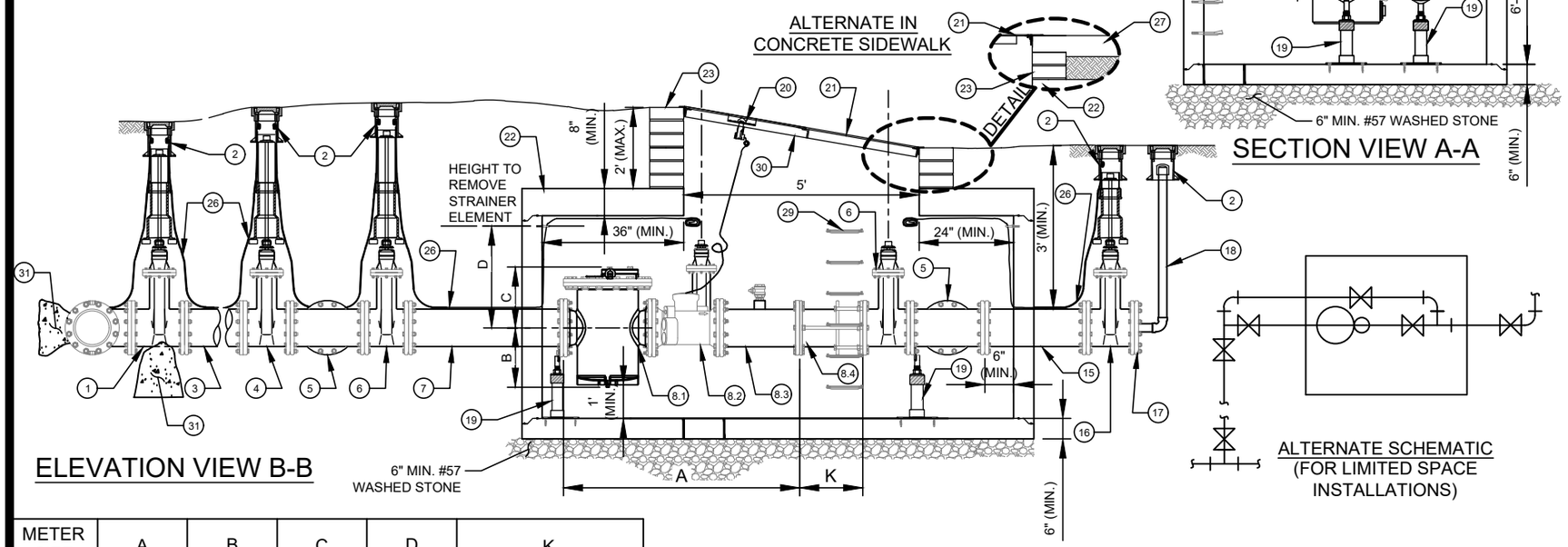
A. ALL FLANGE HARDWARE (BOLT/WASHER/NUT) SHALL BE STAINLESS STEEL - TYPE 304 WITH ANTI-SEIZE COMPOUND.
B. ALL PIPE SHALL BE RESTRAINED JOINT DUCTILE IRON FROM TAP TO PROPERTY LINE VALVE.
C. METER CONFIGURATION AND LENGTH / WIDTH MAY VARY DUE TO BRAND - VERIFY DIMENSIONS TO DETERMINE MINIMUM VAULT SIZE.
D. VAULT SHALL BE SIZED AS NEEDED FOR MINIMUM CLEARANCE AS SHOWN AND RATED FOR NCDOT HS-20 LOADING - SUBMIT SHOP DRAWINGS / P.E. SEALED FOR REVIEW.
E. ALL CONCRETE SHALL BE MINIMUM 4,000 PSI COMPRESSIVE STRENGTH.
F. DESIGN SHALL CONFORM TO ASTM C858 - SPECIFICATIONS FOR "UNDERGROUND PRECAST CONCRETE UTILITY STRUCTURE".
G. STEEL REINFORCING DESIGN SHALL CONFORM TO ASTM C857.
H. REBAR SHALL BE GRADE 60 PER ASTM A615.
I. WELDED WIRE FABRIC SHALL CONFORM TO ASTM A185.
J. DIAGONAL REINFORCING SHALL BE ADDED AT ALL OPENINGS.
K. PIPE PENETRATIONS SHALL BE SEALED WITH FLEXIBLE CONNECTORS (MANHOLE BOOTS) OR WITH 8" OF BRICK & MORTAR (AND 1/2-INCH THICK CONSTRUCTION EXPANSION MATERIAL).
L. FRAME TO BE FLUSH WITH GROUND OR CONCRETE SIDEWALK, GROUND SHALL SLOPE AWAY FROM VAULT.
M. ALL JOINTS SHALL BE MADE WATERTIGHT USING 2 RINGS OF BUTYL RUBBER JOINT MASTIC.
N. ALL VALVES SHALL BE OPEN RIGHT - CLOCKWISE, EXCEPT NO. 16.
O. PRECAST VAULT COMPONENTS SHALL HAVE MARKINGS PER ASTM C478 REQUIREMENTS.



TYPICAL PLAN



SECTION VIEW A-A



ELEVATION VIEW B-B

ALTERNATE SCHEMATIC (FOR LIMITED SPACE INSTALLATIONS)

METER SIZE	A	B	C	D	K
10"	51.75"	16.2"	14.2"	49.6"	SMITH-BLAIR = 10" ROMAC = 10.5"

NO. DESCRIPTION:

1. 10" OUTLET TAPPING SLEEVE AND 10" FL X MJ TAPPING VALVE ON EXISTING MAIN. 10" MJ OUTLET TEE, 10" FOSTER ADAPTOR AND 10" MJ GATE VALVE ON NEW MAIN.
2. STANDARD VALVE BOX ASSEMBLY (TYPICAL) - ALL VALVES.
3. 10" DUCTILE IRON PIPE - RESTRAINED.
4. 10" MJ X FL DUCTILE IRON ADAPTER ON SHORT SIDE SERVICE (NOT SHOWN), 10" MJ X FL GATE VALVE ON LONG SIDE SERVICE (SHOWN).
5. 10" ALL FLANGE DUCTILE IRON TEE.
6. 10" ALL FLANGE GATE VALVE.
7. 10" ALL FLANGE DUCTILE IRON PIPE SPOOL - L = 50" (MIN.) (SPECIAL CLASS 53).
8. 10" FMCT METER ASSEMBLY (FLANGE X FLANGE)
   - 8.1. BERMAD MODEL FP-60F-D FIRE RATED BASKET STRAINER (FL X FL). LL = 22.0"
   - 8.2. 10-INCH MASTER METER OCTAVE OR NEPTUNE MACH10 WITH ITRON W100 TRANSMITTER - LL = 17.75"
   - 8.3. 10" EPOXY COATED/LINED STEEL FL X FL SPOOL WITH 2" FNPT TEST OUTLET - LL = 12" (MARS CO.) AND 2" BALL CORPORATION STOP WITH T-HEAD OPERATING NUT - MNPT X FNPT.
   - 8.4. ROMAC D J400 DISMANTLING JOINT - LL = 9.5" TO 11.5", SET TO 10.5" OR SMITH-BLAIR MODEL 975 DISMANTLING JOINT (RESTRAINED) - LL = 9" TO 11", SET TO 10". ALL HARDWARE BOLTS, NUTS AND TIE RODS SHALL BE 304 S.S.
9. 10" DUCTILE IRON 90° BEND FLANGE X FLANGE.
10. 10" DUCTILE IRON PIPE - FLANGE X FLANGE SPOOL - L = 89" (MIN.) (SPECIAL CLASS 53).
11. 10" X 1 1/2" SERVICE SADDLE WITH 1 1/2" BALL CORPORATION STOP WITH T-HEAD OPERATING NUT - CC - TAPER THREAD X FNPT.
12. 10" DUCTILE IRON PIPE - FLANGE X PE - L = 24" (MIN.) (SPECIAL CLASS 53).
13. 10" MECHANICAL JOINT DUCTILE IRON LONG PATTERN SOLID SLEEVE WITH RESTRAINED JOINT.
14. 10" DUCTILE IRON PIPE - FLANGE X PE - L = 12" (MIN.) (SPECIAL CLASS 53).
15. 10" DUCTILE IRON PIPE - FLANGE X PE - L = 30" (MIN.) (SPECIAL CLASS 53).
16. 10" MECHANICAL JOINT (RJ) GATE VALVE - OPEN LEFT AT PROPERTY LINE.
17. 10" MECHANICAL JOINT PLUG WITH 2" TAP (FNPT).
18. 2" TEMPORARY BLOW OFF ASSEMBLY (GALV. STEEL (SCH 80) - END WITH THREADED COUPLING).
19. GALV. STEEL OR S.S. ADJUSTABLE FLANGE PIPE SUPPORTS (NUMBER REQUIRED = 4) (WITH STAINLESS STEEL ADHESIVE ANCHORS).
20. AMR TRANSMITTERS.
21. 5' X 5' ACCESS DOOR - SEE STD. DETAIL.
22. PRECAST REINFORCED CONCRETE VAULT - 10' X 6' X 6.5' (MIN.) (L X W X D). SEE NOTES C AND D.
23. MINIMUM OF THREE STD. SOLID CONCRETE BRICK COURSES (OR PRECAST RISER) UNDER ACCESS DOOR FRAME - MAX. 2'.
24. JOINT REQUIRED AT FLAT TOP SECTION.
25. 3/8" DIA. GALV. STEEL EYE BOLT (EPOXY ADHESIVE ANCHOR) - TYPICAL.
26. AWG #12 GAUGE SOLID COPPER TRACER WIRE - WITH BLUE INSULATION (30 MILS HDPE) TERMINATE WITH 24" EXCESS WIRE (COILED) AT EYE BOLT AND VALVE BOX (TYPICAL).
27. CAST IN PLACE CONCRETE SIDEWALK - BRICKWORK SHALL NOT EXTEND TO SURFACE. ACCESS DOOR FRAME SHALL REST ON SIDEWALK.
28. VALVE LOCK (FURNISHED BY CLTW) - LOCK VALVE CLOSED.
29. PLASTIC STEP - 12" O.C. VERTICAL SPACING.
30. ATTACH ENGRAVED LABEL, WITH PREMISE NUMBER, TO UNDERSIDE OF DOOR, NEAR THE LIFTING HANDLE.
31. CONCRETE THRUST BLOCKING - 3,600 PSI.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

10-INCH ULTRASONIC WATER METER
(COMBINED FIRE AND DOMESTIC) SERVICE
AND PRECAST CONCRETE VAULT

NO SCALE

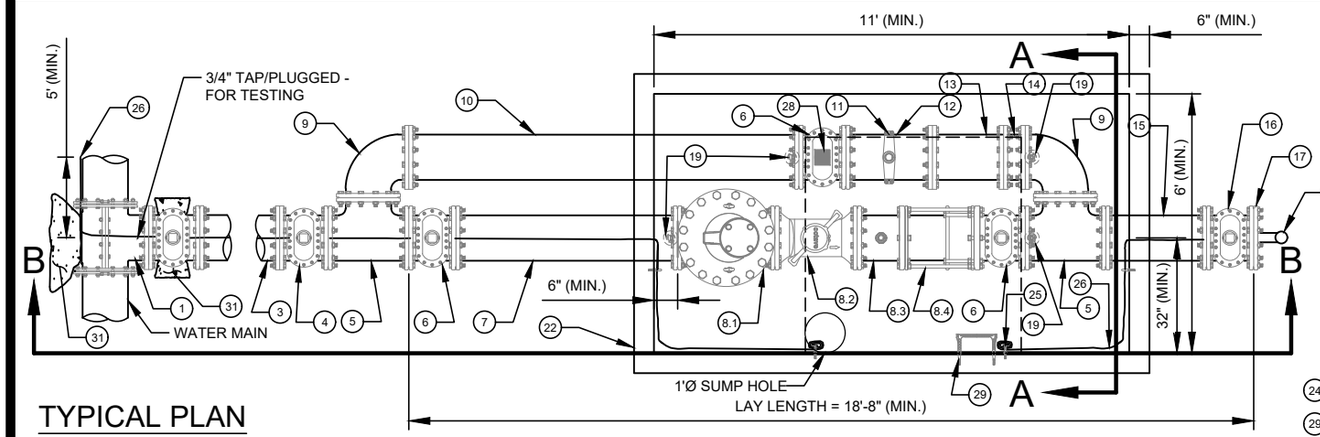
VERSION
2.0

DATE
01/2026

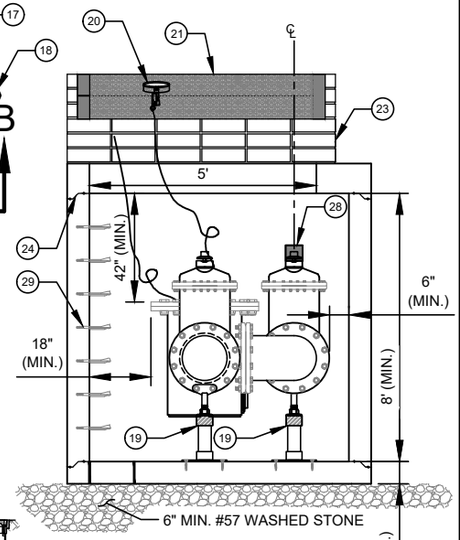
DETAIL
15.5.5

NOTES:

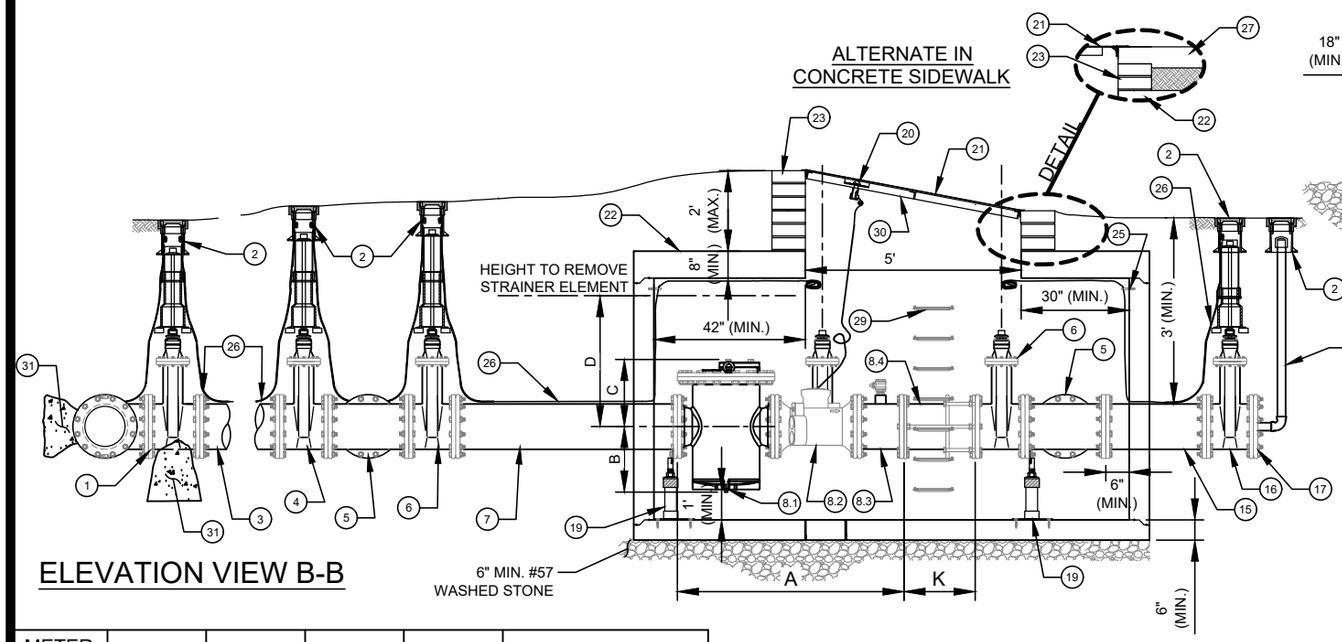
A. ALL FLANGE HARDWARE (BOLT/WASHER/NUT) SHALL BE STAINLESS STEEL - TYPE 304 WITH ANTI-SEIZE COMPOUND.
B. ALL PIPE SHALL BE RESTRAINED JOINT DUCTILE IRON FROM TAP TO PROPERTY LINE VALVE.
C. METER CONFIGURATION AND LENGTH / WIDTH MAY VARY DUE TO BRAND - VERIFY DIMENSIONS TO DETERMINE MINIMUM VAULT SIZE.
D. VAULT SHALL BE SIZED AS NEEDED FOR MINIMUM CLEARANCE AS SHOWN AND RATED FOR NCDOT HS-20 LOADING - SUBMIT SHOP DRAWINGS / P.E. SEALED FOR REVIEW.
E. ALL CONCRETE SHALL BE MINIMUM 4,000 PSI COMPRESSIVE STRENGTH.
F. DESIGN SHALL CONFORM TO ASTM C858 - SPECIFICATIONS FOR "UNDERGROUND PRECAST CONCRETE UTILITY STRUCTURE".
G. STEEL REINFORCING DESIGN SHALL CONFORM TO ASTM C857.
H. REBAR SHALL BE GRADE 60 PER ASTM A615.
I. WELDED WIRE FABRIC SHALL CONFORM TO ASTM A185.
J. DIAGONAL REINFORCING SHALL BE ADDED AT ALL OPENINGS.
K. PIPE PENETRATIONS SHALL BE SEALED WITH FLEXIBLE CONNECTORS (MANHOLE BOOTS) OR WITH 8" OF BRICK & MORTAR (AND 1/2-INCH THICK CONSTRUCTION EXPANSION MATERIAL).
L. FRAME TO BE FLUSH WITH GROUND OR CONCRETE SIDEWALK, GROUND SHALL SLOPE AWAY FROM VAULT.
M. ALL JOINTS SHALL BE MADE WATERTIGHT USING 2 RINGS OF BUTYL RUBBER JOINT MASTIC.
N. ALL VALVES SHALL BE OPEN RIGHT - CLOCKWISE, EXCEPT NO. 16.
O. PRECAST VAULT COMPONENTS SHALL HAVE MARKINGS PER ASTM C478 REQUIREMENTS.



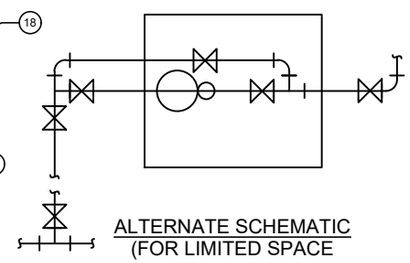
TYPICAL PLAN



SECTION VIEW A-A



ELEVATION VIEW B-B



ALTERNATE SCHEMATIC (FOR LIMITED SPACE INSTALLATIONS)

METER SIZE	A	B	C	D	K
12"	58.55"	19.6"	18.1"	60.8"	SMITH-BLAIR = 10" ROMAC = 10.5"

NO. DESCRIPTION:

1. 12" OUTLET TAPPING SLEEVE AND 12" FL X MJ TAPPING VALVE ON EXISTING MAIN. 12" MJ OUTLET TEE, 12" FOSTER ADAPTOR, AND 10" MJ GATE VALVE ON NEW MAIN.
2. STANDARD VALVE BOX ASSEMBLY (TYPICAL) - ALL VALVES.
3. 12" DUCTILE IRON PIPE - RESTRAINED.
4. 12" MJ X FL DUCTILE IRON ADAPTER ON SHORT SIDE SERVICE (NOT SHOWN), 12" MJ X FL GATE VALVE ON LONG SIDE SERVICE (SHOWN).
5. 12" ALL FLANGE DUCTILE IRON TEE.
6. 12" ALL FLANGE GATE VALVE.
7. 12" ALL FLANGE DUCTILE IRON PIPE SPOOL - L = 60" (MIN.) (SPECIAL CLASS 53).
8. 12" ULTRASONIC WATER METER ASSEMBLY (FLANGE X FLANGE)
   - 8.1. BERMAD MODEL FP-60F-D FIRE RATED BASKET STRAINER (FL X FL). LL = 26.8"
   - 8.2. 12-INCH MASTER METER OCTAVE OR NEPTUNE MACH10 WITH ITRON W100 TRANSMITTER - LL = 19.75".
   - 8.3. 12" EPOXY COATED/LINED STEEL FL X FL SPOOL WITH 2" FNPT TEST OUTLET - LL = 12" (MARS CO.) AND 2" BALL CORPORATION STOP WITH T-HEAD OPERATING NUT - MNPT X FNPT.
   - 8.4. ROMAC D J400 DISMANTLING JOINT - LL = 9.5" TO 11.5", SET TO 10.5" OR SMITH-BLAIR MODEL 975 DISMANTLING JOINT (RESTRAINED) - LL = 9" TO 11", SET TO 10". ALL HARDWARE BOLTS, NUTS AND TIE RODS SHALL BE 304 S.S.
9. 12" DUCTILE IRON 90° BEND FLANGE X FLANGE.
10. 12" DUCTILE IRON PIPE - FLANGE X FLANGE SPOOL - L = 107" (MIN.) (SPECIAL CLASS 53).
11. 12" X 1 1/2" SERVICE SADDLE WITH 1 1/2" BALL CORPORATION STOP WITH T-HEAD OPERATING NUT - CC - TAPER THREAD X FNPT.
12. 12" DUCTILE IRON PIPE - FLANGE X PE - L = 24" (MIN.) (SPECIAL CLASS 53).
13. 12" MECHANICAL JOINT DUCTILE IRON LONG PATTERN SOLID SLEEVE WITH RESTRAINED JOINT.
14. 12" DUCTILE IRON PIPE - FLANGE X PE - L = 12" (MIN.) (SPECIAL CLASS 53).
15. 12" DUCTILE IRON PIPE - FLANGE X PE - L = 30" (MIN.) (SPECIAL CLASS 53).
16. 12" MECHANICAL JOINT (RJ) GATE VALVE - OPEN LEFT AT PROPERTY LINE.
17. 12" MECHANICAL JOINT PLUG WITH 2" TAP (FNPT).
18. 2" TEMPORARY BLOW OFF ASSEMBLY (GALV. STEEL (SCH 80) OR RED BRASS (SCH 40) - END WITH THREADED COUPLING).
19. GALV. STEEL OR S.S. ADJUSTABLE FLANGE PIPE SUPPORT (NUMBER REQUIRED = 4) (WITH STAINLESS STEEL ADHESIVE ANCHORS).
20. AMR TRANSMITTER.
21. 5' X 5' ACCESS DOOR - SEE STD. DETAIL.
22. PRECAST REINFORCED CONCRETE VAULT - 11' X 6' X 8' (MIN.) (L X W X D). SEE NOTES C AND D.
23. MINIMUM OF THREE STD. SOLID CONCRETE BRICK COURSES (OR PRECAST RISER) UNDER ACCESS DOOR FRAME - MAX. 2'.
24. JOINT REQUIRED AT FLAT TOP SECTION.
25. 3/8" DIA. GALV. STEEL EYE BOLT (EPOXY ADHESIVE ANCHOR) - TYPICAL.
26. AWG #12 GAUGE SOLID COPPER TRACER WIRE - WITH BLUE INSULATION (30 MILS HDPE) TERMINATE WITH 24" EXCESS WIRE (COILED) AT EYE BOLT AND VALVE BOX (TYP.).
27. CAST IN PLACE CONCRETE SIDEWALK - BRICKWORK SHALL NOT EXTEND TO SURFACE. ACCESS DOOR FRAME SHALL REST ON SIDEWALK.
28. VALVE LOCK (FURNISHED BY CLTW) - LOCK VALVE CLOSED.
29. PLASTIC STEP - 12" O.C. VERTICAL SPACING.
30. ATTACH ENGRAVED LABEL, WITH PREMISE NUMBER, TO UNDERSIDE OF DOOR, NEAR THE LIFTING HANDLE.
31. CONCRETE THRUST BLOCKING - 3,600 PSI.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

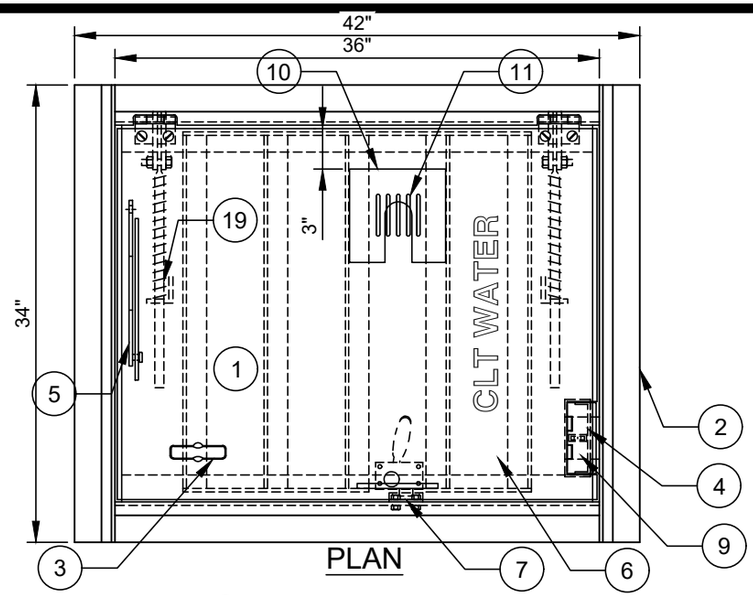
12-INCH ULTRASONIC WATER METER
(COMBINED FIRE AND DOMESTIC) SERVICE
AND PRECAST CONCRETE VAULT

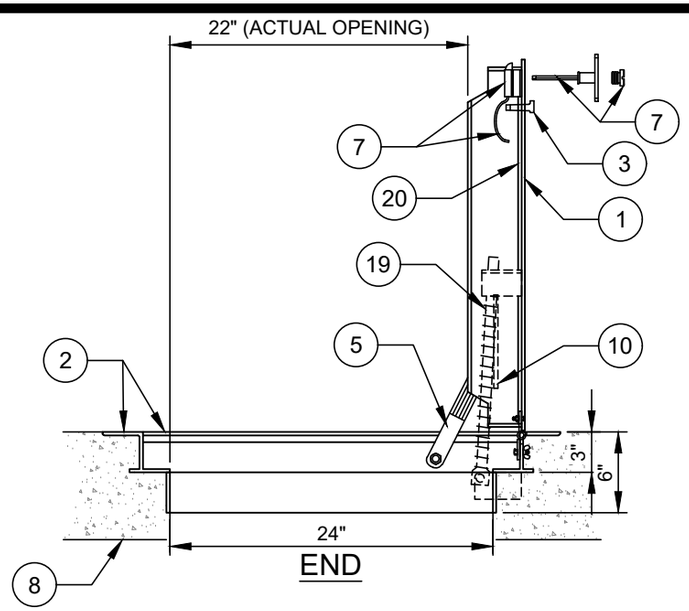
NO SCALE

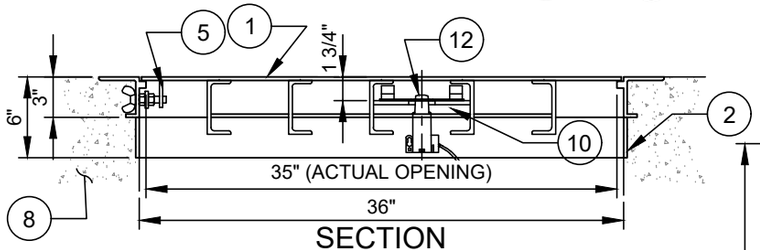
VERSION
2.0

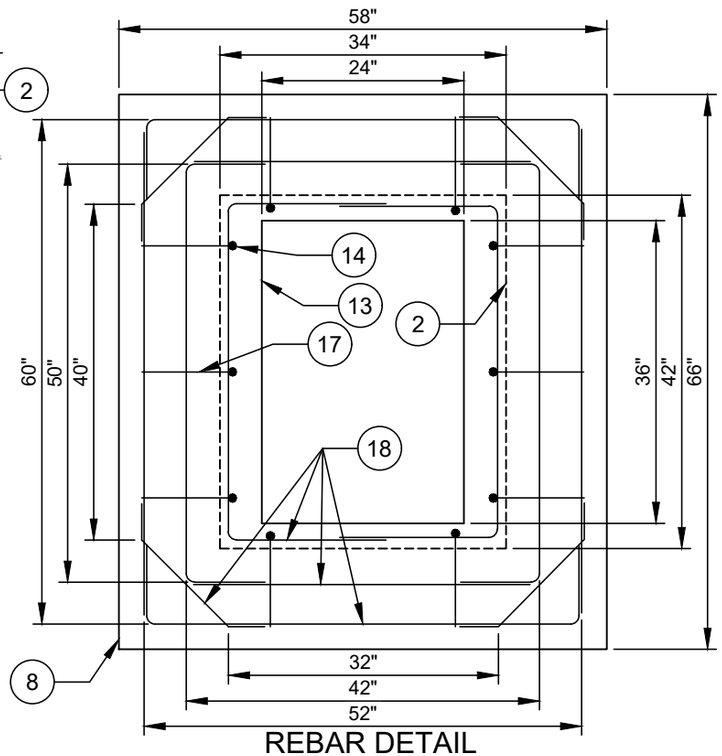
DATE
01/2026

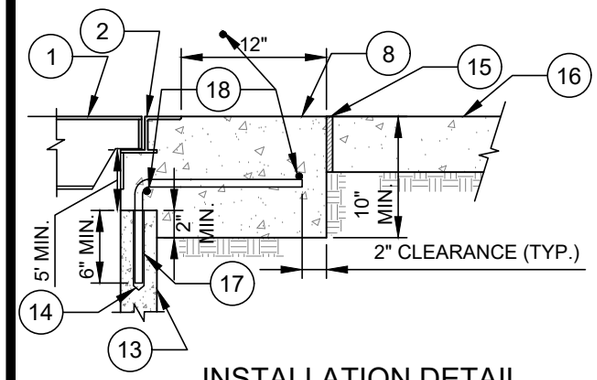
DETAIL
15.5.6











NO. DESCRIPTION:

1. SINGLE DOOR LEAF - REINFORCED.
2. CAST-IN STEEL DOOR FRAME W/ 3" SKIRT.
3. FLUSH DROP HANDLE.
4. RECESSED PADLOCK ASSEMBLY (STANDARD SIZE) WITH STAINLESS STEEL STAPLE / SPRING LOADED HINGED LID.
5. AUTOMATIC HOLD OPEN ARM WITH VINYL GRIP.
6. 2" LETTERING MILLED INTO DOOR LEAF.
7. SLAM LOCK / THREADED PLUG / REMOVABLE KEY / INSIDE HANDLE.
8. CONCRETE FRAME - CAST IN PLACE.
9. PADLOCK TO BE FURNISHED BY CLTW.
10. TRANSMITTER SUPPORT BRACKET.
11. TRANSMITTER SLOT.
12. TRANSMITTER.
13. PRECAST CONCRETE VAULT WALL.
14. DRILLED OR CAST HOLE - EPOXY ADHESIVE.
15. 1/2-INCH EXPANSION MATERIAL (CONSTRUCTION JOINT).
16. CONCRETE/ASPHALT HARDSCAPE.
17. #5 REBAR ANCHOR.
18. #4 REBAR.
19. COMPRESSION SPRING ASSEMBLY - TYPE 300 STAINLESS STEEL.
20. ATTACH ENGRAVED LABEL, WITH PREMISE NUMBER, TO UNDERSIDE OF DOOR, NEAR THE LIFTING HANDLE.

DESIGN REQUIREMENTS:

A. MATERIAL - A36 STEEL HOT DIP GALVANIZED. ENTIRE ASSEMBLY SHALL BE GALVANIZED. GALVANIZED COATING SHALL BE A MINIMUM OF 3.9MLS PER ASTM A123 GRADE 100.
B. LIVE LOAD - AASHTO H - 20 - 44 WHEEL LOAD. (16,000# +30% IMPACT OVER 10" X 20" AREA.
C. DOOR LEAF - 1/4-INCH THICK STEEL DIAMOND PLATE.
D. FINISH - HOT DIP GALVANIZED, SLIP RESISTANT MEETING ADA REQUIREMENTS.
E. HINGE / LOCKNUTS / BOLTS - STAINLESS STEEL - TYPE 316.
F. SLAM LOCK / HOLD OPEN ARM - STAINLESS STEEL - TYPE 316.
G. ACCESS DOOR SHALL BE MODEL AHS, AS MANUFACTURED BY U.S.F. FABRICATION, OR APPROVED EQUAL.
H. BITUMINOUS PAINT SHALL BE APPLIED TO FRAME IN CONTACT AREA WITH CONCRETE.
I. REBARS SHALL BE ASTM A615 - GRADE 60.
J. REBAR SPLICE LENGTH SHALL BE 12" MINIMUM.
K. CONCRETE - f 'c = 3,600 PSI MINIMUM.
L. FORCE REQUIRED TO OPEN LEAF (W/SPRINGS) SHALL BE MINUS 5 LBS. MINIMUM AND 35 LBS. MAXIMUM.
M. COMPRESSION SPRING ASSEMBLY SHALL BE DESIGNED BY MANUFACTURERS TO CONFORM TO LIFTING FORCE REQUIREMENTS - NUMBER OF SPRINGS AS REQUIRED.

WARNING NOTE:

THIS DOOR IS NOT TO BE USED IN ROADWAYS OR DRIVEWAYS. IT MAY BE USED IN OFF STREET LOCATIONS WHICH MAY OCCASIONALLY BE SUBJECT TO H-20 WHEEL LOADS.

NOTES:

THIS INSTALLATION DETAIL AND REINFORNCED CONCRETE FRAME REQUIREMENTS WILL BE USED ON ALL H-10 OR H-20 LOAD RATED ACCESS DOORS REGARDLESS OF DOOR SIZE.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

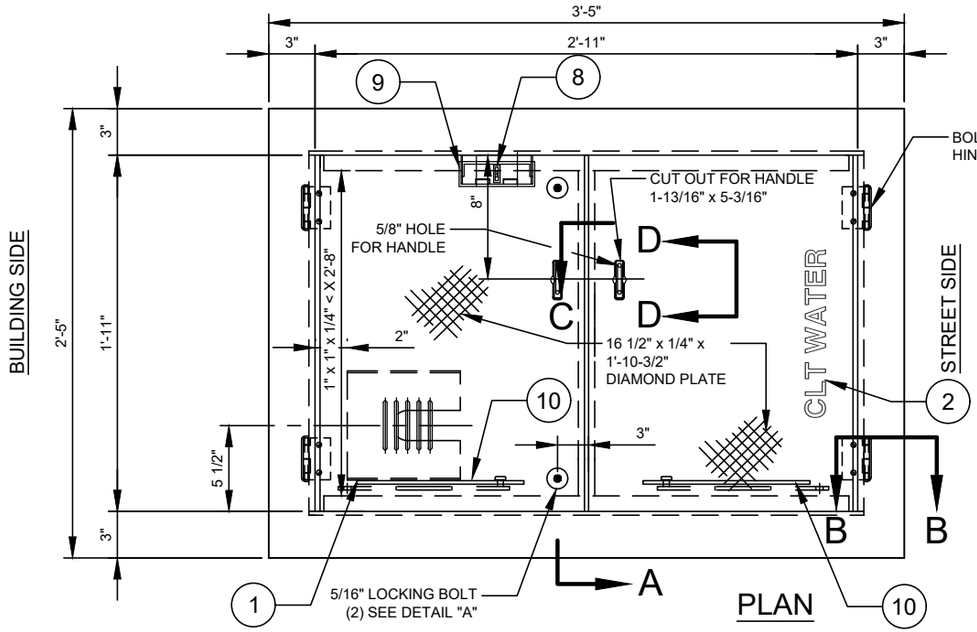
STEEL SINGLE LEAF ACCESS DOOR - 2' X 3'
OFF STREET H-20 WHEEL LOADING (OCCASIONAL - NON-TRAFFIC) FOR 1 1/2 & 2-INCH WATER METER VAULT

NO SCALE

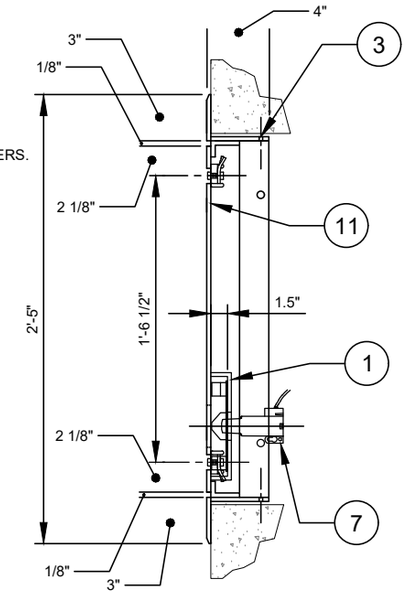
VERSION 2.0

DATE 01/2026

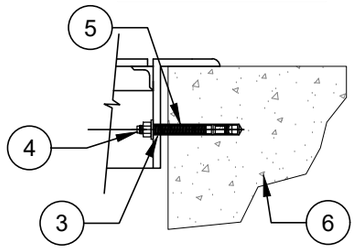
DETAIL 15.6.1



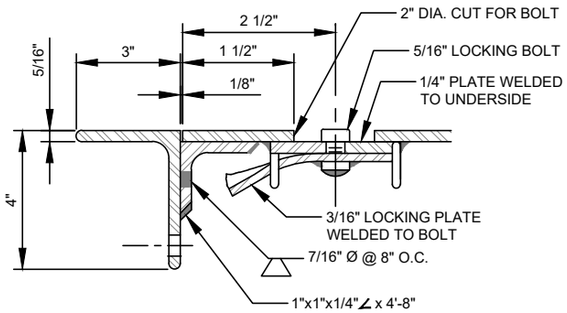
PLAN



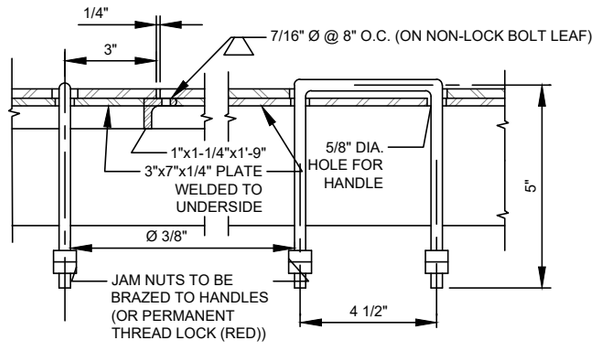
SECTION SIDE



ANCHOR DETAIL

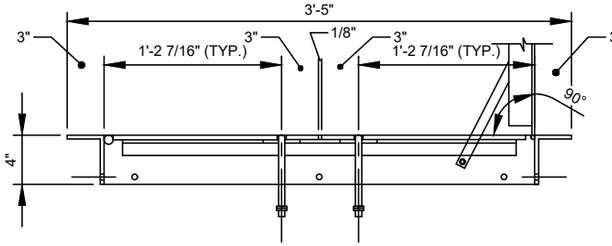


DETAIL A - LOCKING BOLT (2)



DETAIL C
HANDLE (2)

DETAIL D
HANDLE



SECTION FRONT

NO. DESCRIPTION:

1. TRANSMITTER SUPPORT BRACKET (SEE STANDARD DETAIL).
2. 2" LETTERING MILLED INTO DOOR LEAF.
3. 9/16-INCH DIAMETER DRILLED HOLE (10 EACH).
4. 1/2-INCH DIAMETER X 4-1/2-INCH STAINLESS STEEL EPOXY ADHESIVE ANCHOR - (RED HEAD, HILTI OR APPROVED EQUAL).
5. 1/2-INCH DIAMETER DRILLED HOLE IN CONCRETE.
6. CONCRETE VAULT OR PEDESTRIAN SIDEWALK.
7. WATER METER TRANSMITTER.
8. RECESSED PADLOCK ASSEMBLY (STANDARD SIZE) WITH STAPLE/SPRING LOADED HINGED LID.
9. PADLOCK TO BE FURNISHED BY CLTW.
10. AUTOMATIC HOLD OPEN ARM WITH VINYL GRIP.
11. ATTACH ENGRAVED LABEL, WITH PREMISE NUMBER, TO UNDERSIDE OF DOOR, NEAR THE LIFTING HANDLE.

DESIGN REQUIREMENTS:

a. MATERIAL - STRUCTURAL STEEL - ASTM A-36.
b. LIVE LOAD - 1,000 LBS. / SQ. FT. MINIMUM - PEDESTRIAN LOADING. MAXIMUM DEFLECTION 1/150 TH. OF SPAN.
c. DOOR LEAF - 1/4-INCH THICK DIAMOND PLATE.
d. COMPRESSION SPRINGS AND HOLD OPEN BAR ASSEMBLY ARE REQUIRED ON EACH LEAF.
e. BOLT ON STAINLESS STEEL HINGES WITH SUPPORT ANGLES - TYPE 304 STAINLESS STEEL.

NOTES:

A. CONTRACTOR SHALL ANCHOR FRAME USING ANCHOR HOLE NO. 4 - AS APPROVED (ANCHOR DETAIL).
B. FRAME AND COVER TO BE HOT DIP GALVANIZED. ENTIRE ASSEMBLY SHALL BE GALVANIZED. GALVANIZED COATING SHALL BE A MINIMUM OF 3.9MILS PER ASTM A123 GRADE 100.
C. FRAME DIMENSIONS SHALL ALLOW FOR CLOSE FIT INSIDE VAULT AS SHOWN AT TOP OF VAULT WALLS.
D. STAINLESS STEEL FOR ALL HARDWARE.

WARNING NOTE:
THIS DOOR IS NOT TO BE USED IN OR ADJACENT TO DRIVEWAYS OR ANY AREA SUBJECT TO VEHICLE WHEEL LOADS, OR ANY LOAD GREATER THAN 1,000 PSF.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

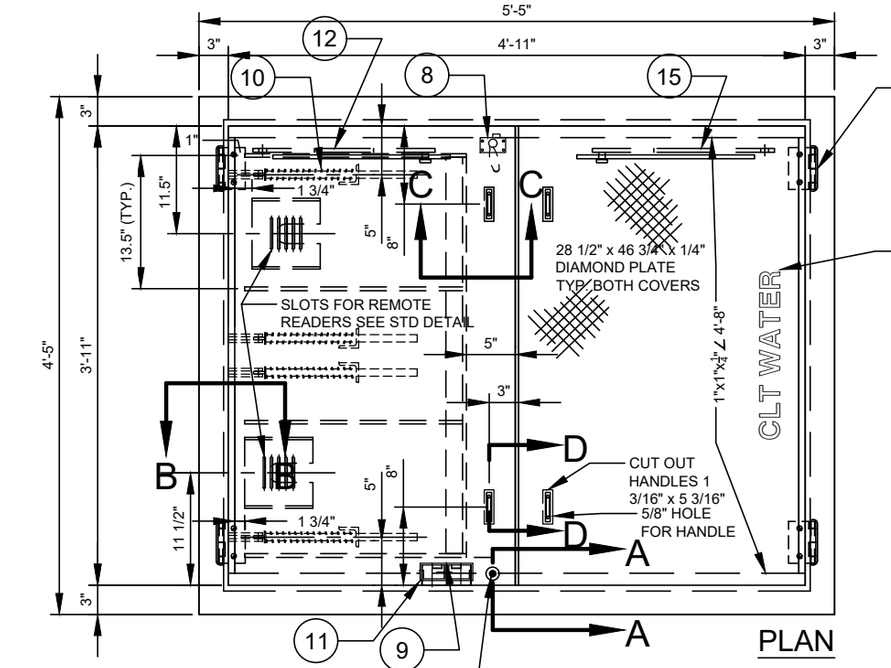
STEEL DOUBLE LEAF ACCESS DOOR - 2' X 3'
PEDESTRIAN LOADING (1,000 PSF) FOR
1 1/2-INCH AND 2-INCH WATER METER VAULT

NO SCALE

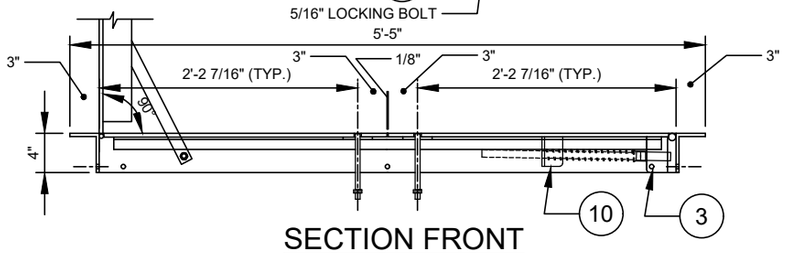
VERSION
2.0

DATE
01/2026

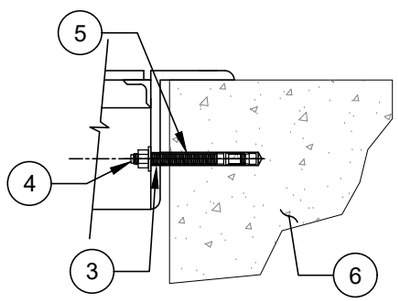
DETAIL
15.6.2



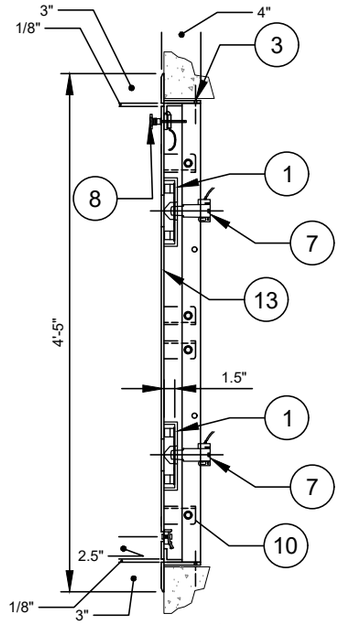
PLAN



SECTION FRONT



ANCHOR DETAIL



SECTION SIDE

NO. DESCRIPTION:

1. TRANSMITTER SUPPORT BRACKET (SEE STANDARD DETAIL).
2. 2" LETTERING MILLED INTO DOOR LEAF.
3. 9/16-INCH DIAMETER DRILLED HOLE (10 EACH).
4. 1/2-INCH DIAMETER X 4-1/2-INCH STAINLESS STEEL EPOXY ADHESIVE ANCHOR - (RED HEAD, HILTI OR APPROVED EQUAL).
5. 1/2-INCH DIAMETER DRILLED HOLE IN CONCRETE.
6. CONCRETE VAULT OR PEDESTRIAN SIDEWALK.
7. WATER METER TRANSMITTER.
8. SLAM LOCK/THREADED PLUG / REMOVABLE KEY / INSIDE HANDLE.
9. RECESSED PADLOCK ASSEMBLY (STANDARD SIZE) WITH STAPLE / SPRING LOADED HINGED LID.
10. OPEN COMPRESSION SPRING ASSEMBLY (# AS REQUIRED) - HORIZONTALLY MOUNTED.
11. PADLOCK TO BE FURNISHED BY CLTW.
12. AUTOMATIC HOLD OPEN ARM WITH VINYL GRIP.
13. ATTACH ENGRAVED LABEL, WITH PREMISE NUMBER, TO UNDERSIDE OF DOOR, NEAR THE LIFTING HANDLE.

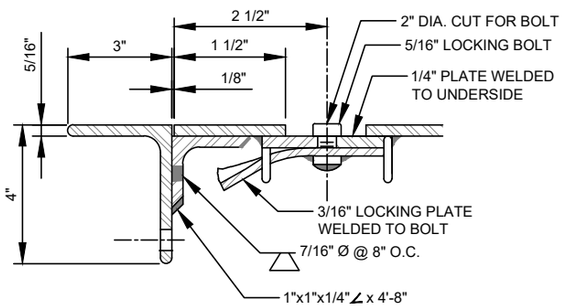
DESIGN REQUIREMENTS:

a. MATERIAL - STRUCTURAL STEEL - ASTM A-36.
b. LIVE LOAD - 1,000 LBS. / SQ. FT. MINIMUM - PEDESTRIAN LOADING. MAXIMUM DEFLECTION 1/150 TH. OF SPAN.
c. DOOR LEAF - 1/4-INCH THICK DIAMOND PLATE.
d. COMPRESSION SPRINGS AND HOLD OPEN BAR ASSEMBLY ARE REQUIRED ON EACH LEAF.
e. SLAM LOCK / HOLD OPEN ARM - STAINLESS STEEL - TYPE 304.
f. COMPRESSION SPRING ASSEMBLY - STAINLESS STEEL - TYPE 304.
g. FORCE REQUIRED TO OPEN LEAF (W/SPRINGS) SHALL BE MINUS 5 LBS. MINIMUM AND 20 LBS. MAXIMUM.
h. BOLT ON S.S. HINGES WITH SUPPORT ANGLES - TYPE 304 STAINLESS STEEL.

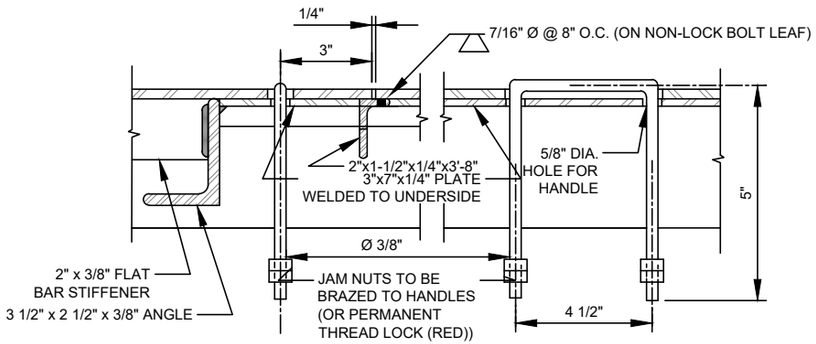
NOTES:

A. CONTRACTOR SHALL ANCHOR FRAME USING ANCHOR HOLE NO. 4 - AS APPROVED (ANCHOR DETAIL).
B. FRAME AND COVER TO BE HOT DIP GALVANIZED. ENTIRE ASSEMBLY SHALL BE GALVANIZED. GALVANIZED COATING SHALL BE A MINIMUM OF 3.9MLS PER ASTM A123 GRADE 100.
C. FRAME DIMENSIONS SHALL ALLOW FOR CLOSE FIT INSIDE VAULT AS SHOWN AT TOP OF VAULT WALLS.
D. STIFFENER TO BE WELDED TO BACK OF ACCESS DOOR USING WELD PATTERN AS SHOWN.
E. COMPRESSION SPRING ASSEMBLY SHALL BE DESIGNED BY MANUFACTURER TO CONFORM TO LIFTING FORCE REQUIREMENTS - NUMBER OF SPRINGS AS REQUIRED.
F. STAINLESS STEEL FOR ALL HARDWARE.

WARNING NOTE:
THIS DOOR IS NOT TO BE USED IN OR ADJACENT TO DRIVEWAYS OR ANY AREA SUBJECT TO VEHICLE WHEEL LOADS, OR ANY LOAD GREATER THAN 1,000 PSF.

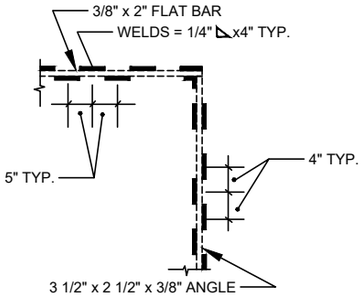


DETAIL A - LOCKING BOLT (1 EA)



DETAIL C HANDLE (4)

DETAIL D HANDLE



STIFFENER
WELD DETAIL "F"

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

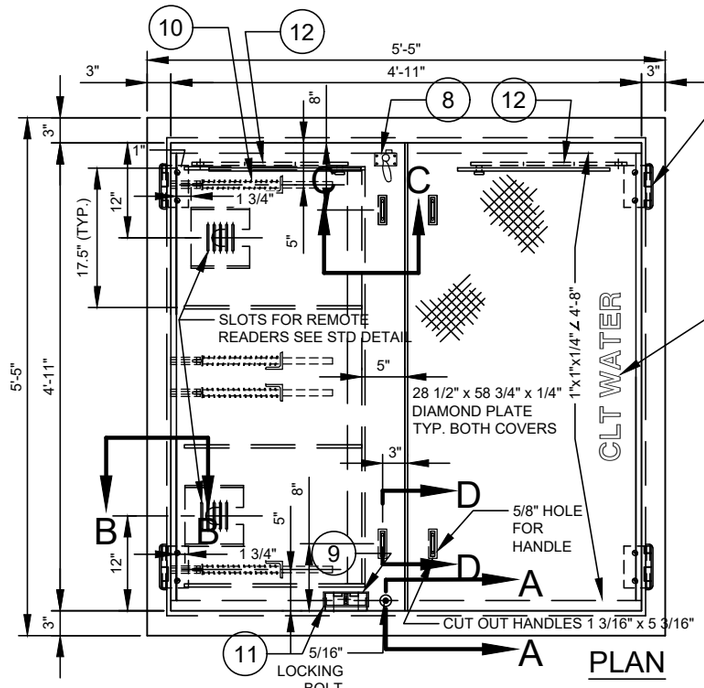
STEEL DOUBLE LEAF ACCESS DOOR - 4' X 5'
PEDESTRIAN LOADING (1,000 PSF) FOR
WATER METER VAULTS

NO SCALE

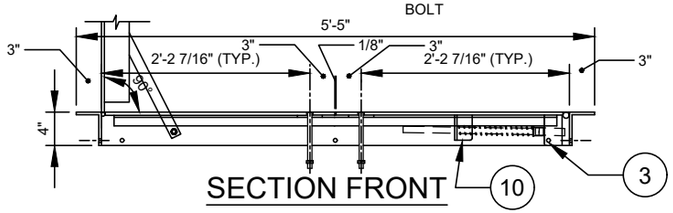
VERSION
2.0

DATE
01/2026

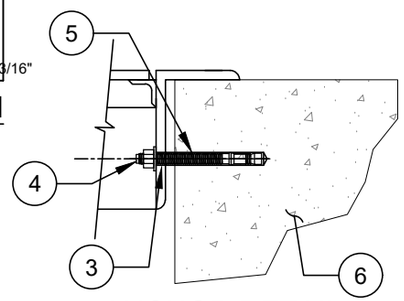
DETAIL
15.6.3



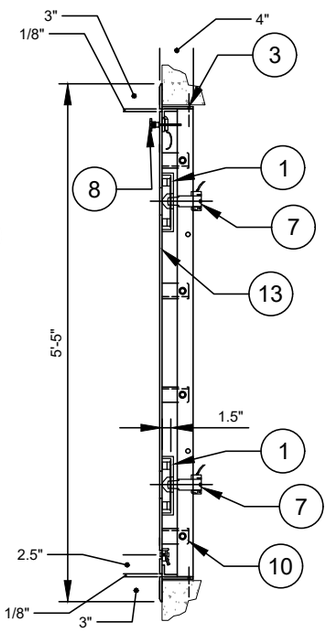
PLAN



SECTION FRONT



ANCHOR DETAIL



SECTION SIDE

NO. DESCRIPTION:

1. TRANSMITTER SUPPORT BRACKET (SEE STANDARD DETAIL).
2. 2" LETTERING MILLED INTO DOOR LEAF.
3. 9/16-INCH DIAMETER DRILLED HOLE (10 EACH).
4. 1/2-INCH DIAMETER X 4-1/2-INCH STAINLESS STEEL EPOXY ADHESIVE ANCHOR - (RED HEAD, HILTI OR APPROVED EQUAL).
5. 1/2-INCH DIAMETER DRILLED HOLE IN CONCRETE.
6. CONCRETE VAULT OR PEDESTRIAN SIDEWALK.
7. WATER METER TRANSMITTER.
8. SLAM LOCK/THREADED PLUG / REMOVABLE KEY / INSIDE HANDLE.
9. RECESSED PADLOCK ASSEMBLY (STANDARD SIZE) WITH STAPLE / SPRING LOADED HINGED LID.
10. OPEN COMPRESSION SPRING ASSEMBLY (# AS REQUIRED) - HORIZONTALLY MOUNTED.
11. PADLOCK TO BE FURNISHED BY CLTW.
12. AUTOMATIC HOLD OPEN ARM WITH VINYL GRIP.
13. ATTACH ENGRAVED LABEL, WITH PREMISE NUMBER, TO UNDERSIDE OF DOOR, NEAR THE LIFTING HANDLE.

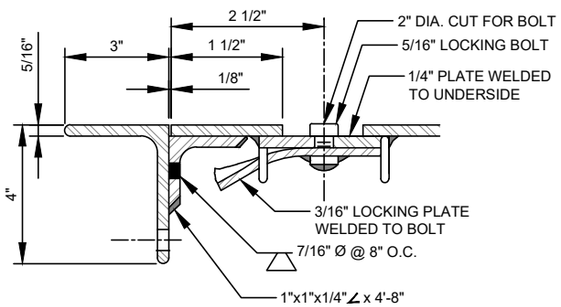
DESIGN REQUIREMENTS:

a. MATERIAL - STRUCTURAL STEEL - ASTM A-36.
b. LIVE LOAD - 1,000 LBS. / SQ. FT. MINIMUM - PEDESTRIAN LOADING. MAXIMUM DEFLECTION 1/150 TH. OF SPAN.
c. DOOR LEAF - 1/4-INCH THICK DIAMOND PLATE.
d. COMPRESSION SPRINGS AND HOLD OPEN BAR ASSEMBLY ARE REQUIRED ON EACH LEAF.
e. SLAM LOCK / HOLD OPEN ARM - STAINLESS STEEL - TYPE 304.
f. COMPRESSION SPRING ASSEMBLY - STAINLESS STEEL - TYPE 304.
g. FORCE REQUIRED TO OPEN LEAF (W/SPRINGS) SHALL BE MINUS 5 LBS. MINIMUM AND 20 LBS. MAXIMUM.
h. BOLT ON S.S. HINGES WITH SUPPORT ANGLES. - TYPE 304 STAINLESS STEEL.

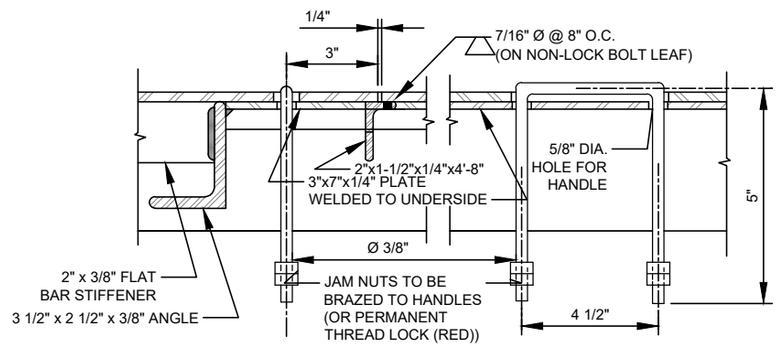
NOTES:

A. CONTRACTOR SHALL ANCHOR FRAME USING ANCHOR HOLE NO. 4 - AS APPROVED (ANCHOR DETAIL).
B. FRAME AND COVER TO BE HOT DIP GALVANIZED. ENTIRE ASSEMBLY SHALL BE GALVANIZED. GALVANIZED COATING SHALL BE A MINIMUM OF 3.9MILS PER ASTM A123 GRADE 100.
C. FRAME DIMENSIONS SHALL ALLOW FOR CLOSE FIT INSIDE VAULT AS SHOWN AT TOP OF VAULT WALLS.
D. STIFFENER TO BE WELDED TO BACK OF ACCESS DOOR USING WELD PATTERN AS SHOWN.
E. COMPRESSION SPRING ASSEMBLY SHALL BE DESIGNED BY MANUFACTURER TO CONFORM TO LIFTING FORCE REQUIREMENTS - NUMBER OF SPRINGS AS REQUIRED.
F. STAINLESS STEEL FOR ALL HARDWARE.

WARNING NOTE:
THIS DOOR IS NOT TO BE USED IN OR ADJACENT TO DRIVEWAYS OR ANY AREA SUBJECT TO VEHICLE WHEEL LOADS, OR ANY LOAD GREATER THAN 1,000 PSF.

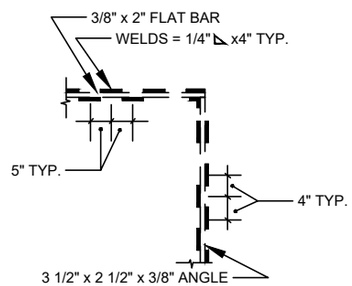


DETAIL A - LOCKING BOLT (1 EA)



DETAIL C HANDLE (4)

DETAIL D HANDLE



STIFFENER WELD DETAIL "F"

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

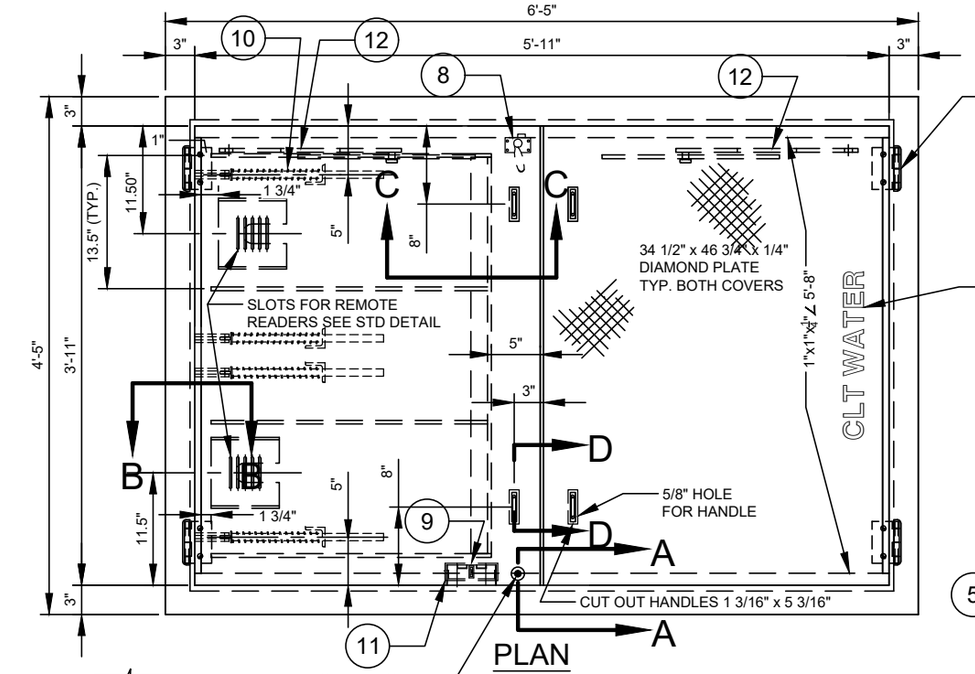
STEEL DOUBLE LEAF ACCESS DOOR - 5' X 5'
PEDESTRIAN LOADING (1,000 PSF) FOR
WATER METER VAULTS

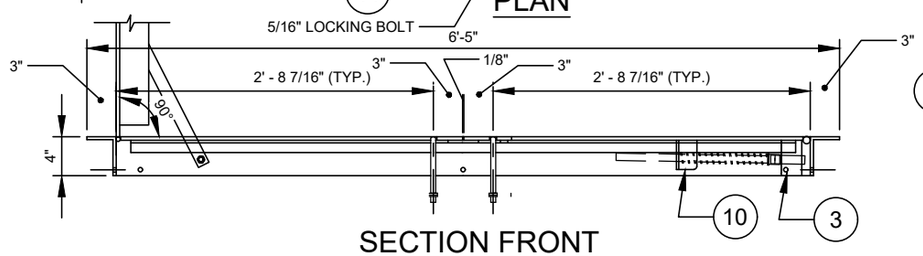
NO SCALE

VERSION
2.0

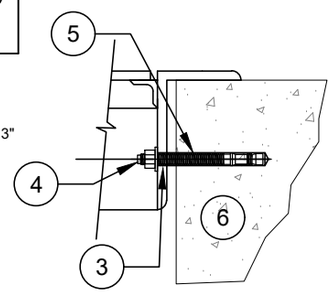
DATE
01/2026

DETAIL
15.6.4

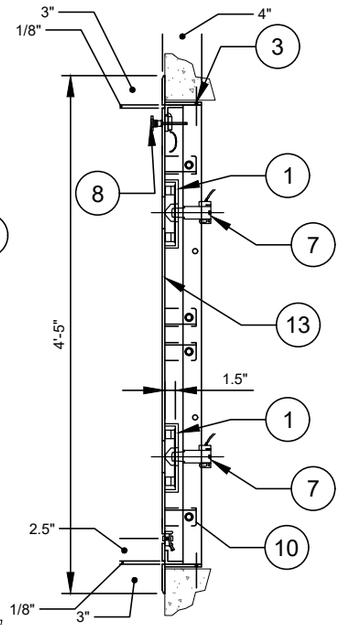




SECTION FRONT



ANCHOR DETAIL



SECTION SIDE

NO. DESCRIPTION:

1. TRANSMITTER SUPPORT BRACKET (SEE STANDARD DETAIL).
2. 2" LETTERING MILLED INTO DOOR LEAF.
3. 9/16-INCH DIAMETER DRILLED HOLE (10 EACH).
4. 1/2-INCH DIAMETER X 4-1/2-INCH STAINLESS STEEL EPOXY ADHESIVE ANCHOR - (RED HEAD, HILTI OR APPROVED EQUAL).
5. 1/2-INCH DIAMETER DRILLED HOLE IN CONCRETE.
6. CONCRETE VAULT OR PEDESTRIAN SIDEWALK.
7. WATER METER TRANSMITTER.
8. SLAM LOCK/THREADED PLUG / REMOVABLE KEY / INSIDE HANDLE.
9. RECESSED PADLOCK ASSEMBLY (STANDARD SIZE) WITH STAPLE / SPRING LOADED HINGED LID.
10. OPEN COMPRESSION SPRING ASSEMBLY (# AS REQUIRED) - HORIZONTALLY MOUNTED.
11. PADLOCK TO BE FURNISHED BY CTLW.
12. AUTOMATIC HOLD OPEN ARM WITH VINYL GRIP.
13. ATTACH ENGRAVED LABEL, WITH PREMISE NUMBER, TO UNDERSIDE OF DOOR, NEAR THE LIFTING HANDLE.

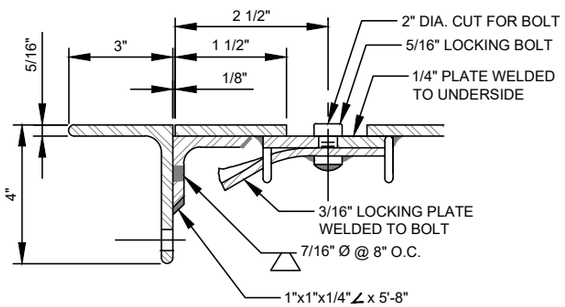
DESIGN REQUIREMENTS:

a. MATERIAL - STRUCTURAL STEEL - ASTM A-36.
b. LIVE LOAD - 1,000 LBS. / SQ. FT. MINIMUM - PEDESTRIAN LOADING. MAXIMUM DEFLECTION 1/150 TH. OF SPAN.
c. DOOR LEAF - 1/4-INCH THICK DIAMOND PLATE.
d. COMPRESSION SPRINGS AND HOLD OPEN BAR ASSEMBLY ARE REQUIRED ON EACH LEAF.
e. SLAM LOCK / HOLD OPEN ARM - STAINLESS STEEL - TYPE 304.
f. COMPRESSION SPRING ASSEMBLY - STAINLESS STEEL - TYPE 304.
g. FORCE REQUIRED TO OPEN LEAF (W/SPRINGS) SHALL BE MINUS 5 LBS. MINIMUM AND 20 LBS. MAXIMUM.
h. BOLT ON S.S. HINGES WITH SUPPORT ANGLES - TYPE 304 STAINLESS STEEL.

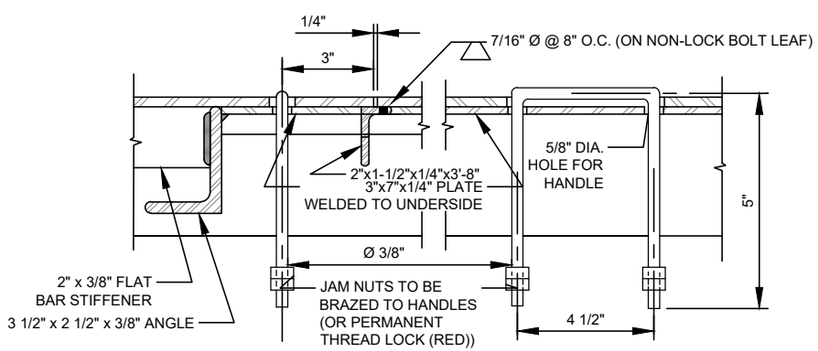
NOTES:

A. CONTRACTOR SHALL ANCHOR FRAME USING ANCHOR HOLES NO. 4 - AS APPROVED (ANCHOR DETAIL).
B. FRAME AND COVER TO BE HOT DIP GALVANIZED. ENTIRE ASSEMBLY SHALL BE GALVANIZED. GALVANIZED COATING SHALL BE A MINUMUM OF 3.9MILS PER ASTM A123 GRADE 100.
C. FRAME DIMENSIONS SHALL ALLOW FOR CLOSE FIT INSIDE VAULT AS SHOWN AT TOP OF VAULT WALLS.
D. STIFFENER TO BE WELDED TO BACK OF ACCESS DOOR USING WELD PATTERN AS SHOWN.
E. COMPRESSION SPRING ASSEMBLY SHALL BE DESIGNED BY MANUFACTURER TO CONFORM TO LIFTING FORCE REQUIREMENTS - NUMBER OF SPRINGS AS REQUIRED.
F. STAINLESS STEEL FOR ALL HARDWARE.

WARNING NOTE:
THIS DOOR IS NOT TO BE USED IN OR ADJACENT TO DRIVEWAYS OR ANY AREA SUBJECT TO VEHICLE WHEEL LOADS, OR ANY LOAD GREATER THAN 1,000 PSF.

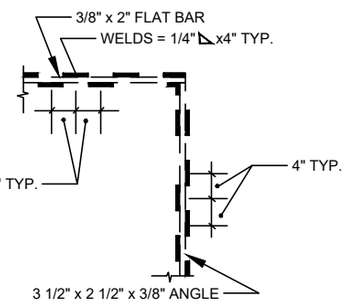


DETAIL A - LOCKING BOLT (1 EA)



DETAIL C HANDLE (4)

DETAIL D HANDLE



STIFFENER WELD DETAIL "F"

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

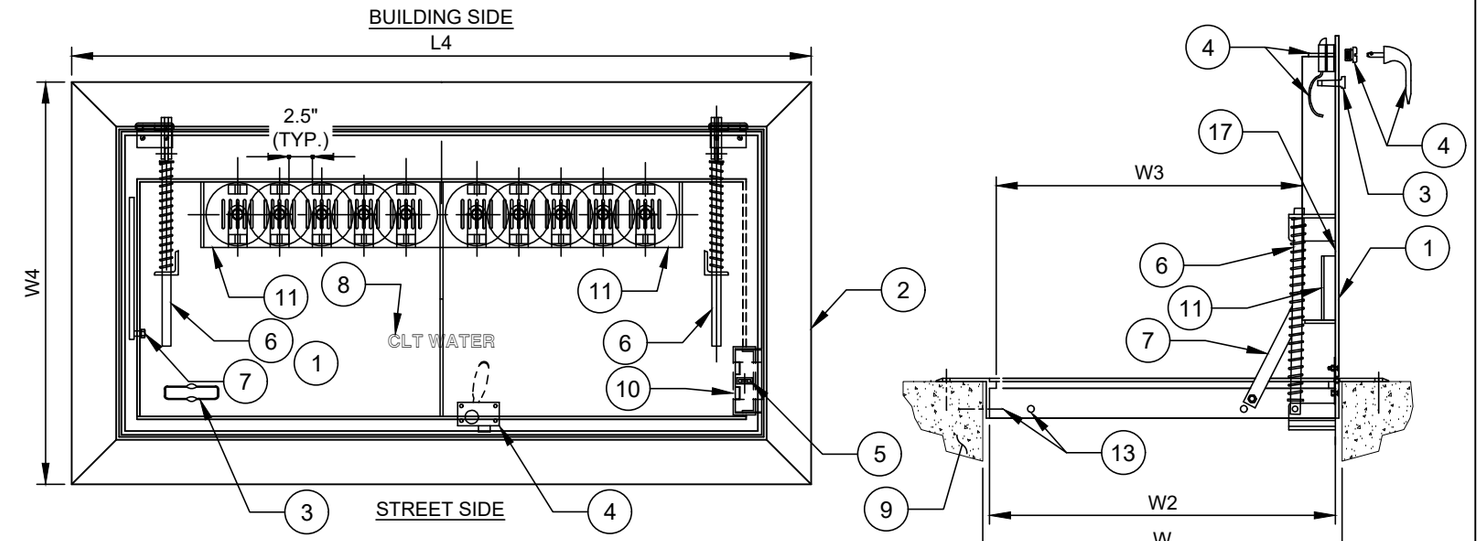
STEEL DOUBLE LEAF ACCESS DOOR - 4' X 6'
PEDESTRIAN LOADING (1,000 PSF) FOR
WATER METER VAULTS

NO SCALE

VERSION
2.0

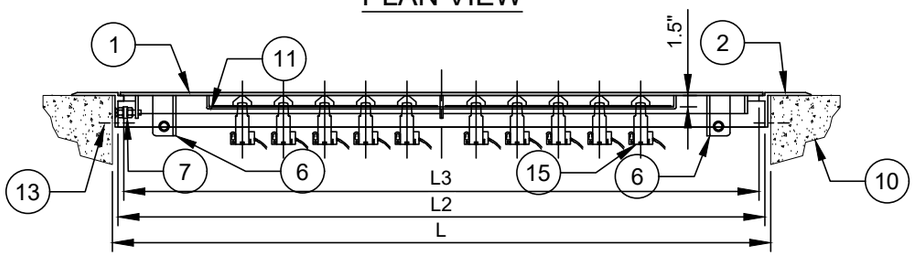
DATE
01/2026

DETAIL
15.6.5

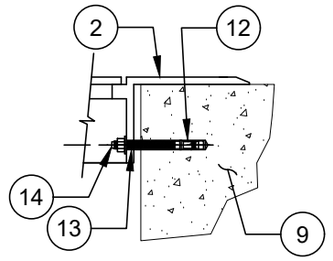


PLAN VIEW

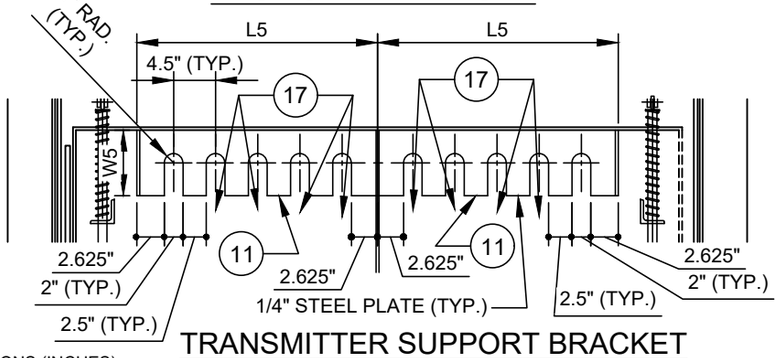
SECTION VIEW SIDE



SECTION VIEW FRONT



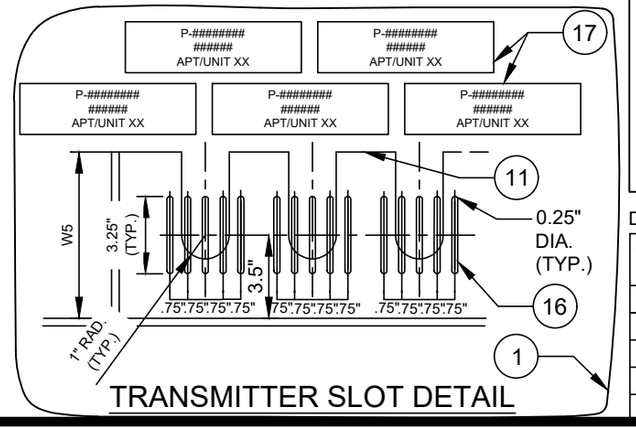
ANCHOR DETAIL



TRANSMITTER SUPPORT BRACKET

DIMENSIONS (INCHES)

VAULT		NUMBER OF METERS	METERS PER BRACKET	L5 BRACKET LENGTH	W5 BRACKET WIDTH	NUMBER OF SLOTS PER BRACKET
L	W					
72	36	10	5	25.25	7	20
60	36	8	4	20.75	7	16
48	36	6	3	16.25	7	12
36	36	4	2	11.75	7	8



TRANSMITTER SLOT DETAIL

NO. DESCRIPTION:

1. SINGLE DOOR LEAF - REINFORCED.
2. ANGLE DOOR FRAME.
3. FLUSH DROP HANDLE.
4. SLAM LOCK / THREADED PLUG / REMOVABLE KEY / INSIDE HANDLE.
5. RECESSED PADLOCK ASSEMBLY (STANDARD SIZE) WITH STAINLESS STEEL STAPLE.
6. OPEN COMPRESSION SPRING ASSEMBLY - HORIZONTALLY MOUNTED.
7. AUTOMATIC HOLD OPEN ARM WITH VINYL GRIP.
8. 2" LETTERING MILLED INTO DOOR LEAF.
9. CONCRETE VAULT OR PEDESTRIAN SIDEWALK.
10. PADLOCK TO BE FURNISHED BY CLTW.
11. TRANSMITTER SUPPORT BRACKETS.
12. 1/2-INCH DIAMETER HOLE IN CONCRETE.
13. 9/16-INCH DIAMETER DRILLED HOLE (# AS REQUIRED).
14. 1/2-INCH DIAMETER X 4-1/2-INCH EPOXY ADHESIVE ANCHOR - (RED HEAD, HILTI OR APPROVED EQUAL).
15. TRANSMITTER.
16. TRANSMITTER SLOT.
17. FOR EACH WATER METER, ATTACH AN ENGRAVED LABEL DIRECTLY ABOVE THE METER/ALIGNED WITH THE TRANSMITTER, INCLUDING THE PREMISE NUMBER, STREET NUMBER (AND UNIT/APT NUMBER IF APPLICABLE), TO UNDERSIDE OF DOOR.

DESIGN REQUIREMENTS:

a. MATERIAL - STEEL A36, EXCEPT AS NOTED.
b. LIVE LOAD - 1,000 LBS. / SQ. FT. MINIMUM - PEDESTRIAN LOADING. MAXIMUM DEFLECTION 1/150 OF SPAN.
c. DOOR LEAF - 1/4-INCH THICK STEEL DIAMOND PLATE.
d. FINISH - HOT DIPPED GALVANIZED. ENTIRE ASSEMBLY SHALL BE GALVANIZED. GALVANIZED COATING SHALL BE A MINIMUM OF 3.9MILS PER ASTM A123 GRADE 100. SLIP RESISTANT MEETING ADA REQUIREMENTS.
e. HINGE / LOCKNUTS / BOLTS - STAINLESS STEEL - TYPE 316.
f. SLAM LOCK / HOLD OPEN ARM - STAINLESS STEEL - TYPE 316.
g. COMPRESSION SPRING ASSEMBLY - STAINLESS STEEL - TYPE 300.
h. FORCE REQUIRED TO OPEN LEAF (W/ SPRINGS) SHALL BE MINUS 5 LBS. MINIMUM AND 35 LBS. MAXIMUM.
i. ACCESS DOOR SHALL BE MODEL AS MANUFACTURED BY U.S.F. FABRICATION, MODEL AS MANUFACTURED BY EJ CORP, OR APPROVED EQUAL.

WARNING NOTE:
THIS DOOR IS NOT TO BE USED IN OR ADJACENT TO DRIVEWAYS OR ANY AREA SUBJECT TO VEHICLE WHEEL LOADS, OR ANY LOAD GREATER THAN 1,000 PSF.

DIMENSIONS (INCHES)

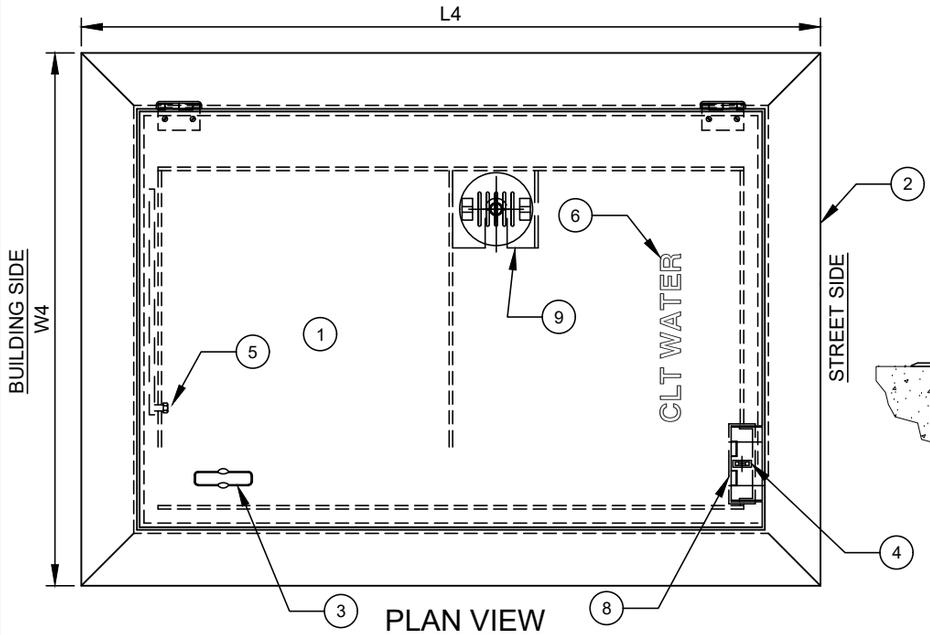
CONC. CLEAR OPENING		FRAME OPENING		CLEAR OPENING		OVERALL FRAME SIZE		BASE WT. W/O OPTIONS	LIFT ASSIST SPRINGS	SLAM LOCK
L	W	L2	W2	L3	W3	L4	W4	POUNDS	REQ'D ?	REQ'D ?
72	36	71	35	70	31	79	43	404	YES	YES
60	36	59	35	58	31	67	43	344	YES	YES
48	36	47	35	46	31	55	43	284	YES	YES
36	36	35	35	34	31	43	43	227	YES	YES

CHARLOTTE WATER

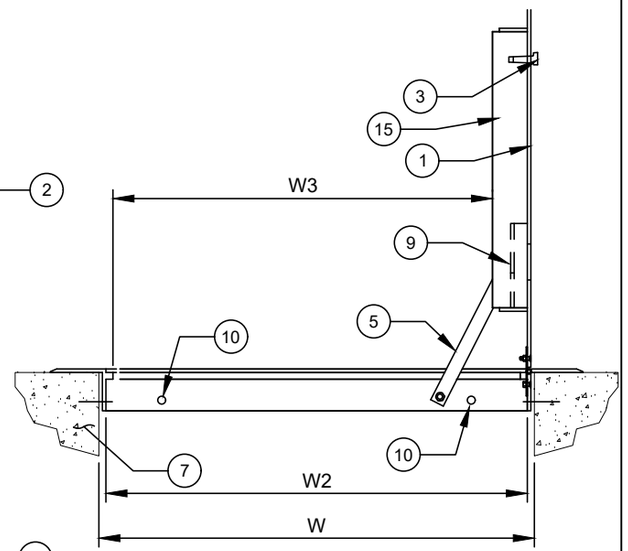
CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

STEEL SINGLE LEAF ACCESS DOOR - PEDESTRIAN LOADING (1,000 PSF) FOR MANIFOLD METER VAULT

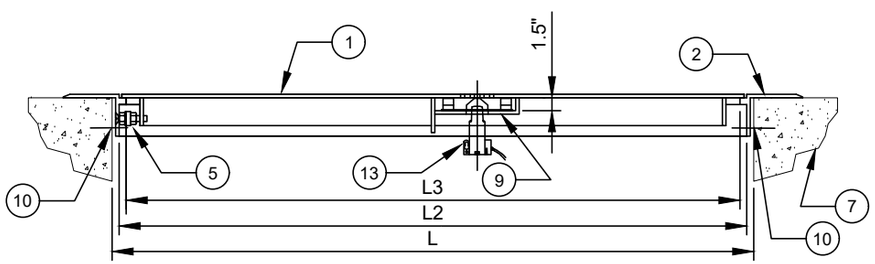
NO SCALE
VERSION 2.0
DATE 01/2026
DETAIL 15.6.6



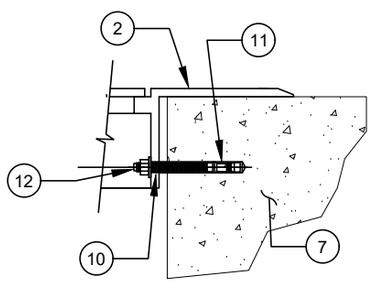
PLAN VIEW



SECTION VIEW SIDE



SECTION VIEW FRONT



ANCHOR DETAIL

NO. DESCRIPTION:

1. SINGLE DOOR LEAF - REINFORCED.
2. ANGLE DOOR FRAME.
3. FLUSH DROP HANDLE.
4. RECESSED PADLOCK ASSEMBLY (STANDARD SIZE) WITH STAINLESS STEEL STAPLE.
5. AUTOMATIC HOLD OPEN ARM WITH VINYL GRIP.
6. 2" LETTERING MILLED INTO DOOR LEAF.
7. CONCRETE VAULT OR PEDESTRIAN SIDEWALK.
8. PADLOCK TO BE FURNISHED BY CLTW.
9. TRANSMITTER SUPPORT BRACKET.
10. 9/16" DIAMETER DRILLED HOLE (# AS REQUIRED).
11. 1/2" DIAMETER HOLE IN CONCRETE.
12. 1/2" DIAMETER X 4-1/2-" EPOXY ADHESIVE ANCHOR - (RED HEAD, HILTI OR APPROVED EQUAL).
13. TRANSMITTER.
14. TRANSMITTER SLOT.
15. ATTACH ENGRAVED LABEL, WITH PREMISE NUMBER, TO UNDERSIDE OF DOOR, NEAR THE LIFTING HANDLE.

DESIGN REQUIREMENTS:

a. MATERIAL - STEEL A36, EXCEPT AS NOTED.
b. LIVE LOAD - 1,000 LBS. / SQ. FT. MINIMUM - PEDESTRIAN LOADING. MAXIMUM DEFLECTION 1/150 OF SPAN.
c. DOOR LEAF - 1/4" THICK STEEL DIAMOND PLATE.
d. FINISH - HOT DIPPED GALVANIZED. ENTIRE ASSEMBLY SHALL BE GALVANIZED. GALVANIZED COATING SHALL BE A MINIMUM OF 3.9MILS PER ASTM A123 GRADE 100. SLIP RESISTANT MEETING ADA REQUIREMENTS.
e. HINGE / LOCKNUTS / BOLTS - STAINLESS STEEL - TYPE 316.
f. HOLD OPEN ARM - STAINLESS STEEL - TYPE 316.
g. FORCE REQUIRED TO OPEN LEAF SHALL BE 35 LBS. MAXIMUM.
h. ACCESS DOOR SHALL BE MODEL AS MANUFACTURED BY U.S.F. FABRICATION, MODEL AS MANUFACTURED BY EJ CORP, OR APPROVED EQUAL.

WARNING NOTE:
THIS DOOR IS NOT TO BE USED IN OR ADJACENT TO DRIVEWAYS OR ANY AREA SUBJECT TO VEHICLE WHEEL LOADS, OR ANY LOAD GREATER THAN 1,000 PSF.

DIMENSIONS (INCHES)

CONC. CLEAR OPENING		FRAME OPENING		CLEAR OPENING		OVERALL FRAME SIZE		BRACKET LENGTH	BRACKET WIDTH
L	W	L2	W2	L3	W3	L4	W4	L5	W5
36	24	35	23	34	20	43	31	7.125	7

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

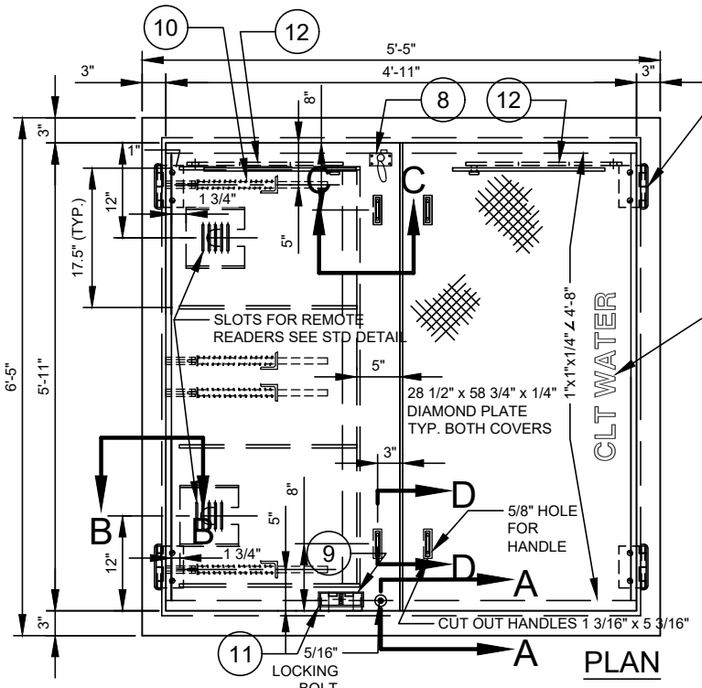
STEEL SINGLE LEAF ACCESS DOOR - PEDESTRIAN LOADING (1,000 PSF) FOR 1 1/2-INCH & 2-INCH WATER METER VAULT

NO SCALE

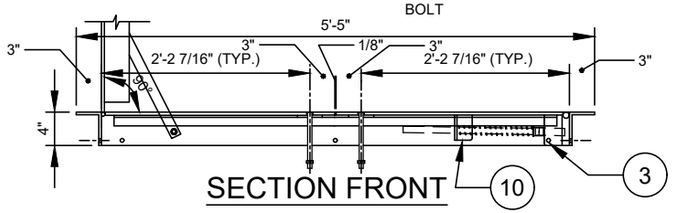
VERSION 3.0

DATE 01/2026

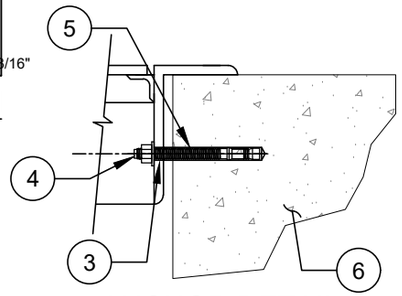
DETAIL 15.6.7



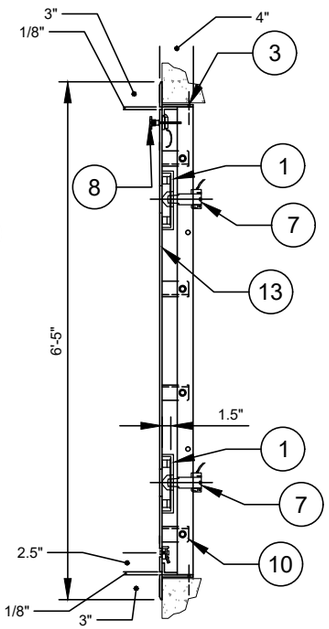
PLAN



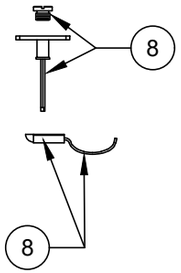
SECTION FRONT



ANCHOR DETAIL



SECTION SIDE



NO.	DESCRIPTION:
1.	TRANSMITTER SUPPORT BRACKET (SEE STANDARD DETAIL).
2.	2" LETTERING MILLED INTO DOOR LEAF.
3.	9/16-INCH DIAMETER DRILLED HOLE (10 EACH).
4.	1/2-INCH DIAMETER X 4-1/2-INCH STAINLESS STEEL EPOXY ADHESIVE ANCHOR - (RED HEAD, HILTI OR APPROVED EQUAL).
5.	1/2-INCH DIAMETER DRILLED HOLE IN CONCRETE.
6.	CONCRETE VAULT OR PEDESTRIAN SIDEWALK.
7.	WATER METER TRANSMITTER.
8.	SLAM LOCK/THREADED PLUG / REMOVABLE KEY / INSIDE HANDLE.
9.	RECESSED PADLOCK ASSEMBLY (STANDARD SIZE) WITH STAPLE / SPRING LOADED HINGED LID.
10.	OPEN COMPRESSION SPRING ASSEMBLY (# AS REQUIRED) - HORIZONTALLY MOUNTED.
11.	PADLOCK TO BE FURNISHED BY CLTW.
12.	AUTOMATIC HOLD OPEN ARM WITH VINYL GRIP.
13.	ATTACH ENGRAVED LABEL, WITH PREMISE NUMBER, TO UNDERSIDE OF DOOR, NEAR THE LIFTING HANDLE.

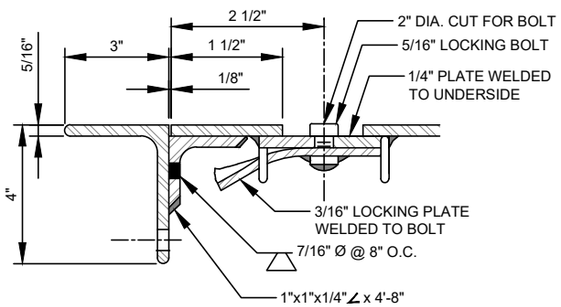
DESIGN REQUIREMENTS:

a. MATERIAL - STRUCTURAL STEEL - ASTM A-36.
b. LIVE LOAD - 1,000 LBS. / SQ. FT. MINIMUM - PEDESTRIAN LOADING. MAXIMUM DEFLECTION 1/150 TH. OF SPAN.
c. DOOR LEAF - 1/4-INCH THICK DIAMOND PLATE.
d. COMPRESSION SPRINGS AND HOLD OPEN BAR ASSEMBLY ARE REQUIRED ON EACH LEAF.
e. SLAM LOCK / HOLD OPEN ARM - STAINLESS STEEL - TYPE 304.
f. COMPRESSION SPRING ASSEMBLY - STAINLESS STEEL - TYPE 304.
g. FORCE REQUIRED TO OPEN LEAF (W/SPRINGS) SHALL BE MINUS 5 LBS. MINIMUM AND 20 LBS. MAXIMUM.
h. BOLT ON S.S. HINGES WITH SUPPORT ANGLES. - TYPE 304 STAINLESS STEEL.

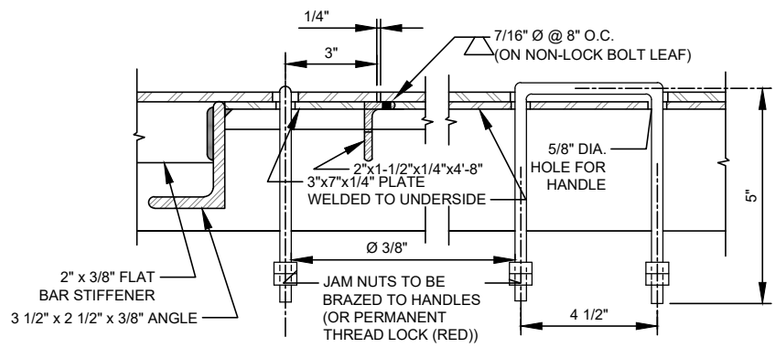
NOTES:

A. CONTRACTOR SHALL ANCHOR FRAME USING ANCHOR HOLE NO. 4 - AS APPROVED (ANCHOR DETAIL).
B. FRAME AND COVER TO BE HOT DIP GALVANIZED. ENTIRE ASSEMBLY SHALL BE GALVANIZED. GALVANIZED COATING SHALL BE A MINIMUM OF 3.9MILS PER ASTM A123 GRADE 100.
C. FRAME DIMENSIONS SHALL ALLOW FOR CLOSE FIT INSIDE VAULT AS SHOWN AT TOP OF VAULT WALLS.
D. STIFFENER TO BE WELDED TO BACK OF ACCESS DOOR USING WELD PATTERN AS SHOWN.
E. COMPRESSION SPRING ASSEMBLY SHALL BE DESIGNED BY MANUFACTURER TO CONFORM TO LIFTING FORCE REQUIREMENTS - NUMBER OF SPRINGS AS REQUIRED.
F. STAINLESS STEEL FOR ALL HARDWARE.

WARNING NOTE:
THIS DOOR IS NOT TO BE USED IN OR ADJACENT TO DRIVEWAYS OR ANY AREA SUBJECT TO VEHICLE WHEEL LOADS, OR ANY LOAD GREATER THAN 1,000 PSF.

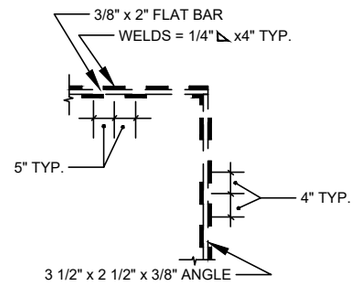


DETAIL A - LOCKING BOLT (1 EA)



DETAIL C HANDLE (4)

DETAIL D HANDLE



STIFFENER WELD DETAIL "F"

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

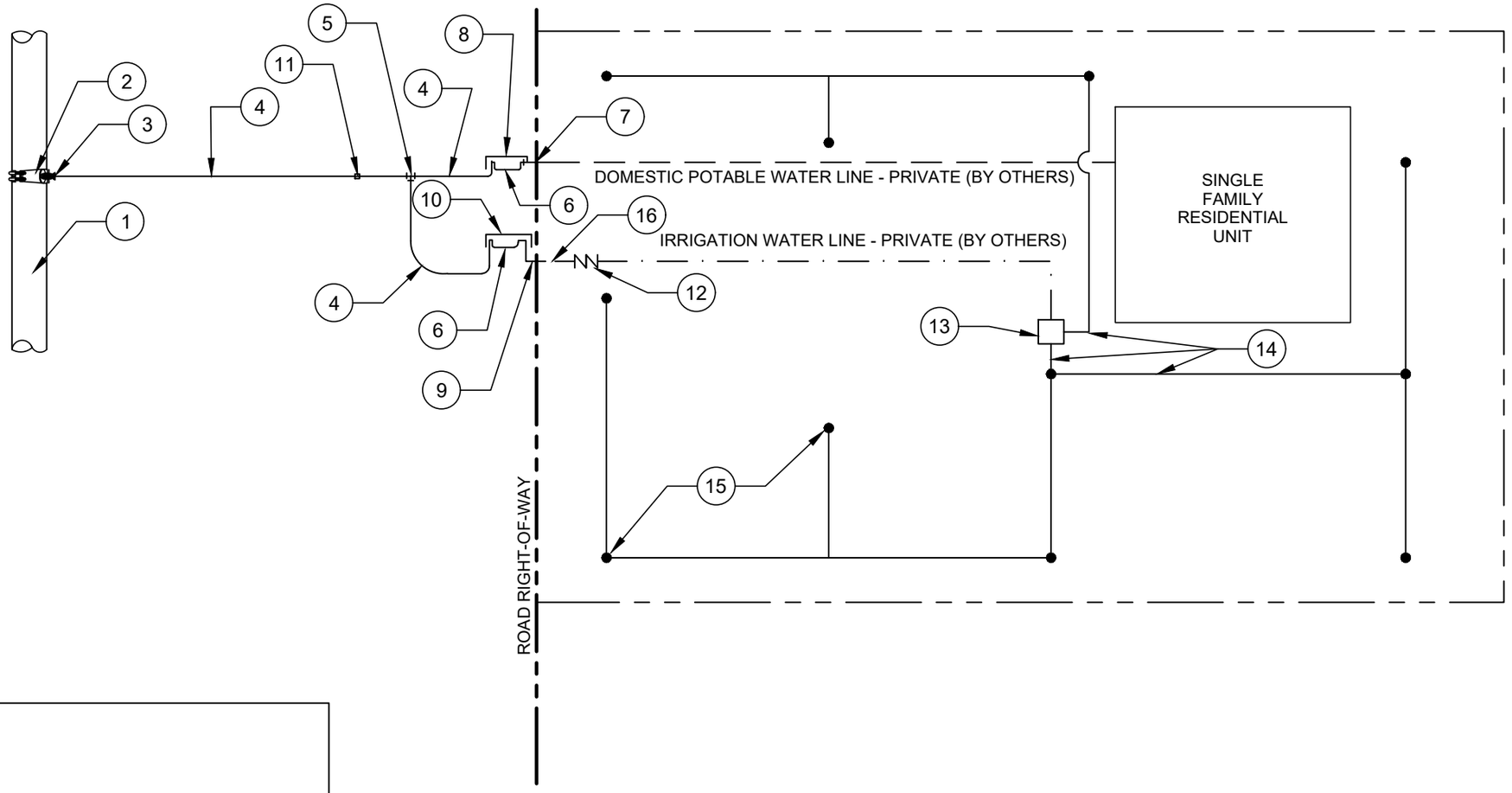
STEEL DOUBLE LEAF ACCESS DOOR - 5' X 6' PEDESTRIAN LOADING (1,000 PSF) FOR WATER METER VAULTS

NO SCALE

VERSION 1.0

DATE 01/2026

DETAIL 15.6.8



NO. DESCRIPTION:

1. PUBLIC WATER MAIN.
2. DOUBLE STRAP SERVICE SADDLE.
3. CORPORATION STOP.
4. COPPER OR HDPE SERVICE LINE.
5. BRANCH / TEE - (MUELLER H - 15381, FORD T444 - 333, OR McDONALD 4760T).
6. ANGLE VALVE / YOKE BAR / METER / ERT.
7. 3/4" COPPER OR HDPE SERVICE TUBING TAIL PIECE.
8. STD. PLASTIC OR CONCRETE METER BOX AND PLASTIC LID.
9. BRASS 90° YOKE STAR NUT x FNPT COUPLING, SCH. 80 PVC ADAPTER (MNPT x SOCKET), 3/4" SCH. 40 PVC (L= AS REQUIRED), SCH. 80 PVC 90° BEND (SOCKET x SOCKET) AND 3/4" SCH. 40 PVC (L= 24 INCH) TAIL PIECE.
10. GREEN PLASTIC IRRIGATION METER BOX AND LID.
11. TEMPORARY LINE STOP, WITH ICE PLUG / PIPE FREEZING ON COPPER TUBING. (OMIT WITH NEW CONSTRUCTION).
12. REDUCED PRESSURE PRINCIPAL BACKFLOW ASSEMBLY (BY OTHERS).
13. IRRIGATION CONTROL SYSTEM (BY OTHERS).
14. IRRIGATION PIPE SYSTEM (BY OTHERS).
15. IRRIGATION SPRINKER HEAD (BY OTHERS).
16. BRANCHES AND / OR IRRIGATION SPRINKLER HEADS ARE NOT PERMITTED BETWEEN IRRIGATION METER AND BACKFLOW ASSEMBLY.

NOTES:

A. SPLIT IRRIGATION SERVICES ARE NOT ALLOWED WHEN DOMESTIC METER BOX IS LOCATED IN CONCRETE.
B. METER LOCATION AND RELATIONSHIP TO ROAD RIGHT-OF-WAY, CURB, SIDEWALK AND DRIVEWAYS WILL VARY FROM SITE TO SITE BASED ON EXISTING CHARLOTTE WATER STANDARDS.
C. CHARLOTTE WATER MAINTENANCE ENDS IN THE METER BOX ASSEMBLY, AT THE LAST BRASS FITTING.
D. DOMESTIC SERVICE SHALL BE ON THE RUN OF THE TEE, AND THE IRRIGATION SERVICE SHALL BE ON THE BRANCH OF THE TEE, AS SHOWN.
E. METER BOXES SHALL BE INSTALLED SIDE BY SIDE, WITH 2 FT. MIN. AND 5 FT. MAX. SEPARATION.
F. SOLVENT WELDS ON PVC PIPE / FITTINGS SHALL BE CLEANED AND PRIMED PRIOR TO APPLYING GLUE.
G. SERVICES SHALL BE ALL COPPER OR HDPE SERVICE TUBING. DO NOT MIX SERVICE TUBING MATERIALS.
H. THIS DETAIL FOR SINGLE FAMILY RESIDENTIAL ONLY.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

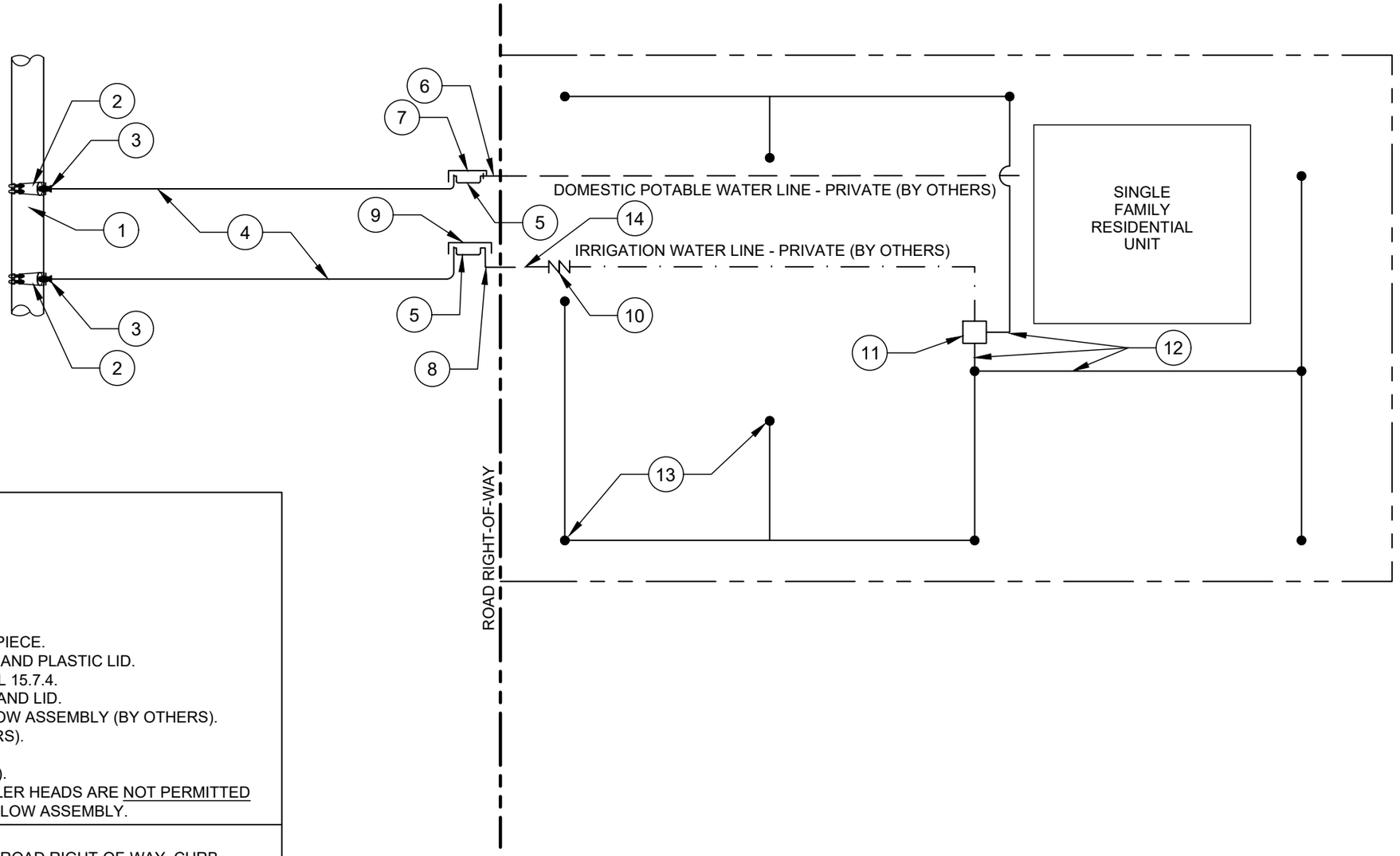
3/4-INCH DOMESTIC WATER SERVICE WITH SPLIT 3/4-INCH IRRIGATION SERVICE BACKFLOW AT ROAD RIGHT-OF-WAY / NO DUAL CHECK AT METER

NO SCALE

VERSION 2.0

DATE 01/2026

DETAIL 15.7.1



NO. DESCRIPTION:

1. PUBLIC WATER MAIN.
2. DOUBLE STRAP SERVICE SADDLE.
3. CORPORATION STOP.
4. COPPER OR HDPE SERVICE TUBING.
5. ANGLE VALVE / YOKE BAR / METER / ERT.
6. COPPER OR HDPE SERVICE TUBING TAIL PIECE.
7. STD. PLASTIC OR CONCRETE METER BOX AND PLASTIC LID.
8. FOR TAILPIECE CONNECTIONS SEE DETAIL 15.7.4.
9. GREEN PLASTIC IRRIGATION METER BOX AND LID.
10. REDUCED PRESSURE PRINCIPAL BACKFLOW ASSEMBLY (BY OTHERS).
11. IRRIGATION CONTROL SYSTEM (BY OTHERS).
12. IRRIGATION PIPE SYSTEM (BY OTHERS).
13. IRRIGATION SPRINKER HEAD (BY OTHERS).
14. BRANCHES AND / OR IRRIGATION SPRINKLER HEADS ARE NOT PERMITTED BETWEEN IRRIGATION METER AND BACKFLOW ASSEMBLY.

NOTES:

A. METER LOCATION AND RELATIONSHIP TO ROAD RIGHT-OF-WAY, CURB, SIDEWALK AND DRIVEWAYS WILL VARY FROM SITE TO SITE BASED ON EXISTING CHARLOTTE WATER STANDARDS.
B. CHARLOTTE WATER MAINTENANCE ENDS IN THE METER BOX ASSEMBLY, AT THE LAST BRASS FITTING.
C. METER BOXES SHALL BE INSTALLED SIDE BY SIDE, WITH 3 FT. MIN. AND 8 FT. MAX. SEPARATION.
D. SOLVENT WELDS ON PVC PIPE / FITTINGS SHALL BE CLEANED AND PRIMED PRIOR TO APPLYING GLUE.
E. SPLIT IRRIGATION SERVICES ARE NOT ALLOWED WHEN DOMESTIC METER BOX IS LOCATED IN CONCRETE.
F. THIS DETAIL FOR SINGLE FAMILY RESIDENTIAL ONLY.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

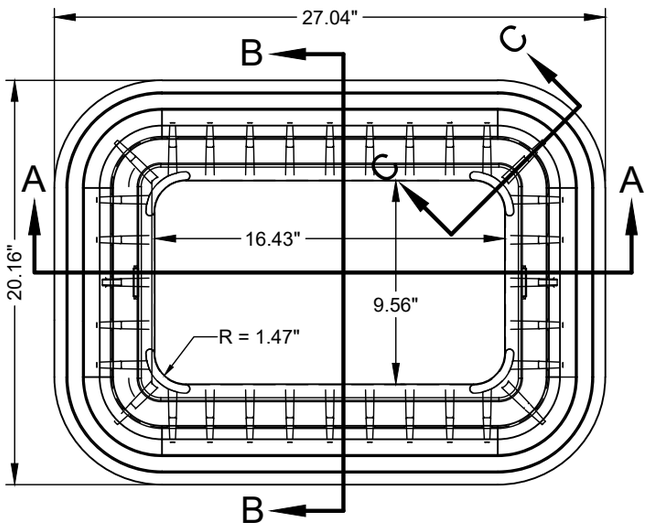
3/4 OR 1 INCH DOMESTIC WATER SERVICE WITH DEDICATED 3/4 OR 1 INCH IRRIGATION SERVICE BACKFLOW AT ROAD RIGHT-OF-WAY / NO DUAL CHECK AT METER

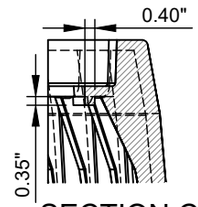
NO SCALE

VERSION 1.0

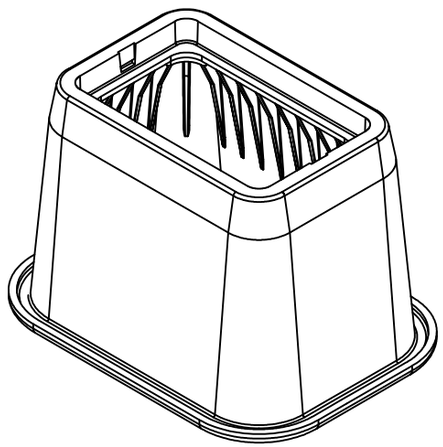
DATE 04/2024

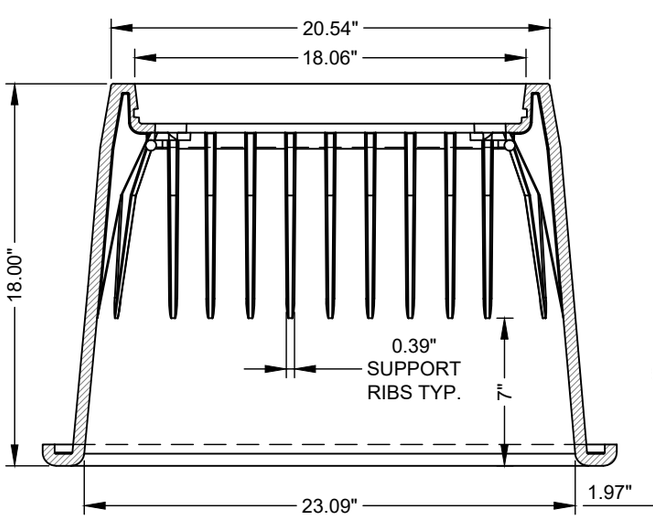
DETAIL 15.7.2



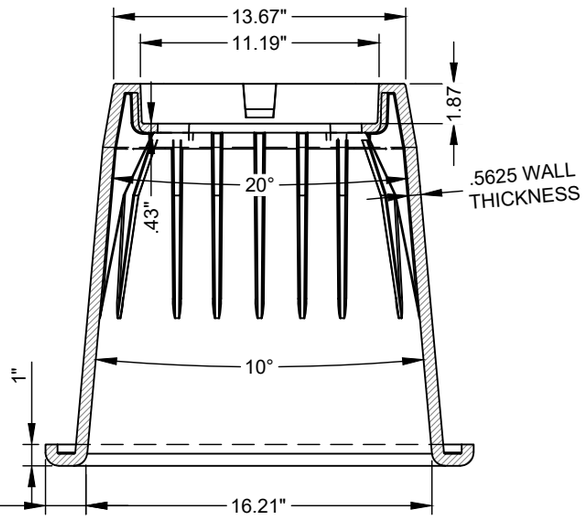


SECTION C-C





SECTION A-A

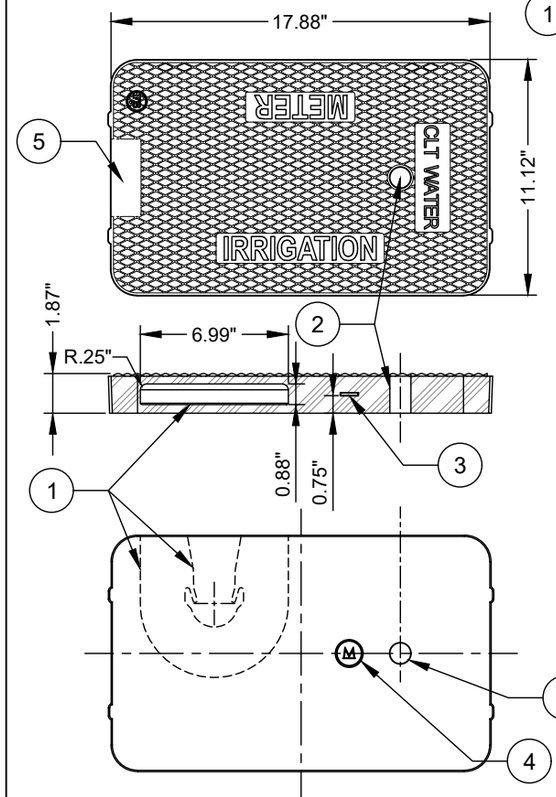


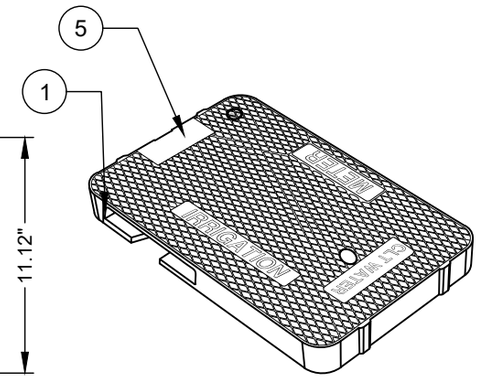
SECTION B-B

NO.	DESCRIPTION:
1.	ENDPOINT TRANSMITTER SUPPORT SHELF.
2.	1 INCH DIAMETER PICK HOLE.
3.	1/8" X Ø3/4" RARE EARTH MAGNET.
4.	IMPRINTED "M" LOCATER MARK UNDER MAGNET.
5.	MANUFACTURER NAME.

NOTES:

A. MATERIAL SHALL BE HIGH DENSITY POLYETHYLENE.
B. LOAD RATING = HS20 HEAVY DUTY.
C. COLOR SHALL BE CHARLOTTE GREEN.
D. MANUFACTURERS; SOUTHEASTERN, DFW AND SIGMA.





BOTTOM VIEW

METER BOX BODY WEIGHT = APPROX. 20 - 24 LBS. LID WEIGHT = APPROX. 8-14 LBS.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

PLASTIC METER BOX AND LID FOR 3/4-INCH AND 1-INCH IRRIGATION WATER SERVICE

NO SCALE

VERSION 2.0

DATE 01/2026

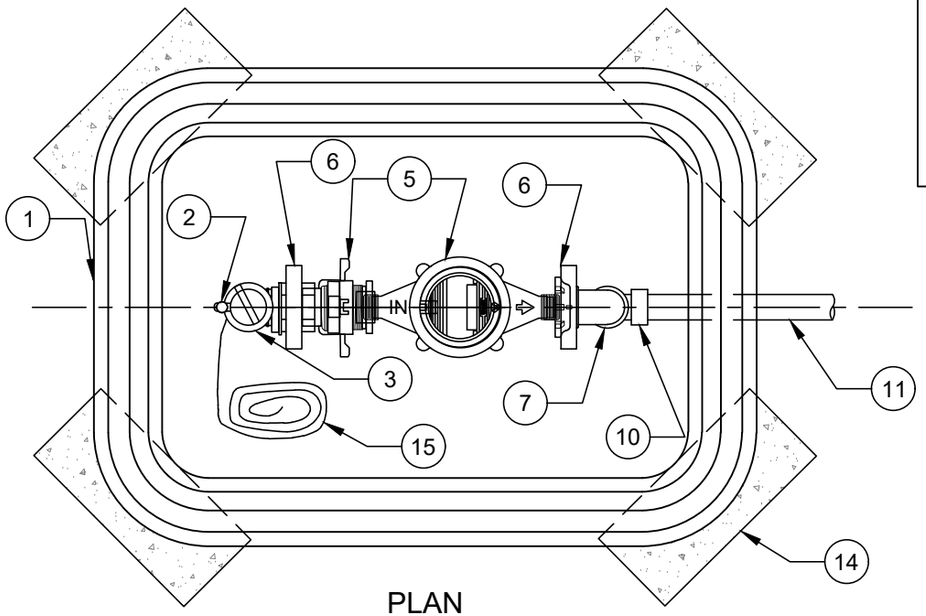
DETAIL 15.7.3

NOTES:

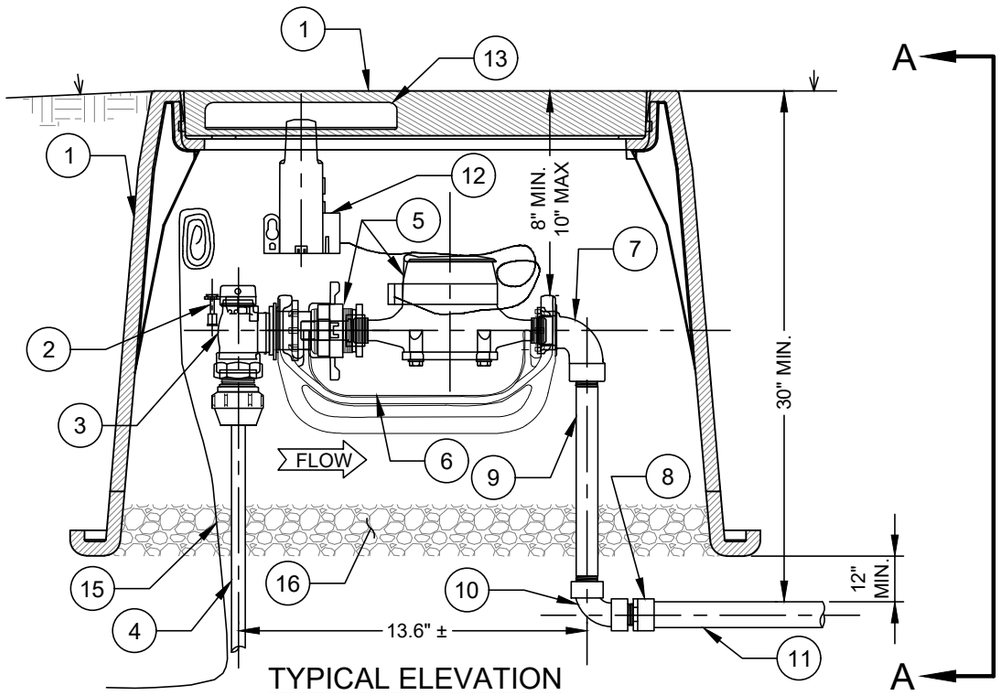
A. CENTER ANGLE BALL VALVE / 90° CONNECTOR (NO. 3 / NO. 7) IN METER BOX.
B. SHOWN AS 3/4" SERVICE, USE 1" COMPONENTS FOR 1" IRRIGATION SERVICE.
C. SOLVENT WELDS ON PVC PIPE / FITTINGS SHALL BE CLEANED AND PRIMED PRIOR TO APPLYING GLUE.

NO. DESCRIPTION:

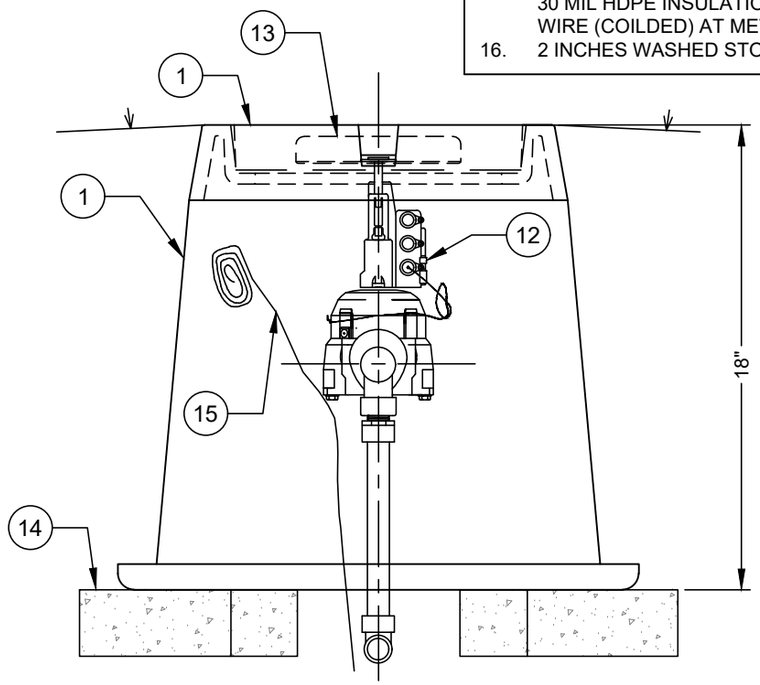
1. PLASTIC GREEN METER BOX AND GREEN LID (CONCRETE BOX REQUIRED IN CONCRETE SIDEWALK APPLICATIONS AS DIRECTED).
2. STUD LOCK, FURNISHED BY CHARLOTTE WATER.
3. 3/4" x 5/8" ANGLE BALL VALVE W / LOCK WINGS (LOCKED - CLOSED).
4. 3/4" COPPER TUBING OR 3/4" HDPE - COPPER TUBING SIZE (CTS).
5. 5/8" METER ASSEMBLY, WITH ERT AMR, FURNISHED BY CHARLOTTE WATER.
6. 5/8" YOKE BAR.
7. BRASS YOKE STAR NUT x FNPT 90° BEND YOKE CONNECTOR - (MULLER H-14214N , FORD L-91-13-NL , McDONALD 74779FY , OR CAMBRIDGE 105NL-SRxxx).
8. SCH. 80 PVC ADAPTER (MNPT x SOCKET).
9. 3/4" OR 1" RED BRASS NIPPLE (LL = 18" AS REQUIRED FOR CLEARANCE).
10. BRASS 90° BEND (FNPT X FNPT).
11. 3/4" SCH. 40 PVC TAIL PIPE (L = 24").
12. ERT - ELECTRONIC RADIO TRANSMITTER.
13. TRANSMITTER SUPPORT SLOT.
14. SOLID STANDARD CONCRETE BRICK-DIAGONAL AT CORNERS - 4 EACH.
15. AWG #12 GAUGE SOLID COPPER TRACER WIRE WITH BLUE 30 MIL HDPE INSULATION, TERMINATE WITH 24 INCH EXCESS WIRE (COILDED) AT METER BOX AND VALVE BOX (TYP.).
16. 2 INCHES WASHED STONE INSIDE BOX.



PLAN



TYPICAL ELEVATION

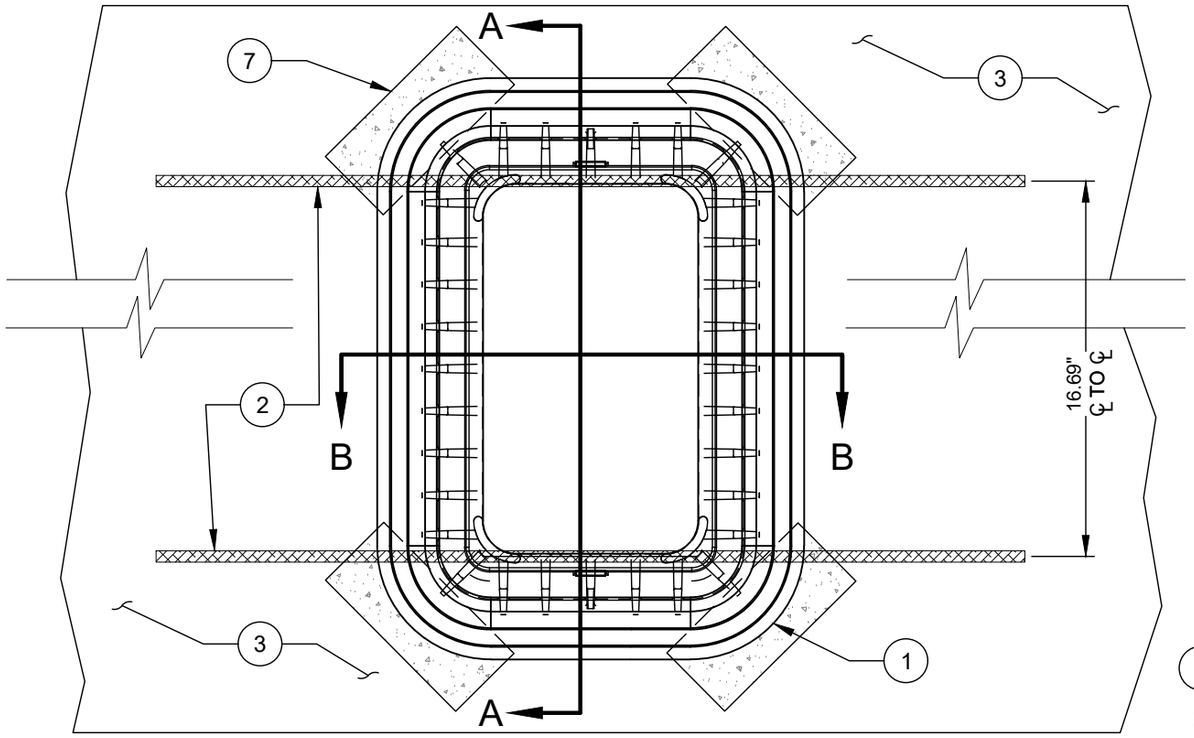


VIEW A-A

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

3/4" - 1" IRRIGATION SERVICE DETAIL
BACKFLOW AT ROAD RIGHT-OF-WAY / NO DUAL CHECK

NO SCALE
VERSION 3.0
DATE 01/2026
DETAIL 15.7.4



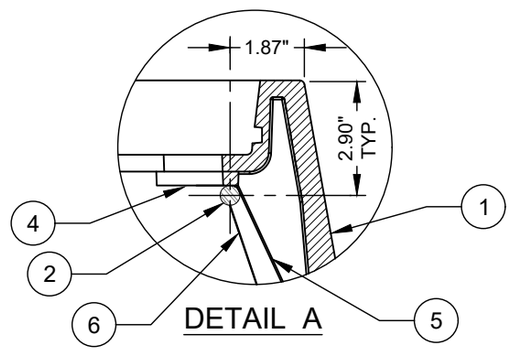
PLAN

NO. DESCRIPTION:

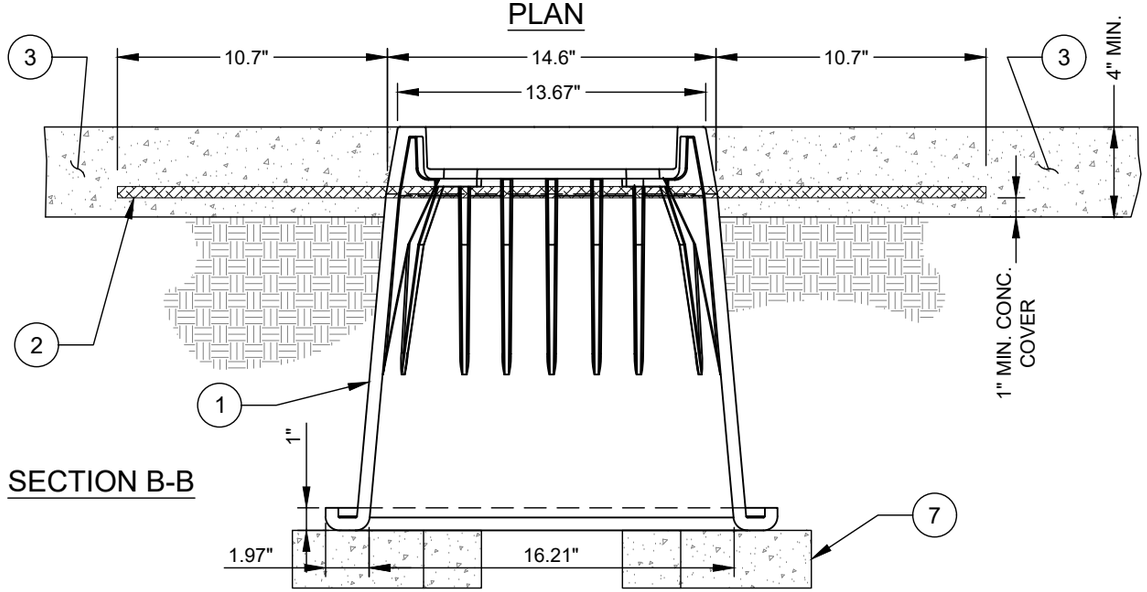
1. GREEN PLASTIC IRRIGATION WATER SERVICE METER BOX AND GREEN PLASTIC LID.
2. 1/2" DIAMETER REBAR x 2, L = 36 INCHES, INSTALLED THROUGH 1/2" DIAMETER DRILLED HOLES IN METER BOX WALLS AND CORNER RIBS. LOCATE AS SHOWN WITH BOX LIP AND SIDE RIBS RESTING ON REBAR.
3. CONCRETE HARDSCAPE, f 'c = 3,600 PSI, MINIMUM.
4. BOX LIP.
5. SIDE RIB.
6. CORNER RIB.
7. SOLID STANDARD CONCRETE BRICK - DIAGONAL AT 4 CORNERS.

NOTES:

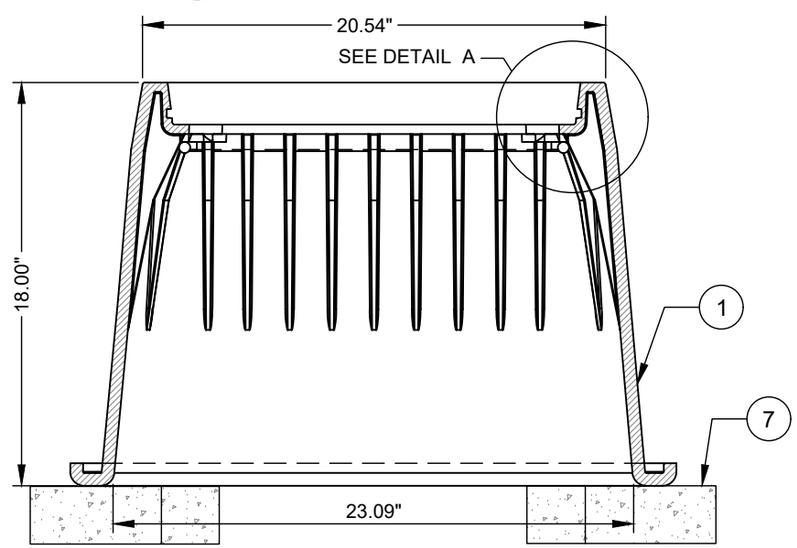
A. RELOCATE METER BOX OUTSIDE CONCRETE HARDSCAPE WHEN POSSIBLE.
B. RELOCATION AND FINAL LOCATION REQUIRES CHARLOTTE WATER APPROVAL.
C. IF RELOCATION IS NOT POSSIBLE, METER BOX MUST BE LOCATED COMPLETELY WITHIN CONCRETE.
D. METER BOX SHALL BE SET FLUSH WITH CONCRETE.



DETAIL A



SECTION B-B



SECTION A-A

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
WATER METERS

3/4 INCH IRRIGATION WATER SERVICE
METER BOX INSTALLATION IN CONCRETE SIDEWALK

NO SCALE

VERSION 1.0

DATE 04/2024

DETAIL 15.7.5

CHAPTER 16
SEWER REHABILITATION

CHAPTER 16.1
CURED-IN-PLACE PIPE LINING (CIPP) FOR MAIN SEWERS

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3.1 INSTALLATION OF CURED-IN-PLACE PIPE LINING 11

PART 1 - GENERAL

1.1 SCOPE

A. Work under this section consists of furnishing all materials, labor, and equipment required for the installation of cured-in-place pipe (CIPP) in main sewers.

1.2 RELATED DOCUMENTS

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

1.3 DEFINITIONS AND ABBREVIATIONS

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

1.4 DESIGN AND PERFORMANCE REQUIREMENTS

A. The CIPP shall be designed for a life of fifty (50) years or greater in accordance with ASTM F1216, Appendix X.1, for "fully deteriorated gravity pipe conditions." The minimum installed, cured liner thickness shall be as listed below. The Bid Form and/or Drawings may list alternate thicknesses for installation based on the Engineer's decision for specific installations and may list specific thicknesses for larger diameter sewers.

8" sewer:	6.0 mm	(0' to 20' deep)
	7.5 mm	(20' to 28' deep)
10" sewer:	6.0 mm	(0' to 14' deep)
	7.5 mm	(14' to 25' deep)
12" sewer:	7.5 mm	(0' to 16' deep)
	9.0 mm	(16' to 24' deep)
15" sewer:	7.5 mm	(0' to 10' deep)
	9.0 mm	(10' to 16' deep)
	10.5 mm	(16' to 24' deep)
16" sewer:	7.5 mm	(0' to 8' deep)
	9.0 mm	(8' to 13' deep)
	10.5 mm	(13' to 18' deep)
	12.0 mm	(18' to 24' deep)
18" sewer:	9.0 mm	(0' to 10' deep)
	10.5 mm	(10' to 14' deep)
	12.0 mm	(14' to 19' deep)
	13.5 mm	(19' to 24' deep)

21” sewer:	10.5 mm	(0’ to 10’ deep)
	12.0 mm	(10’ to 13’ deep)
	13.5 mm	(13’ to 17’ deep)
24” sewer:	12.0 mm	(0’ to 10’ deep)
	13.5 mm	(10’ to 13’ deep)
	15.0 mm	(13’ to 16’ deep)
27” sewer:	13.5 mm	(0’ to 10’ deep)
	15.0 mm	(10’ to 12’ deep)
	16.5 mm	(12’ to 15’ deep)
	18.0 mm	(15’ to 18’ deep)
30” sewer:	15.0 mm	(0’ to 10’ deep)
	16.5 mm	(10’ to 12’ deep)
	18.0 mm	(12’ to 14’ deep)
	19.5 mm	(14’ to 17’ deep)
36” sewer:	18.0 mm	(0’ to 10’ deep)
	19.5 mm	(10’ to 12’ deep)
	21.0 mm	(12’ to 14’ deep)
	22.5 mm	(14 to 16’ deep)

B. The cured liner shall have the following minimum structural properties:

Flexural Strength of 4,500 psi in accordance with ASTM D 790
Flexural Modulus of 250,000 psi in accordance with ASTM D 790
Tensile Strength of 3,000 psi in accordance with ASTM D 638

C. The required structural CIPP wall thickness shall be based on the following design parameters:

Design Safety Factor	2.0
Short-Term Flexural Modulus	250,000 psi
Long-Term Flexural Modulus	125,000 psi
Flexural Strength	4,500 psi.
Creep Retention Factor	50%
Ovality	2%
Soil Modulus	1,000 psi
Soil Density	120 pounds per cubic foot
Soil Coefficient of Friction	0.130 r
Groundwater Depth	Ground Surface Elevation
Live Load	H20 Highway
Poisson’s Ratio	0.3
Enhancement Factor, K	7
Service Temperature Range	40 to 140 degrees F
Maximum Long-Term Deflection	5 percent

1.5 SUBMITTALS

A. Submit a contractor statement of qualifications which identifies key personnel

and their specific CIPP experience, and recent projects listing the total length installed by host pipe diameter. Work and personnel experience listed must reference projects that used process method and materials to be used on this project. Include project names, references/contacts and phone numbers.

B. Submit product data for the fabric tube, resin, catalysts, and waterstops demonstrating conformance to the specifications.

C. Submit manufacturer material certifications for the fabric tube and resin that state conformance to the specifications. The felt tube manufacturer shall provide in their certification a statement identifying how many years they have produced the felt tube. Material certifications shall be current and must reference the project.

D. Submit manufacturers' shipping, storage and handling recommendations for all components of the CIPP system.

E. Submit CIPP wet-out information. Wet-out information shall include the identification of the wet-out facility and process description and a sample wet-out form. The wet-out forms shall document, at a minimum, the date and time of wet-out, the wet-out supervisor, the wet-out facility address, the location where the CIPP will be installed (by manhole numbers, and by pipe ID number), the CIPP diameter, the length of wet-tube and dry-tube, the thickness of the CIPP, the roller gap setting for establishing the liner thickness, the felt manufacturer, the resin used (by product name and batch/shipment number) and quantity, the catalyst(s) used (by product name) and quantity, any quality control samples taken, and all else pertinent to the wet-out process.

F. Installation procedures and curing schedules shall be submitted. Installation procedures shall include acceptable inversion heads and pressures, heating ("cooking") and cool-down procedures and temperatures for varying sewer diameters/lengths/depths, times for each stage of the process, and cure logs for the resin/resin system used. Contractor shall provide this information without delay or claim to any confidentiality. Testing procedures and quality control procedures shall also be submitted.

G. Submit a sample CIPP installation report. The report shall include items such as manhole numbers, and pipe ID numbers, location, project number, date, time, temperature, curing temperature, curing time, and liner thickness.

H. With each shipment of CIPP delivered to the jobsite, submit certifications that the CIPP lining was manufactured in accordance with these specifications and the appropriate ASTM standards. The certifications shall include a signed statement by the wet-out manager/supervisor that no fillers were added to the resin system during manufacture of the CIPP. In addition, wet-out forms documenting the wet-out shall be delivered with each section of CIPP manufactured and delivered to the jobsite.

I. With each shipment of resin to the wet-out facility, submit certification that the resin was manufactured under ISO 9002 certified procedures and meets these specifications.

J. Submit a plan for bypassing sewage around the work area and facilities where sewage flows must be interrupted to complete the work. The plan shall be reviewed by Engineer and shall be acknowledged as acceptable before any work is started. The bypass pumping plan, and requirements for bypass pumping, shall be in accordance with Chapters 11 and 17 of Charlotte Water's Water and Sewer Design and Construction Standards.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Materials shall be shipped, stored, and handled in a manner consistent with written recommendations of the CIPP system manufacturer to avoid damage. Damage includes, but is not limited to, gouging, abrasion, flattening, cutting, puncturing, premature curing, or ultra-violet (UV) degradation. The CIPP shall be maintained at a proper temperature in refrigerated facilities prior to installation to prevent premature curing. All damaged materials shall be promptly removed from the project site at the Contractor's expense.

1.7 QUALIFICATIONS

A. Contractor performing the CIPP installation shall be fully qualified, experienced and equipped to complete this work expeditiously and in a satisfactory manner and shall be certified and/or licensed as an installer by the CIPP manufacturer. Contractor must have successfully installed at least 1,000,000 feet of CIPP for a minimum of ten (10) years in wastewater collection systems utilizing the products and installation methods specified herein.

In addition, if steam cure is being proposed for the CIPP installation as specified herein, Contractor must have successfully installed at least 500,000 feet of CIPP via steam cure for at least five (5) years in wastewater collection systems utilizing the products specified herein. If Contractor does not meet this experience requirement, then water cure shall be used for all installations.

Contractor shall submit detailed references (project names, dates, owner contact names and numbers, project descriptions with lengths installed, etc.) to Engineer as requested to demonstrate compliance with the above experience requirements. The Engineer's decision on whether Contractor meets the experience requirements shall be final, and Contractor shall not be due any additional money if the experience requirements are not met and water cure is required.

B. The Contractor's personnel should have the following experience with the products and installation method to be used on this project.

Project Manager – Should have a minimum of five (5) years managing CIPP projects for wastewater collection systems.

Superintendent - Should have a minimum of five (5) years of on-site supervision of CIPP projects for wastewater collection systems. The superintendant shall have supervised a minimum of 300,000 feet of installed CIPP in wastewater collection systems of the pipe diameters

included in the project.

C. The manufacturer of the felt tube shall have manufactured the product to be used on this project for at least five (5) years. The felt material manufacturer and facility shall not change throughout the duration of the contract unless approved by Engineer in writing.

D. Approved CIPP products are listed in these specifications. Even though the Contractor's product may be listed as approved, Contractor shall still meet the experience requirements specified above, or Contractor will not be approved for this work.

1.8 ENVIRONMENTAL REQUIREMENTS

A. The use of the product shall not result in the formation or production of any detrimental compounds or by-products at the wastewater treatment plant.

1.9 PROJECT ACCESS

A. Contractor shall utilize existing road rights-of-way and sanitary sewer easements to perform the work unless notified otherwise. Contractor shall coordinate with and meet the requirements of North Carolina Department of Transportation, Owner, or any other agency or municipality that may be impacted by the work.

B. The Contractor is required to obtain a written agreement from private property owners granting them permission to perform work on private property. Copies of any and all agreements between the Contractor and private property owners granting temporary access by the Contractor for work on private property shall be submitted to Charlotte Water.

1.10 WARRANTY

A. The materials used for the Assigned Project shall be certified by the manufacturer for the specified purpose. The manufacturer shall warrant the liner to be free from defects in raw materials for two (2) years from the date of final acceptance by Owner. Contractor shall warrant the liner installation for a period of two (2) years.

1.11 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Contractor shall ensure that the products and work comply with the current version of the following American Society for Testing and Materials (ASTM) standards:

1. ASTM D638 - Standard Test Method for Tensile Properties of Plastics

2. ASTM D790 - Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

3. ASTM D2412 - Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading

4. ASTM D5813 - Standard Specification for Cured-in-Place Thermosetting Resin Sewer Pipe

5. ASTM F1216 - Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube

6. ASTM F1743 – Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP)

PART 2 - PRODUCTS

2.1 CURED-IN-PLACE PIPE LINING

A. Cured-In-Place-Pipe (CIPP) lining shall be one of the following products or approved equal. The products below shall adhere to all requirements specified herein and shall be modified as necessary to meet these requirements.

- CIPP Corporation Liners
- Invert-A-Pipe by IPR Southeast LLC
- National Liner by National EnviroTech Group, LLC
- Inliner by Inliner Technologies, Inc.
- Insituform by Insituform Technologies, Inc.
- Diamond Lining Systems by Daystar Composites LLC
- Premier-Pipe USA by J.W.M. Environmental, Inc.
- Pipenology CIPP for SAK Construction

B. The CIPP can be installed and cured using water or steam for sewers less than 18” in diameter. Only water cure shall be allowed for sewers 18” in diameter and larger.

The curing method shall be appropriate for the pipe being lined and must be ultimately approved by Engineer as stated below. For example, sewers with heavy active leaks shall be lined using water cure unless Contractor can prove to Engineer that the steam cure can overcome the heat sink and active water stream.

Engineer will note any concerns with steam curing methods during review of the pre-rehabilitation TV inspections. Those concerns will be in writing, and Contractor shall fully address the concerns. If the Engineer’s concerns are not fully addressed, Contractor shall install those specific sewers using water cure.

C. The liner shall be composed of tubing material consisting of one or more layers of a flexible non-woven polyester felt with or without other additives such as fiberglass or other reinforcing additives. The felt tubing shall be impregnated with a thermosetting isothalic polyester resin and catalyst or vinyl ester and catalyst. The liner material and resin shall be completely compatible. The inside and/or

outside layer of the tube shall be coated with an impermeable material compatible with the resin and fabric. The inside layer of the tube shall be resistant to blistering during the curing process. The liner shall cure in the presence of water or steam at the required temperature for the resin system.

D. The felt material shall be manufactured by companies specializing in felt production for CIPP. The felt manufacturer, references and location of the manufacturing facility shall be submitted to Engineer for review and approval. The felt material manufacturer and facility shall not change throughout the duration of the Agreement unless specifically approved by Engineer in writing.

E. The polyester or vinyl ester resin shall be PREMIUM, NON-RECYCLED resin only. PET (Polyethylene Terephthalate) resins, or those containing fillers, additives or enhancement agents shall not be used. The resin manufacturer shall not include any old resin or rework in the product shipped to the wet-out facility. The resin shall be manufactured under ISO 9002 certified procedures. Such certification shall be submitted to Engineer for each shipment of resin to the wet-out facility. The proposed resin shall equal or exceed the published properties of Reichhold Polylite 33420 resin (for isothalic polyester resin) or Reichhold Atlac 580-20 (for vinyl ester resin).

Engineer may consider strength enhancing fillers as an acceptable additive to the resin if the fillers can be shown to be for the sole purpose of enhancing the strength of the final CIPP product. The amount of strength enhancing fillers will be limited to 26% by volume. The Engineer's decision on allowing strength-enhancing resins shall be final. Any strength enhancing fillers added to the resin shall be added by the resin manufacturer at the resin manufacturer's plant and not at the wetout facility or any intermediate facility.

F. The exact makeup of the resin shall be submitted to Engineer including chemical resistance information, cure logs and temperatures. Polyester resins shall have a minimum Heat Distortion Temperature of 212 degrees Fahrenheit per ASTM D648. Vinyl ester resins shall have a minimum Heat Distortion Temperature of 220 degrees Fahrenheit per ASTM D648.

G. The exact mixture ratio of resin and catalyst shall also be submitted. The catalyst system shall be identified by product name. The resin/catalyst ratio shall be approved by the resin manufacturer in writing. The catalyst system shall be made up of a primary catalyst and a secondary catalyst. The primary catalyst shall be Akzo Perkadox 16 or approved equal and shall be added at a maximum of 1% of the resin volume by weight unless otherwise approved by Engineer. The secondary catalyst shall be Akzo Trigonox or approved equal and shall be added at a maximum of 0.5% of the resin volume by weight unless otherwise approved by Engineer. The resin/catalyst system shall be formulated so that the CIPP will cure as specified below. Resins, catalysts and resin/catalysts mixing ratios shall not be changed during this Agreement unless specifically approved by Engineer in writing.

H. The cure schedules for the CIPP shall be submitted to Engineer for review. The curing process/schedules shall be approved by the resin manufacturer in writing. The cure schedules shall include specific information on incremental temperature

stepping increases and decreases up to “cooking” temperatures, “cooking” temperatures and durations, and cool-down procedures – all to be approved in writing by the resin manufacturer. The CIPP shall cure in the presence of water or steam. The minimum cure/”cook” time shall be as recommended by the resin manufacturer. The cure time shall be increased as deemed necessary by the Contractor/resin manufacturer, including but not limited to, longer CIPP installations, active ground water infiltration into the existing sewers, pipe type, pipe location, etc.

I. The resin shall be shipped directly from the resin manufacturer’s facility to the CIPP wet-out facility. The resin shall not be sent to any intermediate mixing facility. Copies of the shipment documents from the resin manufacturer shall be submitted to Engineer showing dates of shipment, the originating location and the receiving location.

J. The resin shall be used to manufacture the CIPP as shipped. No fillers or additives shall be added at the wet-out facility except for the required catalyst as recommended by the resin manufacturer. Contractor shall submit a Certificate of Authenticity from the resin manufacturer for each shipment to the wet-out facility (to include the date of manufacture and the Heat Distortion Temperature). This information shall be submitted prior to manufacturing any CIPP.

K. Contractor shall identify the wet-out facility where all CIPP will be manufactured. All CIPP shall be manufactured from this designated wet-out facility unless specifically approved otherwise by Engineer in writing. Multiple wet-out facilities shall not be allowed.

L. Engineer, Owner and/or an agent of the Owner may inspect the CIPP during manufacturing (during “wet-out”). Contractor shall submit a schedule for manufacturing the CIPP to Engineer. Engineer and Owner must be given an opportunity to witness the manufacturing of all CIPP for this project. If the CIPP is manufactured without providing the required notice to Engineer, the CIPP will be marked as rejected prior to installation and will not be approved for installation in this project.

M. If Engineer and/or Owner decide to inspect the manufacturing of the CIPP, Contractor shall provide full access to witness the wet-out process and shall provide any and all information related to the manufacturing as requested by Engineer, Owner or Owner’s agent without delay and without claims of confidentiality or product privacy.

N. Engineer or Owner may take samples of the resin from the wet-out facility for infrared analyses (IR Scan). This standard analytical test involves shining a beam of light in the infrared frequency region through a thin sample of the subject resin. The frequency of light is then varied across the infrared spectrum. Chemical functional groups present in the resin being analyzed will absorb infrared light as specific frequencies and with characteristic absorption intensities.

The Owner may request testing at their discretion at any time. Owner will pay for all such infrared analyses and resin testing. To allow the resin samples to be

taken, Contractor shall place a sampling valve in-line at a point prior to the resin/catalyst mixing stage and after the resin/catalyst mixing stage. These sampling valves shall remain in place throughout the duration of the Agreement and shall always be accessible to Engineer and Owner.

The infrared analyses will be used to verify that the resin and resin/catalyst composition and mixture being used is the approved resin and resin/catalyst system. Contractor shall submit results of infrared analyses of the proposed resin and resin/catalyst mixture, performed and certified by the resin manufacturer, prior to manufacturing any CIPP as a shop drawing. The results of these analyses (the resin's chemical fingerprint) will be used as the standard for verifying the resin and resin/catalyst mixture being used throughout the Agreement.

Engineer will compare the submitted chemical fingerprint with the fingerprint of Reichhold Polylite 33420 resin (for isothalic polyester resin) or Reichhold Atlac 580-20 (for vinyl ester resin) for a baseline comparison. Contractor and the resin manufacturer shall fully describe, explain and justify any differences between the Reichhold and proposed resin fingerprints without delay or claim to confidentiality.

O. When cured, the CIPP shall form a continuous, tight-fitting, hard, impermeable liner which is chemically resistant to any chemicals normally found in domestic sewage. The liner shall be chemically resistant to trace amounts of gasoline and other oil products commonly found in municipal sewerage and soils adjacent to the sewer pipe to be lined.

P. The CIPP shall be fabricated to a size that will tightly fit the sewer being rehabilitated after being installed and cured. The liner shall be capable of fitting into irregularly shaped pipe sections and through bends and dips within the pipeline. Allowance for longitudinal and circumferential expansion shall be taken into account when sizing and installing the liner. All dimensions shall be verified in the field by Contractor prior to fabrication of the liner. Field measurements shall be used to ensure maximum closure between the new liner and the existing sewer pipe. There shall be no leakage of groundwater between the existing pipe and the CIPP at the manhole connection or service lateral connections.

Q. The application of the resin to the felt tubing (wet-out) shall be conducted under factory conditions and the materials shall be fully protected against UV light, excessive heat and contamination at all times.

R. The length of the liner shall be the length deemed necessary by Contractor to effectively carry out the insertion of the liner and sealing of the liner at the outlet and inlet manholes. The required length of liner shall be verified in the field by Contractor prior to fabrication of the liner.

S. Contractor shall submit Contractor's proposed plan for ensuring that the installed CIPP meets the above minimum thickness requirements. The plan shall include the proposed CIPP thickness to be installed (pre-installation thickness) and detailed inversion or pull-in procedures to reduce stretching and to reduce migration of resin.

PART 3 - EXECUTION

3.1 INSTALLATION OF CURED-IN-PLACE PIPE LINING

A. Care shall be taken in shipping, handling and laying to avoid damaging the CIPP. Any CIPP damaged in shipment shall be replaced as directed by the Engineer. Any CIPP showing a split or tear or has been mishandled shall be marked as rejected and removed at once from the work. The liner shall be maintained at a proper temperature in refrigerated facilities to prevent premature curing at all times prior to installation. Any liner showing evidence of premature curing will be rejected for use and will be removed from the site immediately.

B. Contractor shall continuously notify the public of the work being performed. Owner will define the specific notification requirements, and Contractor shall meet all of those requirements. At a minimum, Contractor shall distribute door hangers to each property owner affected by the work seventy-two (72) hours prior to performing any work. Contractor shall submit a sample door hanger to Engineer and Owner for review and approval prior to distribution. The door hangers shall include the specific work to be performed, start time and estimated completion time for the work being conducted, impacts to the property owner, contact names and local phone numbers for the Contractor's project manager, superintendent, and the Engineer's on-site representative.

C. Contractor shall develop and submit to Engineer a protocol for addressing odor complaints during the CIPP installation process (primarily styrene odor complaints). The protocol shall include steps to be taken by on-site and management personnel immediately when the complaint is received, including discussing the odor with the property owners/residents to address their concerns and alleviating the odor from the home/residence or business using fans or other means as necessary. Contractor shall also maintain a calibrated portable styrene test unit to immediately document the atmospheric concentrations of the styrene on the site and in the house/residence/business when a complaint is received. The styrene concentrations must be tested prior to exhausting the odors from the house/residence/business. The Contractor shall also utilize an exhaust system during the CIPP installation to exhaust odors from the sewers and into the atmosphere during the installation as deemed necessary. The exhaust system should pull air from the sewer instead of forcing air through the sewer and sewer laterals. This will help to minimize the potential for odors to travel up service laterals and into homes/businesses. The exhaust system(s) shall be strategically placed to exhaust the concentrated odors in an isolated location.

D. Contractor shall perform and provide all necessary traffic control measures to complete the work. Warning signs, barricades and flagmen must be provided in accordance with the NCDOT Transportation's "Manual on Uniform Traffic Control Devices" at all times and places necessary. No roads shall be closed for construction activities. At least one (1) lane of traffic will be safely maintained at all times when construction is in progress. Access to businesses and residences

along the roads shall be maintained at all times. All lanes will be open when work is suspended for one (1) hour or longer.

E. Contractor shall clean and televise each length of pipe to be lined as specified in Chapter 16, Cleaning and Television Inspection, of Charlotte Water's Water and Sewer Design and Construction Standards.

F. Water for use in the installation of cured-in-place-pipe lining for main sewers will be available from approved fire hydrants owned and operated by Charlotte Water only. Use of fire hydrants other than those approved by Charlotte Water will not be allowed. The Contractor shall meet all Owner requirements for connecting to fire hydrants and **will be charged** for water usage. Prior to connection to, and use of any hydrant, the Contractor must apply for and successfully obtain a temporary fire hydrant use permit (Vehicle Mounted "Tanker Truck" Permit). All instructions and requirements for obtaining the permit are listed under the **Fire Hydrant Program for Temporary Service** section of Charlotte Water's website. The Contractor is responsible for meeting all requirements whether listed herein or not.

The Contractor shall submit to the Engineer, a copy of the approved permit number for each vehicle prior to connection to, and use of, any fire hydrant.

The Contractor shall be well versed in the proper operation of valves and hydrants and will be responsible for any damage caused by improper operation or usage of hydrants. All cure water must be discharged to the wastewater collection system.

G. Contractor shall bypass pump sewage flows around the lining work while it is being performed. Contractor is responsible for handling and accommodating all existing wastewater flows during the work. Prior to performing the work, Contractor shall submit, for approval by Engineer, a detailed plan of the method Contractor proposes in order to maintain the existing flow during construction. The plan must include a provision for handling the existing peak flow by pumping. The peak flow shall be considered the existing pipe flowing full, which is highly possible during rain events. When pumping is used, an identical standby pump(s) shall be on site in the event of failure of the primary pump(s). Flows in the lateral specified for lining will not require bypass pumping. Contractor shall coordinate with the homeowner/business in advance of all work to ensure the lateral will be inactive at the time of the CIPP installation. All bypass pumping work shall be performed as specified in Chapters 11 and 17 of Charlotte Water's Water and Sewer Design and Construction Standards.

H. Contractor shall take precautions to avoid damage or flooding to public or private property being served by the line being cleaned. Contractor shall be responsible for all flooding and pay for cleanup from flooding to the satisfaction of the property owner. Contractor shall document all backups and submit documentation to Engineer including the reason for the backup, the time and date of the backup, the property owner's name, address and phone number, the resolution to problem, the time and date the problem was resolved, and any special cleanup work that had to be performed. This required documentation

shall be submitted for all backups regardless of when they occur. All cleanup shall be completed within four (4) hours of the backup.

I. Contractor shall furnish and install the CIPP lining in the full length of sewer. The installation of the CIPP shall be in complete accordance with the applicable provisions of ASTM F1216 or ASTM F1743 except as modified herein, these specifications and the manufacturers' specifications.

J. Water or air shall be used to invert CIPP installed via ASTM F1216 or to invert the calibration hose through CIPP installed via ASTM F1743. The water inversion of the CIPP and calibration hoses shall be accomplished by using natural water pressure (head) achieved by erecting platforms or scaffolding to an elevation determined by Contractor or by using CIPP installation vessels/units that creates water pressure. Contractor shall determine the necessary inversion heads (pressure) for each line segment. If an installation vessel/unit is used, a pressure relief valve shall be installed on the vessel so that the necessary pressure/inversion heads are not exceeded at any time during the inversion. Water or air pressure shall not be varied by any means throughout the inversion process except when approved by Engineer. Contractor shall submit required inversion heads/inversion processes for each installation as a shop drawing without delay and claim to confidentiality or product/installation privacy.

K. CIPP shall be cured with water or steam in strict accordance with the manufacturer's recommendations. This shall include achieving cooking temperatures, cooking times, and cool-down procedures. The Contractor shall submit required curing schedules and procedures for each installation as a shop drawing without delay and claim to confidentiality or product/installation privacy.

Cool down shall meet the minimum criteria established herein or the manufacturer's recommendations, whichever is more stringent. The water temperature inside the pipe shall be cooled at a maximum rate of 20 degrees per hour until the water temperature is within 20 degrees of the ambient temperature. Do not "shock" the liner with dramatically cooler water. Slowly introduce cooler water into the cool down cycle. The cool down period cannot be less than 1 hour even if the water temperature inside the pipe is within 20 degrees of the ambient temperature.

L. The Contractor shall install and utilize the VeriCure process (or approved equal) for monitoring the cure temperature of the CIPP. VeriCure shall be installed from manhole to manhole under the bottom of the CIPP. The installation and use of VeriCure shall be in strict accordance with the manufacturer's recommendations. The cure temperature data shall be recorded electronically with the required monitoring devices/computers/computer software. Printed color data reports (hardcopies or pdf format) with detailed descriptions/summaries of the data along with the digital data file shall be submitted to the Engineer for review prior to requesting payment for the CIPP. All special software to review the data file shall also be submitted.

M. In larger diameter sewers (30 inch or larger) and/or when the section being water cured has a volume of 20,000 gallons or greater, the cure water shall be released from the sewer being lined in a slow, methodical manner. A quick "batch"

release of the water shall not be allowed. The cure water shall be released by cutting a small/narrow opening in the CIPP to allow the water to slowly drain while the CIPP cool-down process is being implemented. This will serve to slowly release the water and also allow some cool-down of the water prior to/during the release. The entire release process shall occur over a minimum 6-hour period unless approved otherwise by the Engineer. The Owner may also sample the cure water during the release to test for chemical compounds that may have a detrimental effect on the downstream water reclamation facility. The Contractor shall accommodate all sampling efforts by the Owner. If damaging chemical compounds (such as styrene or vinyl chloride) exist at high enough levels that may impact treatment processes (as determined by the Owner), the Contractor shall modify the cure water release time to further slow the release of the water to allow additional time and dilution in the sewer system.

N. The CIPP shall be neatly cut two (2) inches from the manhole walls after installation unless otherwise directed by Engineer. The CIPP shall be sealed at the manholes to provide a watertight liner connection at the manhole. There shall be no leakage of groundwater into the manhole between the CIPP and existing sewer pipe and between the existing sewer pipe and manhole wall. A hydrophilic waterstop (non-bentonite) comprised of modified chloroprene rubber shall be installed around the liner six (6) inches from each manhole wall prior to processing the liner to provide additional waterstop protection. As the CIPP is expanded, the waterstop shall be pressed tightly against the existing sewer to provide a leak-tight seal. The waterstop shall be Hydrotite as manufactured by Greenstreak (St. Louis, Missouri) or equal. All CIPP connections to manholes shall be further sealed with an approved non-shrink grout to completely cover the CIPP/manhole connection point. CIPP lining shall be sealed to manhole linings (where specified) in an acceptable manner as approved by Engineer. Further, all invert channels shall be coated with an approved grout to match the CIPP elevations in the manhole. Submit detailed drawings of the pipe-manhole connections to Engineer for approval, including termination points in manholes and transitions with manhole linings where installed.

O. Contractor shall fully reopen all of the existing active service connections in each length of sewer following lining. The service connections shall be reopened from inside the sewer by means of a closed-circuit television camera-controlled cutting device appropriate for the CIPP. All openings shall be clean and neatly cut and shall be flush with the lateral pipe. The openings shall also be buffed with a wire brush to remove rough edges and provide a smooth finish. The bottom of the openings shall be flush with the bottom of the lateral pipe to remove any lip that could catch debris. Openings shall be 100% of the service lateral pipe. Contractor shall re-open any service lateral that does not meet this requirement as evidenced by the post-rehabilitation inspections at no additional cost to Owner. The Contractor shall be responsible for all costs associated with repairs to improperly opened or damaged active service connections. See section 3.1.H of this document.

P. <u>Preliminary Post-CIPP TV Inspections:</u> Immediately after the CIPP is installed and the services connections are completely opened and brushed, the Contractor shall televise the installed CIPP to verify and document that the CIPP was properly installed and cured and that all service connections have been

opened as specified. The preliminary post-CIPP TV inspection videos shall be submitted to the Engineer within 1 day of the CIPP being installed. This will allow Engineer to confirm that there are no CIPP issues that need addressed on this sewer and/or future installations and that the service laterals are properly opened. The preliminary post-CIPP inspections shall clearly show the CIPP liner and all service connections.

Contractor may submit these inspections as the final post-CIPP inspections if all grout/concrete work is finalized in the connecting manholes (including grouting the pipe connections, coating the invert channels, and performing the specified manhole rehabilitation) and all specifications are met. Completing all of the manhole work may be difficult to get finished so that the TV inspections can be submitted within one (1) day as specified above.

Q. Installation reports shall be generated for each segment of liner installed. The reports shall document installation, including manhole numbers, street names/sewer location, project number, date, time, temperature, curing temperature, curing time, liner thickness, etc. A sample report shall be submitted to Engineer for approval prior to installing any lining.

R. For every sewer segment that is lined (sewer segment is defined as the sewer between two manholes), Contractor shall remove one restrained sample of the installed liner at least twelve (12) inches in length for testing of installed CIPP flexural properties and thickness. The CIPP testing shall include determining flexural strength, flexural modulus, tensile strength and thickness of each sample. These four separate individual tests make up one completed CIPP test.

For sewers twelve (12) inches in diameter and smaller, the sample shall be captured by installing the lining through a section of PVC pipe (same diameter as the existing sewer diameter) within the most downstream manhole of the installation and at all intermediate manholes if multiple sewer segments are lined at the same time. For sewers fifteen (15) inches in diameter and larger, plate samples shall be taken and cured in the same water as the installed CIPP.

Contractor shall be responsible for capturing the samples and preparing the samples for testing (cutting the samples to the required dimensions, removing the PVC pipe, etc.). The testing laboratory shall specify the dimensions for the samples. In addition, Contractor shall cut a 1-inch-wide representative sample (taken at least 2 inches from the end of the specimen) for the Engineer's records. Contractor shall label all samples including writing on the samples where they were taken (manhole numbers and work orders) and the date they were taken.

Each day, Contractor shall submit the samples taken that day to Owner and/or Owner representative. Owner will forward the samples to the testing laboratory. Owner will copy Contractor on all submittals to the testing laboratory. The testing laboratory shall submit all test results directly back to Owner with a copy to Contractor. The test results should be returned to Owner within twenty-one (21) days from the laboratory receiving the samples and should be available prior to the following month's pay estimate. All testing shall be performed by an independent, accredited, certified and experienced (minimum 5 years of experience) testing laboratory.

The tests shall be used to verify that the installed CIPP meets these specifications. CIPP thickness shall be measured in accordance with ASTM D5813. Flexural properties shall be determined per ASTM D790. Tensile strength shall be determined per ASTM D638.

The CIPP testing will include determining flexural strength, flexural modulus, tensile strength and thickness of each sample to verify that the installed CIPP meets the specifications. CIPP thickness shall be measured in accordance with ASTM D5813. Flexural properties shall be determined per ASTM D790. Tensile strength shall be determined per ASTM D638. Engineer will share the test results with the Contractor as requested.

S. Any lining that does not meet the specified installed strength and/or thickness requirements, regardless of the amount below the specified requirements, shall be corrected by Contractor in a manner approved by Engineer at no additional cost to Owner. The Engineer's decision on how to correct deficient CIPP installations shall be final. Options for correcting deficient liner that will be considered by Engineer include removing the liner, excavating and replacing the sewer from manhole to manhole, pipe bursting the sewer from manhole to manhole, or providing Owner with a substantial credit.

A standardized credit system has been established for Charlotte Water funded contracts. Private work is not eligible for compensation under this program. Credits will only be considered for lining that does not meet the required thickness. CIPP lining thickness may be up to 5% below the specified minimum installed thickness before the credit will be applied. For example, if the minimum specified thickness is 6 mm, the credit will only apply if the CIPP is less than 5.7 mm thick. There will be no "re-calculations" of required thicknesses based on actual flexural test results for that sample. The minimum specified thicknesses shall be required regardless of the final flexural properties of the CIPP as installed. If a credit is acceptable to Engineer and Owner, the credit shall be calculated by multiplying the bid price by the percent that the liner thickness is below the minimum required installed thickness as follows:

Credit = (1 – (installed CIPP thickness/min required thickness)) x Bid Price

Contractor shall not assume that a credit will be acceptable to Engineer or Owner or that the above formula will be used in all situations or for all installed CIPP thicknesses. Liner thickness of less than 85% of the required minimum thickness will not be eligible for any payment.

All credits shall be accounted for on the monthly pay estimates (each and every month) as the failed test results are received by Engineer. Credits shall not accumulate until the end of the Agreement. In addition, any other defective CIPP shall be repaired within twenty-one (21) days of being identified or payment will be withheld, and work will not be allowed to continue.

T. Following installation of the CIPP, reopening and brushing of all active service lateral connections, and completion of all manhole rehabilitation including vacuum testing (where applicable), Contractor shall conduct a final post-

rehabilitation television inspection of the completed work to verify that the liner installation is acceptable as defined herein. The sewers shall be thoroughly cleaned prior to performing the television inspections. No cleaning equipment shall be in the sewers during the post-rehabilitation inspections. The pipe shall be dry so that the entire CIPP can be seen. This will require that temporary plugging or bypass pumping be provided for all post-rehabilitation television inspections.

The post-rehabilitation television inspections shall be in accordance with the inspections specified in Chapter 16, Sewer Cleaning and Television Inspection, of Charlotte Water's Water and Sewer Design and Construction Standards. The post-rehabilitation television inspections shall be within 1.0 percent of the actual sewer length as measured above ground from center of manhole to center of manhole. Any inspection that exceeds this limit shall be re-performed and re-submitted to the Engineer prior to payment at no additional cost to the Owner. One copy of the final post-rehabilitation inspections shall be submitted to the Engineer for review and approval as specified. The inspections must be in order, correct and complete or the Engineer will immediately return the inspections to the Contractor for corrections.

U. The final CCTV inspection shall not be performed until all manhole rehabilitation work is completed (including vacuum testing where applicable). Contractor shall submit the required digital inspections within 30 calendar days after completion of CIPP lining and/or manhole rehabilitation work, and/or as negotiated with the Engineer.

V. There shall be no holes, dry spots, lifts, ribs, wrinkles, blisters, ridges, splits, bulges, cracks, delaminations or other type defects in the CIPP lining. In addition, there shall be no groundwater leakage through the CIPP or between the liner and the existing pipes including at the connections to manholes. Defective lining and groundwater leakage shall be repaired in a manner suitable to and approved by Engineer at no additional cost to Owner.

The Engineer's decision on how to correct defective lining shall be final. Options for repairing defective lining that will be considered by Engineer include removing the liner and re-lining the sewer, excavating and replacing the sewer from manhole to manhole, pipe bursting the sewer from manhole to manhole, or installing a sectional CIPP patch to repair the defective area.

If a CIPP patch is approved as a repair method for manhole-to-manhole CIPP, Owner will not pay the full bid price for that sewer segment (manhole to manhole). The price reduction (credit) shall be negotiated with Contractor and shall be acceptable to Owner. The credit shall be equal to at least 25% of the unit price bid for the CIPP installation and shall apply to the entire CIPP lining from manhole to manhole. Owner shall have the final decision on the amount of the credit. Any such credits shall be accounted for on the pay estimates as the defective CIPP is repaired. Credits shall not accumulate until the end of the Agreement.

END OF SECTION

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CHAPTER 16.2
CURED-IN-PLACE PIPE LINING (CIPP) FOR SERVICE LATERALS

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PART 1 - GENERAL

1.1 SCOPE

A. Work under this section consists of furnishing all materials, labor, and equipment required for the installation of cured-in-place pipe (CIPP) in 4” and 6” service laterals.

1.2 RELATED DOCUMENTS

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

1.3 DEFINITIONS AND ABBREVIATIONS

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

1.4 DESIGN AND PERFORMANCE REQUIREMENTS

A. The minimum installed, cured liner thickness shall be derived from traditionally accepted pipe formulas for various loading parameters and modes of failure and shall be as recommended by the liner manufacturer for the specific installation conditions included. The minimum installed thickness shall be 3 mm for 4” laterals and 4 mm for 6” laterals.

B. The cured liner shall have the following minimum structural properties:

Flexural Strength of 4,500 psi in accordance with ASTM D 790
Flexural Modulus of 250,000 psi in accordance with ASTM D 790
Tensile Strength of 3,000 psi in accordance with ASTM D 638

C. Contractor shall submit thickness calculations, design parameters, etc. to support the proposed installation.

1.5 SUBMITTALS

A. Submit a contractor statement of qualifications which identifies key personnel and their specific experience with lining service laterals and recent projects listing the total quantity of laterals lined. Work and personnel experience listed must reference projects that used process method and materials proposed. Include project names, references/contacts and phone numbers.

B. Submit product data for the fabric tube, resin, catalysts, etc. to demonstrate conformance to the specifications.

C. Submit manufacturer material certifications for the fabric tube and resin that state conformance to the specifications. The felt tube manufacturer shall provide in their certification a statement identifying how many years they have produced the felt tube. Material certifications shall be current and must reference the project.

D. Submit manufacturers' shipping, storage and handling recommendations for all components of the CIPP system.

E. Submit CIPP wet-out information to include how the wet-out must be performed, including specifics on saturating the felt tube, temperature issues, mixing of the resin system, and all else pertinent to the wet-out process.

F. Installation procedures and curing schedules shall be submitted.

G. Submit a sample CIPP installation report. The report shall include items such as service lateral location between manhole numbers, house address served by the lateral being lined, location, project number, date, time, length lined, resin system, ambient temperature, curing time, and liner thickness.

H. With each shipment of CIPP delivered to the jobsite, submit certifications that the CIPP lining was manufactured in accordance with these specifications and the appropriate ASTM standards.

I. Submit a plan for bypassing sewage around the work area and facilities where sewage flows must be interrupted to complete the work. The plan shall be reviewed by Engineer and shall be acknowledged as acceptable before any work is started. The bypass pumping plan, and requirements for bypass pumping, shall be in accordance with Chapters 11 and 17 of Charlotte Water's Water and Sewer Design and Construction Standards.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Materials shall be shipped, stored, and handled in a manner consistent with written recommendations of the CIPP system manufacturer to avoid damage. Damage includes, but is not limited to, gouging, abrasion, flattening, cutting, puncturing, premature curing, or ultra-violet (UV) degradation. The CIPP shall be maintained at a proper temperature prior to installation to prevent premature curing. All damaged materials shall be promptly removed from the project site at Contractor's expense.

1.7 QUALIFICATIONS

A. The manufacturer of the CIPP lateral lining system must have a minimum of 5 years experience and at least 50,000 successful laterals installed. Contractor performing the service lateral CIPP installation shall be fully qualified, experienced and equipped to complete this work expeditiously and in a satisfactory manner and shall be certified and/or licensed as an installer by the CIPP manufacturer. Contractor must have at least 20,000 successful CIPP service lateral installations and have a minimum of 5 years experience utilizing the products and installation method intended for use on this project. The Contractor's superintendent should have successfully lined at least 2,000 laterals using a CIPP lateral lining system. Submit a detailed list of references to include the number of laterals lined with contact names and phone numbers to document compliance with these qualifications.

1.8 ENVIRONMENTAL REQUIREMENTS

A. The use of the product shall not result in the formation or production of any detrimental compounds or by-products at the wastewater treatment plant.

1.9 PROJECT ACCESS

A. Contractor shall utilize existing road rights-of-way and sanitary sewer easements to perform the work unless notified otherwise. Contractor shall coordinate with and meet the requirements of North Carolina Department of Transportation, Charlotte Department of Transportation, or any other agency or municipality that may be impacted by the work.

B. The Contractor is required to obtain a written agreement from private property owners granting them permission to perform work on private property. Copies of any and all agreements between the Contractor and private property owners granting temporary access by the Contractor for work on private property shall be submitted to Charlotte Water.

1.10 WARRANTY

A. The materials used shall be certified by the manufacturer for the specified purpose. The manufacturer shall warrant the liner to be free from defects in raw materials for two (2) years from the date of final acceptance by Owner. Contractor shall warrant the liner installation for a period of two (2) years.

1.11 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Contractor shall ensure that the products and work comply with the current version of the following American Society for Testing and Materials (ASTM) standards:

1. ASTM D638 - Standard Test Method for Tensile Properties of Plastics
2. ASTM D790 - Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
3. ASTM D2412 - Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
4. ASTM D5813 - Standard Specification for Cured-in-Place Thermosetting Resin Sewer Pipe
5. ASTM F1216 - Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube
6. ASTM F1743 – Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP)

PART 2 - PRODUCTS

2.1 CURED-IN-PLACE-PIPE LINING FOR LATERALS

A. Cured-In-Place-Pipe (CIPP) lining for laterals shall be BLD “Service Connection Seal + Lateral” Full Wrap Style Connection Seal by BLD Services, LLC or approved equal. Any “equal” product shall be of similar nature and have similar properties and characteristics as the BLD system.

B. The liner shall be fabricated to a size that when installed will neatly fit the internal circumference of the service lateral specified by Owner. Allowance shall be made for circumferential stretching during insertion. The liner shall be a one-piece joint-less polyester felt tube that will create a watertight seal at the mainline connection.

C. The CIPP lateral lining system shall be installed from the main sewer and inserted up into the service lateral pipe by an approved inversion/insertion method without the need for a cleanout. The CIPP lateral lining system must be capable of lining up to fifty (50) feet of lateral from the main without a cleanout.

D. The CIPP lateral lining system must provide a watertight seal at the mainline and a structural repair of the lateral over the specified length. Contractor shall verify the lengths in the field before impregnation of the resin. The required length of liner shall be verified in the field by Contractor prior to fabrication of the liner.

E. When cured, the CIPP shall form a continuous, tight-fitting, hard, impermeable liner which is resistant to any chemicals normally found in domestic sewage. The liner shall be chemically resistant to trace amounts of gasoline and other oil products commonly found in municipal sewerage and soils adjacent to the sewer pipe to be lined.

F. The CIPP shall be fabricated to a size that will tightly fit the service lateral being rehabilitated after being installed and cured. The liner shall be capable of fitting into irregularly shaped pipe sections and through bends and dips within the service lateral. Allowance for longitudinal and circumferential expansion shall be considered when sizing and installing the liner. All dimensions shall be verified in the field by Contractor prior to fabrication of the liner. Field measurements shall be used to ensure maximum closure between the new liner and the existing sewer pipe. The liner shall be a one-piece joint-less polyester felt tube that will create a watertight seal at the mainline connection. Any leakage found shall be eliminated by Contractor at no additional cost to Owner.

G. The felt tube shall be impregnated with the specified resin and catalyst system. This impregnation is termed “wet-out”. All wet-out shall be performed on site using a vacuum impregnation system.

2.2 GROUTING OF SERVICE LATERAL CONNECTIONS

A. Service laterals that are actively leaking may need to be grouted to stop the leak prior to installing the CIPP lateral lining system. The CIPP lateral lining system shall be capable of lining overactive leaks and properly sealing and curing in this situation. Grouting is only intended for use when the active leaks are too significant to line over. Contractor shall identify those laterals that need to be grouted prior to CIPP and submit the list and reasons for grouting to Engineer for review and approval. Engineer must approve grouting of laterals prior to the work or payment will not be made for the lateral grouting. In some cases, Engineer may specify that lateral grouting be performed as a stand-alone rehabilitation technique to eliminate the active infiltration.

B. All lateral grouting shall adhere to NASSCO's Standard Specification for Pressure Testing and Grouting of Sewer Pipe Joints, Laterals and Lateral Connections Using the Packer Method with Solution Grouts, latest version. The grout shall be Avanti AV-100, AV-118 or approved equal. Contractor shall make recommendations for alternate grouts as applicable for the specific installation and application being performed.

C. The lateral grouting shall be accomplished using a grout packer unit that travels down the main sewer to the defective service lateral (guided into place by a CCTV camera), pressurizes against the pipe wall and pumps grout at the lateral connection to completely seal the active leak. The main packer unit shall include a lateral packer/bladder that is inverted into the lateral from the mainline assembly a minimum of two (2) feet and inflated against the lateral pipe wall to completely isolate the lateral.

D. Once in place, Contractor shall pressure inject grout though the lateral packer into the annular space between the lateral grouting plug and the lateral pipe. The pressure injection of grout shall continue until all voids are completely sealed and the grout has properly gelled (per the grout manufacturer's recommendations and requirements).

E. Once the grouting is completed, Contractor shall air-test the lateral connection using the packer unit to confirm the lateral connection is completely sealed. The air-test pressure shall be 0.5 psi per foot of pipe depth plus 2 psi with a not-to-exceed pressure of 10 psi per NASSCO standards. If the lateral cannot hold this pressure, the lateral shall be re-grouted, and then re-tested. Once the lateral passes the air test, Contractor shall deflate and remove the packer unit and TV inspect the lateral connection to document that the active leaks have been completely stopped. If a CIPP lateral liner is to be installed after grouting, Contractor can eliminate the air-testing of the lateral connection and just provide the TV inspection.

F. Contractor shall document all lateral air-testing and grouting on approved installation forms. The forms and final TV inspection shall be submitted to Engineer within 30 calendar days of installation.

PART 3 - EXECUTION

3.1 INSTALLATION OF SERVICE LATERALS

A. All service laterals shall be installed AFTER installation and completion of CIPP for main line sewers.

B. Contractor shall thoroughly clean and televise each lateral specified to be inspected and/or lined, including the removal of all roots, grease, debris, silt, etc. Refer to Chapter 16, Sewer Cleaning and Television Inspection, for general cleaning and TV requirements including format and data submittal requirements. All work shall be in accordance with Chapter 16, Sewer Cleaning and Television Inspection, as applicable.

   All cleaning and TV inspections shall be performed from the main sewer. The cleaning equipment and CCTV inspections shall be performed by launching the cleaning heads and camera from the main sewer up into the lateral to the edge of the sewer and/or road R/W. The main TV camera shall record video as it travels down the main sewer to the lateral location to provide Engineer with a current view of the sewer and other lateral connections. The cleaning operations shall fully clean the service lateral and remove all debris, roots, grease, etc from the lateral to facilitate the CIPP installation. The service lateral TV inspections shall extend to the existing cleanout (if one exists). If a cleanout does not exist, Contractor shall locate the lateral at the edge of the road and/or sewer R/W using a sonde on the TV camera and install a stake over the lateral where a cleanout should be installed (at the edge of the road R/W and/or property line). Installation of cleanouts may be required at direction of the Owner/Engineer. It shall be the responsibility of Contractor to verify, prior to installation, that all internal debris has been removed from the sewer line.

C. Contractor shall carefully inspect the interior of the service lateral to determine the location of any conditions which may prevent proper installation of the lateral liner into the pipelines, and it shall be noted so that these conditions can be corrected. Digital files in MPEG-4 Video file format with the H.264 Codec recording with embedded meta-data is required for submittal to the Engineer. Each submittal to the Engineer will include the ITpipes software database file within the approved structure along with the MPEG-4 video files. Inspection logs shall be included and in pdf file format. Acceptable formats for submittal include USB flash drives, external hard drive, or via a pre-approved (by Charlotte Water) file sharing website. Each submittal to the Engineer shall include a transmittal that lists the file names and all sewer segments and video files included with the submittal. See Chapter 16, Sewer Cleaning and Television Inspection for additional requirements.

D. Line Obstructions – If inspection reveals an obstruction that cannot be removed by conventional sewer cleaning equipment, as in solids, dropped joints or collapsed pipe then Contractor shall inform Engineer and Engineer will determine whether to repair the service lateral or remove the service lateral from the scope.

E. Contractor shall fully open and brush the existing lateral connections to the existing mainline CIPP as necessary to facilitate the installation of the lateral lining system.

F. Care shall be taken in shipping, handling and laying to avoid damaging the CIPP. Any CIPP damaged in shipment shall be replaced as directed by Engineer. Any CIPP showing a split or tear or has been mishandled shall be marked as rejected and removed from the jobsite at once.

G. Contractor shall continuously notify the public of the work being performed. Owner will define the specific notification requirements, and Contractor shall meet all of those requirements. At a minimum, Contractor shall distribute door hangers to each property owner affected by the work seventy-two (72) hours prior to performing any work. Contractor shall submit a sample door hanger to Engineer and Owner for review. The door hangers shall include the specific work to be performed, start time and estimated completion time for the work being conducted, impacts to the property owner, contact names and local phone numbers for the Contractor's project manager, superintendent, and the Engineer's on-site representative.

H. Contractor shall perform and provide all necessary traffic control measures to complete the work. Warning signs, barricades and flagmen must be provided in accordance with the NCDOT Transportation's "Manual on Uniform Traffic Control Devices" at all times and places necessary. No roads shall be closed for construction activities. At least one (1) lane of traffic will be safely maintained at all times when construction is in progress. Access to businesses and residences along the roads shall be maintained at all times. All lanes will be open when work is suspended for one (1) hour or longer.

Contractor shall provide all appropriate signing and barricades and shall provide flag persons at all times and places necessary. Traffic control will be strictly enforced in order to provide fire and police protection to the area and access to driveways while construction is in progress. Occupants must be notified a minimum of two (2) hours in advance of private drive closings. Closure time will be limited to a maximum of 2 hours. Where businesses have only one (1) means of access, the Contractor shall provide an alternative means of access or perform work during hours when the business is closed.

Contractor shall submit to Engineer a detailed traffic control plan for performing all phases of the Work within one (1) week prior to performing the Work in residential roads and three (3) weeks prior to working in major thoroughfares. The traffic control plan shall be specific to each road and each sewer and manhole. The traffic control plan shall be modified as necessary in the field to accommodate unforeseen traffic control issues and problems and safety concerns. No work shall begin until the traffic control plan is reviewed and approved by the Engineer, Owner, NCDOT and/or Town.

I. Water for use in the installation of service laterals will be available from approved fire hydrants owned and operated by Charlotte Water only. Use of fire hydrants other than those approved by Charlotte Water will not be allowed. The Contractor shall meet all Owner requirements for connecting to fire hydrants and

will be charged for water usage. Prior to connection to, and use of any hydrant, the Contractor must apply for and successfully obtain a temporary fire hydrant use permit (Vehicle Mounted "Tanker Truck" Permit). All instructions and requirements for obtaining the permit are listed under the **Fire Hydrant Program for Temporary Service** section of Charlotte Water's website. The Contractor is responsible for meeting all requirements whether listed herein or not.

The Contractor shall submit to the Engineer, a copy of the approved permit number for each vehicle prior to connection to, and use of, any fire hydrant.

The Contractor shall be well versed in the proper operation of valves and hydrants and will be responsible for any damage caused by improper operation or usage of hydrants. All cure water must be discharged to the wastewater collection system.

J. Contractor shall bypass pump sewage flows around the lining work while it is being performed. Contractor is responsible for handling and accommodating all existing wastewater flows during the work. Prior to performing the work, Contractor shall submit, for approval by Engineer, a detailed plan of the method Contractor proposes in order to maintain the existing flow during construction. The plan must include a provision for handling the existing peak flow by pumping. The peak flow shall be considered the existing pipe flowing full, which is highly possible during rain events. When pumping is used, an identical standby pump(s) shall be on site in the event of failure of the primary pump(s). Flows in the lateral specified for lining will not require bypass pumping. Contractor shall coordinate with the homeowner/business in advance of all work to ensure the lateral will be inactive at the time of the CIPP installation. All bypass pumping work shall be performed as specified in Chapters 11 and 17 of Charlotte Water's Water and Sewer Design and Construction Standards.

If, at any time during construction, effluent from the existing sewer is not fully contained by the bypass system, gravity service will be restored, and work shall be suspended until the problem is resolved to the satisfaction of Engineer. This includes wastewater flow into trenches during excavation work. Sewer system overflows will not be tolerated. All fines imposed on Owner associated with overflows caused by the Contractor's work shall be paid by Contractor.

K. Contractor shall furnish and install the CIPP lateral lining in the specified laterals and to the required/specified length. The installation of the CIPP shall be in complete accordance with the manufacturer's specifications and applicable provisions of ASTM F1216 or ASTM F1743 except as modified herein.

L. Contractor shall designate a location where the liner will be vacuum impregnated prior to installation. Contractor shall allow Engineer and/or Owner to inspect the materials and "wet-out" procedure. A catalyst system compatible with the resin and liner shall be used.

M. The wet-out liner shall be loaded inside a pressure apparatus above ground and utilizing a hydrophilic sealant (or equivalent) on the backside of the connection to enhance a watertight seal. Also, a two-part 100% solid epoxy (reference ASTM C-881) shall be applied to the lateral brim interface to insure adhesion against

the host pipe. The pressure apparatus, with an end attached to a robotic device, shall be winched through the mainline pipe to the service connection. The robotic device, together with a television camera, will be used to position the pressure apparatus' inversion elbow at the service connection opening. Air pressure, supplied to the pressure apparatus through an inversion hose, shall be used to invert the wet-out liner through the lateral pipe to the R/W location and/or cleanout location. The inversion head will be adjusted to be of sufficient pressure to cause the impregnated liner to invert completely in the lateral pipe and hold the tube tight to the pipe wall. Care shall be taken during the curing process so as not to overstress the tube.

N. Curing – All curing shall be accomplished through ambient cure means. An accelerated ambient-temperature curing resin system shall be utilized to expedite curing as recommended by the CIPP system manufacturer. Initial cure shall be deemed to be completed when inspection of the exposed portions of the CIPP appears to be hard and sound. The cure period shall be of a duration recommended by the resin manufacturer, as modified for the installation process. Contractor shall cool the hardened CIPP to a temperature of approximately 100 degrees F before relieving the pressure from the pressure apparatus. Care shall be taken to maintain proper pressure throughout the cure and cool-down periods. No flow shall pass through the lateral until the initial cure is achieved.

O. Installation reports shall be generated for each service lateral lined. The reports shall document installation, including manhole numbers and service lateral location, street names/sewer location, project number, date, time, temperature, curing time, liner thickness, etc. A sample report shall be submitted to Engineer for approval prior to installing any lining.

P. Finish – The finished CIPP shall provide a watertight connection seal at the mainline and extend continuous over the entire length of the service lateral and be free of dry spots, lifts, ribs, bumps, delaminations, etc., and there shall be no leakage of groundwater around, through or under the CIPP. This continuous one-piece structural pipe-within-a-pipe shall not inhibit the closed-circuit television post video inspection of the mainline or service lateral pipes. Any liner that does not meet these Specifications shall be repaired by Contractor as agreed to by Engineer at the Contractor's expense.

Q. Testing: For every twenty (20) laterals, one (1) flat plate sample shall be taken and sent to a third-party test laboratory for confirmation of short-term flexural modulus and strength properties in accordance with ASTM F1216. The test results shall meet or exceed the values used in the design of the CIPP lateral liner.

R. The Contractor shall select the independent testing laboratory and shall pay the laboratory for all tests. All testing shall be performed by an independent, accredited, certified and experienced (minimum 5 years of experience) testing laboratory as chosen by the Contractor. The Contractor shall submit the name and location of the testing laboratory for approval by Charlotte Water and/or the Engineer. The submittal shall include the laboratory's experience testing CIPP samples, the laboratory's accreditation/certification to perform CIPP testing from a recognized accreditation body, and a certified statement from the laboratory

that they are independent from and not associated with the Contractor in any way.

S. After the lateral liner is fully cured, Contractor shall TV the finished lateral liner from the main sewer to the termination point and shall submit one (1) copy of the final video inspections to Engineer for review and acceptance. The post-rehab TV inspections shall be submitted prior to final acceptance.

T. During the warranty period, any defects which will affect the integrity or strength of the CIPP liner shall be repaired at the Contractor's expense in a manner mutually agreed upon by Owner and Contractor.

END OF SECTION

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CHAPTER 16.3
MANHOLE REHABILITATION

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PART 1 - GENERAL

1.1 SCOPE

A. This Section covers the cleaning, repair, structural restoration, and rehabilitation of existing manholes as required to eliminate leakage into the manholes and to restore structural integrity. The work includes but is not limited to cleaning entire manhole interior, repair/reconstruction of the failed sections of the structure; stopping active leaks through manhole walls and joints; preparation of surfaces to receive the application of coatings designed to resist the affects of hydrogen sulfide gas or the effects of aging; and application of those coatings to provide a monolithic liner on the inside walls of the manhole as specified.

B. All ancillary work shall be constructed properly in accordance with the Drawings and Specifications. All defects shall be remedied to the Engineer's satisfaction prior to approval.

1.2 RELATED DOCUMENTS

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

1.3 DEFINITIONS AND ABBREVIATIONS

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

1.4 REFERENCE SPECIFICATION, CODES, AND STANDARDS

A. Contractor shall ensure that the products and work comply with the reference specifications and all requirements of Charlotte Water's Water and Sewer Design and Construction Standards (latest version).

B. Contractor shall ensure that the products and work comply with the current version of the following American Society for Testing and Materials (ASTM) standards:

1. ASTM C78 Standard Test Method for Flexural Strength of Concrete
2. ASTM C94 Standard Test for Ready Mix Concrete
3. ASTM C109 Standard Test Method for Compressive Strength of Hydraulic Cement Mortars
4. ASTM C234 Standard Test Method for Comparing Concretes on the Basis of the Bond Developed with Reinforcing Steel
5. ASTM C267 Standard Test Method for Chemical Resistance of Mortars, Grouts, and Monolithic Surfacings
6. ASTM C321 Standard Test Method for Bond Strength of Chemical-Resistant Mortars
7. ASTM C496 Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens
8. ASTM C596 Standard Test Method for Drying Shrinkage of Mortar Containing Hydraulic Cement

9. ASTM C666 Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing
10. ASTM C827 Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures
11. ASTM C882 Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete by Slant Shear
12. ASTM C952 Standard Test Method for Bond Strength of Mortar to Masonry Units
13. ASTM C1072 Test Method for Measurement of Masonry Flexural Bond Strength
14. ASTM C1244 Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill

1.5 QUALIFICATIONS

A. Contractor performing the work must have at least five years of experience coating manholes with cementitious mortar and shall have successfully installed a cementitious mortar lining product in a minimum of 2,000 manholes as documented by verifiable Owner references.

B. Contractor performing the work shall be fully qualified, experienced and equipped to complete this work expeditiously and in a satisfactory manner and shall be an approved installer as certified and licensed by the product manufacturer.

C. Contractor's proposed superintendent/foreman for the work should have successfully installed a cementitious lining product in a minimum of 1,000 manholes as documented by verifiable Owner references. Contractor shall submit information to demonstrate that the experience requirements are met.

D. The cementitious product shall have been manufactured for installation specifically in manholes for at least five years and shall have been installed in at least 10,000 manholes. References that are documented and that can be verified shall be submitted to demonstrate that the cementitious products meet these requirements. Contact names and numbers shall be included with the references.

E. Approved cementitious products are listed in these specifications. Even though the product may be listed as approved, the product manufacturer and Contractor(s) shall still meet the experience requirements specified above, or the products and Contractor will not be approved for this work.

1.6 SUBMITTALS

A. Three hard copies (one to be returned to Contractor after review, one to remain with Engineer and one to remain with Owner) and one pdf of all submittals specified herein shall be submitted to the Engineer.

B. Contractor shall submit complete shop drawings of the manhole lining system to demonstrate compliance with these specifications, to show materials of construction and to detail installation procedures. Testing procedures and quality control procedures shall also be submitted.

C. Certifications that the manhole lining was manufactured in accordance with these specifications and the appropriate ASTM standards shall be submitted with each shipment.

D. For all products to be used for manhole rehabilitation, Contractor shall submit manufacturer documents containing product technical information, ASTM test results and certification, application procedures and specifications for approval, and testing and quality control procedures.

E. References for Contractor, superintendent and products shall be submitted to verify the specified experience.

F. Submit a plan for bypassing sewage around the work area and facilities where sewage flows must be interrupted to complete the work. The plan shall be reviewed by Engineer and shall be acknowledged as acceptable before any work is started. The bypass pumping plan, and requirements for bypass pumping, shall be in accordance with Chapter 11 and/or Chapter 17 of Charlotte Water's Water and Sewer Design and Construction Standards.

1.7 WARRANTY

A. The materials used for the project shall be certified by the manufacturer for the specified purpose. The manufacturer shall warrant the cementitious liner material to be free from defects in raw materials for two (2) years from the date of final acceptance by Owner. Contractor shall warrant the liner installation for a period of two (2) years from final acceptance.

PART 2 - PRODUCTS

2.1 MATERIALS – CEMENTITIOUS MORTAR LINING SYSTEM

A. Contractor shall line the interior of the manholes with a cementitious mortar lining system where specified in accordance with the specifications of the manufacturer.

B. The cementitious manhole lining system for the interior of manholes shall be a monolithic system suitable for use as a trowel - or spray-applied monolithic surfacing in sewer manholes. The cementitious lining system shall be one of the following specified products or approved equal:

- Strong Seal MS-2A, MS-2C, or High Performance by Strong Seal Systems
- QM-1s Restore or Aluminaliner by Quadex
- Cemtec Silatec MSM or CAM by A.W. Cook Cement
- Sewpercoat PG by Kerneos, Inc.
- Permacast MS-10,000 or CR-9000 by Action Products Marketing Corp.
- PerpetuCrete MSC or CA by Protective Liner Systems
- Mainstay ML-72, ML-CA or ML-PF by Madewell
- Reliner MSP or Maximum CA Cement by Standard Cement Materials

C. Where additional hydrogen sulfide resistance is required and when specified by Engineer (identified on the drawings as hydrogen sulfide resistant cementitious mortar),

the cementitious lining system shall be a 100% Calcium Aluminate Product (product comprised of calcium aluminate cement and calcium aluminate aggregate). Partial calcium aluminate products (or blended products) shall not be considered an equal and shall not be approved. The 100% Calcium Aluminate Product shall be one of the products listed below or approved equal. Any proposed equal product must have been manufactured and successfully installed in high, hydrogen-sulfide manholes for at least ten (10) years as documented by manufacturing records and detailed project references (project names, owner contact name and number, project description, etc.). There will be no exceptions to this requirement. The Engineer's decision on whether a product is an "equal" shall be final.

- High Performance by Strong Seal Systems
- Aluminaliner PF by Quadex
- Sewpercoat PG by Imerys
- Mainstay ML-PF by Madewell
- Cemtec HITECH 100 by A.W. Cook Cement
- Maximum CA Plus Cement by Standard Cement Materials

D. The cementitious lining system shall be a pumpable cement mixture. The lining shall be installed via low-pressure application or trowel application. The materials shall be suitable for all the specified design conditions.

E. The cementitious lining shall provide a minimum service life of twenty-five (25) years. The cured cementitious lining shall be continuously bonded to all the brick, mortar, concrete, chemical sealant, grout, pipe and other surfaces inside the sewer manhole. Provide bond strength data on cured, cementitious lining based on ASTM test methods referenced herein.

F. The cementitious liner when cured shall have the following minimum characteristics at twenty-eight (28) days as measured by the applicable ASTM standards referenced herein:

1. Minimum compressive strength of 6,000 psi
2. Minimum bond strength of 130 psi
3. Shrinkage of less than 0.05%

G. The cementitious lining shall be compatible with the thermal condition of the existing sewer manhole surfaces. Surface temperatures will range from 20ºF to 100ºF. Provide test data on shrinkage of the cementitious lining based on the ASTM standards referenced herein.

H. Chemical sealants or grouts used to seal active manhole leaks, to patch cracks, to fill voids and to otherwise prepare the manhole surfaces for the lining installation shall be suitable for the intended purpose and shall be compatible with the lining as certified by the manufacturer.

I. External Coating: Whenever the outside of exposed manholes walls are specified to be coated with a special exterior cementitious mortar product, the exterior mortar shall be HB2 Repair Mortar by ThoRoc, SikaTop 123 by Sika Corporation, or approved equal.

2.2 MATERIALS – INJECTION GROUTING

A. The grout used to completely stop identified leaks shall be a polyurethane grout and shall be Hydro Active Cut by DeNeef Construction Chemicals, AV-202 Multigrout by Avanti International, or approved equal.

B. The grout shall be suitable for injection and shall expand to seal identified leaks. The grout shall be installed per the manufacturer's recommendations. The material shall be suitable for all the specified design conditions.

C. The grout shall provide a minimum service life of twenty-five (25) years. When cured, the grout shall be suitable for sewer system service and chemically resistant to any chemicals or vapors normally found in domestic sewage. The grout shall be compatible with the thermal condition of the existing sewer manhole surfaces. Surface temperatures will range from 20°F to 100°F.

D. The grout shall effectively seal the identified leak in the sewer manhole and prevent any penetration or leakage of groundwater infiltration at this location or other nearby locations or within the same pre-cast manhole joint as a direct result of the injected grout. Any leaks from such migration shall be sealed at no additional cost to the Owner.

PART 3 - EXECUTION

3.1 NOTIFICATIONS

A. Contractor shall continuously notify the public of the work being performed. Owner will define the specific notification requirements, and Contractor shall meet all of those requirements. At a minimum, Contractor shall distribute door hangers to each property owner affected by the work seventy-two (72) hours prior to performing any work. Contractor shall submit a sample door hanger to Engineer and Owner for review and approval. The door hangers shall include the specific work to be performed, start time and estimated completion time for the work being conducted, impacts to the property owner, contact names and local phone numbers for the Contractor's project manager, superintendent, and the Engineer's on-site representative.

B. In the event of leakage, as a result of a water main or service leak, Contractor is required to notify Engineer, Engineer's representative, and 311.

3.2 DELIVERY, STORAGE, AND SHIPPING

A. Care shall be taken in shipping, handling and placing to avoid damaging the lining products. Any lining product damaged in shipment, showing deterioration, or which has been exposed to any other adverse storage condition that may have caused damage, even though no such damage can be seen, shall be marked as rejected and removed from the jobsite at once.

B. While stored, the lining products shall be adequately packaged and protected. The lining products shall be stored in a manner as recommended by the manufacturer.

3.3 INSTALLATION – CEMENTITIOUS LINING

A. Contractor shall notify all affected property owners seventy-two (72) hours in advance, giving the date, start time and estimated completion time for the work being conducted and the impacts to the property owner.

B. Water for use in the installation of cementitious lining will be available from approved fire hydrants owned and operated by Charlotte Water only. Use of fire hydrants other than those approved by Charlotte Water will not be allowed. The Contractor shall meet all Owner requirements for connecting to fire hydrants and **will be charged** for water usage. Prior to connection to, and use of any hydrant, the Contractor must apply for and successfully obtain a temporary fire hydrant use permit (Vehicle Mounted "Tanker Truck" Permit). All instructions and requirements for obtaining the permit are listed under the **Fire Hydrant Program for Temporary Service** section of Charlotte Water's website. The Contractor is responsible for meeting all requirements whether listed herein or not.

   The Contractor shall submit to the Engineer, a copy of the approved permit number for each vehicle prior to connection to, and use of, any fire hydrant.

   The Contractor shall be well versed in the proper operation of valves and hydrants and will be responsible for any damage caused by improper operation or usage of hydrants. All cure water must be discharged to the wastewater collection.

C. Contractor shall clean each sewer manhole to be surfaced and shall dispose of any resulting material. The cleaning shall be performed using a high-power jet wash at a minimum of 3500 psi water pressure to remove all dust, biological growths, grease, oil, paint or any other surface contaminants or coatings. The tip of the nozzle shall be a maximum of 4 inches from the manhole wall during cleaning to ensure that 3,500 psi is being applied to the walls.

D. Coatings that cannot be removed shall be sanded with coarse sandpaper to rough the surface sufficient to obtain and ensure adequate bonding of the lining. Roots shall be removed by manually cutting the roots from inside the manhole.

E. Contractor shall conduct a visual inspection of each manhole after it is cleaned. All active, hydrostatic infiltration leaks shall be plugged or sealed with an appropriate grout compatible with the cementitious lining. Injection grouting may be required to seal active leaks, including leaks in existing invert channels and benches. All loose mortar and rubble of existing walls, benches and inverts shall be removed.

F. Prior to installing the lining, Engineer and/or the Engineer's representative, along with Contractor must inspect and approve the surface preparation work. Contractor shall notify Engineer when the manholes are ready for inspection. Contractor is responsible for ensuring proper preparation and installation conditions including temperature and moisture regardless of the findings by Engineer during the inspection. The manhole lining shall be completed immediately after the inspection, or the manhole may need to be re-cleaned prior to spraying to remove accumulated debris on the benches and walls.

G. Contractor shall prepare the manhole to receive cementitious lining as necessary by reshaping and repairing benches, inverts, and walls where required including smoothing out irregular shaped corbel and chimney sections prior to spray application. All interior

surfaces shall be prepared as recommended by the manufacturer. Minimum requirements are as listed below.

1. All cracks and other voids must be repaired and filled with suitable non-shrinking cements, sealants or grouts, including all voids between the existing sewer pipes and manhole walls.
2. All patches shall be smooth and even with the manhole wall.
3. All existing manhole rungs/steps shall be removed, and voids filled.
4. All surfaces shall be suitably prepared for the required bonding of the cementitious lining as recommended by the manufacturer.

H. A complete, watertight seal shall be provided at pipe and manhole wall connections including filling in all voids around the connection and completely covering the connection with an approved non-shrink grout. Contractor shall submit details of how the watertight connections will be made to Engineer for review and approval. The invert channel shall be coated with an appropriate quick-set grout product in complete accordance with the manufacturer's instructions.

I. When CIPP is installed in the connecting sewer(s), the invert channel shall be coated with an approved grout to build up the invert channel to the invert elevations of the new CIPP; to fill all voids, cracks, holes, etc.; and to form a smooth flow channel. The entire channel shall be coated. The coating shall be a minimum ¼-inch thick. The Contractor shall submit details of the proposed grout for this application.

J. Contractor shall furnish and place the cementitious lining in each manhole as shown in the standard details of Charlotte Water's Water and Sewer Design and Construction Standards. The installation of the lining shall be in complete accordance with the applicable provisions of ASTM and the manufacturers' specifications.

K. Contractor shall bypass pump sewage flows around the lining work while it is being performed. Contractor is responsible for handling and accommodating all existing wastewater flows during the work. Prior to performing the work, Contractor shall submit, for approval by Engineer, a detailed plan of the method Contractor proposes in order to maintain the existing flow during construction. The plan must include a provision for handling the existing peak flow by pumping. The peak flow shall be considered the existing pipe flowing full, which is highly possible during rain events. When pumping is used, an identical standby pump(s) shall be on site in the event of failure of the primary pump(s). Lateral flows will not require bypass pumping. Contractor shall coordinate with the homeowner/business in advance of all work to ensure the lateral will be inactive at the time of the manhole rehabilitation. All bypass pumping work shall be performed as specified in Chapter 11 and/or Chapter 17 of Charlotte Water's Water and Sewer Design and Construction.

L. The walls and benches shall be coated to the required minimum 1-inch thickness by spray-on or trowel-applied methods. Invert channels shall also be coated as specified herein. Cementitious mortar lining shall be monolithically applied in one pass or application and shall be troweled smooth after application. The manhole lining shall not be installed until all required main sewer rehabilitation and other manhole rehabilitation work are complete.

M. The cementitious lining shall cover the complete interior of the existing sewer manhole including the benches (shelves). The lining shall effectively seal the interior surfaces of the sewer manhole and prevent any penetration or leakage of groundwater infiltration. When cured, the lining shall form a continuous, tight-fitting, hard, impermeable surfacing which is suitable for sewer system service and chemically resistant to any chemicals or vapors normally found in domestic sewage.

N. Contractor shall plug off and/or protect the connecting pipes while coating the manhole walls to prevent any material from washing down the sewers. If material enters the sewer pipes, Contractor will be required to clean the sewers from manhole to manhole to remove all material and then televise the sewer to demonstrate that all material is removed at no cost to Owner.

O. Contractor shall take precautions to avoid damage or flooding to public or private property being served by the manhole being rehabilitated. Contractor shall be responsible for all flooding and pay for cleanup from flooding to the satisfaction of the property owner. Contractor shall document all backups and submit documentation to Engineer including the reason for the backup, the time and date of the backup, the property owner's name, address and phone number, the resolution to problem, the time and date the problem was resolved, and any special cleanup work that had to be performed. This required documentation shall be submitted for all backups regardless of when they occur. All cleanup shall be completed within four (4) hours of the backup.

P. External Coating: The existing surface shall be completely cleaned, and all loose material removed prior to applying the cementitious material. Installation shall be in strict accordance with the manufacturer's recommendations including utilizing any required bonding agents and providing proper curing conditions. The installed thickness shall be at least two (2) inches, troweled smooth after application.

3.4 INSTALLATION – INJECTION GROUTING

A. Contractor shall inject grout to seal the specified leaks. The grout shall be injected in accordance with the manufacturer's instructions. Grout shall continue to be pumped until the leak is completely sealed. The hole drilled to inject the grout shall be covered with non-shrink grout.

3.5 ACCEPTANCE TESTS - CEMENTITIOUS MORTAR LINING SYSTEM

A. Field acceptance of the cementitious lining shall be based on Engineer and/or Engineer's representative's field inspections and evaluation of the appropriate installation and curing test data. The cementitious lining shall provide a continuous monolithic surfacing with uniform thickness throughout the manhole interior. If the thickness of the lining is not uniform or is less than specified, it shall be repaired or replaced at no additional cost to the Owner.

B. If Engineer and/or Engineer's representative has to enter the manholes to inspect the work, Contractor shall provide forced air ventilation, gas monitors and detectors, harnesses, lights, confined space entry permits, etc. for Engineer and/or Engineer's representative to enter the manhole and perform the inspection in complete accordance with OSHA requirements at no additional cost to Owner.

C. Samples shall be taken of the installed liner each day that cementitious lining is installed as follows: one (1) sample if one (1) to five (5) manholes were coated that day, two (2) samples if six (6) to ten (10) manholes were coated that day, three (3) samples if eleven (11) to fifteen (15) manholes were coated that day, and four (4) samples if sixteen (16) or more manholes were coated that day. Samples shall be taken at equally spaced intervals throughout the day. The frequency of tests may be increased by Engineer and performed by Contractor at no additional cost to Owner when the required tests show that the installed lining does not meet the specifications.

D. Samples shall be cube samples. At least six (6) cubes shall be taken for each sample for testing. All cube samples shall be taken in the field from the material being sprayed. Contractor shall show the samples to Engineer and/or Engineer's representative each day and they shall initial the samples for delivery to the testing laboratory. Contractor shall properly take and store the samples and shall deliver the samples to the testing laboratory. The laboratory shall document that they received the initialed samples. The tests shall be performed by an independent testing laboratory. All costs associated with the tests shall be paid for by Contractor. The test results shall be submitted to Engineer immediately when available, no later than thirty (30) days after the lining is installed, or final acceptance will be withheld.

   The samples shall be tested in accordance with the applicable ASTM standards to verify that the installed liner meets the compressive strength requirements specified herein and the lining manufacturer's published data on the product. Tests shall include 7-day and 28-day strength tests (3 tests/cubes for each time period for each sample). Shrinkage and bond strength tests shall be performed on each batch or lot of material shipped to the Contractor.

E. Engineer will direct which manholes shall be tested via vacuum testing when all manhole rehabilitation work to that manhole is complete. Manholes shall not be vacuum tested until at least seven (7) days after the cementitious lining was installed. Vacuum testing shall be performed in accordance with ASTM C-1244 except that the minimum test time shall be one (1) minute. Engineer and/or Engineer's representative shall be present for all testing. Contractor shall notify Engineer forty-eight (48) hours prior to testing.

   Contractor shall submit test reports of the testing which include the project name, manhole tested, data on testing (vacuum pressure, test duration, etc.), and whether the manholes passed or failed the test. Test reports must be submitted for failed tests with the reason for failure noted on the report. Engineer and/or Engineer's representative shall sign all test reports to document that Engineer and/or Engineer's representative was present for the testing. Any manhole that fails the vacuum test shall be repaired and retested immediately by Contractor at no additional cost.

F. There shall be no groundwater infiltration or other leakage (active or previously active) through the manhole walls, benches, inverts or pipe connections at the manholes after it has been lined. If leakage is found, it shall be eliminated with an appropriate cement mortar, grout or sealant as recommended by the manufacturer and approved by Engineer at no additional cost to Owner. Injection grouting may be required to stop leaks around the pipe connections or in the invert channel or benches. Engineer's decision on how defective lining is repaired shall be final. If any defective lining is discovered after it has been installed or during the warranty period, it shall be repaired or replaced in a satisfactory manner at no additional cost to Owner. Repaired manholes

including those repaired during the warranty period shall be vacuum tested at no additional cost to Owner. In the event of leakage, as a result of a water main or service leak, Contractor is required to notify Engineer, Engineer's representative, and 311.

G. Final acceptance shall not be granted for the installed cementitious lining until (1) the manhole passes the vacuum test, (2) all material tests are submitted, and (3) the final CCTV inspection of the CIPP liner (if applicable) is submitted as specified in Chapter 16, CIPP for Main Sewers (when CIPP is installed; final CCTV performed after manhole rehabilitation is completed).

3.6 ACCEPTANCE TESTS – INJECTION GROUTING

A. Field acceptance of the grout shall be based on Engineer and/or Engineer's representative's visual inspections, their evaluation of the appropriate installation, and the absence of any visible active leaks in the general area of the original leak location or within the same pre-cast manhole joint.

B. If Engineer and/or Engineer's representative has to enter the manholes to inspect the work, Contractor shall provide forced air ventilation, gas monitors and detectors, harnesses, lights, confined space entry permits, etc. for Engineer and/or Engineer's representative to enter the manhole and perform the inspection in complete accordance with OSHA requirements at no additional cost to Owner.

C. There shall be no groundwater infiltration or other leakage (active or previously active) at or near the original leak location or within the same the pre-cast manhole joint after it has been repaired. If leakage is found and deemed to be a direct result of the original repair as determined by Engineer and/or Engineer's representative, it shall be eliminated as approved by Engineer at no additional cost to Owner. The Engineer's decision on how additional leak(s) are repaired shall be final. If any additional leaks are discovered after it has been installed or during the warranty period, they shall be repaired in a satisfactory manner at no additional cost to Owner. In event of leakage as a result of water main or service leak, Contractor is required to notify Engineer, Engineer's representative, and 311.

END OF SECTION

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CHAPTER 16.4
PIPE BURSTING

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PART 1 - GENERAL

1.1 SCOPE

A. The work under this Section includes the pipe bursting of existing sewers throughout the service area.

B. This Section covers pipe bursting of existing pipe while simultaneously installing a new high-density polyethylene (HDPE) pipe of the same size or larger size pipe where the old pipe existed, reconnecting existing sewer service house connections and performing television inspection of the HDPE pipe.

C. All ancillary work shall be constructed properly in accordance with the Drawings and Specifications. All defects shall be remedied to the Engineer's satisfaction prior to approval.

1.2 RELATED DOCUMENTS

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

1.3 DEFINITIONS AND ABBREVIATIONS

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

1.4 REFERENCE SPECIFICATION, CODES, AND STANDARDS

A. Contractor shall ensure that the products and work comply with the reference specifications and all requirements of Charlotte Water's Water and Sewer Design and Construction Standards (latest version).

B. Contractor shall ensure that the products and work comply with the current version of the applicable American Society for Testing and Materials (ASTM) standards.

1.5 QUALIFICATIONS

A. Contractor shall be fully experienced in installing HDPE pipe via pipe bursting methods. The pipe bursting equipment shall be the Grundocrack System as manufactured by T.T. Technologies, Inc.; the InneReam Pipeline Replacement System by Nowak Pipe Reaming, Inc.; or approved equal. Contractor shall have a minimum of 25,000 linear feet of documented pipe bursting experience.

B. Contractor performing the work shall be fully qualified, experienced and equipped to complete this work expeditiously and in a satisfactory manner and shall be an approved installer as certified and licensed by the product manufacturer.

1.6 SUBMITTALS

A. Submit complete shop drawings and manufacturer's technical data showing complete information on material composition, physical properties, and dimensions of new pipe and fittings. Include manufacturer's recommendations for handling, storage, and repair of pipe and fittings damaged.

B. Submit method of construction and restoration of existing sewer service connections. This shall include detail drawings and written descriptions of the entire construction procedure to bypass sewage flow, install pipe, and reconnect sewer service connections.

C. Submit certification of workmen training for installing pipe by pipe manufacturer.

D. Submit a plan for bypassing sewage around the work area and facilities where sewage flows must be interrupted to complete the work. The plan shall be reviewed by Engineer and shall be acknowledged as acceptable before any work is started. The bypass pumping plan, and requirements for bypass pumping, shall be in accordance with Chapters 11 and/or 17 of Charlotte Water's Water and Sewer Design and Construction Standards.

1.7 DELIVERY, STORAGE, AND SHIPPING

A. Transport, handle and store pipe and fittings as recommended by manufacturer. If new pipe and fittings become damaged before or during installation, it shall be repaired by the manufacturer or replaced at the Contractor's expense, before proceeding further.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Replacement pipe installed by pipe bursting shall be HDPE pipe. The pipe shall be manufactured from a high density, high molecular weight polyethylene resin which conforms to ASTM D1248 and meets the requirements for Type III, Class A, Grade P34, Category 5 and has a Plastic Pipe Institute (PPI) rating of PE 3408 when compounded. The pipe produced shall have a minimum cell classification of 345434C under ASTM D3350.

B. The HDPE pipe installed shall be minimum SDR 17 and sized according to the Ductile Iron Pipe Standard (DIPS). The HDPE pipe shall be capable of supporting the full-bearing load. Contractor shall submit thickness calculations during the project's submittal phase before installation. Sections of HDPE pipe shall be butt-fused in accordance with the HDPE pipe manufacturer's specifications.

C. Service saddles shall be Romac CB Saddle as manufactured by Romac Industries, Inc., Electrofuse Saddle as manufactured by GF Central Plastics, or approved equal.

D. Pipe end restraint shall be Central Plastics Electrofusion Flex Restraint Couplings or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

A. Contractor shall perform the pipe bursting in strict accordance with the equipment and HDPE manufacturers' specifications and recommendations. Contractor shall locate all utilities in the area prior to performing the pipe bursting and shall be responsible for all restoration and damage caused by the installation, including upheaval of the ground and damage to adjacent utilities.

B. For main sewer replacement, Contractor shall disconnect existing service laterals from the main sewer prior to pipe bursting to prevent excessive damage to the lateral. After the bursting is complete, Contractor shall connect all active service laterals to the HDPE pipe. All laterals to be replaced shall be a minimum of five (5) feet in length from the sewer main. Refer to the Standard Details of Charlotte Water's Water and Sewer Design and Construction Standards (latest version) for additional requirements.

C. The new HDPE pipe shall be connected to the existing manholes in accordance with the Standard Details of Charlotte Water's Water and Sewer Design and Construction Standards (latest version) for connecting HDPE pipes to manholes. The connection shall be leak-tight.

3.2 CONSTRUCTION METHOD

A. To the extent possible, equipment shall be provided with a sound attenuation enclosure. Sound blankets are required where necessary to meet noise requirements. Sound blankets shall be free standing and 12-ft high minimum. Sound blankets shall reduce sound by at least 10 dB at 125 Hz.

B. Contractor shall install all pulleys, rollers, bumpers, alignment control devices and other equipment required to protect existing manholes, and to protect the pipe from damage during installation. Lubrication may be used as recommended by the manufacturer. Under no circumstances shall the pipe be stressed beyond its elastic limit. Winch line shall be centered in pipe to be burst with adjustable boom.

C. The installed pipe shall be allowed the manufacturer's recommended amount of time, but not less than four (4) hours, for cooling and relaxation due to tensile stressing, prior to any reconnection of service lines, sealing at manholes, and backfilling of the insertion pit. Sufficient excess length of new pipe, but not less than four (4) inches, shall be allowed to protrude into the manhole. Restraint of pipe ends shall be required as shown on the Standard Details of Charlotte Water's Water and Sewer Design and Construction Standards (latest version). The electrofusion couplings shall be placed on the pipe ends against the manhole wall and fused in place. Installation of electrofusion couplings shall be done in accordance with the manufacturer's recommended procedures.

Completely seal the connection at the manhole per the Standard Detail to make a watertight connection.

3.3 PIPE JOINING

A. The HDPE pipe shall be assembled and joined at the site using the butt-fusion method to provide a leak proof joint. Threaded or solvent-cement joints and connections are not permitted. All equipment and procedures used shall be used in strict compliance with the manufacturer's recommendations. Fusing shall be accomplished by personnel certified as fusion technicians by a manufacturer of HDPE pipe and/ or fusing equipment.

B. The butt-fused joint shall be in true alignment and shall have uniform roll-back beads resulting from the use of proper temperature and pressure. The joint shall be allowed adequate cooling time before removal of pressure. The fused joint shall be watertight and shall have tensile strength equal to that of the pipe. All joints shall be subject to acceptance prior to insertion. All defective joints shall be cut out and replaced at no cost. Any section of the pipe with a gash, blister, abrasion, nick, scar or other deleterious fault greater in depth than ten percent of the wall thickness, shall not be used and must be removed from the site. However, a defective area of the pipe may be cut out and the joint fused in accordance with the procedures stated above. In addition, any section of pipe having other defects such as concentrated ridges, discoloration, excessive spot roughness, pitting, variable wall thickness or any other defect of manufacturing or handling shall be discarded and not used.

3.4 TESTS

A. Tests for compliance with this specification shall be made as specific herein and in accordance with the applicable ASTM specification. A certificate with this specification shall be furnished, upon request, by the manufacturer for all material furnished under this specification. HDPE pipe and fittings may be rejected in accordance with the requirements of this specification.

3.5 EQUIPMENT

A. The pipe bursting tool shall be designed and manufactured to force its way through existing pipe material by fragmenting the pipe and compressing the old pipe sections into the surrounding soil as it progresses. The bursting unit shall generate sufficient force to burst and compact the existing pipeline. The bursting tool shall be selected in accordance with the manufacturer's recommendations to meet the project specific requirements for the type and size of pipe being burst and upsized if specified.

B. The pipe bursting tool shall be pulled through the sewer by a winch located at the upstream manhole. The bursting unit shall pull the HDPE pipe with it as it moves forward. The tool shall be capable of being set into reverse, unlocked from the burst head, and backed out of the manhole through the new pipe to the entry point.

C. The action of the pipe bursting tool shall increase the external dimensions sufficiently, causing breakage of the pipe at the same time expanding the surrounding ground. This action shall not only break the pipe but also create the void into which the burster can be winched enabling forward progress. At the same time the HDPE pipe, directly attached to the bursting head, shall also move forward.

D. The burster shall provide its own forward momentum while being assisted by winching. A hydrostatic winch shall give the burster friction by which it can be moved forward. To form a complete operating system, the burster must be matched to a constant tension hydrostatic winching system.

3.6 WINCH UNIT

A. A winch shall be attached to the front of the bursting unit. The winch shall provide a constant tension to the burster in order that it may operate in an efficient manner. The winch shall ensure directional stability in keeping the unit online and grade.

B. The winch shall be hydrostatically operated and automatically provide a constant tension throughout the operation. The winch shall be of the constant tension type and shall be fitted with a direct reading load gauge to measure the winching load.

C. The constant tension winch shall supply sufficient cable in one continuous length so that the pull may be continuous between approved winching points.

D. The winch cable and cable drum must be provided with safety cage and supports so that it may be operated safely without injury to persons or property.

E. Contractor shall provide a system of guide pulleys and bracing at each manhole to minimize cable contact with the existing sewer between manholes.

F. The supports to the trench shoring in the insertion pit shall remain completely separate from the winch boom support system and shall be designed so that neither the pipe nor the winch cable shall be in contact with them.

3.7 SEWER SERVICE CONNECTIONS

A. All sewer service connections shall be identified, located and disconnected from the main prior to the pipe insertion to prevent damage to the laterals and to expedite reconnection. Upon commencement, pipe insertion shall be continuous and without interruption from one manhole to another.

B. Connection of the new service lateral to the mainline shall be accomplished by means of a compression-fit service connection or an electrofuse saddle. The service connection shall be specifically designed for connection to the sewer main being installed. All laterals to be replaced shall be a minimum of five (5) feet in length from the sewer main. Install the saddles using procedures and equipment as referenced in manufacturer's written installation instructions.

3.8 ACCEPTANCE TESTS

A. The following acceptance tests shall be performed to verify proper installation of the new HDPE pipes. The Engineer and/or Engineer's representative shall witness all tests.

1. All new main sewers installed from manhole to manhole shall be tested via low pressure air testing in accordance with ASTM F1417-11A. The tests shall be performed from manhole to manhole and include any service laterals connecting to the main sewer. To perform the test, plugs shall be installed at each manhole and at cleanouts installed at the edge of the property line and road or sewer right-of-way, and the isolated sewers shall be tested as a system. Contractor shall provide all necessary equipment and pressure gauges to use for the testing. If new service laterals are not installed from the main sewer to the edge of the sewer or road R/W and/or a new cleanout is not installed, then the air test will not be required.

   The air test pressure shall be performed in accordance with ASTM F1417-11A and shall be increased by 0.5 psi for every foot of ground water above the crown of the sewer pipe. If the ground water level is 2 ft or more above the top of the pipe at the upstream end, or if the air pressure required for the test is greater than 9-psi gauge, this air testing practice should not be used. Before this air testing practice is used, the ground water level should be lowered by pumping or dewatering. If ground water levels cannot be determined in the field, then the test pressures shall be increased by a minimum of one (1) psi.

   Refer to ASTM F1417-11A for additional requirements.

2. All new main sewers and service laterals shall be inspected via closed circuit television (CCTV) inspection after all work is completed. Refer to Chapter 16, Sewer Cleaning and Television Inspection, of Charlotte Water's Water and Sewer Design and Construction Standards, for requirements.

B. Defects which may affect the integrity or strength of the pipe shall be repaired at the contractor's expense.

END OF SECTION

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CHAPTER 16.5
SEWER CLEANING AND TELEVISION INSPECTION

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PART 1- GENERAL

1.1 SCOPE

A. Work in this section shall consist of furnishing all labor and equipment required to completely clean sewers from manhole to manhole and to inspect and document the interior condition of gravity sanitary sewer mains utilizing closed circuit television (CCTV) equipment.

1.2 RELATED DOCUMENTS

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

1.3 DEFINITIONS AND ABBREVIATIONS

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

1.4 SUBMITTALS

A. Contractor shall provide one copy of the CCTV inspections to Engineer. The inspections and submittals shall be in digital format as specified herein. Digital files in MPEG-4 Video file format with the H.264 Codec recording with embedded meta-data is required for the submittal. Each submittal will include the ITpipes software database file within the approved structure along with the MPEG-4 video files. Inspection logs shall be included and in pdf file format. Acceptable formats for submittal include USB flash drives, external hard drive, or via a pre-approved (by Charlotte Water) file sharing website. Each submittal to the Engineer shall include a transmittal that lists the file names and all sewer segments and video files included with the submittal.

PART 2 - PRODUCTS

A. Only ITpipes video inspection software shall be utilized. Use of other video inspection software and “conversion” to ITpipes is not allowed.

PART 3 - EXECUTION

3.1 CLEANING AND TELEVISION INSPECTION OF SEWERS

A. Contractor shall perform and provide all necessary traffic control measures to complete the work as required by the governing authority having jurisdiction over the work.

B. Prior to starting the clean and TV work, Contractor shall walk the sewers to be cleaned and televised to locate manholes and identify additional manholes not shown on the drawings. Contractor shall note any added manholes and notify Owner/Engineer so manhole numbers can be assigned prior to starting the TV inspections. In general, additional manholes that are found during the inspections

shall be numbered as the downstream manhole number followed by an “A”. Contractor shall also update the drawings to show any changes based on the actual sewer layout. These “red-line” markups shall be submitted to Engineer along with the TV inspections.

C. Contractor shall thoroughly clean and televise the sewers and submit one (1) copy of the final television inspection video and report in pdf file format to Engineer for review as specified herein. The Contractor’s cleaning operations shall fully clean the sewers and remove all roots, grease and debris. The cleaning shall be performed and completed from manhole to manhole prior to the television inspection. Contractor shall also clean the next downstream sewer (if included in the project area) prior to performing the TV to make sure there is no debris in the downstream sewer that may back-up flow and impact the TV inspections. No cleaning equipment shall be in the sewers while the television inspections are being performed.

D. The equipment used for the cleaning operations shall be specifically designed for cleaning sewers. Contractor shall use the appropriate equipment to clean all debris, roots and grease from each sewer segment thoroughly. The required equipment may be high velocity water jet cleaning equipment with various attachments or mechanical cleaning equipment such as power buckets or power rodders. Contractor shall select the cleaning equipment and procedures based on the conditions of the sewers at the time the work commences.

E. All solids shall be removed at the downstream manhole of the section being cleaned. Passing material from one sewer segment to another will not be permitted. Cleaning operations shall begin at the most upstream sewers and proceed downstream. The solids shall be removed from the site and disposed of properly at no cost to Owner. Owner **will not** provide a site for debris disposal. Collection system debris will not be accepted at Owner’s Zone 4 site on Tyvola Road, or any other Owner operated facility.

F. Contractor shall submit a list of permitted sites that will be used for disposal of the waste material. If Contractor elects to do so, debris collected from the Owner’s collection system may be disposed of at the Charlotte Motor Speedway (CMS) Landfill located at 5105 Morehead Road, Concord, NC 28207, pending approval by Republic Services.

G. If Contractor elects to dispose of debris at the CMS Landfill, the following process must be followed:

1. Contractor must establish an account with Republic Services.
2. Work will be assigned to Contractor by Owner or Owner’s representative.
3. Owner will perform inspection of the Contractor’s vactor truck to ensure debris containment tank is empty and clean prior to starting work for Owner.
4. Contractor will be issued a disposal manifest with listed work orders and/or other identifying information.
5. Contractor must contact Republic Services twenty-four (24) hours in advance to make an appointment for debris disposal.
6. Contractor must present the signed manifest to Republic Services at the time of disposal.

7. A copy of the completed manifest must be provided to Owner.
8. Contractor is made aware that the above process and requirements for completing and submitting the application, obtaining inspections, and acquisition of a permit, can take up to 30 days.
9. Contractor is directed to https://www.republicservices.com/ for additional information and instructions.

H. No outside debris will be allowed for disposal at the CMS Landfill site. Debris must have originated from Owner's collection system. Any Contractor found with outside debris will be suspended from work until the issue is addressed. Continued violation of this requirement will result in extended suspension or termination of the Agreement.

I. Contractor shall provide a landfill scale ticket as proof of proper waste disposal each time sewer debris is disposed of.

J. Prior to inserting any mechanical cutter into the sewer (such as a root cutter), Contractor shall first quickly televise the sewer to make sure there are no other utilities passing through the sewer pipe (such as gas lines, cable lines, power lines, water lines, etc.). This requirement is intended to prevent any damage to other existing utilities and to protect workers. The television inspection does not need to be recorded or submitted to Engineer unless there are existing utilities in the sewer, in which case a snapshot video and an accurate location will be required.

K. Water for use during sanitary sewer cleaning will be available from approved fire hydrants owned and operated by Charlotte Water only. Use of fire hydrants other than those approved by Charlotte Water will not be allowed. The Contractor shall meet all Owner requirements for connecting to fire hydrants and **will be charged** for water usage. Prior to connection to, and use of any hydrant, the Contractor must apply for and successfully obtain a temporary fire hydrant use permit (Vehicle Mounted "Tanker Truck" Permit). All instructions and requirements for obtaining the permit are listed under the **Fire Hydrant Program for Temporary Service** section of Charlotte Water's website. The Contractor is responsible for meeting all requirements whether listed herein or not.

The Contractor shall submit to the Engineer, a copy of the approved permit number for each vehicle prior to connection to, and use of, any fire hydrant.

The Contractor shall be well versed in the proper operation of valves and hydrants and will be responsible for any damage caused by improper operation or usage of hydrants.

L. Contractor shall take precautions to avoid damage or flooding to public or private property being served by the line being cleaned. Contractor shall be responsible for all flooding and pay for cleanup from flooding to the satisfaction of the property owner. Contractor shall document all backups and submit documentation to Engineer including the reason for the backup, the time and date of the backup, the property owner's name, address and phone number, the resolution to problem, the time and date the problem was resolved, and any special cleanup work that had to be performed. This required documentation shall be submitted for all backups

regardless of when they occur. All cleanup shall be completed within four (4) hours of the backup.

M. Contractor shall take care in cleaning older sewers and shall protect existing sewers from damage caused by improper use of cleaning equipment. Contractor is advised that the sewers assigned for cleaning and inspection may be in poor structural condition.

N. After the sewers are completely cleaned, the sewers shall be inspected via closed circuit television (CCTV). As specified previously, no cleaning equipment shall be in the sewers while the television inspections are being performed. The purposes of the CCTV inspections are to verify that the sewers have been thoroughly cleaned, to document the condition of the existing sewers and the locations of service connections, to locate sewer defects that need repaired, and to confirm that the lining (if specified) can be properly installed and cured.

O. The camera equipment used for the CCTV inspections 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. The camera shall be a color, pan-and-tilt camera.

P. The picture quality and definition shall be to the satisfaction of Engineer. Contractor shall submit a sample television inspection after the inspection of the first section(s) of sewer(s) is performed so that Contractor and Engineer can agree on performance and quality of the inspections which must be met. Sewers not inspected to the Engineer's satisfaction shall be re-inspected by Contractor at no additional cost to Owner.

Q. All cameras shall move through the sewers via self-powered tractor assemblies – no skid assemblies shall be permitted. The tractor assemblies used for the inspections shall be the appropriate size assembly for the pipe being televised according to the manufacturer of the television equipment. For example, an 8-inch tractor assembly shall be used to televise 8-inch-diameter sewers.

R. All inspections shall begin above ground with a video look down into the start manhole to completely show the manhole and flow in the invert channel below. The inspections shall then begin from the center of the upstream manhole and end in the center of the downstream manhole. Prior to starting the camera down the line, a tape measure shall be placed at the pipe opening at the upstream manhole to clearly show/verify, on-screen, the pipe diameter of the section of pipe to be televised during the subsequent inspection. The camera shall be moved through the line from upstream to downstream at a uniform rate. The camera shall be stopped at major defects and service connections and shall be panned, tilted and rotated to fully view the defects and connections. All such inspections shall be documented on digital recordings as specified. Particular attention should be paid to service connections and whether the services are active or plugged.

S. Flow levels shall be controlled to a maximum depth of 20% of the pipe diameter. Options for controlling the flow (if it exceeds 20% depth) that will be considered for approval include use of flow-through plugs (with continuous monitoring of upstream flow levels) and bypass pumping. Contractor may also consider

performing the work on off-peak hours when flow is lower (pending approval by Owner); any such alternate work times must not impact residents (noise, lights, general disruption, etc.). If this controlled flow level is too high to allow the sewer pipe to be clearly visible (flow blocking or inhibiting the TV camera and video), then further flow control (further plugging or bypass pumping) shall be immediately implemented at no additional cost.

Every attempt shall be made to avoid any circumstance where the camera goes under water during the video inspection, specifically when televising through pipe sags. For sag areas, if the camera goes under water or will go under water, Contractor shall use jet equipment to pull the water out of the sag prior to videoing through the sag (the jet equipment shall be removed from the line before starting the video inspection). This flow control shall be considered incidental as this is standard practice prior to televising through any area where the camera goes under water and proceeds “blindly”; no additional payment by Owner will be made for performing this work. Some flow needs to remain in the sags if possible so that the extent of the sag (start and end point) is clearly visible. If the camera lens becomes fouled by going under water, the camera shall be removed, cleaned and the inspection shall start over at the start manhole.

T. The inspections shall be complete from manhole to manhole without the need for reverse setups unless approved otherwise by Engineer. If, during the work, the CCTV inspection is blocked by debris, a protruding lateral or sewer system defect, Contractor shall remove the blockage or repair the defect, if possible, as authorized by Engineer and then continue the inspection. No additional payment by Owner will be made for the initial CCTV inspections that were blocked.

U. Reverse setups will only be allowed and accepted per approval by the Engineer. Contractor shall notify Engineer in writing of such situations for Engineer’s review and approval.

V. The accuracy of the measurements cannot be stressed too strongly. Daily calibration of measuring devices shall be performed. Sewer lengths shown and reported on the CCTV inspection video and logs shall be within one percent (plus or minus) of the actual sewer length as measured above ground from center of one manhole to the center of the next manhole. CCTV inspections that do not meet these criteria shall be re-performed and re-submitted to Engineer at no additional cost to Owner.

W. If the Contractor’s cleaning or television equipment become lodged in the sewers during the work, Contractor shall be responsible for removing the equipment, including excavation of the sewer, and paying all costs associated with the removal unless otherwise agreed to by Engineer.

X. Upon completion of the cleaning and television inspection work, Contractor shall submit one copy of the final digital television inspections to Engineer as specified. The inspections must be in order and complete or Engineer will immediately return the inspections to Contractor for corrections. The final inspection shall mean that the sewer has been completely cleaned (no roots, debris, grease, tuberculation, etc.), the inspection is complete from manhole to manhole without the need for a reverse setup unless otherwise approved.

3.2 REMOVAL OF PROTRUDING SERVICE CONNECTIONS

A. Service connections that are protruding into the main sewer shall be cut flush when specified by the Engineer. The cutting shall be accomplished using an internal cutter specifically designed for such work. The internal remote cutter shall be capable of cutting any pipe material including PVC, vitrified clay, cast iron, ductile iron and orangeburg pipe. All cut pieces of the service connection shall be removed from the main sewer pipe.

3.3 DIGITAL VIDEO INSPECTIONS AND CCTV DATABASE

A. All inspections shall be performed using ITpipes software in the field. ITpipes must be installed in the truck that is performing the television inspections and used for the live field inspections. If ITpipes with the specific Charlotte Water template is not in the truck(s), the work shall immediately cease until it is installed in the truck(s) to be used during the inspection process. All televised sewer inspections performed (including sewer laterals) shall be submitted to Engineer in electronic (digital) format. Use of other video inspection software and "conversion" to ITpipes is not allowed.

B. Contractor must use the ITpipes Charlotte Water template available from ITpipes. This template contains all correct data entry fields, all observation inputs and required parameters, template settings for overlay control and setup, and other settings. Contractor shall obtain the template prior to performing any CCTV inspections. Inspections performed without using the Charlotte Water template will be rejected, and Contractor will have to re-perform the inspections at no cost to Owner.

C. Digital files in MPEG-4 Video file format with the H.264 Codec recording with embedded meta-data is required. Each submittal to Engineer shall include the ITpipes software database file within the approved structure along with the MP4 video files. Contractor shall make all adjustments necessary to adhere to the required format specified herein including performing the work using the required software at no additional cost to Owner. After the first submittal, Engineer will notify Contractor of any required changes in the data and file format, and Contractor shall make such modifications at no additional cost.

D. The digital recording shall include video information that accurately reproduces the original picture of the video inspection. The video portion of the digital recording shall be free of electrical interference and shall produce a clear and stable image.

E. The final sewer inspection video shall include overlay/text display with an initial display screen and with a continuous running screen. Each inspection start shall include overlay display of section details including at a minimum:

1. Owner name
2. Project name
3. Contractor name
4. Street name (if applicable)
5. Date/time of inspection

6. MH Start #/MH End #
7. Pipe material
8. Pipe size
9. Direction of Video
10. Weather or Flow Level
11. Pipe Identifier Number (GM Number)
12. A constant display of the street name, MH start #/MH End #, date and distance shall appear on screen.

E. Contractor's CCTV inspector shall move or remove overlay display accordingly, so it does not interfere with the inspection review of particular observations/defects as the inspection is occurring. As an observation/defect is noted by the Contractor's CCTV inspector, a text display shall appear with the text describing the observation/defect. Text shall display for a minimum of four (4) seconds. Distance shall appear continuously in the lower left corner of the video image as the camera is traveling down the line. It is imperative that distance is accurate. Contractor's CCTV inspector shall calibrate/test footage at the beginning of each day as incorrect footage will result in return of inspections.

F. Completed work shall consist of MPEG-4 Video files with the H.264 Codec recording with embedded meta-data captured live off the inspection camera. The video file resolution shall be 640 x 480.

G. Each pipe inspection's observations shall be related to a time point within the video.

H. Each pipe inspection MPEG-4 file shall have a related text file, with an identical name but different extension on the file. This file shall contain the distances of each observation and the related time point for that observation.

I. During the inspection, the video file recording shall pause as the operator selects the observation/defect notation, eliminating "on hold" video. In situations of reverse inspection, the reverse inspection shall be in a separate video file.

J. The files shall be named as follows (unless directed otherwise by the Engineer):

EXAMPLE:

Pipe ID is GM-31619 and manhole numbers are (Upstream) MH-249417 to (Downstream) MH-249341

Then, the video filename = GM-31619_MH-249417_MH-249341.mp4

K. The database file and the corresponding video files shall be submitted to Engineer in digital media format.

L. Submittal shall include pdf files of video inspection logs.

M. Each digital submittal shall include a transmittal listing the file names and all sewer segments and video files included. Contractor shall maintain a "master" database that contains all databases and all video files performed. The databases shall be

merged to reduce the number of individual database files as required by the Engineer. Engineer will specify which files to merge.

N. Recorded Observations for each inspection shall include observation distance, observation defect/description, video counter time where observation occurs within digital video, and severity rating for each observation/defect.

O. Charlotte Water has developed customized data fields for its viewing software. Contractor will be required to use these data fields, without any modifications, to enter project information for each inspection. These data fields are available from ITpipes. Observations for each inspection shall include:

1. Distance (part of the Charlotte Water catalog)
2. Defect/description (part of the Charlotte Water catalog)
3. Counter time observation occurs within digital video (part of the Charlotte Water catalog)
4. Severity rating for each observation/defect (part of the Charlotte Water catalog)
5. Infiltration rating (part of the Charlotte Water catalog)

P. The final inspection shall mean that the sewer has been completely cleaned (no roots, debris or grease), the inspection is complete from manhole to manhole without the need for a reverse setup unless otherwise approved. The inspections must be in order and complete or Engineer will immediately return the inspections to Contractor for corrections.

END OF SECTION

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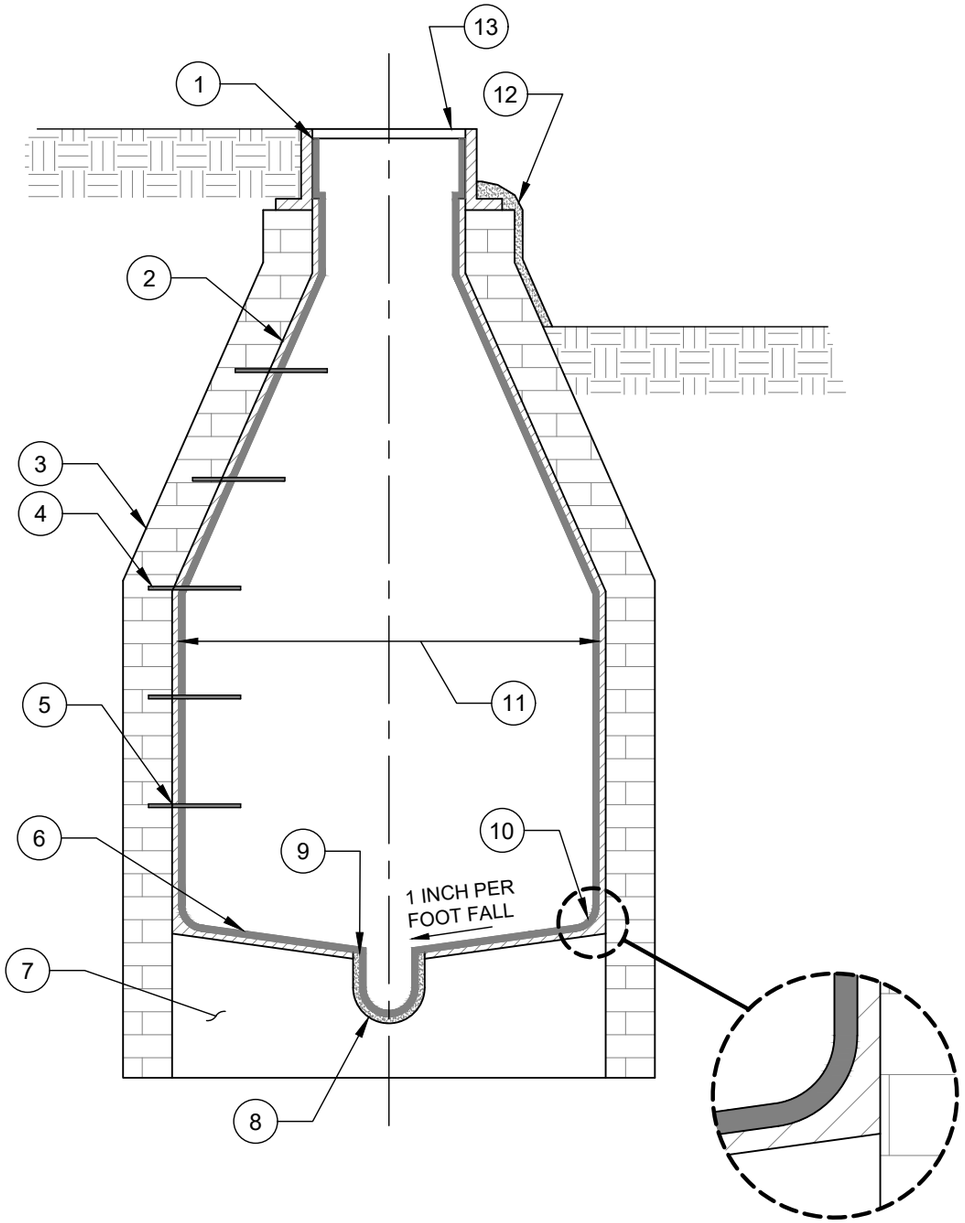

NO.	DESCRIPTION:
1.	EPOXY COATING WHERE SPECIFIED - MIN. 160 MILS THICK. EXTEND EPOXY TO TOP OF FRAME.
2.	MIN. 1 INCH THICK CEMENTITIOUS LINER ON VERTICAL WALL TO 1 INCH ABOVE BOTTOM OF FRAME. SEE NOTES A AND B.
3.	EXISTING MANHOLE WALL.
4.	EXISTING MANHOLE STEPS TO BE REMOVED UNLESS DIRECTED OTHERWISE BY THE SEALING ENGINEER.
5.	PLUG VOIDS AROUND STEPS WITH GROUT PRIOR TO INSTALLING CEMENTITIOUS LINER.
6.	MIN. 1 INCH THICK CEMENTITIOUS LINER ON BENCHING ALL AROUND. SEE NOTE B.
7.	EXISTING BENCHING. REBUILD WITH MIN. 3,600 PSI QUICKSET CONCRETE TO CROWN OF SEWERS WHERE SPECIFIED OR WHERE DIRECTED BY THE SEALING ENGINEER.
8.	EXISTING INVERT CHANNEL.
9.	COAT INVERT CHANNEL WITH GROUT. SEE SPECIFICATIONS.
10.	SEE SPECIFICATIONS PERTAINING TO WALL/BENCH INTERFACE.
11.	MANHOLE DIAMETER VARIES. TO BE DETERMINED IN FIELD. SEE NOTE A.
12.	SPECIAL CEMENTITIOUS MORTAR ON OUTSIDE OF EXPOSED MANHOLE WALLS WHERE SPECIFIED. MIN. 1 INCH THICK AND EXTENDED TO ABOVE AND AROUND FRAME AS SHOWN.
13.	EXISTING FRAME & COVER. RESET, RAISE OR REPLACE PER REHABILITATION OF MANHOLE FRAME AND COVER STD. DETAIL WHERE SPECIFIED.

NOTES:

A. MANHOLE SHOWN IS A TYPICAL SHAPE. HOWEVER, MANHOLE SHAPES WILL VARY.

B. THE SEALING ENGINEER WILL SPECIFY THE REQUIRED MATERIAL FOR EACH MANHOLE.

C. PROVIDE ADDITIONAL CEMENTITIOUS MATERIAL AS NECESSARY TO PROVIDE A 1 INCH PER FOOT FALL FROM THE MANHOLE WALL TO THE INVERT CHANNEL. ANY AND ALL ADDITIONAL CEMENTITIOUS MATERIAL REQUIRED TO PROVIDE THE 1 INCH PER FOOT FALL SHALL BE INCIDENTAL TO THE WORK. THE CONTRACTOR IS ADVISED THAT MOST OF THE EXISTING BENCHES ARE FLAT. PROVIDE CHANNEL IN BENCHING FOR SEWERS ENTERING MANHOLES ABOVE BENCHING. CHANNEL TO PROVIDE SMOOTH TRANSITION TO MAIN INVERT CHANNEL.

D. THIS DETAIL APPLIES TO BRICK OR PRECAST MANHOLES.

CHARLOTTE WATER

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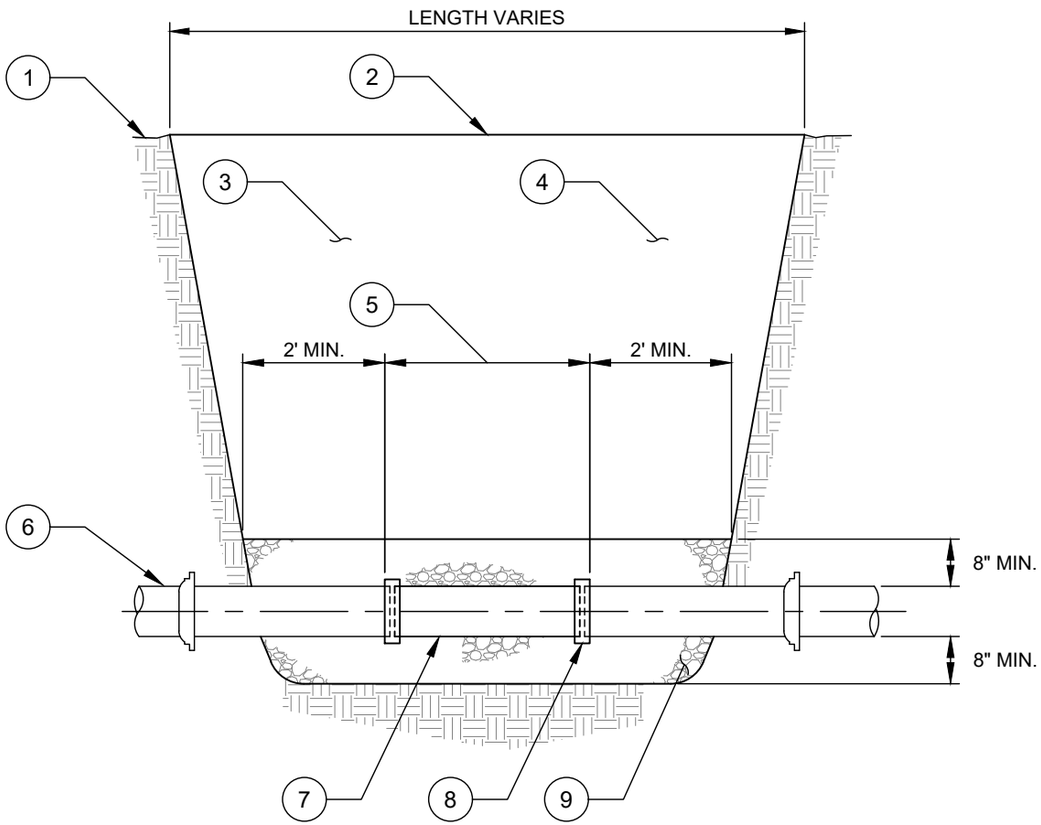
REHABILITATION OF EXISTING MANHOLES

NO SCALE

VERSION
1.0

DATE
04/2024

DETAIL
16.1



NO.	DESCRIPTION:
1.	UNDISTURBED SOIL.
2.	FINISHED GRADE. RESTORE TO MATCH EXISTING CONDITIONS. REFER TO CLTW SPECIFICATIONS AND DETAILS.
3.	REMOVE EXCAVATED MATERIAL UNDER PAVED SURFACES. SEE NOTE B.
4.	COMPACTED SOIL IN GRASSED AREAS/ COMPACTED ABC STONE OR PIT GRAVEL IN PAVED AREAS. COMPACTION TO BE AS SPECIFIED.
5.	POINT REPAIR SEGMENT. SEE NOTES A, C, D, AND E.
6.	EXISTING SEWER PIPE (VARIES).
7.	NEW SEWER PIPE LENGTH VARIES. ALL PIPE USED FOR POINT REPAIRS SHALL BE PVC OR DUCTILE IRON UNLESS OTHERWISE NOTED.
8.	RUBBER SLEEVE COUPLING WITH STAINLESS STEEL COMPRESSION BANDS AND SHEAR RINGS - MISSION ARC, FERNCO STRONGBACK OR APPROVED EQUAL. TYPICAL EACH END, COUPLING TO BE MIN. 6" WIDE.
9.	COMPACTED #57 STONE.

NOTES:

A. THE SEQUENCE OF WORK FOR PERFORMING POINT REPAIRS SHALL BE AS FOLLOWS:
- A.1. BYPASS PUMP FLOWS AROUND POINT REPAIR SEGMENT.
- A.2. EXCAVATE TO 8" BELOW EXISTING SEWER.
- A.3. NEATLY CUT EXISTING SEWER AT EACH END OF POINT REPAIR AND REMOVE EXISTING SEWER COMPLETELY.
- A.4. INSTALL #57 STONE TO SEWER INVERT ELEVATION AND COMPACT.
- A.5. INSTALL NEW SEWER AT A CONSTANT SLOPE BETWEEN THE TWO EXISTING PIPE ENDS. CONNECT THE NEW SEWER TO THE EXISTING WITH SPECIFIED COUPLINGS. REMOVE STONE BEDDING AS REQUIRED TO INSTALL PIPE AND COUPLINGS AND FILL VOIDS UNDER PIPE WITH STONE.
- A.6. RETURN FLOW THROUGH PIPE.
- A.7. BACKFILL AND COMPACT AS SHOWN.

B. UNDER PAVED SURFACES ONLY, CONTRACTOR SHALL REMOVE EXCAVATED SOIL AND DISPOSE OF IT OFFSITE. CONTRACTOR SHALL IMPORT ABC STONE OR PIT GRAVEL FOR BACKFILLING FROM TOP OF #57 STONE TO PAVEMENT SUBGRADE.

C. SERVICE LATERALS LOCATED WITHIN POINT REPAIR SEGMENTS SHALL BE CONNECTED TO NEW SEWER WITH A DIP TEE. REFER TO APPROPRIATE STD. DETAIL.

D. LENGTH OF POINT REPAIR WILL BE DETERMINED BY THE OWNER'S REPRESENTATIVE AFTER REVIEWING THE TELEVISION INSPECTION. THE CONTRACTOR SHALL EXTEND POINT REPAIRS IN THE FIELD AS NECESSARY AND APPROVED BY THE SEALING ENGINEER TO CONNECT TO SOLID PIPE.

E. THE CONTRACTOR SHALL USE A TRENCH BOX OR SHEETING AND SHORING IN ACCORDANCE WITH OSHA REGULATIONS TO SUPPORT THE TRENCH WALLS DURING THIS WORK. THE CONTRACTOR WILL NOT BE ALLOWED TO SLOPE TRENCH WALLS.

F. REFER TO APPROPRIATE STD. DETAIL FOR CONNECTING TO MANHOLES.

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SEWER REHAB

TYPICAL POINT REPAIR

NO SCALE

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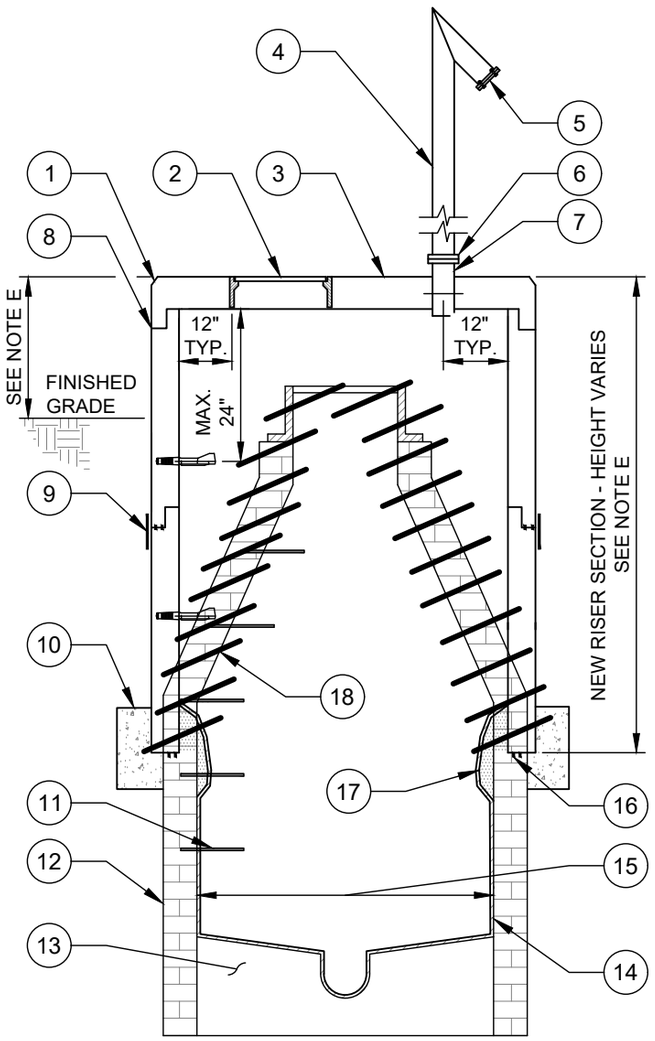
DETAIL 16.2



NO. DESCRIPTION:

1. 3/4" CHAMFER ALL AROUND.
2. 24" OR 30" CAM-LOCK WATERTIGHT FRAME AND COVER. FRAME CAST INTO FLAT-TOP SECTION. SEE NOTE H.
3. FLAT-TOP MANHOLE SECTION. SEE NOTE G.
4. STEEL VENT PIPE WHEN SPECIFIED. HEIGHT TO BE SPECIFIED BY SEALING ENGINEER. SEE NOTE I.
5. BOLT-ON BIRD SCREEN ON VENT PIPE OPENING.
6. 150# SLIP-ON TYPE WELDING FLANGES (TYP). SEE NOTE I.
7. VENT PIPE STUB-OUT. SEE NOTE I.
8. GROUT ALL OUTSIDE JOINTS ABOVE GRADE WITH NON-SHRINK GROUT.
9. MIN. 6" WIDE BUTYL RUBBER JOINT WRAP ON EXTERIOR OF ALL JOINTS.
10. CONCRETE COLLAR ALL AROUND JOINT. SEE NOTE F.
11. EXISTING MANHOLE STEPS TO BE REMOVED UNLESS DIRECTED OTHERWISE BY THE SEALING ENGINEER.
12. EXISTING MANHOLE WALL. SEE NOTE B.
13. EXISTING BENCHING.
14. MIN. 1 INCH THICK CEMENTITIOUS LINER ON VERTICAL WALL TO 6" ABOVE RISER SECTION. SEE NOTE J.
15. MANHOLE DIAMETER VARIES. CONTRACTOR TO DETERMINE IN FIELD. SEE NOTE C.
16. INSTALL 2 PIECES BUTYL RUBBER UNDER RISER SECTION WHERE POSSIBLE. SEE NOTE F.
17. FILL INSIDE JOINT WITH NON-SHRINK GROUT. SEE NOTE F.
18. REMOVE EXISTING MH. SEE NOTES C AND D.

NOTES:

A. ALL WORK AND MATERIALS TO BE IN ACCORDANCE WITH CLTW STANDARD SPECIFICATIONS AND DETAILS.

B. THIS DETAIL DEPICTS AN EXISTING BRICK MANHOLE WITH A TYPICAL CHIMNEY SECTION. SOME MANHOLES MAY BE PRECAST CONCRETE WITH CONE SECTIONS.

C. CONTRACTOR TO MEASURE THE INSIDE DIAMETER OF EXISTING MANHOLE TO SELECT APPROPRIATE DIAMETER OF NEW RISERS.

D. CONTRACTOR TO REMOVE EXISTING WALLS TO SOLID STRUCTURE (TO AT LEAST BELOW THE CONE OR CHIMNEY SECTION) OR TO THE SPECIFIED LOCATION. THE LIMITS OF REMOVAL SHALL BE APPROVED BY THE SEALING ENGINEER IN THE FIELD. CONTRACTOR TO ALSO REMOVE EXISTING FRAMES AND COVERS, VENT PIPES AND ALL APPURTENANCES, STEPS, ETC. CONTRACTOR TO DISPOSE OF ALL MATERIALS OFF-SITE. NO DEBRIS SHALL BE DROPPED INTO THE SEWER. IF DEBRIS ENTERS THE SEWER, THE CONTRACTOR WILL BE REQUIRED TO CLEAN THE SEWER AT NO ADDITIONAL COST TO THE OWNER.

E. CONTRACTOR TO INSTALL NEW RISER SECTIONS AS NECESSARY TO EXTEND THE MANHOLE TO THE SPECIFIED/APPROVED ELEVATION. SEALING ENGINEER SHALL APPROVE FINAL ELEVATIONS IN THE FIELD. BOTTOM RISER TO BE PROVIDED WITH A FLAT JOINT UNLESS OTHERWISE APPROVED.

F. CONTRACTOR TO SEAL NEW RISER SECTION/EXISTING WALL JOINT TO PROVIDE A LEAK-TIGHT JOINT. THE CONTRACTOR SHALL PERFORM ALL WORK NECESSARY TO PROVIDE A LEAK-TIGHT SEAL. WHERE POSSIBLE, BUTYL RUBBER SEALANT SHALL BE PROVIDED UNDER THE NEW RISER SECTION. IN ALL CASES, A CONCRETE COLLAR SHALL BE POURED AROUND THE JOINT. COLLAR TO BE MINIMUM 6 INCHES WIDE AND 12" HIGH CENTERED ON JOINT ALL AROUND. ON THE INSIDE OF THE JOINT, CONTRACTOR TO SEAL JOINT WITH NON-SHRINK GROUT. GROUT TO COMPLETELY FILL JOINT AND SHALL EXTEND AT LEAST 6 INCHES EACH SIDE OF JOINT ALL AROUND. GROUT TO BE TAPERED TO THE EXISTING WALL SECTION BELOW THE JOINT. GROUT TO BE RESISTANT TO HYDROGEN-SULFIDE.

G. NEW FLAT-TOP SECTIONS TO BE INSTALLED ON TOP OF NEW RISER SECTIONS UNLESS SPECIFIED OTHERWISE. FRAMES TO BE CAST INTO FLAT-TOP. SEE NOTE H. IN SOME INSTANCES, THE SEALING ENGINEER MAY SPECIFY THAT A STANDARD CONE SECTION BE INSTALLED INSTEAD OF A FLAT-TOP.

H. FOR FLAT-TOPS, ALL FRAMES SHALL BE CAST INTO THE FLAT-TOP SECTION UNLESS OTHERWISE SPECIFIED. FOR CONE SECTIONS, FRAMES SHALL BE BOLTED TO THE CONE. ALL COVERS SHALL BE CAM-LOCK WATERTIGHT COVERS UNLESS OTHERWISE SPECIFIED/APPROVED.
   H.1. 24"-DIAMETER FRAMES/COVERS SHALL BE PROVIDED ON MANHOLES FOR SEWERS 24" AND SMALLER.
   H.2. 30"-DIAMETER FRAMES/COVERS SHALL BE PROVIDED ON MANHOLES FOR SEWERS LARGER THAN 24".

I. WHERE SPECIFIED, FLAT TOP SECTIONS SHALL BE FURNISHED WITH THE VENT PIPE CAST INTO THE TOP SECTION. SEE CLTW STANDARD SPECIFICATIONS AND DETAILS. IF A VENT PIPE IS SPECIFIED, FURNISH VENT PIPE TO THE SPECIFIED HEIGHT (HEIGHT TO VENT OPENING) PER CLTW STANDARD SPECIFICATIONS AND DETAILS.

J. ALL MANHOLES THAT ARE REHABILITATED USING THIS DETAIL SHALL BE COATED WITH CEMENTITIOUS MORTAR TO 6" ABOVE THE EXISTING MANHOLE/NEW RISER SECTION INTERFACE. REFER TO APPROPRIATE STD. DETAIL FOR REHABILITATION OF EXISTING MANHOLES EXCEPT FOR THE LIMIT OF CEMENTITIOUS MORTAR AT THE TOP OF THE MANHOLE.

CHARLOTTE WATER

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STANDARD DETAILS
SEWER REHAB

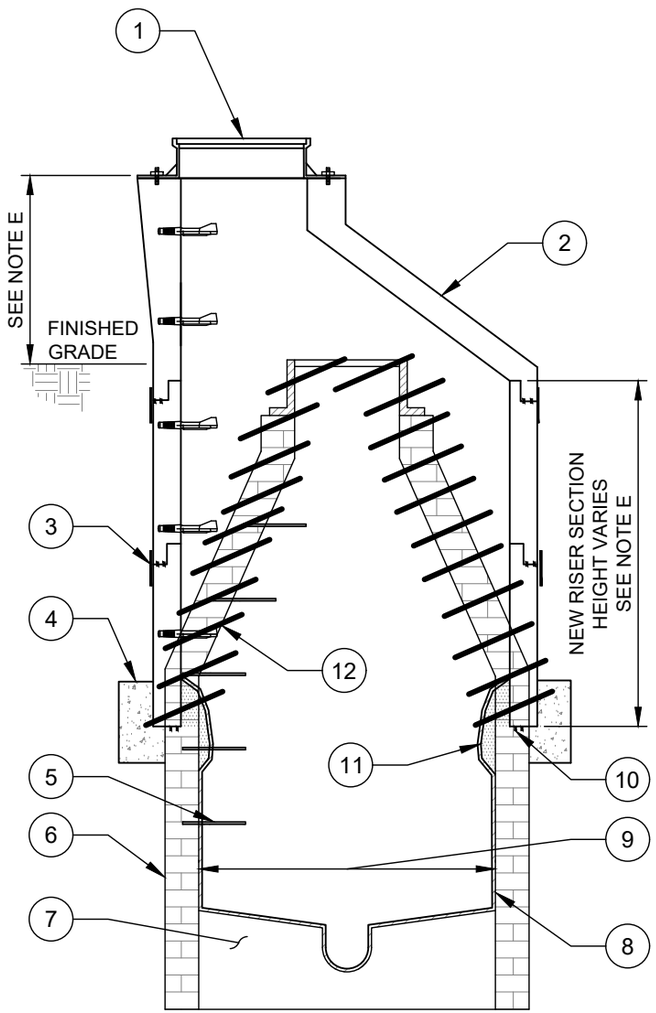
REHABILITATION OF MANHOLE WALLS AND TOP SECTION

NO SCALE

VERSION 1.0

DATE 04/2024

DETAIL 16.3



NO. DESCRIPTION:

1. FRAME AND COVER. SOLID OR WATERTIGHT AS DIRECTED. SEE NOTE H.
2. CONE SECTION. SEE NOTE G.
3. MIN. 6" WIDE BUTYL RUBBER JOINT WRAP ON EXTERIOR OF ALL JOINTS.
4. CONCRETE COLLAR ALL AROUND JOINT. SEE NOTE F.
5. EXISTING MANHOLE STEPS TO BE REMOVED UNLESS DIRECTED OTHERWISE BY THE SEALING ENGINEER.
6. EXISTING MANHOLE WALL. SEE NOTE B.
7. EXISTING BENCHING.
8. MIN. 1 INCH THICK CEMENTITIOUS LINER ON VERTICAL WALL TO 6" ABOVE RISER SECTION. SEE NOTE I.
9. MANHOLE DIAMETER VARIES. CONTRACTOR TO DETERMINE IN FIELD. SEE NOTE C.
10. INSTALL 2 PIECES BUTYL RUBBER UNDER RISER SECTION WHERE POSSIBLE. SEE NOTE F.
11. FILL INSIDE JOINT WITH NON-SHRINK GROUT. SEE NOTE F.
12. REMOVE EXISTING MH. SEE NOTES C AND D.

NOTES:

A. ALL WORK AND MATERIALS TO BE IN ACCORDANCE WITH CLTW STANDARD SPECIFICATIONS AND DETAILS.

B. THIS DETAIL DEPICTS AN EXISTING BRICK MANHOLE WITH A TYPICAL CHIMNEY SECTION. SOME MANHOLES MAY BE PRECAST CONCRETE WITH CONE SECTIONS.

C. CONTRACTOR TO MEASURE THE INSIDE DIAMETER OF EXISTING MANHOLE TO SELECT APPROPRIATE DIAMETER OF NEW RISERS.

D. CONTRACTOR TO REMOVE EXISTING WALLS TO SOLID STRUCTURE (TO AT LEAST BELOW THE CONE OR CHIMNEY SECTION) OR TO THE SPECIFIED LOCATION. THE LIMITS OF REMOVAL SHALL BE APPROVED BY THE SEALING ENGINEER IN THE FIELD. CONTRACTOR TO ALSO REMOVE EXISTING FRAMES AND COVERS, VENT PIPES AND ALL APPURTENANCES, STEPS, ETC. CONTRACTOR TO DISPOSE OF ALL MATERIALS OFF-SITE. NO DEBRIS SHALL BE DROPPED INTO THE SEWER. IF DEBRIS ENTERS THE SEWER, THE CONTRACTOR WILL BE REQUIRED TO CLEAN THE SEWER AT NO ADDITIONAL COST TO THE OWNER.

E. CONTRACTOR TO INSTALL NEW RISER AND CONE SECTIONS AS NECESSARY TO EXTEND THE MANHOLE TO THE SPECIFIED/APPROVED ELEVATION. THE FINAL ELEVATION MAY BE HIGHER THAN, LOWER THAN OR EQUAL TO THE EXISTING ELEVATION. THIS DETAIL ILLUSTRATES A HIGHER ELEVATION. THE CONTRACTOR SHALL DETERMINE THE REQUIRED RISER AND CONE HEIGHTS TO MEET THE SPECIFIED ELEVATION. SEALING ENGINEER SHALL APPROVE FINAL ELEVATIONS IN THE FIELD. BOTTOM RISER TO BE PROVIDED WITH A FLAT JOINT UNLESS OTHERWISE APPROVED.

F. CONTRACTOR TO SEAL NEW RISER SECTION/EXISTING WALL JOINT TO PROVIDE A LEAK-TIGHT JOINT. THE CONTRACTOR SHALL PERFORM ALL WORK NECESSARY TO PROVIDE A LEAK-TIGHT SEAL. WHERE POSSIBLE, BUTYL RUBBER SEALANT SHALL BE PROVIDED UNDER THE NEW RISER SECTION. IN ALL CASES, A CONCRETE COLLAR SHALL BE POURED AROUND THE JOINT. COLLAR TO BE MINIMUM 6 INCHES WIDE AND 12" HIGH CENTERED ON JOINT ALL AROUND.

G. NEW CONE SECTIONS TO BE INSTALLED ON TOP OF NEW RISER SECTIONS UNLESS SPECIFIED OTHERWISE. FRAMES TO BE BOLTED ONTO CONE SECTIONS PER CLTW STANDARD DETAILS. REFER TO APPROPRIATE STD. DETAIL FOR CLEANOUT REPLACEMENT FOR ALL WORK IN PAVED AREAS.

H. COVERS SHALL BE CAM-LOCK WATERTIGHT COVERS OR SOLID COVERS AS DIRECTED BY THE SEALING ENGINEER.

I. ALL MANHOLES THAT ARE REHABILITATED USING THIS DETAIL SHALL BE COATED WITH CEMENTITIOUS MORTAR TO 6" ABOVE THE EXISTING MANHOLE/NEW RISER SECTION INTERFACE. REFER TO APPROPRIATE STD. DETAIL FOR REHABILITATION OF EXISTING MANHOLES EXCEPT FOR THE LIMIT OF CEMENTITIOUS MORTAR AT THE TOP OF THE MANHOLE.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
SEWER REHAB

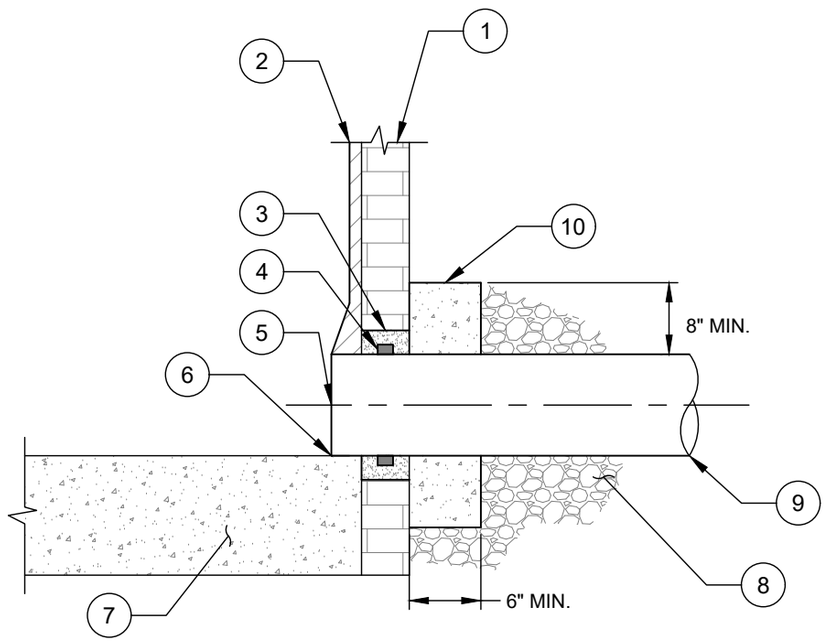
REHABILITATION OF MANHOLE WALLS AND TOP SECTION (WITH CONE SECTION)

NO SCALE

VERSION 1.0

DATE 04/2024

DETAIL 16.4



SECTION VIEW

NO. DESCRIPTION:

1. EXISTING MANHOLE WALL.
2. MIN. 1 INCH THICK LINER TO BE INSTALLED AFTER SEWER REPLACEMENT IS COMPLETE WHERE SPECIFIED. MATCH LINER TO END OF PIPE AS SHOWN. REFER TO APPROPRIATE STD. DETAIL FOR REHABILITATION OF EXISTING MANHOLES.
3. REMOVE EXISTING PIPE AND MANHOLE WALL AS NECESSARY TO INSTALL NEW PIPE. OPENING IN WALL SHALL BE APPROXIMATELY THE PIPE OD+3" ALL AROUND. AFTER PIPE INSTALLATION, FILL VOIDS AROUND PIPE COMPLETELY WITH NON-SHRINK GROUT.
4. HYDROPHILIC WATERSTOP (HYDROTITE BY SIKA OR APPROVED EQUAL) WRAPPED AROUND PIPE MIN. 4 TIMES.
5. EXTEND NEW PIPE MIN. 2" INTO MANHOLE.
6. MATCH NEW PIPE TO EXISTING INVERT ELEVATION.
7. EXISTING MANHOLE BASE.
8. #57 STONE ALL AROUND.
9. NEW SEWER PIPE.
10. INSTALL CONCRETE COLLAR ALL AROUND NEW PIPE. CONCRETE SHALL BE MIN 3,600 PSI. PER CLTW STANDARD SPECIFICATIONS.

NOTES:

A. CONTRACTOR SHALL REFER TO THIS DETAIL WHEN CONNECTING NEW SEWER PIPES TO EXISTING MANHOLES. THE NEW PIPES MAY BE INSTALLED FOR A POINT REPAIR, PIPE REPLACEMENT, OR SERVICE LATERAL REPLACEMENT. FOR PIPE BURSTING, REFER TO APPROPRIATE STD. DETAIL.

B. TRACER WIRE INSTALLED PER CLTW TRACER WIRE DETAIL AS APPLICABLE.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
SEWER REHAB

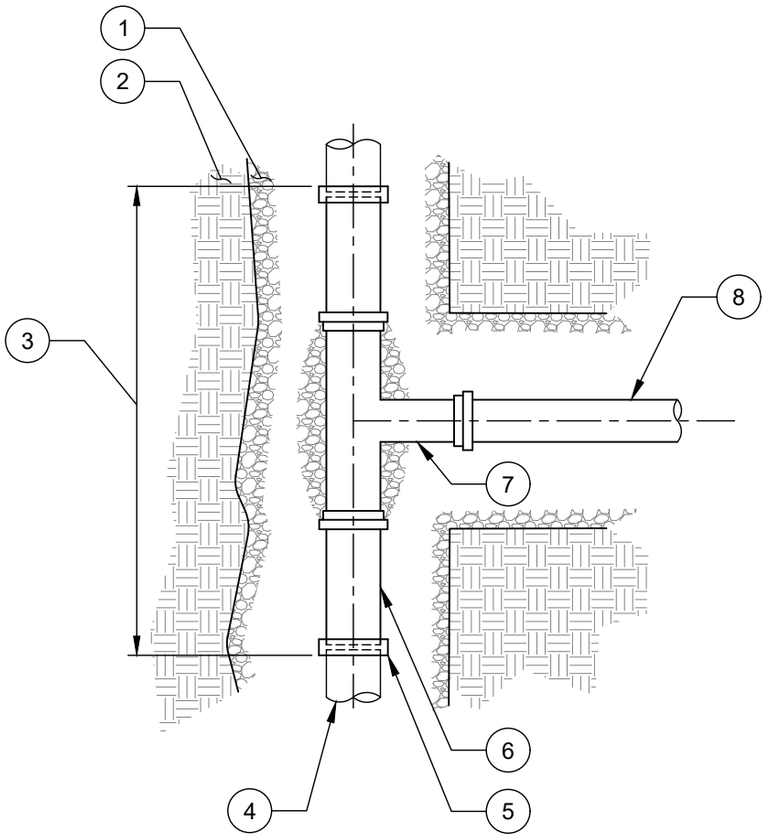
NEW PIPE CONNECTION AT EXISTING MANHOLE

NO SCALE

VERSION
1.0

DATE
04/2024

DETAIL
16.5



PLAN VIEW

NO.	DESCRIPTION:
1.	#57 STONE. SEE NOTE E.
2.	UNDISTURBED EARTH.
3.	CUT AND REMOVE EXISTING SEWER SERVICE CONNECTION AND REPLACE WITH NEW DIP SEWER AND TEE SERVICE CONNECTION. SEE NOTE B. MIN. LENGTH OF REPLACEMENT SHALL BE 7'.
4.	EXISTING SEWER.
5.	RUBBER SLEEVE COUPLING WITH STAINLESS STEEL COMPRESSION BANDS AND SHEAR RINGS - MISSION ARC, FERNCO STRONGBACK OR APPROVED EQUAL. (TYP. EACH END) (MIN. 6" WIDE).
6.	NEW SEWER. LENGTH AS REQUIRED (TYP. EACH END).
7.	NEW DUCTILE IRON TEE. SEE NOTE F.
8.	NEW REPLACEMENT SERVICE LATERAL PIPE. SEE NOTES C AND D.

NOTES:

A. REPLACE EXISTING SERVICE LATERALS WHERE SPECIFIED BY THE SEALING ENGINEER. REPLACEMENT TO INCLUDE THE TEE AND 6 FEET OF SERVICE LATERAL TO RECONNECT TO THE EXISTING LATERAL OR ADDITIONAL LATERAL TO INSTALL THE NEW LATERAL ALL THE WAY TO THE EDGE OF THE PROPERTY LINE OR ROAD R/W. INSTALL A CLEANOUT AT THE END OF THE NEW LATERAL PER THE APPROPRIATE STD. DETAIL WHEN DIRECTED BY THE SEALING ENGINEER. THE SEALING ENGINEER WILL DETERMINE WHICH SERVICES TO REPLACE FROM REVIEW OF TELEVISION INSPECTIONS.

B. INSTALL THE NEW SEWER AT A CONSTANT SLOPE BETWEEN THE TWO EXISTING PIPE ENDS.

C. INSTALL FITTINGS, ADAPTERS AND RUBBER SLEEVE COUPLINGS AS NECESSARY TO CONNECT NEW TEE AND SERVICE LATERAL. NEW SERVICE LATERALS SHALL BE DUCTILE IRON PIPE (DIP) OR POLYVINYL CHLORIDE (PVC). NEW LATERALS AND TEE BRANCHES SHALL BE THE SAME SIZE AS THE EXISTING LATERAL.

D. NEW SERVICE LATERAL SHALL BE INSTALLED AT THE EXISTING LATERAL SLOPE AND IN THE EXISTING LATERAL LOCATION. CONNECT NEW LATERAL TO EXISTING LATERAL WITH RUBBER SLEEVE COUPLINGS WITH STAINLESS STEEL COMPRESSION BANDS AND SHEAR RINGS. BYPASS FLOWS FROM THE LATERAL DURING CONSTRUCTION TO MAINTAIN SEWER SERVICE. DISPOSE OF EXISTING LATERAL PIPE MATERIAL OFFSITE.

E. INSTALL AND COMPACT #57 CRUSHED STONE TO A MIN. OF 1 FOOT ABOVE THE TOP OF THE NEW SEWER PIPE, TEE, FITTINGS AND SERVICE LATERAL PIPES (COMPLETE TO CLEANOUT). IN PAVED AREAS, INSTALL AND COMPACT IMPORTED ABC STONE OR PIT GRAVEL FROM TOP OF STONE TO PAVEMENT SUBGRADE. IN UNPAVED AREAS, INSTALL AND COMPACT COMMON FILL FROM TOP OF STONE TO FINISHED GRADE. RESTORE SURFACE TO MATCH EXISTING CONDITIONS.

F. TEES SHALL BE ROTATED MINIMUM 22 1/2° PER CLTW STANDARDS. INSTALL FITTINGS AS NECESSARY TO RETURN THE NEW LATERAL TO THE EXISTING LATERAL ELEVATION. ALL TEES SHALL BE DUCTILE IRON. REFERENCE SPECIFICATIONS FOR TEE INSTALLATION.

G. TRACER WIRE INSTALLED PER CLTW TRACER WIRE DETAIL AS APPLICABLE.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
SEWER REHAB

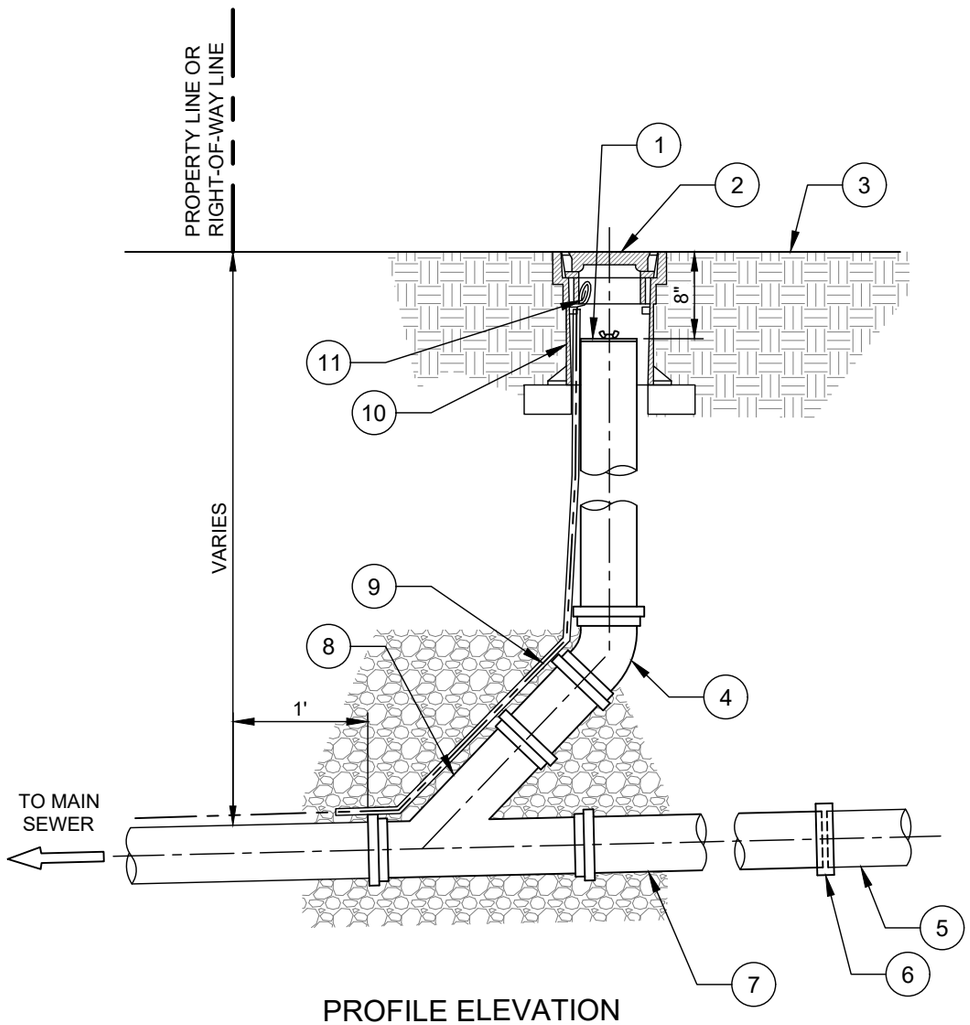
SERVICE LATERAL REPLACEMENT

NO SCALE

VERSION
1.0

DATE
04/2024

DETAIL
16.6



PROFILE ELEVATION

NO. DESCRIPTION:

1. CLEANOUT CAP SHALL BE PLASTIC GRIPPER PLUG, END OF PIPE MODEL, BY CHERNE INDUSTRIES OR APPROVED EQUAL.
2. COVER TO READ "SEWER". SEE NOTE A.
3. FINAL GRADE. SEE NOTE A.
4. 45° BEND.
5. EXISTING SERVICE LATERAL.
6. CONNECT NEW LATERAL PIPE TO EXISTING LATERAL WITH RUBBER SLEEVE COUPLING WITH STAINLESS STEEL COMPRESSION BANDS AND SHEAR RINGS - MISSION ARC, FERNCO STRONGBACK OR APPROVED EQUAL. COUPLING TO BE MIN. 4" WIDE.
7. NEW DIP OR PVC SERVICE LATERAL PIPE. SEE NOTE C.
8. 45° WYE BRANCH.
9. #12 AWG SOLID COPPER TRACER WIRE, WITH 30 MILS GREEN HDPE INSULATION.
10. TWO PIECE CAST IRON VALVE BOX, RATED FOR TRAFFIC LOADING. SEE NOTE D.
11. TRACER WIRE TERMINATION. SEE CLTW STD. DETAIL.

NOTES:

A. CLEANOUT COVER TO BE FLUSH WITH THE FINAL GRADE. RESTORE SURFACE TO MATCH EXISTING CONDITIONS IN ACCORDANCE WITH CLTW STANDARD SPECIFICATIONS AND DETAILS.

B. LOCATION OF CLEANOUT SHALL BE AS DIRECTED BY SEALING ENGINEER.

C. NEW SERVICE LATERAL PIPE, CLEANOUT PIPING AND FITTINGS SHALL BE DIP OR PVC. NEW SERVICE LATERALS SHALL BE INSTALLED TO MATCH THE EXISTING SLOPES AND CONFIGURATIONS UNLESS NOTED OTHERWISE. REFER TO APPROPRIATE STD. DETAIL.

D. FOR 6" CLEANOUTS, VALVE BOX TO BE REPLACED WITH US FOUNDRY MODEL 7621 COVER OR EQUAL.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
SEWER REHAB

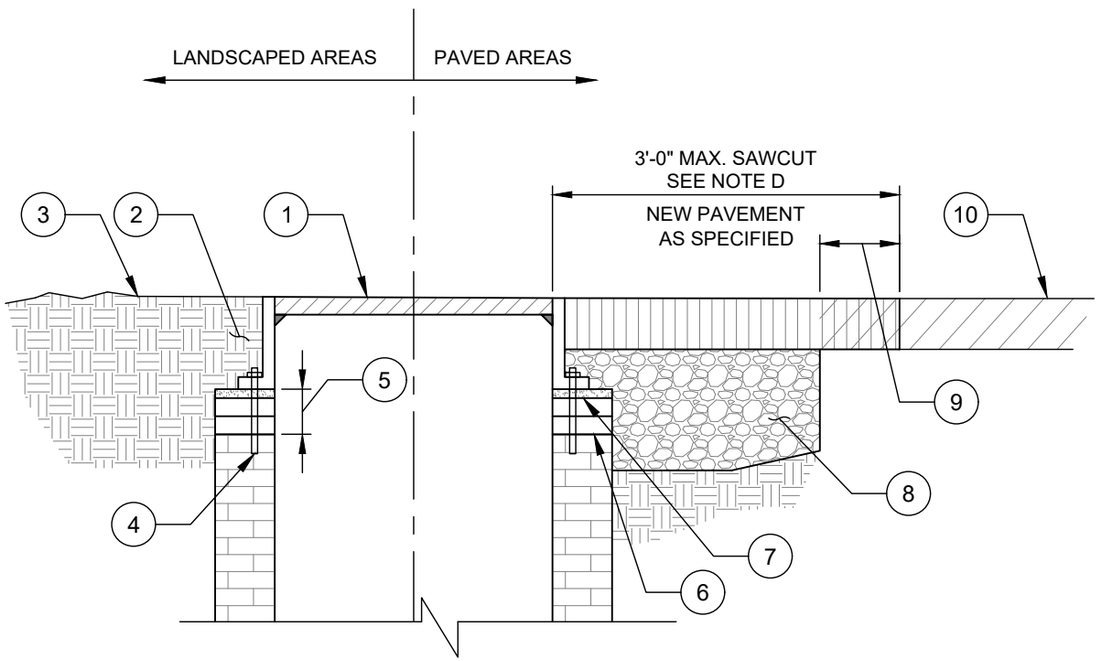
CLEANOUT REPLACEMENT

NO SCALE

VERSION
1.0

DATE
04/2024

DETAIL
16.7



PROFILE VIEW

NO.	DESCRIPTION:
1.	MANHOLE FRAME AND COVER. SEE NOTES A, E, AND F.
2.	COMPACTED SOIL TO GRADE. SEED AND MULCH AS SPECIFIED.
3.	EXISTING GRADE.
4.	ANCHOR BOLTS ALL AROUND. ANCHOR FRAME TO SOLID BRICK, BLOCK, OR CONCRETE.
5.	6" MIN. SEE NOTE B.
6.	NEW MASONRY WORK, CONCRETE, RUBBER OR EXPANDED POLYPROPYLENE ADJUSTING GRADE RINGS. SEE NOTES B AND C.
7.	3:1 SAND/CEMENT MORTAR. MIN. 1/2" THICK ALL AROUND. SEE NOTE C.
8.	INSTALL AND COMPACT ABC STONE TO SUBGRADE. SEE NOTE G.
9.	1 FOOT OVERLAP.
10.	EXISTING PAVEMENT.

NOTES:

A. CONTRACTOR SHALL REFER TO THIS DETAIL WHEN RAISING MANHOLES AND WHEN RESETTING OR REPLACING EXISTING FRAMES AND COVERS. ALL REHABILITATION OF FRAMES AND COVERS SHALL BE COMPLETED PRIOR TO OTHER MANHOLE REHABILITATION WORK. THIS DETAIL ILLUSTRATES MANHOLES AT GRADE. FOR FRAME AND COVERS ABOVE GRADE, WORK SHALL BE IN ACCORDANCE WITH THIS DETAIL AND ALL OTHER REQUIREMENTS IN CLTW STANDARD SPECIFICATIONS AND DETAILS.

B. CONTRACTOR TO REMOVE AT LEAST 6" OF EXISTING BRICK AND/OR MATERIAL PRIOR TO INSTALLING NEW MASONRY OR CONCRETE, RUBBER, OR EXPANDED POLYPROPYLENE ADJUSTING RINGS, TO PROVIDE A NEW SOLID SURFACE FOR SEATING THE FRAME AND TO PROVIDE A LEAK-TIGHT SEAL.

C. REMOVE ALL LOOSE BRICKS AND MORTAR AND PROVIDE A SMOOTH LEVEL SURFACE PRIOR TO INSTALLING MASONRY OR CONCRETE, RUBBER, OR EXPANDED POLYPROPYLENE ADJUSTING RINGS. BRUSH SURFACE WITH STIFF WIRE BRUSH PRIOR TO PLACING MORTAR.

D. REFERENCE CDOT/NCDOT OR OTHER GOVERNING MUNICIPALITIES CURRENT STANDARDS. IN PAVED AREAS, PAVEMENT SHALL BE SAW-CUT NEATLY IN ACCORDANCE WITH APPROPRIATE GOVERNING BODY STANDARD.

E. MANHOLE COVER TO BE FLUSH WITH EXISTING GRADE UNLESS NOTED OTHERWISE.

F. ALL NEW FRAME AND COVERS (WHERE REQUIRED) SHALL BE SOLID OR WATERTIGHT AS SPECIFIED BY THE SEALING ENGINEER.

G. FOR COVERS IN PAVED AREAS, FILL AROUND FRAME AND EXPOSED MANHOLE WALL COMPLETELY WITH ABC STONE. ABC STONE TO EXTEND TO EXISTING PAVEMENT - NEW PAVEMENT (TO MATCH OR EXCEED EXISTING) TO BE INSTALLED FROM TOP OF ABC STONE TO TOP OF FRAME.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
SEWER REHAB

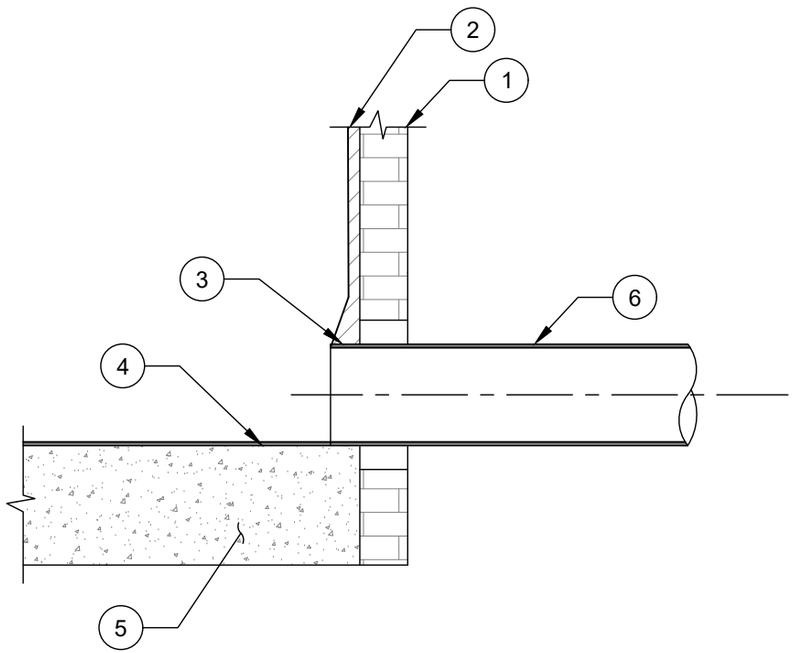
REHABILITATION OF MANHOLE FRAME AND COVER

NO SCALE

VERSION
1.0

DATE
04/2024

DETAIL
16.8



SECTION VIEW

NO.	DESCRIPTION:
1.	EXISTING MANHOLE WALL.
2.	NEW CEMENTITIOUS LINER. SEE APPROPRIATE STD. DETAIL. SEE NOTES B AND C.
3.	LINER PIPES SHALL BE NEATLY CUT 2" FROM THE MANHOLE WALL.
4.	BUILD UP EXISTING INVERT WITH NON-SHRINK GROUT TO MATCH NEW LINER INVERTS. PROVIDE CONSTANT SLOPE FROM INLET TO OUTLET PIPES. BYPASS FLOWS AROUND MANHOLE WHEN PERFORMING THIS WORK UNTIL GROUT HAS CURED. SEE APPROPRIATE STD. DETAIL FOR REHABILITATION OF EXISTING MANHOLES.
5.	EXISTING MANHOLE BASE.
6.	NEW LINER PIPE INSIDE EXISTING SEWER PIPE. SEE NOTE D.

NOTES:

A. CONTRACTOR SHALL REFER TO THIS DETAIL WHEN TERMINATING LINER PIPES IN MANHOLES.

B. CONTRACTOR SHALL FILL ANY VOIDS BETWEEN EXISTING SEWER PIPE AND MANHOLE WALL AND BETWEEN THE EXISTING SEWERS AND LINER PIPES WITH NON-SHRINK GROUT PRIOR TO INSTALLING CEMENTITIOUS LINER. SEE NOTE D.

C. THIS DETAIL SHOWS THE LINER TERMINATION IN A REHABILITATED MANHOLE. IF MANHOLE IS NOT REHABILITATED AS NOTED ON DRAWINGS, CONTRACTOR SHALL CUT LINER PIPE 2" FROM THE EXISTING WALL, FILL VOIDS AROUND EXISTING PIPE AND LINER PIPE WITH GROUT, AND COAT THE EXISTING INVERT CHANNEL TO MATCH LINER PIPE AND/OR EXISTING SEWER PIPES. SEE NOTE D.

D. WATERSTOP MATERIAL (HYDROTITE BY SIKA OR APPROVED EQUAL) BETWEEN THE EXISTING SEWER AND CIPP IS NOT SHOWN FOR CLARITY - REFER TO THE MATERIAL SPECIFICATIONS. WATERSTOP TO BE INSTALLED AROUND THE CIPP APPROXIMATELY 6" FROM THE INSIDE OF THE MANHOLE WALL.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
SEWER REHAB

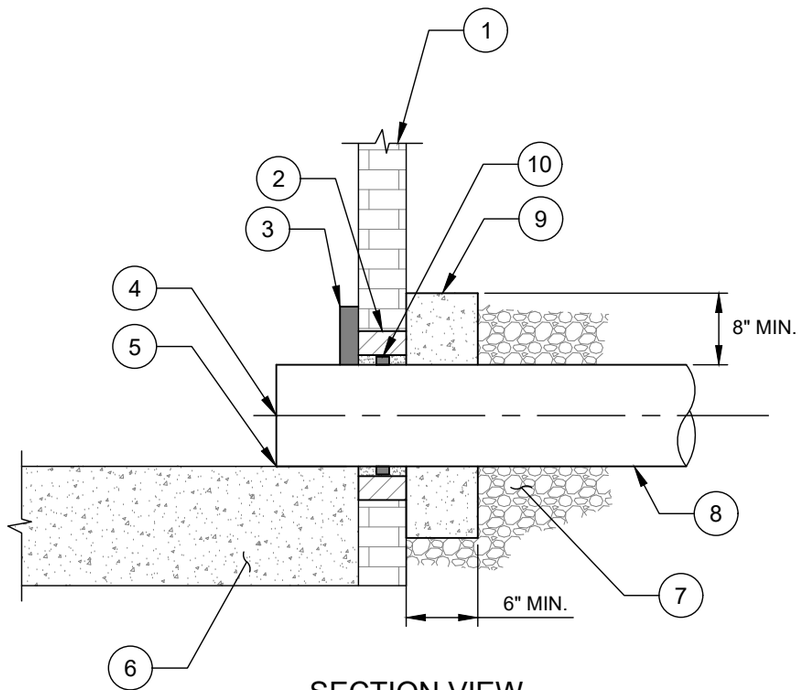
LINER CONNECTION AT MANHOLE

NO SCALE

VERSION
1.0

DATE
04/2024

DETAIL
16.9



SECTION VIEW

NO.	DESCRIPTION:
1.	EXISTING MANHOLE WALL.
2.	REMOVE EXISTING PIPE AND MANHOLE WALL AS NECESSARY TO INSTALL NEW PIPE. MAX OPENING IN WALL SHALL BE PIPE OD+3" ALL AROUND. AFTER PIPE INSTALLATION, FILL VOIDS AROUND PIPE COMPLETELY WITH NON-SHRINK GROUT.
3.	ELECTROFUSION FLEX RESTRAINT(S) BY GEORG FISCHER CENTRAL PLASTICS, HARCO, OR PERFORMANCE PIPE, FUSED TO PIPE ON INSIDE OF MANHOLE TO PREVENT MOVEMENT. SEE NOTE B.
4.	EXTEND PIPE INTO MH. SEE NOTE C.
5.	MATCH NEW PIPE TO EXISTING INVERT ELEVATION.
6.	EXISTING MANHOLE BASE.
7.	#57 STONE ALL AROUND.
8.	NEW HDPE PIPE INSTALLED VIA PIPE BURSTING.
9.	INSTALL CONCRETE COLLAR ALL AROUND NEW PIPE. CONCRETE SHALL BE MIN 3,600 PSI.
10.	HYDROPHILIC WATERSTOP (HYDROTITE BY SIKA OR APPROVED EQUAL) WRAPPED AROUND PIPE MIN. 4 TIMES.

NOTES:

A. CONTRACTOR SHALL REFER TO THIS DETAIL WHEN CONNECTING NEW HDPE SEWER PIPES INSTALLED VIA PIPE BURSTING TO EXISTING OR NEW MANHOLES.

B. INSTALL FLEX RESTRAINTS AFTER HDPE HAS FULLY RELAXED. RESTRAINT TO BE LOCATED AGAINST MANHOLE WALL. PROVIDE 1 RESTRAINT FOR 8" AND 10" PIPE, 2 RESTRAINTS FOR 12" PIPE AND 3 RESTRAINTS FOR 16" AND 18" PIPE.

C. EXTEND PIPE INTO MH A SUFFICIENT LENGTH TO ALLOW INSTALLATION OF FLEX RESTRAINTS AND TO ACCOMMODATE MH REHAB IF SPECIFIED. PIPE SHALL NOT IMPEDE FLOW THROUGH MANHOLE. COORDINATE WITH SEALING ENGINEER.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

SEWER REHAB

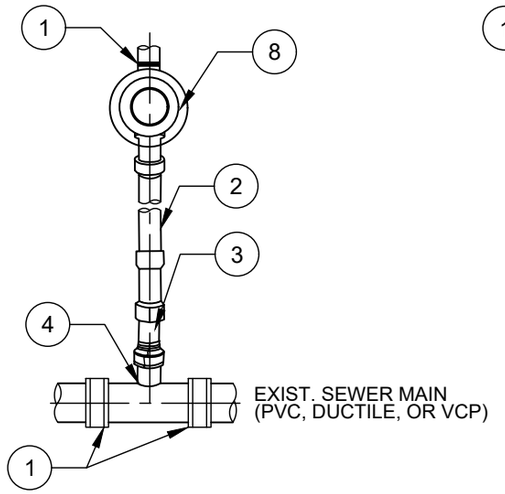
HDPE PIPE CONNECTION AT MANHOLE FOR PIPE BURSTING

NO SCALE

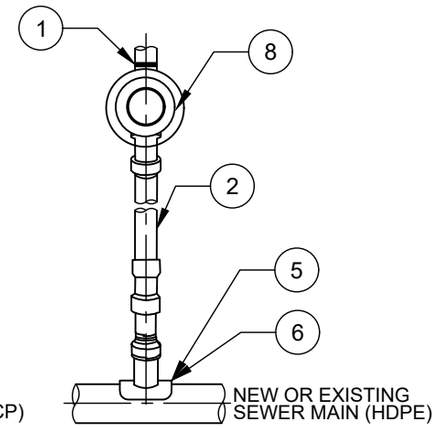
VERSION
1.0

DATE
04/2024

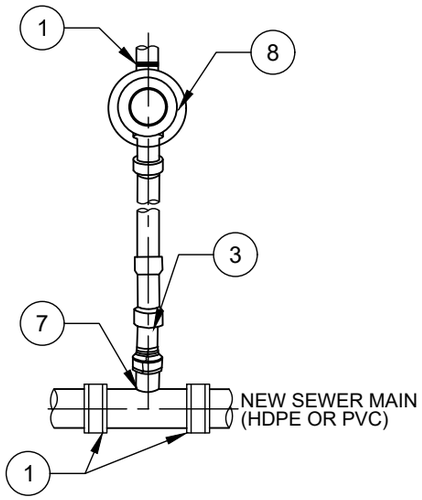
DETAIL
16.10



NEW HDPE LATERAL INTO
EXISTING SEWER



NEW HDPE LATERAL INTO
NEW OR EXISTING HDPE SEWER



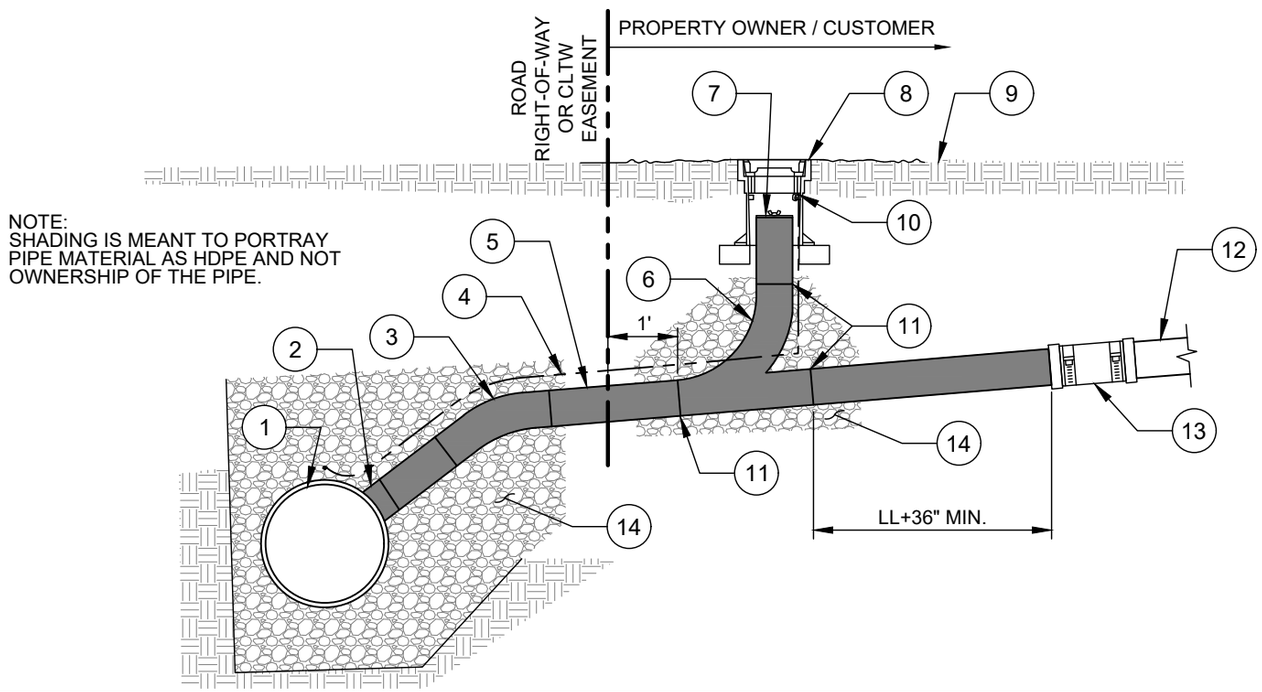
EXISTING LATERAL INTO
NEW HDPE OR PVC SEWER

NO. DESCRIPTION:

1. RUBBER COUPLING.
2. NEW HDPE SEWER LATERAL (DR 17).
3. TRANSITION COUPLING.
4. EPOXY SADDLE.
5. ELECTROFUSION SADDLE.
6. STRAPPED RUBBER SADDLE (PVC HUB, RUBBER SADDLE, AND SS BAND).
7. FABRICATED HDPE TEE.
8. CLEAN OUT.

NOTES:

A. RUBBER COUPLINGS SHALL BE SHIELDED TYPE WITH STAINLESS STEEL SERIES 300 BANDSCREW AND HOUSING WITH SHEAR BAND.
B. RUBBER SADDLES SHALL BE SEALED WITH AN ELASTOMERIC SEALANT. SEE SPECIFICATIONS.
C. CHANGES IN PIPE TYPE AND CONNECTIONS ARE NOTED ON THE DRAWINGS
D. IF ADDITIONAL COUPLINGS ARE NEEDED TO MAKE A CONNECTION, THE CONTRACTOR SHALL USE ELECTROFUSION COUPLINGS
E. ELECTROFUSION SADDLES SHALL CONSIST OF A FUSION SADDLE WITH AN INTEGRAL FUSION COUPLER AT ITS OUTLET.



NO. DESCRIPTION:

1. HDPE SEWER MAIN INSTALLED BY PIPE BURSTING.
2. ELECTROFUSION SADDLE TEE.
3. BEND - 22.5° OR 45°.
4. TRACER WIRE-CONTINUOUS AWG #12 GAUGE SOLID COPPER TRACER WIRE WITH 30 MIL THICK GREEN HDPE INSULATION.
5. HDPE GRAVITY SEWER PIPE - DR17, BUTT FUSED OR ELECTROFUSED.
6. HDPE LONG RADIUS WYE.
7. PLASTIC GRIPPER (END OF PIPE-TYPE) PLUG.
8. CAST IRON SEWER VALVE BOX TOP SECTION AND LID.
9. FINISH GRADE.
10. TRACER WIRE TERMINATION. SEE STANDARD DETAIL.
11. ELECTROFUSION COUPLING OR BUTT FUSION JOINT.
12. CUSTOMER SEWER LATERAL.
13. FLEXIBLE, SHIELDED, COUPLING WITH SHEAR BAND.
14. SEWER MAIN, SADDLE TEE, AND BEND SHALL BE COMPLETELY EMBEDDED WITH #57 WASHED STONE.

NOTES:

A. MINIMUM LATERAL SLOPE SHALL BE 1.0%.
B. BASED ON SITE CONDITIONS, CLTW MAY APPROVE THE CLEANOUT INSIDE THE ROAD RIGHT-OF-WAY.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
SEWER REHAB

4-INCH TO 6-INCH SEWER CLEANOUT AND LATERAL ON HDPE PIPE BY PIPE BURSTING

NO SCALE

VERSION
1.0

DATE
04/2024

DETAIL
16.11

CHAPTER 17

TEMPORARY BYPASS PUMPING SYSTEMS FOR GRAVITY SEWER PIPE DIAMETERS GREATER THAN 24-INCHES IN DIAMETER

CHAPTER 17

TEMPORARY BYPASS PUMPING SYSTEMS FOR GRAVITY SEWER PIPE DIAMETERS GREATER THAN 24-INCH IN DIAMETER

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PART 1 - GENERAL

1.1 DESCRIPTION AND SCOPE

A. The Contractor shall furnish, construct, maintain and operate bulkheads, containment system, plugs, hoses, piping, and pumps to bypass sewage flow around the project area for the duration of the project. The bypass system shall, at all times, prevent backup or overflow onto streets, yards and unpaved areas or into buildings, adjacent ditches, storm sewers, and waterways. The Contractor shall design and provide the bypass system with sufficient firm pumping capacity to pump the existing sewer being bypassed flowing full and/or to convey the flows specified further herein. Firm capacity is defined as the capacity of the pumping system when the largest pump is out of service. The Contractor is advised that during rain events the flow in the existing sewers will increase rapidly and will fill the pipe and, in many cases, surcharge the pipe.

B. Spills of any type, including but not limited to all spills and/or leaks caused by the operation of bypass pumps or other operations of the Contractor, are strictly prohibited at all times; notwithstanding such prohibition, any such occurrence shall be reported to Charlotte Water immediately after discovery and all costs, associated with the overflow and overflow clean up, including any fines and legal costs incurred by Charlotte Water and costs associated with property damage as a result of the overflow, shall be paid for solely by the Contractor. Costs of damage to real or personal property as a result of an overflow, and any other direct, indirect, incidental or consequential damages resulting therefrom or related thereto, shall be the sole responsibility of the Contractor, for which the Contractor will defend, indemnify and hold Charlotte Water harmless. In addition to these responsibilities of the Contractor, any spill that reaches a natural stream caused by the negligent operations of the Contractor may be deemed to be a substantial violation of the Contract Documents and a basis for termination under the General Conditions of this Contract.

C. The Contractor is forewarned of the potential for sewer surges which cause rapid increases in sewer discharges, in particular during rain events and from upstream pump station on/off operations. The Contractor's bypass equipment and set up shall be adequate to prevent overflows under these surge conditions. The Contractor shall provide ample free board and wet well volume as required to contain the sewage. If risers to assist with sewage containment are proposed by the Contractor, the risers shall be coordinated with the upstream system to prevent any backups, overflows, or any other problems.

1.2 RELATED DOCUMENTS

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

1.3 DEFINITIONS AND ABBREVIATIONS

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

1.4 BYPASS PUMPING SYSTEM – DESIGN REQUIREMENTS

A. The bypass pumping systems shall have sufficient capacity to pump a peak flow of the line segment to be bypassed as specified herein. The Bypass Contractor shall provide all pipeline plugs, pumps of adequate size to handle peak flow during a 10-year storm event, and temporary discharge piping to ensure that the total flow of the main can be safely diverted around the project area. The bypass pumping system will be required to be operated 24 hours a day.

B. The Contractor shall provide back-up pump(s) equal in capacity to the largest primary pump. Back-up pumps shall be on-line but isolated from the primary system by a valve. Contractor and pump supplier shall determine system pressure requirements based on proposed bypass piping size and layout and shall submit the proposed system curve for the pumping system as designed.

C. The bypass pumping system shall pump the following flows:

1. The pumping system shall meet the firm capacity as defined as the capacity of the pumping system when the largest pump is out of service. This flow represents the peak flow during a 10-year rain event measured in the upstream sewer system over the last several years per flow metering data. If flow monitoring for the upstream sewer system is not available, it is the responsibility of the contractor to perform flow monitoring for a duration of up to 3 months minimum to size the pumping system. Flow projections shall be developed by licensed NC PE and submitted to Charlotte Water for review and approval.

D. If multiple force mains are used, the discharge piping shall be manifolded so the flow can be diverted to each specific pipe or any combination of pipes by quickly opening and/or closing valves. This will also allow a pipe to be isolated to make any necessary repairs.

E. The Bypass Contractor shall have adequate standby equipment available and ready for immediate operation and tied into the bypass system for use in the event of an emergency or breakdown.

F. Flow from all connecting sewers must be accommodated. Connecting sewers larger than 24” shall utilize hard piping and must have primary and standby sound-attenuated diesel auto-priming pumps. If connecting to the main bypass discharge line, the connection must have an isolating gate valve.

G. Suction and Discharge Manholes: Existing manholes to be used as suction manholes and discharge manholes shall be modified by the Contractor as required. The suction manholes are subject to flooding during rain events - all modifications shall provide a leak tight manhole to prevent inflow into the manholes during flood conditions. The discharge manholes shall be sealed and protected per Paragraph 2.4C.

H. Plugging of Flows: A minimum of two (2) plugs shall be used at each location where sewers are being plugged for bypass operations, meaning one plug shall be installed in the outgoing pipe of the manhole where the plugging occurs and then a second plug installed in the next downstream manhole in the incoming pipe. This will provide redundancy in the plugging operation for added safety. All plugs shall be restrained and reinforced to prevent movement and blowouts. The

contractor shall tie-off and/or anchor plugs such that in a blowout event, the plug cannot be transported downstream.

I. A light tower shall be provided at each suction manhole/pump setup for pump watch during overnight hours.

1.5 QUALITY ASSURANCE

A. Any violations resulting from sewage spills shall be the sole responsibility of the Contractor.

1.6 QUALIFICATIONS

A. The design, installation and operation of the temporary pumping system shall be the Contractor's responsibility. The Bypass Contractor (bypass pumping system contractor) shall demonstrate to the Engineer that they specialize in the design and operation of temporary bypass pumping systems. The Bypass Contractor shall provide a minimum of five references of temporary bypass pumping projects of at least 30 million gallons per day (mgd) with at least one of the projects over 50 mgd, of a similar size and complexity as this project, performed by their firm within the past five years. The references shall include project scope of work and contact numbers and names for the Charlotte Water and General Contractor if the work was performed as a subcontractor. Charlotte Water reserves the right to approve or disapprove of a bypass pumping contactor based on experience or performance on other similar projects.

B. The Bypass Contractor must have a physical location and service facility within 60 miles of the project site.

C. All bypass pumping equipment shall be owned and maintained by the Bypass Contractor. No subleasing of bypass pumps or piping shall be allowed, approved or acceptable. Proof of ownership shall be submitted to the Engineer for review and verification. Charlotte Water will not approve the Bypass Contractor if he/she does not own the bypass pumping equipment being furnished for this project.

In addition, all pumps set up and tear down and piping installation and removal shall be performed by employees of the Bypass Contractor as documented by employee records. Subcontracting of the set up and tear down shall not be allowed.

Further, all pump and piping maintenance, repairs, pump watch (manning of pumps 24 hours per day), etc. shall be performed by employees of the Bypass Contractor as documented by employee records. Subcontracting of these duties (and any other duties related to the bypass pumping system) shall not be allowed.

1.7 SUBMITTALS

A. The Contractor shall coordinate with the Engineer to determine the required Bypass System and the type and number of pumps to be used. For bypass pumping systems, Contractor shall submit, prior to installation, a detailed plan and description outlining all details and provisions of the temporary bypass pumping system. The plan shall be specific and complete, including such items as schedules, locations, elevations, type of plugs, plug restraints and blocking, temporary piping, capacities of equipment, instrumentation and controls, alarm systems, communication systems, soundproof enclosures, materials,

precautions taken regarding handling the wastewater flow, and all other incidental items necessary and/or required to ensure proper operation of the bypass pumping system, including protection of the access and bypass pumping locations from damage due to the discharge flows, ability to pump dry weather and wet weather flows, and compliance with the requirements and permit conditions specified in these Contract Documents. No bypass pumping shall begin until all provisions and requirements have been reviewed and approved by Charlotte Water.

B. The design of the temporary bypass system shall be sealed by a North Carolina licensed Professional Engineer. The bypass pumping plan shall include, but not be limited to, the following:

1. Overall sequence of construction for bypass pumping system.

2. General layout for the bypass pumping system including locations and staging areas for pumps and piping locations/routes.

3. Modifications to existing sewer manholes and structures to perform the bypass pumping and restoration to such structures upon completion.

4. Modifications to existing sewer manholes and structures such that the manhole covers are elevated to the 100-year base flood elevation plus 1-foot.

5. Suction and Discharge Piping:

   a. Drawings showing the alignment of the bypass pipes.

   b. Flow stoppage system, including pipe and channel plugging method, types of plugs, plug materials, size of plugs, plug restraints and blocking, location and number of proposed tie-off and/or anchors used to prevent movement or blowouts for plugs.

   c. Details of suction piping including number, size, materials, fittings including quick disconnects, connections to other piping, method of installation, and all other details related to the pump suction piping.

   d. Details of discharge piping including number, size, materials, fittings including quick disconnects, connections to other piping, method of installation, details of the discharge location and piping arrangement at that location, and all other details related to the pump discharge piping.

   e. Sections showing suction and discharge piping depth, embedment, select fill and special backfill.

   f. Restraint systems for piping including thrust and restraint block sizes and locations and/or retraining systems on the piping.

   g. Any temporary pipe supports, and anchoring required.

   h. Show force main pipe material and thickness can withstand all normal operating and surge pressures with a safety factor of 2.0.

   i. Protection against main breaks and damage.

j. Method of protecting discharge manholes or structures from erosion and damage.

k. Schedule for installation of and maintenance of bypass pumping lines.

6. Bypass Pumps

a. Bypass pump sizes, capacity, number of each size to be on site, basis of selection (calculations), and power requirements.

b. Calculations of static lift, friction losses, and flow velocity (pump curves showing pump operating range shall be submitted) for each set up.

c. Size and location of standby power generators and diesel storage and access plan if engine driven equipment is to be provided, or plan for suitable connection to existing electrical gear, if electrical power is to be provided.

d. Elevation of bypass pumps, standby power generators and diesel storage base compared to the 100-year flood base elevation.

e. Design plans for access to bypass pumping locations.

f. Method of noise control for each pump and/or generator including primary sound enclosures and sound blankets.

g. Fuel tank location, size, and containment systems.

h. Fuel consumption rate information (include for proposed pumps, at full capacity, include breakdown for one pump running, two pumps running, etc.).

i. Instrumentation and control system to determine flow levels and to eliminate the risk of spills due to improper installation and operations. The instrumentation and control system submitted by the Contractor for approval by Charlotte Water shall include all equipment proposed (including redundant instrumentation and control equipment) and sequences of instrumentation activation as well as all alarms and fail-safe provisions.

7. Continuous on-site monitoring plan.

8. Traffic control requirements and measures are to be employed throughout the project.

9. General contact and emergency contact information for all personnel responsible for the operations and maintenance of the bypass pumping operations.

1.8 PLAN APPROVAL

A. Completed Bypass Pumping Plans shall be submitted to Charlotte Water for review and approval 30 days prior to any proposed bypass pumping operations.

B. Contractor shall provide full list of employees on watch, schedule, and contact information for each. The list shall include a hierarchy of who is to be notified in the event of an emergency.

PART 2 - PRODUCTS

2.1 BYPASS PUMPING EQUIPMENT

A. The pumps used must be manufactured by a company that is ISO 9001 registered with a RAB (registration accreditation board) accredited third party registrar. The pump manufacturer shall to also be ISO 9001 certified for Engineering Design Services and After Market Service. A copy of the ISO 9001 certificate shall be included with the bypass pump submittal to the Engineer.

B. Pumps shall be dry self-priming type, in good working order, with a working pressure gauge on the discharge. All pumps used shall be fully automatic self-priming units that do not require the use of foot-valves or vacuum pumps in the priming system. All pumps used must be constructed to allow dry running for long periods of time to accommodate the cyclical nature of wastewater flows. The pumping equipment shall be sound attenuated as specified herein and be mounted on an environmental skid which has the capacity of containing any and all hazardous fluids utilized within the engine compartment. All diesel-driven engines must be Tier 3 or newer.

C. Pumps may either be engine driven equipment or electrically driven equipment. Contractor shall be responsible for all power costs associated with provision and operation of engine driven equipment including but not limited to purchase and delivery of fuel. Contractor shall be responsible for providing all equipment and connections required to provide electrically driven equipment and for protecting the power feed. If diesel powered pumps are provided, Contractor shall store sufficient fuel on site to allow for 72 hours of continuous operation without fuel delivery. 72 hours of continuous operation shall be based on 24 hours of operation at the system's firm capacity. The fuel shall be stored responsibly above the 100-year base flood elevation with self-containment and where possible shall not be located in a floodplain.

D. Pumps shall meet the requirements of the governing municipality's noise ordinance. All pumps shall be Quiet Flow™, Critically Silenced™ or sound attenuated to 68 dBA at 23 feet. Pumps shall be provided with a pre-engineered sound attenuation enclosure. Sound blankets shall not be acceptable for primary noise attenuation, but sound blankets may also be required around the entire bypass pumping system if noise becomes an issue. If required, the sound blankets shall be free standing and 12-ft high minimum, shall have Class 1 flammability per ASTM E-84 and shall reduce sound by at least 10 dB at 125 Hz.

E. Contractor shall provide the necessary stop/start controls for each pump. The stop/start control shall be an integral part of the engine control panel. For bypassing sewers greater than 24" and when using 6-inch pumps and larger, transducers are required to maintain the proper surcharge levels in the sewer line.

F. Contractor shall provide level control device to allow pumps to ramp up and down in response to incoming sewage flow. Provide standby level control device to alarm high liquid level and to start pumps. The level control devices shall be designed to operate for a minimum of 24 hours on battery backup in the event of power failure.

G. All pumps shall be manned 24 hours per day when operational. The Engineer will not consider allowing the use of auto dialers to report pumping system emergency

conditions. Full time telemetry is required, and interface with Charlotte Water may be required. All proposed auto-dialer information is to be submitted to Charlotte Water for review and approval.

H. Alarm systems shall be local (flashing light) and shall also activate the auto dialer. At a minimum, the following alarms shall be reported:

1. High liquid level in the bypass pumping suction manhole with level control device.
2. Engine failure
3. Power failure

I. Charlotte Water shall be notified immediately if the bypass pumping system is unable to keep up with the incoming flow, regardless of the reason.

J. The local alarm and level control devices shall be designed to operate for a minimum of 24 hours on battery backup in the event of power failure.

2.2 FORCE MAIN PIPING

A. All discharge piping shall be rigid piping with positive, restrained joints. Allowable piping materials shall be fused, high-density polyethylene pipe (HDPE) as manufactured by Phillips Driscopipe, Inc. or equal, with a minimum wall thickness equaling SDR26 or PVC Pressure Pipe as manufactured by Certa-Lok or approved equal. Under no circumstances will aluminum “irrigation” type piping, glued PVC pipe or soft (lay-flat) hose be allowed.

All fused joints shall be performed by a certified operator (certified by a manufacturer of pipe fusion equipment). An appropriately sized fusion machine shall remain on site throughout the duration of the project to address any emergency pipe repair issues.

B. The force main piping shall be designed and rated for at least 1.25 times the maximum system pressure. The maximum velocity in the suction and discharge piping shall be 10 feet per second. The Contractor shall be responsible for all design calculations and shall be responsible for securing and protecting all force main piping in any manner required by Charlotte Water, Engineer or other controlling agency. The discharge piping shall be protected from pedestrian and vehicular traffic. Contractor shall add additional protection as deemed necessary to fully protect the piping at no additional cost to Charlotte Water. Design of the force main piping in accordance with these specifications shall be documented, including calculations, and submitted to Charlotte Water for approval.

C. Contractor shall provide a temporary cast iron or steel cover over the bypass pumping suction manhole and discharge manhole to safeguard the manholes, to prevent inflow and to minimize odors. At the discharge manhole, the Contractor shall route the discharge piping down into the manhole and shall install 90-degree bends on the end of the piping to direct the flow out of the discharge manhole and heading downstream. The piping arrangement shall be such that the flow is not vertically directed. This piping arrangement will help to direct the flow and minimize turbulence (and odors) in the discharge manhole.

D. A flow meter shall be installed on the discharge piping to continuously document the flow rate being pumped. The flow meter shall be continuously reviewed by the Contractor and compared to the pump curves submitted by the Contractor to

confirm that the bypass pumping system is operating as designed and expected. If the bypass pumping system is not pumping as designed and submitted, the Contractor shall take immediate actions to modify and correct the situation in manner approved by the Engineer. If at any time the bypass pumps are not keeping up with the flow and the specified pumping rate is not being achieved and the situation cannot be immediately resolved, the Contractor shall cease all pumping operations, return the flow to gravity through the existing sewer, and re-design the pumping system.

PART 3 - EXECUTION

3.1 BYPASS SYSTEM

A. Charlotte Water shall have the authority to increase normal working hours of the Contractor during bypass pumping operations.

B. Bypass System shall be comprised of a bypass pumping system combined with temporary piping to convey flow in the existing sewers.

C. It is essential to the operation of the existing sewerage system that there is no interruption in the flow of sewage throughout the duration of the project. To this end, the Contractor shall provide, maintain and operate all temporary facilities such as dams, plugs, pumping equipment (both primary and back-up units as required), piping, all necessary power, and all other labor and equipment necessary to intercept the sewage flow before it reaches the point where it would interfere with the work, carry it past the work, and return it to the existing sewer downstream of the work.

D. The Bypass Contractor shall provide all necessary means to safely convey the sewage past the work area. The Bypass Contractor will not be permitted to stop or impede the main flows under any circumstances. The Bypass Contractor shall maintain sewer flow around the work area in a manner that will protect public and private property from flooding and damage.

E. The Bypass System shall be leak free and shall (at a minimum) maintain the required firm pumping capacity. The Bypass System shall provide reliable and trouble-free pumping of the existing wastewater flow. All local alarms shall be readily visible to and accessible by Charlotte Water.

F. If, at any time during construction, effluent from the existing sewer is not fully contained by the bypass system and/or the bypass system is not keeping up with the flow, gravity service shall be restored immediately, and work shall be suspended until the problem is resolved to the satisfaction of the Engineer. Sewer system overflows will not be tolerated. All fines imposed on Charlotte Water associated with overflows caused by the Contractor's work shall be paid by the Contractor.

G. Odor Issues: If odor complaints occur at any time during the Contract, the Contractor shall take immediate measures to minimize the odor. It will be the Contractor's sole responsibility and cost to do all that is necessary to resolve the odor issues, including revising any bypass pumping layouts/configurations and adding odor control measures (such as chemical additions).

3.2 FIELD QUALITY CONTROL AND MAINTENANCE

A. The Contractor shall provide at least one (1) trained employee to man the bypass pumping system continuously while the pumps are in use to monitor the system and check for alarms and leaks. At no time during the bypass pumping operations shall the system be unmanned.

B. System Testing:

1. The Bypass Contractor shall perform leakage and pressure tests of the bypass pumping discharge piping using clean water prior to actual operation. The Engineer shall be given 24 hours' notice prior to testing.

2. Test pressure shall be 1.25 times the maximum system operating pressure. The test must hold pressure for a minimum of 1 hour.

3. The bypass design operating pressure must not exceed 10 PSI below the max pressure rating of the HDPE.

C. Contractor shall inspect the bypass discharge piping system a minimum of every two (2) hours to ensure no damage or leaks. All leaks must be addressed immediately. Flow shall be diverted off of the leaking piping immediately until repairs are made. The Contractor shall document each inspection and shall submit the inspection logs to the Engineer at the end of each week (or more frequently as required by the Engineer).

D. Contractor shall inspect the pump operation a minimum of every two (2) hours to ensure trouble-free and leak free operation. A monitoring log shall be maintained by the Contractor and available for observation by the Engineer/Charlotte Water upon request. All systems, piping, pumps, air vents, monitoring equipment, valves, plugs, security measures, level indicating devices and all related appurtenances associated with the bypass system shall be continuously and regularly monitored for proper and leak free operation.

E. Contractor shall record the following information every ½ hour in the monitoring log:

1. System Discharge Pressure

2. Pump RPM

3. Suction Manhole surcharge level

4. Plug Pressure

5. Fuel levels

6. Flow

F. Any time the bypass pumping system is operating, the Contractor shall continuously perform the following maintenance services:

1. The Bypass Contractor shall insure that the temporary pumping system is properly maintained. At least one (1) trained pump watch employee (with a fully stocked service vehicle) shall be onsite 24/7 when pumps are operating.

2. The trained employee shall be full time employees of the bypass contractor with at least one year experience with bypass pumping. No temporary employees are permitted to operate or watch the bypass.

G. Spare Parts and Extra Materials:

1. Spare parts for each type of pump and piping shall be kept on site.
2. HDPE repair bands for each size HDPE shall be kept on site.
3. At least one (1) extra plug of each size utilized in the bypass pumping setup.
4. At least one (1) fuel filter.
5. At least one (1) pipe repair clamp shall be on site at all times.

H. In the event of accidental spill or overflow, Contractor shall take all necessary actions immediately to stop the spill or overflow and take action to clean up, disinfect the spill and immediately notify Charlotte Water. Disinfection shall include, but is not limited to, removal of all debris, pumping of any excess overflow back into the system, neutralization by raking and liming. Charlotte Water will provide the Contractor with a call-down emergency list for contacts in the event of a spill or overflow. All bypass system abnormalities, operational changes, maintenance, and repairs shall be reported immediately to the Engineer and Charlotte Water. All alarms shall be responded to in person by qualified Contractor's personnel immediately.

3.3 INSTALLATION AND REMOVAL

A. Contractor shall locate the bypass pipelines to minimize any disturbance to existing utilities and site areas (such as trees) and shall obtain approval of the pipeline locations from the Engineer.

B. The Contractor shall remove manhole sections or make connections to the existing sewer and construct temporary bypass pumping structures only at access locations as approved by the Engineer and as may be required to provide adequate suction conduit.

C. Plugging or blocking of sewage flows shall incorporate a primary and secondary plugging device. When plugging or blocking is no longer needed for performance and acceptance or work, it is to be removed in a manner that permits the sewage flow to slowly return to normal without surge, to prevent surcharging or causing other major disturbances downstream.

D. During all bypass pumping operation, the Contractor shall protect existing structures, equipment and piping from damage inflicted by any equipment. The Contractor shall be responsible for all physical damage to the existing structures, equipment and piping caused by human or mechanical failure.

E. When working inside existing structures, the Contractor shall exercise caution and comply with all federal, state, and local occupational safety and health standards when working in the presence of gases, combustible or oxygen-deficient atmospheres, and confined spaces.

F. The Contractor shall notify the Engineer at least 48 hours prior to initial startup and/or to any significant changes to the bypass system. This includes moving pumps and/or piping, installing or removing plugs, starting a new bypass location, ceasing an existing bypass location, reestablishing gravity flow, etc. The Engineer must inspect and approve the existing layout and all pumping equipment at each significant change to the bypass system. A bypass pumping checklist addressing all relevant features of the bypass system shall be generated by the Contractor and approved by the Engineer. The bypass pumping checklist shall be completed

by both the Contractor and Engineer prior to the startup of any bypass pumping operations and/or to any significant changes to the bypass system.

G. When the bypass piping crosses local streets and private driveways, the Contractor must bury the bypass pipelines in trenches, cover with flowable fill or ABC stone, and install asphalt patches per the Standard Specifications and Details. Steel road plates may be used for short periods of time until the asphalt can be installed. Bypass road ramps will only be allowed if specifically approved by the Engineer. Upon completion of the bypass pumping operations, and after the receipt of written approval of the Engineer, the Contractor shall remove all the piping, restore all property to pre-construction condition and restore all pavement in accordance with the standard specifications and details.

H. When bypass pumping operations are complete, piping shall be drained and flushed into the sewer system prior to disassembly. The piping shall be flushed for a period long enough to ensure that all piping is clean and free from wastewater. All pumps, piping, fittings, thrust blocks, etc. shall be removed from the site upon project completion.

END OF SECTION

TEMPORARY BYPASS PUMPING DETAILS
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17.1 TEMPORARY SEWER BYPASS DETAIL

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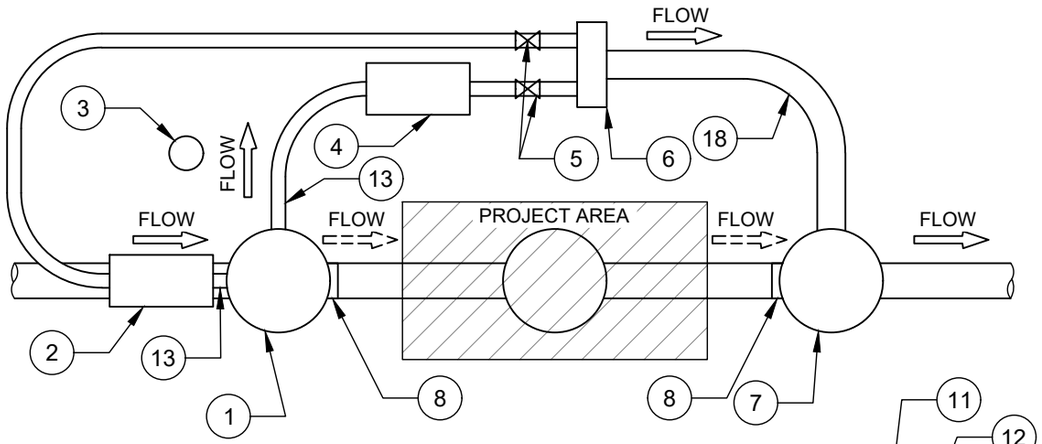
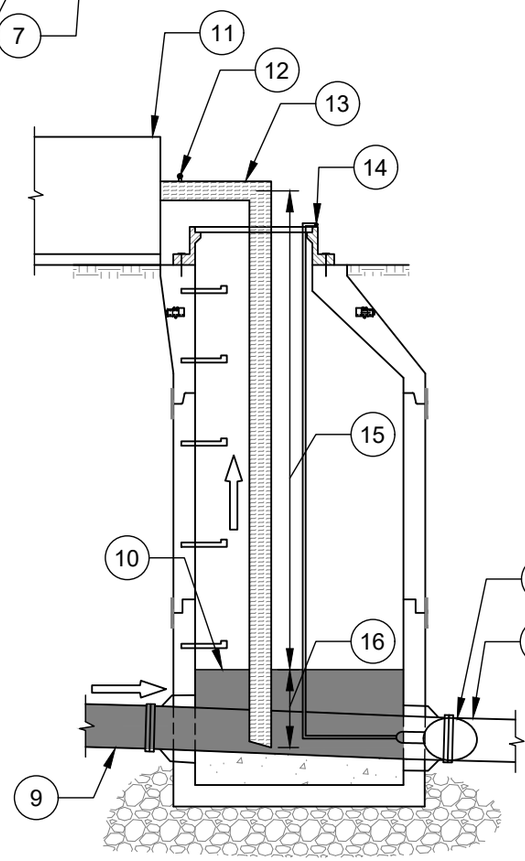
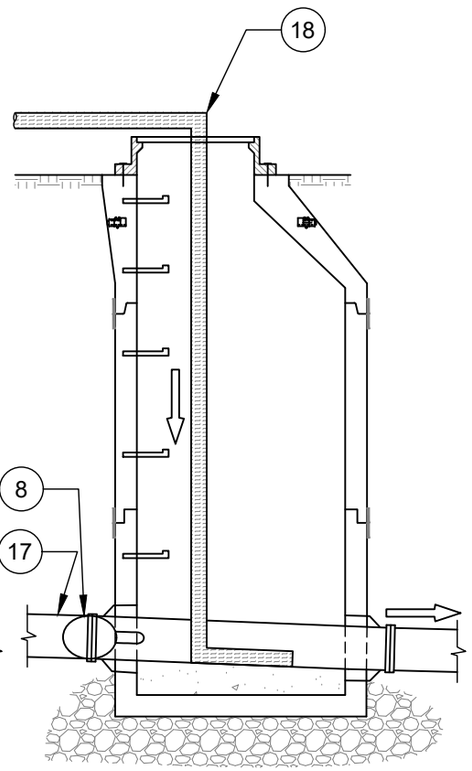


BYPASS PUMPING



TYPICAL SUCTION MANHOLE CROSS SECTION



TYPICAL DISCHARGE MANHOLE CROSS SECTION

NO.	DESCRIPTION:
1.	UPSTREAM MANHOLE; SEE TYPICAL SUCTION MANHOLE CROSS SECTION (THIS SHEET).
2.	BACK-UP PUMPS.
3.	LIGHT TOWER FOR PUMP WATCH OVERNIGHT.
4.	PRIMARY PUMPS.
5.	CHECK VALVE.
6.	MANIFOLD.
7.	DOWNSTREAM MANHOLE; SEE TYPICAL DISCHARGE MANHOLE CROSS SECTION (THIS SHEET).
8.	PIPE PLUG. ONE PLUG SHALL BE INSTALLED IN THE OUTGOING PIPE OF THE MANHOLE WHERE THE PLUGGING OCCURS AND THEN A SECOND PLUG INSTALLED IN THE NEXT DOWNSTREAM MANHOLE IN THE INCOMING PIPE.
9.	UPSTREAM PIPE WITH LIVE FLOW.
10.	FLUID LEVEL.
11.	PUMP.
12.	GAUGE.
13.	SUCTION PIPE.
14.	AIR GUAGE.
15.	STATIC SUCTION LIFT.
16.	SUBMERGENCE.
17.	DOWNSTREAM PIPE / PROJECT WORK AREA.
18.	DISCHARGE PIPE.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

SEWER BYPASS PUMPING

TEMPORARY SEWER BYPASS DETAIL

NO SCALE

VERSION
1.0

DATE
04/2024

DETAIL
17.1

CHAPTER 18
CORROSION CONTROL

CHAPTER 18
CORROSION CONTROL

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PART 1 - GENERAL

1.1 SUMMARY

A. The Engineer shall be responsible for design of corrosion protection systems, including, but not limited to, evaluating and selecting materials, coatings, and linings.

B. Section Includes:

1. External Pipe Coatings
2. Prepackaged Magnesium Anodes
3. Magnesium Ribbon Anodes
4. Prepackaged Zinc Anodes
5. Zinc Ribbon Anodes
6. Test Stations
7. Reference Electrodes
8. Coupons
9. Wire
10. Thermite Weld Equipment
11. Coating for Thermite Welds
12. Compression Connectors
13. Cable Splicing
14. Insulating Flange components
15. Insulating Couplings
16. Insulating Corporation Valves
17. Insulating Unions
18. Casing End
19. Insulated Casing spacers
20. Casing End Seals
21. Polyethylene Mesh Separator Pad

1.2 DEFINITIONS AND ABBREVIATIONS

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

1.3 SUBMITTALS

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

1. Product brochures
2. Catalog cut sheets
3. Shop drawings including dimensions and part/material lists

4. Certification of compliance
5. Prior product acceptance test reports
6. Reference contact data
7. Shipping tickets and purchase invoices

B. Provide product data for the following:

1. External Pipe Coatings
2. Prepackaged Magnesium Anodes
3. Magnesium Ribbon Anodes
4. Prepackaged Zinc Anodes
5. Zinc Ribbon Anodes
6. Test Stations
7. Reference Electrodes
8. Coupons
9. Wire
10. Thermite Weld Equipment
11. Coating for Thermite Welds
12. Compression Connectors
13. Cable Splicing
14. Insulating Flange components
15. Insulating Couplings
16. Insulating Corporation Valves
17. Insulating Unions
18. Casing End
19. Insulated Casing spacers
20. Casing End Seals
21. Polyethylene Mesh Separator Pad

C. Shop Drawings:

Required shop drawings shall include coating, lining, and encapsulation system, details of each component, and pipeline laying schedule showing stations and locations of any coating, lining, and encapsulation including location of test stations.

D. Design:

Provide Soil Corrosivity Assessment, AC Interference Study, and/or test data.

E. Product Certificates: Required for all products furnished.

F. Qualification Data: For qualified assessment and testing agency.

1.4 COATINGS AND LININGS

A. External and internal steel pipe surfaces shall be coated. Internal ductile iron pipe surfaces shall be coated. External ductile iron pipe surfaces shall be coated or encapsulated.

B. Only those persons competent in the design of corrosion control using coatings and cathodic protection shall evaluate and select coating, encapsulation and lining systems taking into consideration the factors specific to the intended application, installation and service conditions. Coating, lining and encapsulation system evaluations and selections shall be documented

1.5 CATHODIC PROTECTION

A. During or prior to detailed design, the following should be undertaken and evaluated:

1. For steel pipe, an applied effective high-quality coating in conjunction with cathodic protection (CP) is required.

2. For concrete pipe, a corrosion assessment is required to determine the risk to the pipe and determination of the requirement for CP.

3. For ductile iron (DI) pipe, a corrosion assessment is required to determine the risk to the pipe and determination of the requirement for coatings and CP.

B. Corrosion allowance is typically utilized for corrosion protection on DI pipe and should remain even if CP is being utilized on the pipe. Support structures and piles should also incorporate corrosion allowance based on the soils and environment encountered, as piles are typically bare (uncoated). If additional pile protection is required in addition to the corrosion allowance, the application of impressed current systems can be utilized.

C. A Soil Corrosivity Assessment consists of lab testing of soil samples at pipe depth for testing of soil resistivity, chlorides, sulfates and pH. These soil samples are best obtained through the geotechnical program of the project. In addition to soil samples and lab testing, Wenner 4-pin soil resistivity testing is strongly recommended for the most accurate soil resistivity and for confirmation of the saturated lab soil resistivity test.

1. Soil Resistivity Testing (Wenner 4-pin method)

   a. Soil resistivity is an electrical characteristic of the combination of soil and ground water (electrolyte). The soil resistivity affects the ability of corrosion currents to flow through the electrolyte. Soil resistivity is a function of soil moisture, texture and concentrations of ionic soluble salts, and is considered to be a comprehensive indicator of soil corrosivity. For lab testing, samples are saturated and measured values do not always reflect in-situ conditions. Soils in the field are subject to varying moisture content due to weather and other factors. 4-pin Wenner testing offers a better indication of soil resistivity values at site and is required for cathodic protection and AC mitigation designs. Testing should be completed in accordance with ASTM test method G67.

   b. Testing at a single pin spacing gives limited information because the average resistance is measured for the depth of the set pin spacing. In practice, the top few inches or feet of soil is normally dry compared to pipe depth. Measurements at multiple pin spacings for each location are recommended to allow calculation of layer resistivity values and more accurate results.

c. When possible, pin spacing should be as perpendicular as possible to any buried pipeline and/or structures, as well as any powerlines.

d. Typical pin spacing for CP are 2.5, 5, 10, 15 and 20 ft, provided pipe depth is not deeper than 20 ft. For AC or stray current modelling, the addition of 30, 50, 70 and 100 ft pin spacings are required. For CP, the quantity and location of resistivity measurements are based on project specifics and available physical space available along the project route. For AC, resistivity locations are at a minimum located at the start and end of any parallel sections but are to be determined through the AC screening process.

2. Chlorides

a. Published literature for chloride concentrations detrimental to concrete or cement embedded steel in soils varies slightly, however can be explained by the various contributing environmental factors. In combination with water soluble chlorides, the availability of oxygen, electrical resistivity and relative humidity of the concrete, pH and temperature are the primary rate-controlling factors of corrosion after initiation.

b. For concrete pipe, in soil resistivities below 1,500 ohm-cm, values above 350 ppm to 400 ppm have been reported to initiate corrosion (AWWA/ACPPA). Other sources reported concentrations of 700 ppm and greater initiated corrosion (Hausman, 1967). For conservatism, 350 ppm is an appropriate threshold for further investigation.

c. For Ductile Iron (DI) and steel pipe, <500 ppm is the chloride threshold.

3. Sulfates

a. Sulfate concentrations over 2,000 ppm can attack the cement mortar coating, particularly in fluctuating groundwater conditions. Prolonged sulfate attack can lead to deterioration of cement or concrete and exposing of embedded steel. For these conditions, ACPPA recommends using portland cement with a C3A content of 5 percent or less or silica fume in an amount equal to 8 to 10 percent of the cement weight. Alternatively, a barrier coating can be used to isolate the pipe exterior from sulfates.

b. For Ductile Iron (DI) and steel pipe, <150 ppm is the sulfate threshold.

4. pH

a. Acidic soil conditions can damage the concrete or cement mortar coating and lower the pH of reinforcing steel, causing corrosion. ACPPA recommends mitigation of acidic soils at pH levels below 5.0.

b. For Ductile Iron (DI) and steel pipe, >6.5 is Neutral to alkaline (no corrosion risk).

D. Test Stations, including test boxes and test posts, should be utilized at regular intervals to ensure adequate connection points and testing locations along the service length. They should also be utilized at stray current locations and foreign metallic crossings.

1. For locations where maintained grasses or landscaping near roadways, flush mount test boxes are required (Standard Detail 8.1). Where overgrown or potential overgrown areas are encountered and locating flush mount test boxes may be difficult, above ground test posts are required (Standard Detail 8.2).

2. Interference test stations (INF) shall be installed at locations where stray current interference is expected and/or measured. Stray current can be experienced from a 3rd party system, isolated CP system, or powered light rail transit systems. To cause corrosion, stray current must be picked up by a foreign structure, travel along the structure to another location where it is discharged (with resulting corrosion) and returns to its intended path through the electrolyte. The amount of metal lost from corrosion is directly proportional to the amount of current discharged from the affected structure. Stray current corrosion can be restricted to a few small points of discharge and, in some cases, through wall penetration can occur in a relatively short time.

    a. Galvanic anodes and interference bonds are commonly utilized for the mitigation of DC and AC stray current interference.

    b. Stray current is experienced from impressed current CP (ICCP) systems which contain a higher driving voltage than galvanic anodes. Galvanic anodes are not a concern for causing 3rd party stray current.

    c. Stray currents are eliminated where non-metallic pipes (HDPE, PVC, etc.) and structures are utilized.

E. CP coupons to be considered at locations where the Project pipe parallels or crosses a foreign pipeline or powerline, CP coupons allow for enhanced testing and monitoring. Coupons allow for “IR” free readings in locations where current interruption is impractical and allow for current density measurements to better understand CP current distribution. Coupons are also useful for pipelines where electrical isolation devices are protected by over voltage devices that influence current interruption testing.

F. Insulation kits, isolation unions, monolithic insulating joints (MIJ), isolating spools and other isolating devices are to be utilized to electrically isolate select buried structures from a select CP system, tie-in points, structural supports, electrical grounding or piping arrangement. Electrical isolation ensures that any structures not intended for protection that would otherwise create an electrical current sink or drain are isolated and can also be used to avoid dissimilar metal contact/corrosion.

1.6 AC STUDY AND MITIGATION

A. High voltage AC powerlines may present safety and integrity risks to existing or proposed metallic pipelines that parallel or cross their right of way. An AC interference study may be required to address these risks. A summary of AC powerline effects on nearby metallic pipelines are shown in the table below:

Powerline Condition	Risk	Assessment
Steady-State	Shock Hazard	Touch voltage evaluation in accordance with NACE SP0177-2019 criteria at all test stations and pipeline above-grade appurtenances.
	AC Corrosion	Evaluation in accordance with SP21424-2018, based on AC and DC current density calculations for a 1 cm^2 holiday.
Phase-Ground Fault	Shock Hazard	Touch and step voltage assessment in accordance with limits calculated as per IEEE Standard 80-2013.
	Coating Damage	Coating stress voltage evaluation as per NACE SP0177-2019 (& 2014) and industry common practice.
	Electrical Arcing	Safe separation distance assessment based on NACE SP0177-2019 (CEA Report 239 T 8177 regression formula).

B. Transmission powerlines operating at 60 kV or greater are the primary concern. The effects of distribution powerlines (less than 60 kV) can be difficult to model and are typically evaluated during commissioning or annual cathodic protection surveys.

C. An AC interference study may need to be initiated under the following situations. Typically, the party installing a new system is responsible for performing a study to ensure existing utilities are not impacted.

1. A new pipeline intended to be constructed on or near a powerline ROW
2. A new powerline intended to be constructed on or near a pipeline ROW
3. A lateral being built from an existing pipeline that is exposed to AC interference
4. An extension to a pipeline that is on or near an existing AC powerline ROW
5. High voltages or AC corrosion found on existing pipeline on or near an existing powerline ROW

D. The need for AC interference studies with paralleling transmission powerlines > 60 kV is dependent on the length of parallel and the separation distance between the pipeline and powerline. In general, AC interference studies are required when one of the following conditions applies:

1. Parallel is more than 3 miles long at a separation distance less than 0.5 mile
2. Parallel is more than 1 mile long at a separation distance less than 1000 ft
3. Parallel is more than 1000 ft long at a separation less than 300 ft

Parallel configurations outside these ranges are not expected to present significant AC interference risks, however these guidelines cannot cover every possible configuration that may present AC interference risks to pipelines in the real world. Continuous monitoring of AC voltages and corrosion risk is recommended as even configurations

believed to be low risk may sometimes have abnormal operating conditions which can result in pipe integrity or safety hazards to pipeline personnel.

E. If the parallel criteria are not met, a crossing or proximity study may need to be considered instead. Only powerline fault conditions need to be considered for these types of studies. They are required when:

1. The powerline crosses over the pipeline
2. The powerline structures (including substation) are within 300 ft of the pipeline
3. Underground phase conductors are withing 30 ft of the pipeline

F. AC interference from distribution powerlines < 60 kV is typically not a concern as the risks are typically lower than those of transmission powerlines. In addition, distribution powerlines are also difficult to model accurately due to frequent taps, loading imbalances and the presence of high frequency harmonics (i.e. 180 Hz). There are special cases when they can have a significant influence, for example when the parallel is long or when there are high frequency harmonics present in the loading. In all cases, however, it is generally recommended that their effect be evaluated during commissioning or annual CP surveys.

G. AC interference software modeling shall be performed with the CDEGS software by Safe Engineering, or a software with similar capabilities. Powerline parameters such as conductor heights, loading, phasing, grounding details, fault levels and clearing times are required inputs to AC interference software modeling. Projected loading and fault levels shall be used where possible to account for future increases in the power system.

H. Soil resistivity measurements are also typically required for the assessment of AC corrosion risk and design of AC mitigation grounding systems. These measurements shall be collected using the Wenner 4-pin method. Two types of measurements are typically taken:

1. Shallow measurements at: 3, 5, 10, 15, 20-foot spacings
2. Deep measurements at: 3, 5, 10, 15, 20, 30, 50, 70, 100-foot spacings

I. A steady-state touch voltage of 15 V or more with respect to local earth at above-grade or exposed sections of the pipeline is considered to constitute a shock hazard. Therefore, mitigation measures are recommended for all accessible locations where the 15 V limit is exceeded.

J. The NACE AC corrosion standard SP21424-2018 has established the following criteria based on the maximum allowable AC current density based on a 1 cm2 holiday:

1. 30 A/m^2 if the DC current density exceeds 1 A/m^2
2. 100 A/m^2 if the DC current density is less than 1 A/m^2

K. When the DC current density is unknown, the 30 A/m^2 criteria shall be applied. There is a strong emphasis in the standard placed on monitoring of the current densities and corrosion rates via installation of coupons and/or corrosion rate probes to ensure that all AC corrosion risks have been effectively mitigated.

L. Under fault conditions, safety limits should be calculated using the IEEE Standard 80 methodology based on the fault clearing time for primary protection. Additionally, the risk of coating stress damage and electrical arcing shall also be evaluated.

M. AC mitigation systems typically consist of grounding systems at key locations along the powerline parallel, dead-front test stations and AC electrical continuity inside facilities accessible by utility personnel. The grounding systems typically consist of packaged zinc anodes or zinc ribbon connected to the pipeline via test stations, although magnesium anodes are also acceptable mitigation options. Zinc is preferred over magnesium anodes for extended life. Where the pipeline has a cathodic protection galvanic anode system installed, the CP system may fully act as the mitigation system, but AC modelling shall be used to confirm.

N. Recommended minimum safe separation distances to prevent the risk of arcing from grounded powerline structures are included in the table below:

Powerline Voltage (kV)	Maximum Arc Length (ft)
60-72	17
138-144	36
230-260	68
345	92
500	135

Note that the values above are worst case arcing distances. The actual safe separation distances are typically lower, especially when the powerline has shield wires installed. With shield wires installed, 33 ft is generally accepted as a safe separation distance.

O. Pipe construction and maintenance activities near powerlines may also pose safety risks which would not exist when the pipe is buried. In areas where the pipeline is to be installed or excavated adjacent to powerlines, a best practice as per NACE SP0177-2019 is to have a competent person in charge of electrical safety ("safety watch") on site, equipped with the appropriate means and protective equipment to measure the voltage on the pipeline and advise on mitigation of any hazards during construction. Possible mitigation controls include continuity bonding, temporary gradient mats and grounding of the pipe.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect materials from dirt and damage.

B. The Contractor shall be responsible for the safe storage of materials furnished by or to them, and accepted by them and intended for the work, until they have been incorporated in the completed project. Handling and storage of all project materials are to be in compliance with the manufacturer's recommendations for handling and storage.

C. Material and Equipment Storage Sites: Unless otherwise shown on the plans, the Contractor will be responsible for locating and providing storage areas for construction materials and equipment. Unless prior written consent from the owner of the proposed storage area is received by Charlotte Water, the Contractor will be required to store all equipment and materials within the limits of the project site or the limits of the right-of-way and temporary construction easement provided. The materials and equipment storage shall comply with all local and state ordinances throughout the construction period. Material and equipment may only be stored within road right-of-way if approved by the controlling

agency. Bulk storage of stacked materials shall not be permitted in or along road rights-of-way.

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

D. Care of Coatings and Linings: Pipe, fittings, and other accessories including frames and covers, steps, straps, etc., shall be so handled such that the coating or lining will not be damaged. If, however, any part of the coating or lining is damaged, the repair shall be made by the Contractor at their expense in a manner satisfactory to the Engineer and the coatings manufacturer.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials, equipment, and labor for construction of corrosion control systems shall be furnished in accordance with these specifications and in accordance with the Plans prepared by a Registered Professional Engineer licensed to practice in the state of North Carolina.

B. Cable Definitions and Information

Abbreviation	Meaning	Material	Rated for Direct Burial
HMWPE	High Molecular Weight Polyethylene	Polyethylene	Yes
HDPE	High Density Polyethylene	Polyethylene	Yes
RHH	Rubber High Heat	Thermoset (XLPE)	No
RHW	Rubber Heat and Water Resistant	Thermoset (XLPE)	Yes
THHN	Thermoplastic High Heat Nylon	Thermoplastic (PVC)	No
THWN	Thermoplastic Heat and Water-Resistant Nylon	Thermoplastic (PVC)	Yes
THW	Thermoplastic Heat and Water Resistant	Thermoplastic (PVC)	No
TW	Thermoplastic Water Resistant	Thermoplastic (PVC)	No
XLPE	Cross Linked Polyethylene	Thermoset	Yes
USE-2	Underground Service Entrance	Polyethylene	Yes

C. Unless amended on the Construction Drawings, or approved by Charlotte Water, all materials, apparatus, supplies, methods of manufacture, or construction shall conform to the specifications contained in this Section. National material standards (ASTM, ANSI, AWWA, etc.) referred to herein shall be considered to be the latest revisions only. Each coating system shall be applied as recommended by the coating manufacturer. All components of a coating system shall be supplied by the same manufacturer. Pipe and fitting coating systems shall be integrally designed to provide complete corrosion protection.

2.2 EXTERNAL PIPE COATINGS

A. Shop Coating for Prestressed Concrete Pipe and Concrete Bar Wrapped Cylinder Pipe: Prestressed concrete pipe and concrete bar wrapped cylinder pipe shall be externally coated where indicated on the Plans. The external coating shall be a polyamide epoxy-coal tar with a minimum 20 mils thickness and shall be shop applied. The coating shall be a high-build corrosion resistant coating that provides one coat protection for concrete in underground conditions. The coating material shall conform to the performance requirements of AWWA C210.

1. Primer/Filler: As recommended by the External Coating manufacturer.
2. External Coating: Tnemec 46H-413, Hi-Build Tnemec-Tar, Carboline Bitumastic 300 M or an approved equal.
3. The coating shall be applied to a minimum dry film thickness of 20 mils. The coating will be applied to all external pipe surfaces in the area where coating is required by the Plans.

B. Shop Coating for Steel and Ductile Iron Pipe: Steel pipe shall be externally coated. Ductile iron pipe shall be externally coated where indicated on the Plans. Where abrasive blasting for external coating is required on ductile iron pipe, surfaces shall be prepared for coating per NAPF 500 03 04. The external coating for the steel and/or ductile iron pipe shall be shop applied and shall be one of the following coating systems:

1. 100 percent solids polyurethane, in accordance with AWWA C222, with the following minimum properties, or approved equal:
    a. Adhesion to steel (ASTM D4541): greater than 2,000 psi.
    b. Resistance to cathodic disbondment (CSA Z245): excellent; less than 12 mm radius.
    c. Resistivity: $1x10^{14}$ ohms per cm^2 minimum.
    d. Dielectric strength: > 200 volts per mil.
    e. Water Absorption (ASTM D471): <3% (no absorption below surface).
    f. Solids Content (ASTM D1259): 99%.
    g. Volatile Organic Compounds (VOC's) (ASTM D2369): 0.11 lbs. per US gallon.
    h. Hardness (ASTM D2240 Shore D): 70 +/-5.
    i. Flexibility (ASTM D522) 20 mils: 180 degrees over 3" mandrel.
    j. Abrasion resistance (ASTM D4060 CS-17 wheels, 1 kg weights, 1000 revolutions): 75 mg loss.
    k. Final coating shall have a nominal dry film thickness of 35 mils with a minimum dry film thickness of 30 mils.

    Coating material shall be Madison Chemical Industries Corropipe II TX-15 or Polibrid 705E or LifeLast Durashield 110/210 or approved equal.
2. Three-layer tape wrap system in accordance with AWWA C214 with the following minimum properties, or approved equal:

a. Primer: A liquid primer composed of butyl, tackifiers, and other ingredients to protect against soil oxidation and bacteria growth. Total solids shall be 20% (plus or minus 2%) by weight.

b. Innerwrap: A two component extruded black tape consisting of polyethylene and butyl rubber adhesive specially designed to conform to the particular pipe material being coated. The innerwrap shall have the following properties:

1) Thickness: 20 mils (9 mils polyethylene backing, 11 mils butyl rubber adhesive).

2) Adhesion to primed steel: 20 oz/in width (ASTM D1000).

3) Tensile strength: 30 lbs./in width (ASTM D1000).

4) Water vapor transmission rate: <0.2 gm/100 in^2/24 hr.

5) Dielectric strength: 21 kV (ASTM D149).

6) Insulation resistance: 1,000,000 M Ohms (ASTM D257).

7) Tape width: As recommended by coating manufacturer

c. Middlewrap: A two component extruded grey tape consisting of polyethylene and butyl rubber adhesive. The middlewrap shall contain stabilizers and inhibitors to resist the destructive effects of ultra-violet light. The middlewrap shall have the following properties:

1) Thickness: 30 mils (25 mils polyethylene backing, 5 mils butyl rubber adhesive).

2) Adhesion to backing: 45 oz/in width.

3) Tensile strength: 60 lbs./in width (ASTM D1000).

4) Abrasion resistance: Excellent (ASTM D1000).

5) Water vapor transmission rate: <0.2 gm/100 in^2/24 hr.

6) Dielectric strength: 23 kV (ASTM D149).

7) Insulation resistance: 1,000,000 M Ohms (ASTM D257).

8) Tape width: As recommended by coating manufacturer.

d. Outerwrap: A two component extruded white tape consisting of polyethylene and butyl rubber adhesive. The outerwrap shall contain stabilizers and inhibitors to resist the destructive effects of ultra-violet light. The outerwrap shall have the following properties:

1) Thickness: 30 mils (25 mils polyethylene backing, 5 mils butyl rubber adhesive).

2) Adhesion to backing: 45 oz/in width.

3) Tensile strength: 60 lbs./in width (ASTM D1000).

4) Abrasion resistance: Excellent (ASTM D1000).

5) Water vapor transmission rate: <0.2 gm/100 in^2/24 hr.

6) Dielectric strength: 23 kV (ASTM D149).

7) Insulation resistance: 1,000,000 M Ohms (ASTM D257).

8) Tape width: As recommended by coating manufacturer.

Coating system shall be YGIII (80 mils system) as manufactured by Polyken Technologies, or approved equal, and shall have the following 80 mils system properties:

a. Peel adhesion to primed steel: 300 oz/in (ASTM D1000).

b. Cathodic disbondment: 0.25 in radius (ASTM G8).

c. Water vapor transmission: 0.07 perms (ASTM E96).

d. Water vapor transmission rate: 0.03 g/100 in (ASTM F1249).

e. Volume resistivity: 10 ohm-cm (D257).

f. Dielectric breakdown: 650 volts/mil (D1000).

g. Dielectric strength: 20-23 kV (ASTM D149).

h. Impact resistance: 90 in-lbs. (ASTM G14).

i. Impact resistance: 1000 lbs., no holidays (ASTM G13).

j. Penetration resistance: 11-15% (ASTM G17).

3. Polyolefin (extruded butyl rubber adhesive with polyethylene topcoat) system in accordance with AWWA C215 with the following minimum properties, or approved equal:

a. Compounded butyl rubber adhesive coating with less than 0.1% water absorption. Nominal thickness 10 mils.

b. Topcoat: High density polyethylene resin topcoat that is spirally extruded onto adhesive coating in multiple layers to form a seamless bonded coating. The polyethylene topcoat shall have the following properties:

1) Nominal thickness: 40 mils.

2) Density: >0.95 (ASTM D1505).

3) Elongation: >600% (ASTM D638).

4) Tensile strength: <2800 psi (ASTM D638).

c. Total coating system shall have the following properties:

1) Thickness: 50 mils (40 mils polyethylene topcoat, 10 mils butyl rubber adhesive).

2) Impact resistance: >60-inch lbs. (ASTM G14).

3) Cathodic disbondment: 6 mm radius (ASTM G8 OR G95).

4) Water absorption: 0.06% (ASTM D570).

Coating system shall be Pritec as manufactured by Shawcor or approved equal.

C. Shop Applied Materials For Coating Special Sections, Connections, and Fittings of Steel and Ductile Iron Pipe: Steel pipe special sections, connections, and fittings shall be externally coated. Ductile iron special sections, connections, and fittings shall be externally coated where indicated on the Plans.

1. Shop applied materials for coating special sections, connections, and fittings shall be either fusion bonded epoxy per AWWA C213, polyurethane per AWWA C222 or liquid epoxy per AWWA C210 or two component extruded tape consisting of polyethylene and butyl rubber adhesive in accordance with AWWA C209.
2. Two component extruded tape in accordance with AWWA C209 shall be Polyken 934 Jointwrap and Repair Tape (or approved equal) having the following properties:
    a. Thickness: 35 mils (7 mils polyethylene backing, 28 mils butyl rubber adhesive).
    b. Adhesion: 225 oz/in width (ASTM D1000).
    c. Tensile strength: 15 lbs./in width (ASTM D1000).
    d. Water vapor transmission rate: 0.05 gm/100 in^2/24 hr.
    e. Dielectric strength: 23 kV (ASTM D149).
    f. Insulation resistance: 1.4 x 107 M Ohms (ASTM D1000).
    g. Tape width: As recommended by the coating manufacturer.
    h. The filler tape (Polyken 939 or approved equal) recommended by the jointwrap tape manufacturer shall be used to fill uneven areas of the sections, connections, and fittings to assure a smooth application of the jointwrap tape.

D. Field Applied Materials for Coating Repairs: Shop applied coatings that are damaged in transit or during handling shall be repaired prior to backfilling. The field applied repair coatings shall be as recommended by the shop applied coating manufacturer and shall be entirely compatible with the original coating system. The field coating repairs shall be performed in accordance with all recommendations of the coating manufacturer.

E. Field Applied Materials for Coating Steel and Ductile Iron Pipe Joints: The field applied materials for coating steel pipe joints and ductile iron pipe joints (where indicated on the Plans) shall be one of the following coating systems:

1. Joint Wrap and Repair Tape: A two component extruded tape consisting of polyethylene and butyl rubber adhesive in accordance with AWWA C209. The tape shall contain stabilizers and inhibitors to resist the destructive effects of ultra-violet light. The jointwrap and repair tape (Polyken 934 or approved equal) shall have the following properties:
    a. Thickness: 35 mils (7 mils polyethylene backing, 28 mils butyl rubber adhesive).
    b. Adhesion: 225 oz/in width (ASTM D1000).
    c. Tensile strength: 15 lbs./in width (ASTM D1000).
    d. Water vapor transmission rate: 0.05 gm/100 in^2/24 hr.
    e. Dielectric strength: 23 kV (ASTM D149).
    f. Insulation resistance: 1.4 x 107 M Ohms (ASTM D257).
    g. Tape width: As recommended by the coating manufacturer.

h. The filler tape (Polyken 939 or approved equal) recommended by the jointwrap tape manufacturer shall be used to fill uneven areas at the pipe joint to assure a smooth application of the jointwrap tape.

2. Heat-shrinkable sleeves specifically designed for corrosion protection of water pipelines that utilize a crosslinked polyolefin backing coated with a protective, heat activated adhesive for bonding to metallic substrates and pipeline coatings in accordance with AWWA C216. The heat-shrinkable sleeves (Canusa CPS Aqua-Shield, Covalence WPCT or approved equal) shall have the following minimum properties:

a. Tensile strength: 2,200 psi

b. Elongation: 400%

c. Volume resistivity: 1014 ohm-cm

d. Dielectric strength: 400 V/mil

e. Water vapor transmission: 0.05

f. Adhesion to steel: 25 N/cm

g. Lap shear: 12 psi

h. Impact: 25 in-lbs.

i. The filler material recommended by the heat-shrink sleeve manufacturer shall be used to fill uneven areas at the pipe joint to assure a smooth application of the heat-shrink sleeve.

3. Polyurethane coating per AWWA C222.

4. Liquid epoxy coating per AWWA C210.

F. Field Applied External Coating System for Insulating Flanges, Insulating Couplings, and Insulating Corporation Valves: Insulating flanges, insulating couplings, and insulating corporation valves shall receive an exterior tape wrapping in the field. The coating applicator must abide by and follow all manufacturer's application specifications for the coating system. All components of the coating system shall be manufactured by a single supplier to assure compatibility of individual components. The coating system shall comply with AWWA C217. The coating system shall be manufactured by Trenton Corporation, Denso North America, Chase Corporation TapeCoat or an approved equal. The materials shall be as follows:

1. Primer: The primer shall be Trenton Wax-Tape Primer, Denso Paste, TC Enviroprime or approved equal.

2. Filler Putty: A cold applied anti-corrosive moldable filler material used to even the contours of irregular fittings and surfaces. The filler putty shall have the following properties:

a. The filler putty shall be Trenton Fill-Putty, Denso Profiling Mastic, TC Enviro Profile Putty or approved equal. Filler putty shall be used at all irregular surfaces to provide a smooth surface for the application of the innerwrap and outerwrap.

3. Innerwrap:

   a. The innerwrap shall be Trenton #1 Wax-Tape, Denso LT Tape, TC Envirotape or approved equal.

4. Outerwrap: A resin coated, woven fiberglass fabric.

   a. The outerwrap shall be Trenton Glas-Wrap, Denso Glass Outer Wrape or approved equal.

G. Field Applied Mastic: The mastic coating shall be applied only where specifically required by the specifications. The mastic coating shall be used for coating thermite welds to prestressed concrete pipe and concrete bar wrapped cylinder pipe, and asphaltic coated ductile iron pipe that will be in direct contact with poured concrete. The cold applied mastic coating shall be Roskote R28 Rubberized Mastic, Carboline - Bitumastic No. 50 or approved equal with the coating shall have the following properties:

1. Composition: A pyrobituminous resin processed by homogenization with inhibitive pigments and aromatic solvents.
2. Electrical volume resistivity: 2.12 X 10^{13} ohms-cm.
3. Percent solids: 58.6% by volume, 68.2% by weight.
4. Service temperature: 0 to 250^0F.
5. Weight per gallon: 9.42 pounds.
6. Specific gravity: 1.13.
7. Flash point: 44^0F - seta closed cup.
8. Color: black.

2.3 PREPACKAGED MAGNESIUM ANODES

A. Magnesium anodes shall be sized by the Engineer in accordance with the specific project requirements. The high potential magnesium anode shall meet the requirements listed in ASTM B843, with a minimum potential of 1.75 volts with respect to a copper/copper sulfate reference electrode ($Cu/CuSO_4$). The composition of the high potential anode alloy shall be as follows:

Aluminum	0.010% Maximum
Manganese	0.50 to 1.30%
Copper	0.02% Maximum
Nickel	0.001% Maximum
Iron	0.03% Maximum
Silicon	0.05% Maximum
Other	0.05% each or 0.03% Max Total
Magnesium	Remainder

B. The magnesium anodes shall be vibratory packaged by the anode manufacturer in permeable cotton bags or cardboard tubes containing special low resistance backfill material. The backfill material shall have the following composition:

Hydrated Gypsum 75%

Bentonite	20%
Sodium sulfate	5%

C. The anode and backfill shall be prepackaged into a single unit, in a vibrated cardboard tube or cotton bag as described above. The box shall contain centering devices to maintain the anode in a centered position surrounded fully by the special backfill. Centering devices are not required for the bagged anodes. A minimum of 10 feet of AWG No. 12 copper wire (solid or stranded) with black TW, THHN or RW90 insulation (blue can be used as alternate with proper identification at the cable end in the test station) shall be attached to the anode by the manufacturer. For bulk custom ordering for large projects, upgrades in lead lengths (depending on design) and cable insulation to THWN or RHW should be considered. Wire to anode attachment shall be by silver solder and sealed to prevent any moisture penetration.

2.4 MAGNESIUM RIBBON ANODES

Magnesium ribbon anodes shall be sized by the Engineer in accordance with the specific project requirements. The composition of the high potential anode shall be as follows:

Aluminum	0.010% Maximum
Manganese	0.50 to 1.30%
Copper	0.02% Maximum
Nickel	0.001% Maximum
Iron	0.03% Maximum
Silicon	0.05% Maximum
Other	0.05% each or 0.30% Maximum Total
Magnesium	Remainder

2.5 PREPACKAGED ZINC ANODES

A. Zinc anodes shall be sized by the Engineer in accordance with the specific project requirements. The zinc alloy shall meet the requirements of ASTM B418, Type II with a minimum potential of 1.10 volts with respect to a copper/copper sulfate reference electrode (Cu/CuSO4). The anode shall conform to the following composition:

Aluminum	0.005% Maximum
Cadmium	0.003% Maximum
Copper	0.002% Maximum
Iron	0.0014% Maximum
Lead	0.003% Maximum
Other	0.001% Maximum total for all others
Zinc	Remainder

B. The zinc anodes shall be vibratory packaged by the anode manufacturer in permeable cotton bags or cardboard tubes containing special low resistance backfill material. The backfill material shall have the following composition:

Hydrated Gypsum	75%
Bentonite	20%
Sodium Sulfate	5%

C. The anode and backfill shall be prepackaged into a single unit, in a vibrated cardboard tube or cotton bag as described above. The box shall contain centering devices to maintain the anode in a centered position surrounded fully by the special backfill. Centering devices are not required for the bagged anodes. A minimum of 10 feet of AWG No. 12 copper wire (solid or stranded) with black TW, THHN or RW90 insulation (white can be used as alternate with proper identification at the cable end in the test station) shall be attached to the anode by the manufacturer. For bulk custom ordering for large projects, upgrades in lead lengths (depending on design) and cable insulation to THWN or RHW should be considered. Wire to anode attachment shall be by silver solder and sealed to prevent any moisture penetration.

2.6 ZINC RIBBON ANODES

A. Zinc ribbon anodes shall be sized by the Engineer in accordance with the specific project requirements. The anode shall be continuously extruded over a steel wire core of 0.13 inch centrally located in the zinc alloy. The zinc alloy shall meet the requirements of ASTM B418, Type II.

B. Zinc ribbon anode can be used for both AC grounding mats (Detail 4.2) and for continuous cathodic protection and/or AC mitigation along the pipe (Detail 4.1).

2.7 TEST STATIONS

A. Test Box: The flush mount test box shall consist of a nonconductive terminal board mounted in a locking cast iron lid and collar (suitable for placement in heavy traffic areas) and a plastic shaft. The cast iron test box lid shall have “TEST STATION” or “CP TEST” cast into the lid design. The lid shall feature a cast-in bolt to lock into the cast iron collar. The cast iron collar to be at least 1.5 inches high and be adjustable for future paving projects. The plastic shaft is to be made of ABS (acrylonitrile butadiene styrene), 18 inches long with a flared bottom to resist sinking in soil. The plastic shaft shall have a minimum 4-inch inner diameter. The plastic shaft is to be riveted to the cast iron collar. The terminal board shall be made of nonconductive PVC (polyvinyl chloride) plastic, and contain a minimum of five terminals (Seven terminal boards are preferred to provide the most flexibility in design, but if 7 terminal boards are not available 5 terminals are acceptable if both AC and DC coupons are not required at non-anode locations; or if AC or DC coupons are not required at anode locations – refer to standard detail 8.1 for anticipated layouts), using 0.25 inch threaded brass or nickel-plated machine screws and nuts. The terminal board shall be secured to the lid. The test box shall be from one of the following manufacturers:

1. C.P. Test and Valve Products Inc (Preferred)
    a. NM model
        1) 1” cast iron paving adapter available
        2) Yellow lid
        3) Five and seven terminal boards available. Seven terminal boards are preferred for all test station and shall be used where both AC and DC

coupons required, or where AC or DC coupons are required at anode locations.

2. Handley Industries, Inc.

a. T451Q model

1) "Q" designation is for "adjustable to grade" test box (18.625" – 24").

2) Lid is silver in color, with optional factor yellow painted lid (Option A added at end)

3) Five terminal board available. This test station shall not be used when both AC and DC coupons required at non-anode locations; or when AC or DC coupons are required at anode locations.

B. Test Post: The above-ground test post shall consist of a nonconductive terminal board mounted on a polyethylene post with a polycarbonate enclosure/lid. The test post is recommended to contain a Charlotte Water sticker on the exterior of the post. The polyethylene post shall have a minimum length of 6 feet, with a polyethylene anchor at the bottom to resist sinking or turning in soil. The polyethylene post shall have a 3-inch diameter. The polycarbonate enclosure/lid is to be attached to the post. The terminal board shall be made of nonconductive polycarbonate plastic, and contain a minimum of eleven terminals, using 0.25 inch by 20 thread brass or nickel-plated machine screws and nuts. The test head shall contain a shock guard to protect the cable connects from direct contact. The test post shall be from one of the following manufacturers:

1. Cott Manufacturing Co.

a. Big Fink model

2. Tinker & Rasor

a. T-3 model

3. Pro-Mark Utility Supply Inc.

a. PM TS-3 model

C. Test Box Concrete: Poured concrete for the flush-mounted test station slabs shall be ready-mix conforming to ASTM C94. Minimum allowable 28-day compressive field strength shall be 3,600 psi when cured and tested in conformance with ASTM C31 and ASTM C39. Portland cement shall be Type 1.

D. Test Station Terminal Lugs: Test station terminal lugs shall be one-hole, compression terminal lugs (eyelet) for 0.25-inch bolt size.

E. Current Measuring Shunt: Test station shunts shall be constructed to fit the terminal posts for the specified test station. For locations where anodes are present, a 0.1-ohm shunt with a current capacity of 2 amperes shall be used. The shunt shall be as manufactured by Cott Manufacturing Company Model "Red" or approved equal.

For AC Grounding Mat locations (Standard Detail 4.2), a 0.01 ohm "Yellow" Cott shunt with a current capacity of 8 amperes shall be used.

2.8 REFERENCE ELECTRODES

A. The reference electrode shall be a permanent copper/copper sulfate reference electrode, unless indicated differently on the Plans. The copper/copper sulfate reference electrode

shall be designed for a minimum 30-year life. The reference electrode shall be prepackaged in a permeable cloth bag with special copper/copper sulfate reference electrode backfill. A minimum overall package dimensions of 6-inch diameter and 10 inches length is required. Lead wire shall be of sufficient length to reach the test station terminals without splicing. The lead wire shall be minimum AWG No. 14 stranded copper wire with either HMWPE or RHH-RHW insulation. The wire insulation shall be yellow (black can be used as alternate with proper identification at cable end in the test station, if yellow is not available). The lead wire shall be attached to the electrode core with the manufacturer's standard connection. The connection shall be stronger than the wire. No splicing of the reference electrode lead wire shall be permitted under any circumstances. The reference electrode shall be from one of the following manufacturers:

1. Electrochemical Devices, Inc. (EDI)
    a. Model UL-CUG-SW (30-year life)
    b. Model UL50-CUG-SW (50-year life)
2. CerAnode
    a. SC-CU-2-A6 (30-year life)
3. Corrpro
    a. Permacell Plus 802 (30-year life)

Note: The EDI models listed above can also be ordered from the manufacturer with an optional steel rod coupon. This would be acceptable where coupons are also required.

2.9 COUPONS

A. The coupon shall consist of ductile iron or carbon steel depending on the pipe material. Lead wire shall be of sufficient length to reach the test station terminals without splicing. The lead wire shall be minimum AWG No. 14 stranded copper wire with either HMWPE, RHW, or THWN insulation. The wire insulation shall be green for ductile iron and red for carbon steel (alternate colors can be used with proper identification at cable end in the test station, if described colors are not available). The lead wire shall be attached to the coupon with the manufacturer's standard connection. The connection shall be stronger than the wire. No splicing of the coupon lead wire shall be permitted under any circumstances. The coupon shall be from one of the following manufacturers:

1. For Carbon Steel
    a. M.C. Miller
        1) COU100-R50
    b. Electrochemical Devices, Inc. (EDI)
        1) UX08-STL-2W50 (special order)
        2) Factory order add-on to reference electrode (listed in Section 2.8):
            a) ULI-CUG-2W050 (add to UL-CUG-SW) or
            b) ULI50-CUG-2W050 (add to UL50-CUG-SW)
2. For Ductile Iron
    a. M.C. Miller

1) COU200-G50

b. Electrochemical Devices, Inc. (EDI)

1) UX08-DCI-2W50 (special order)

2.10 WIRE

A. All wiring shall be copper wire of the AWG wire size and color shown in the Details. Typical cable colors are as follows:

1. Magnesium anode (galvanic) – black (blue alternative with identifier)
2. Zinc anode (galvanic) – black (white alternative with identifier)
3. Cu/CuSO4 reference electrode – yellow
4. DC Coupon (carbon steel) – red (with identifier)
5. DC Coupon (ductile iron) – green (with identifier)

B. Tracer wire – blue (solid conductor with identifier)

C. Wire for bonded joints shall be single conductor, stranded copper with high molecular weight polyethylene (HMWPE) insulation (white). Wire size shall consist of either:

1. AWG No. 2 for piping larger than 36-inch,
2. AWG No. 4 for 16-inch through 36-inch piping, and
3. AWG No. 6 for piping smaller than 16-inch.

D. Wire for test lead wires shall be single conductor, stranded copper wire with 600-volt HMWPE, XLPE or THWN insulation as required (colors and size as shown in the Details). Typical cable colors are as follows:

1. Pipe lead – black, blue, red, white or orange
2. Casing lead - green

E. Galvanic anode header cables (magnesium and zinc) shall be single conductor, stranded copper with high molecular weight polyethylene (HMWPE) insulation. Wire size shall be minimum AWG No. 8 black (with cable identifier on cable end in test station).

A summary of the above listed cable types is included in the below table:

Item	Min Cable Size	Cable Color(s)	Min Cable Length (ft)	Cable Type/ Insulation
Galvanic Anode – Magnesium	#12	Black (Blue alt)	10	TW, THHN or RW90
Galvanic Anode - Zinc	#12	Black (White alt)	10	TW, THHN or RW90
Galvanic Anode Header Cable	#8	Black	A/R	HMWPE
Reference Electrode	#14	Yellow	50	HMWPE or RHH-RHW
DC Coupon - Carbon Steel	#14	Red	25	HMWPE, RHW, or THWN

DC Coupon - Ductile Iron	#14	Green	25	HMWPE, RHW, or THWN
Tracer Wire	#14	Blue	A/R	HMWPE or HDPE
Bonding Wire	#6, #4 or #2	White	A/R	HMWPE
Test Lead Wire - Piping	#10 and #8	Blk, wht, blue, red or org	A/R	HMWPE, XLPE or THWN
Test Lead Wire - Casing	#10 and #8	Green	A/R	HMWPE, XLPE or THWN

2.11 THERMITE WELD EQUIPMENT

Thermite weld molds and charges shall be suitable for the sizes and types of materials and shapes encountered. Adapter sleeves shall be utilized for all thermite welds.

2.12 COATING FOR THERMITE WELDS

A. Thermite welds to ductile iron pipe, steel pipe, and steel casings are to be coated with a specially designed covering for cathodic protection wire connections to piping and fittings. The manufacturers application procedure must be followed during installation. The covering shall consist of one of the following manufacturers and applicable components:

1. KEMA Coatings Ltd
    a. Polyguard 600 Series Primer (base layer - primer)
    b. KEMA 250 Module Sealant (second layer - sealant)
    c. KEMA 250-12 Module Sealant (third layer - top coat)
2. Royston Laboratories Division
    a. Royston Roybond 747 Primer
    b. Handy-Cap

B. Thermite welds to PCCP and CBWCP shall be coated with a brush applied mastic (10 mils minimum thickness) and embedded in the concrete mortar.

2.13 COMPRESSION CONNECTORS

A. Compression connectors shall be specially manufactured for splicing copper cables together. The connectors shall be copper and shall be appropriately sized based on the cable sizes being spliced. The compression connectors shall consist of one of the following manufacturers:

1. Burndy Corporation
    a. (Type YC-C)
2. Thomas & Betts
    a. (547XX COLOR)

2.14 CABLE SPLICING

A. When splicing is required, it shall only be performed by properly trained and competent personnel. The following cable splicing methods are approved for use:

1. 3M Company 3-Layer Tape
    a. 3M Scotchfil Electrical Insulation Putty (base layer)
    b. 3M Scotch 130C Linerless Rubber Splicing Tape (second layer)
    c. 3M Scotch Super 88 (88+) Vinyl Electrical Tape (top layer)
2. The Raychem Corporation
    a. Raychem Heat Shrink Kit (model determined by cable sizes)

2.15 INSULATING FLANGE COMPONENTS

A. Two methods of flange isolation are recommended:

1. Insulating flange kits shall include an insulating gasket, insulating sleeves and insulating washers. The insulating gasket shall be Type "E" with G-10 retainer and EPDM "quad" ring seal. The insulating sleeves shall be full length with double washer set configuration, comprised of G-10. The insulating washers shall be G-10 and installed on both sides of the flange. Steel washers shall also be used between the insulating washers and the nuts. The pressure rating for the insulating flange materials shall be greater than the design pressure of the piping. The insulating flange isolation kits shall consist of one of the following manufacturers:
    a. GPT Industries
        1) Linebacker 61 (potable water)
        2) Linebacker
    b. Flexitallic (for diameters <42” ONLY)
    c. For repair and retrofit work at non-potable locations, consideration may be given to the following if flange face condition is an issue:
        1) GPT Industries
            a) RC Gaskets (0.187” thickness)

B. As an alternative to flange isolation, the use of non-metallic or HDPE spool pieces, which act as a long lead isolator is best suited in underground applications and low resistive mediums. Presently HDPE spool pieces are being utilized on small diameter pipe within the Charlotte Water system. Non metallics can also be utilized in locations where stray current may be an issue.

2.16 INSULATING COUPLINGS

A. The insulating materials shall include an insulating gasket and a "full boot" plastic tubular insulator inside the middle ring to prevent contact of pipe-ends isolated from one another. Insulation shall be provided to both ends of the coupling.

2.17 INSULATING CORPORATION VALVES

A. The insulating corporation valves (stops) shall consist of a brass fitting with a nylon insulator. The insulated corporation ball valve shall be manufactured by Ford Meter Box Company. The corporation valve shall be Model FB600, and the service insulator coupling shall be as follows:

1. 3/4-inch service: SI-C02-33-AWT-NL
2. 1-inch service: SI-C04-44-AWT-NL
3. 1-1/2-inch service: SI-C04-66-AWT-NL
4. 2-inch service: SI-C04-77-AWT-NL

2.18 INSULATING UNIONS

A. The insulating (di-electric) unions shall consist of a high-test, air-refined malleable iron nut and body with an integral molded nylon insulator. Unions are to be used for above-ground locations only.

2.19 CASING END

A. Sealing of the end of the casing can be completed two different ways:

1. Linked Rubber Seal - The linked rubber seal shall consist of a belt of interconnected rubber links connected together with zinc plated hardware. The linked rubber seal shall be from the following manufacturer:
    a. Garlock – Link-Seal
2. Bricked Ends – As approved by Charlotte Water

2.20 INSULATED CASING SPACERS

A. Casing insulators (spacers) shall be stainless steel bands with glass filled polymer plastic runners that are a minimum 2 inches wide. Casing insulators shall be sized in accordance with the casing insulators (spacers) manufacturer's recommendations so as to center the pipe within the casing. The number of casing spacers and the distance between them shall be in accordance with the recommendations of the manufacturer of the casing spacers, however a minimum of three casing spacers (one at each end and one at the midpoint of the pipe) shall be required for each section of pipe. The insulated casing spacers shall be sized to be capable of supporting the weight of the pipe filled with water. The insulating casing spacers shall be from one of the following manufacturers:

1. Advance Products & Systems, Inc.
    a. Model SSI
2. BWM Company
    a. Model BWM-SS-8 (up to 24” diameter)
    b. Model BWM-SS-12 (>24” diameter)

2.21 CASING END SEALS

A. Casing end seals shall be made of 1/8-inch thick rubber and shall be full conical in shape. The casing end seal shall be configured to the exact dimensions of the piping and casing. The rubber end seals shall fully enclose the end of the casing and shall be watertight. The casing end seals shall be from one of the following manufacturers:

1. Advance Products & Systems, Inc.
    a. Model AW Wrap-Around End Seal
2. Garlock
    a. Model W Wrap-Around End Seal
3. Viscotaq, containing the following 3 complimentary products
    a. Viscotaq Viscopaste Pipe End Seal
    b. Viscotaq Coatwrap Pipe End Seal
    c. Viscotaq Outerwrap Pipe End Seal

2.22 POLYETHYLENE MESH SEPARATOR PAD

A. The mesh separator pad shall be a flexible polyethylene/PVC mesh pattern webbing pad, with no cathodic protection shielding properties. The Separator pad shall be from one of the following manufacturers:

1. Stuart Steel Protection Corp.
    a. Stuart Diamond Rockstop (160 mils / 0.16”)
2. Sika Corporation
    a. Tuff-N-Nuff Rockshield (250 mils / 0.25” or 375 mils / 0.375”)
3. Denso
    a. Denso Rockshield (250 mils / 0.25” or 440 mils / 0.44”)

PART 3 - EXECUTION

3.1 EXTERNAL PIPE COATINGS

A. General:

1. External steel pipe surfaces (including all piping, joints, valves, fittings, hydrant piping, etc.) are to be coated and used in conjunction with CP. Ductile iron pipe (including all piping, joints, valves, fittings and hydrant piping) shall be coated where indicated on the plans, drawings or specifications.
2. Predominant coating method to be shop application. The piping shall receive an exterior coating in the pipe manufacturer's shop or at a separate applicator's facility.
3. All components of the coating system shall be manufactured by a single supplier to assure compatibility of individual components.

4. Field applied coatings to be limited to repairing damage to shop coating; coating exposed metal at joints, fittings, valves, bond and test wire connections; and other appurtenances that are not shop coated.

5. Extent of piping to be shop coated and extent to be field coated to be clearly identified in Contractor's material and quality assurance submittals. Quality assurance submittals shall include pipe and casing coating, handling and testing procedures.

6. All coatings used on project shall be as specified herein, unless otherwise approved by the Engineer prior to bidding. All products comprising completed coating system to be compatible and the same products to be used throughout the project. Pipe surfaces that will come in contact with potable water inside the pipeline (e.g., spigot ends of bell and spigot joints) to be coated with materials having NSF-61 certification.

B. Application of Shop Applied Materials to Steel and Ductile Iron Pipe: The coating applicator, regardless of the location where the coating is applied, shall be certified as qualified by the coating manufacturer. The coating applicator must abide by and follow all manufacturer's application specifications for the coating system. All components of the coating system shall be manufactured by a single supplier to assure compatibility of individual components.

C. Surface Preparation Prior to Coating: The exterior surface of the piping shall be cleaned in accordance with the coating manufacturer's recommendations.

D. Certification of External Coating: The pipe or fitting manufacturer or coating applicators, as appropriate, will test and certify the exterior coating prior to shipping to the project site. When the pipe or fitting arrives at the job site, the Contractor shall visually inspect the pipe or fitting, and repair any and all damage as directed by the coating manufacturer and in accordance with these specifications.

E. Inspection of External Coating: Immediately prior to installation of the pipe or fitting, the Contractor shall visually inspect all exterior coatings on pipe, fittings, specials and closures for holidays and other defects. All holidays and defects shall be repaired by the Contractor as directed by the coating manufacturer and in accordance with this specification, and to the satisfaction of the Engineer. The coating shall then be electrically tested for flaws in the coating with a holiday detector by the Contractor. The electrical test shall be in accordance with AMPP/NACE SP0274 or SP0188 as appropriate. All holidays shall be immediately repaired by the Contractor. The repaired coating shall be rechecked by the Contractor with a holiday detector. Once the coating is verified to be free of holidays, the piping or fitting may be installed in the trench. Holiday testing shall also be completed, with any holiday indications repaired, prior to backfill.

F. Protection of Coating Systems During Construction

1. At all times during construction of the pipeline, the Contractor shall take every precaution to prevent damage to the protective coating. No metal tools or heavy objects shall be permitted to come into contact unnecessarily with the finished coating. Workmen shall not be permitted to walk on the coating, except when absolutely necessary and approved by the Engineer, in which case, they shall wear shoes with rubber or composition soles and heels or other suitable footwear which will not damage the coating.

2. Externally coated pipe shall be hoisted from the trench side to the trench by means of a minimum of two 18-inch wide belt slings of sufficient strength to handle the weight of the piping safely.

3. Any and all coating damage shall be repaired with specified coating repair materials prior to backfill.

G. Transportation, Handling and Storage of Coated Pipe

1. Pipe shall be handled in accordance with AWWA C214 and in such a manner as to protect the pipe and the coating from damage.

2. At the pipe coating plant, if forklifts are used, all bearing surfaces of a forklift apparatus must be padded with suitable padding material. Web slings may also be used at the pipe manufacturer's plant.

3. At the project site, the pipe shall only be handled with slings. Metal chains, cables, tongs, forklifts or other equipment likely to cause damage to the coating, will not be permitted. Web slings shall be a type that will not damage the coating. When pipe is handled with slings, there should be a minimum of two slings. Slings should be a minimum of 18 inches wide and of sufficient strength to handle the weight of the pipe safely. Slings shall not pass through the pipe. Hooks on the end of the pipe will not be allowed. Handling equipment, materials, and procedures shall be submitted to the Engineer for approval. If possible, the pipe should be handled from cutback ends.

4. Storing of the coated pipe shall be on padded 12-inch wide (minimum) skids or select loamy or sand dirt berms, or suspended from cutback ends, where possible. In urban areas, the pipe should be suspended on padded skids or skids placed at cutback areas. Where skid chucks are used in contact with coated pipe, they should be padded with several layers of carpeting. Padded chucks should be placed such that coated pipe is nested on the skid rather than the chuck. Coated pipe shall not be laid on pavement without benefit of padding at contact points. In preparation for transporting pipe, the use of web slings is necessary for tie downs.

5. If cables or chains are used during transportation, they must be properly padded with approved, suitable material as required to protect the coating from damage while in transit. Use of a padded horizontal separator strip between successive rows of pipe is necessary to prevent damage to the pipe coating, i.e.: strips of rug material over all contact areas where pipe will rest.

6. Pipe to be stored outdoors for more than six months with coating that is susceptible to damage by ultraviolet light shall be protected from exposure to direct sunlight in accordance with guidance provided by the coating manufacturer.

3.2 INTERNAL PIPE LININGS

A. Steel and ductile iron pipe and fittings shall be internally lined with a corrosion protective coating.

B. Linings shall be certified as per NSF61 or equivalent drinking water standard.

C. Linings shall be cement mortar, liquid epoxy or fusion bonded epoxy complying with one of the AWWA specifications outlined below.

1. Cement mortal linings for ductile iron pipe and fittings shall comply with AWWA C104.

2. Fusion bonded epoxy linings for ductile iron fittings shall comply with AWWA C116.
3. Cement mortal linings for steel pipe and fittings shall comply with AWWA C205.
4. Liquid epoxy linings for steel pipe and fittings shall comply with AWWA C210.

3.3 COATING AND LINING QUALITY ASSURANCE

A. The Contractor shall be responsible for coating and lining quality control including coating inspection. The Contractor shall prepare and submit a coating quality plan for acceptance to the Engineer. This plan shall include a coating inspection and test plan.

B. Coating inspection shall be performed as indicated in the coating inspection and test plan.

C. Coating inspection shall be performed or supervised by a coating inspector certified to AMPP NACE level 2 minimum or equivalent with documented experience in the types of coatings being applied.

D. Surface preparation and coating application may be subject to inspection by the Engineer. The Contractor shall provide reasonable advance notification of inspection hold points.

E. The Contractor shall record the results of coating inspections and tests. The Contractor's QC records and reports shall be available for review and shall be submitted to the Engineer.

3.4 THERMITE WELDING

A. All thermite welds shall be made as shown on the Drawings and in accordance with the manufacturer's recommendations using the proper combination and size of equipment for the pipe and wire size being welded. Refer to detail drawings 5.3 and 5.4 for additional thermite weld information. All welding materials and equipment shall be the product of a single manufacturer. Personnel applying the thermite weld shall be properly trained and competent in thermite welding and shall use appropriate safety measures.

B. Assure that the area where the attachment is to be made is absolutely dry. Remove mill coating, dirt, grime and grease from the pipe or fitting surface at the weld location by wire brushing or by the use of suitable safety solvents. Clean a 2.5-inch square area of the pipe or fitting surface at the weld location to a bright shiny surface, free of all weld seams, serious pits and flaws by use of a mechanical grinder or hand files/rasps. All thin-walled metallic pipe and internally lined metallic pipe shall contain manufacturer installed external bonding plates for the application of thermite welds.

C. Prepare the wire for welding by assuring that the cable is absolutely dry. The cable shall be free of dirt, grease and other foreign products. Cut the cable in such a way as to avoid flattening or forcing out of round. To prevent deformation of the cable, cut the cable with cable cutters. Remove approximately 1.5 inch of the insulation in a manner that will avoid damage to strands. Install adapter sleeves for all bonds and test wires prior to welding. Either prefabricated factory sleeved joint bonds or bond wire with formed sleeves made in the field are acceptable.

D. Preheat the exposed thermite weld area until a visible absence of moisture is present (i.e. moisture ring).

E. Hold prepared graphite mold (including metal disk, metal powder and starting powder) firmly over the prepared area with wire adapter sleeve positioned in the appropriate mold

contour. Hold the cable at an approximate 30-degree angle to the pipe surface when welding. Using striker, ignite starting powder.

F. When the weld has cooled, remove the weld slag and test the weldment for strength by striking a sharp blow with a two-pound brass hammer or chipping hammer while pulling firmly on the wire. Reweld unsound welds and retest weldments. Any failed welds are to rewelded in a separate location, with only one charge/weld permitted per location (repeating weld in same location is prohibited). Thoroughly clean mold and mold covers after completion of each weld to assure that no slag will penetrate into the next weld.

G. Thermite welds shall be minimum 6 inches separation distance from other weld locations.

H. After soundness of the weld has been verified, thoroughly clean the weld area with a stiff wire brush and coat all exposed metal areas with one of the following:

1. Thermite welds to ductile iron and steel pipe and fittings, steel bonding plates on ductile iron and steel pipe, and steel casings shall be coated with an approved coating material (refer to Section 2.12):

a. KEMA (to be completed by trained and competent personnel)

1) Prime any exposed area with Polyguard 600 Series Primer, overlapping the existing coating by 4”. Allow primer to completely dry before applying KEMA 250 Sealant.

2) Cut KEMA 250 Sealant in length long enough to cover the exposed area and allow 4” overlap onto the existing coating.

3) Prior to applying the KEMA 250 Sealant, lift the wire near the thermite weld button slightly to allow the KEMA coating to be applied under the wires.

4) For the first piece, cut slits in the KEMA 250 Sealant so the wire may pass through. From the wire side of the bond, pass the KEMA 250 Sealant under and around the wire and weld button and mold it around each. Press down firmly to ensure no trapped air is present and adhesion is achieved.

5) For the second piece, cut a single slit in the middle of the KEMA 250 Sealant and slide the wire through the slit to the weld at the 12 O’clock position. This piece of KEMA 250 Sealant should have a 1” overlap beyond the first piece of KEMA 250 Sealant. Press down firmly and mold it under the wire and around the weld button.

6) Lay the balance of the KEMA 250 Sealant until 4” overlap onto the existing pipeline coating (or undisturbed piping) providing 1” overlap on each subsequent piece. Press the wires firmly into the KEMA 250 Sealant coating.

7) Cut the KEMA 250 (12) Topcoat into lengths sufficient to cover the whole affected area with an additional 1” overlap on the base layer. Repeat the previous bullet point step and offset the overlap on each piece to ensure the overlap is not in the same place as a previous location. Be sure to mold a strip of KEMA 250 (12) Topcoat around the test lead wire and sandwich the wire between each of the layers to avoid moisture penetration. Ensure the tough tape backing on the

KEMA 250 (12) Topcoat is facing up (away from the pipe surface). Press firmly to provide good adhesion. This is considered the finish layer.

8) Use a roller or other approved means to remove air pockets.

9) Follow all manufacturer's instructions for installation.

b. Elastomeric cap

1) Shall extend on all four sides beyond the cleaned area.

2) Apply primer over the entire weld area and over the entire area where the elastomeric cap will be placed.

3) Push the dome of the prefabricated cap containing elastomeric material firmly into weld area.

4) Lift the wire away from the pipe and apply the elastomeric material completely around and underneath the wire.

5) Push the wire back down on the pipe.

6) Follow all manufacturer's instructions for installing prefabricated caps.

7) For coated pipe and fittings, repair any and all external coatings that are removed or damaged during the thermite welding.

2. Thermite welds to concrete pipe steel bonding plate shall be coated with a minimum of 10 mils of a brush applied mastic. The mastic shall cover the entire area of the weld and the steel bonding plate. The mastic shall be allowed to completely dry before fully embedding within concrete mortar at the pipe joint. Follow all manufacturer's instructions for applying mastic coating.

3.5 BONDED JOINTS

A. All new ductile iron and/or non-welded steel pipeline joints, including those on pipe, fittings, valves and branch connections, except those specified to be insulated or welded, shall be bonded as shown on the Drawings. All bond cables shall be thermite welded to the pipe or fitting as described above.

B. All joints are to be bonded with two HMWPE insulated copper cables. Wire size shall be AWG No. 2 for piping larger than 36-inch, AWG No. 4 for 16-inch to 36-inch piping, and AWG No. 6 for piping smaller than 16-inch.

3.6 PREPACKAGED ZINC AND MAGNESIUM ANODES

A. Prepackaged zinc and magnesium anodes shall be installed where indicated. Prior to installation, remove all plastic shipping covers from the anode (the prepackaged cotton bag or prepackaged cardboard box shall not be removed). Install the anodes in existing soils (free from rocks, roots, organic material, trash or other debris) and backfill with a minimum of 12 inches of existing soil. Do not install the anode in sand, rock or gravel backfill. Galvanic anode to be installed as shown on standard details. On close proximity metallic pipelines, the galvanic anodes shall be installed no closer to the foreign metallic pipeline than the midpoint between the two pipes. Anode shall be pre-soaked with 5 gallons of water within 4 hours of final backfill as per manufacturer’s instructions. Prepackaged cotton bag anodes can be inserted into a bucket of water and left to absorb

the water, whereas prepackaged cardboard tubes require water to be poured over them while in place to ensure anode integrity.

B. At anode test stations, horizontally run anode lead wires shall be buried a minimum of two feet below grade. Handle wire with care. Do not suspend or lower the anode by the lead wire. For individual anode application, the manufacturer installed lead wire shall be run directly into the test station. For multiple anode application, splice each AWG No. 12 copper wire supplied with the anode to an AWG No. 8 HMWPE stranded copper cable through the use of a compression connector (refer to Section 2.13 above). Tape the splice with insulation putty (ensuring complete coverage and a smooth contour), three layers of high voltage rubber splicing tape with 50% overlap, followed by three layers of vinyl electrical tape with 50% overlap (refer to Section 2.14 above). Terminate the ends of the AWG No. 8 anode header cable or anode leads in the test boxes utilizing the terminal lugs and shunts as indicated. Header cable should utilize colored tape or identifier to indicate anode type.

C. At fire hydrant test stations, anode lead wires shall be buried a minimum of two feet below grade. Handle wire with care. Do not suspend or lower the anode by the lead wire. Route the AWG No. 12 copper wire supplied with the anode to the test box as shown. Terminate the ends of the anode lead wires in the test boxes utilizing the terminal lugs and shunts as indicated.

D. Galvanic anodes shall be installed a minimum 15 feet from the nearest AC or DC coupon.

3.7 ZINC AND MAGNESIUM RIBBON ANODES

A. Zinc and/or magnesium ribbon anodes shall be installed where shown on the Drawings. Maintain separation between the pipe and the anode as shown on the Drawings. Backfill around the anode ribbon shall be thoroughly compacted with a six-inch minimum cover. The backfill material shall be native soil or bentonite that is free of roots, organic material, trash and rocks. Do not backfill the anode with sand, rock or gravel.

B. Attachment of the anode lead wires to the ribbon anodes shall be made by removing the anode material from the iron core and installing a compression connector around the wire (refer to Section 2.12 above) and the anode core. This compression connection shall then be silver soldered. Follow the anode manufacturer's instructions for removing the anode material from the core. Tape the splice with insulation putty (ensuring complete coverage and a smooth contour), three layers of high voltage rubber splicing tape with 50% overlap, followed by three layers of vinyl electrical tape with 50% overlap (refer to Section 2.13 above). Lead wires shall be attached to the anode at locations shown on the Drawings. The lead wires shall be terminated with terminal lugs and shunts in the test boxes as indicated. Direct connection of the ribbon anode to the pipe shall not be acceptable.

C. Anodes shall be continuous between test stations as indicated on the Drawings. Anode splices shall be allowed and shall be made by removing the anode material from the iron core and installing a compression connector (refer to Section 2.12 above) around the two iron cores of the adjacent anodes. This compression connection shall then be silver soldered. Follow the anode manufacturer's instructions for removing the anode material from the core. Tape the splice with insulation putty (ensuring complete coverage and a smooth contour), three layers of high voltage rubber splicing tape with 50% overlap, followed by three layers of vinyl electrical tape with 50% overlap (refer to Section 2.13 above).

3.8 TEST STATIONS

A. Install test stations at the locations indicated. Test boxes are to be located directly over the pipeline except in areas that would place the test station in a roadway. Locate those test stations three feet back-of-curb in a non-paved area adjacent to roadway.

B. Attach test wires as indicated using the proper thermite welding equipment and charges specified for the wire size and respective pipe material. Follow all procedures as outlined in Section 3.4 above.

C. All test station wires shall be routed (horizontal trench) a minimum of two feet below finished grade. Maintain sufficient slack in the test wires so that the wires can extend a minimum of 18 inches from the test box or test post. Connect the test wires to the test station terminal block with one-hole eyelet, compression terminal lugs for 0.25-inch bolt size. Install a shunt and a copper shorting strap to connect the anode leads to the pipe lead where indicated on the Drawings.

D. The test boxes shall be set in poured concrete, with a total concrete dimension of two feet x two feet and four inches thick reinforced with #4 rebar. The flush mounted test box lids shall be free of concrete and not cemented over.

E. Where test leads are installed horizontally outside of the pipe trench, the test lead wires shall be routed under the roadway to the test box or test post through minimum 1- inch diameter PVC conduit. Install cable warning tape 12 inches above conduit.

3.9 REFERENCE ELECTRODES

A. Install reference electrodes at the test stations indicated. The reference electrode shall be installed with a minimum offset of 6 inches the pipe. Native trench material shall be used to backfill the reference electrode for a minimum of six inches. Prior to installation, remove the plastic shipping cover from the reference electrode. The cloth bag containing the special backfill shall remain intact. Reference electrode to remain a minimum of 15 feet from nearest galvanic anode.

3.10 CLEARANCE TO OTHER STRUCTURES

A. Twelve inches of natural clearance shall be maintained to other structures, where possible. When 12 inches of clearance cannot be maintained, install a flexible polyethylene mesh webbing pad around the new piping and secure with non-metallic tape.

3.11 INSULATING FLANGES, INSULATING COUPLINGS, AND INSULATING CORPORATION VALVES

A. Insulating flanges, insulating couplings, and insulating corporation valves shall be installed where shown on the Drawings. The Contractor shall carefully align and install the insulating components according to the insulator manufacturer's instructions. Before backfilling, the Contractor shall test each insulator for electrical insulation. If the insulator is not properly isolated, the Contractor shall, at his expense, repair or replace all defective components. The Contractor shall test the repaired insulator. This process will continue until the insulator is tested to be properly isolated. Insulation that passes for effective isolation during the pre-backfill test but does not render positive isolation results during the acceptance testing must be repaired by the Contractor at no additional cost

to the Owner. The Contractor shall provide the Engineer a minimum notice of one week prior to the conducting the testing of the isolation.

B. Install test wires, reference electrode, and test box at insulating flanges and insulating couplings as shown in the Details.

3.12 COATING OF INSULATING FLANGES, INSULATING COUPLINGS, AND INSULATING CORPORATION VALVES

A. The insulating flanges, insulating couplings, and insulating corporation valves (including all isolation components) shall be fully coated for a minimum of 12 inches on either side of the flange, coupling, or corporation valve. The insulator shall be coated after verification of proper electrical isolation. The insulator shall be coated as described below.

1. Clean the surface of the insulator, and all of its components by power tool cleaning in accordance with the SSPC SP3. Follow all surface preparation and installation recommendations of the coating manufacturer.

2. Apply a uniform coat of the primer to the external surface of the insulator, and all of its components including bolts, nuts, etc. The primer shall extend a minimum of twelve inches on either side of the insulator.

3. Apply filler mastic to all irregular surfaces of the insulator to assure a smooth profile for application of the inner tape coating.

4. Apply innerwrap to the insulator, and its components in a spiral fashion with a minimum overlap of 55%. The innerwrap shall extend a minimum of twelve inches on either side of the insulator.

5. Apply outerwrap to the insulator, and its components in a spiral fashion with a minimum overlap of one inch. The outerwrap shall be applied with sufficient tension to provide continuous adhesion of the outerwrap tape. Install test facilities at the insulating flanges as shown on the Drawings.

3.13 CONCRETE BUTTRESSES, SUPPORT BLOCKS, ANCHOR BLOCKS, AND OTHER CONCRETE STRUCTURES

A. Position reinforcing steel used in the construction of support blocks, anchor blocks, and any and all other concrete structures so that they are not in contact with the piping. Maintain a minimum of 2 inches of clearance between the piping and all reinforcement steel or other metallic components. Under no circumstances shall metallic pipe be in contact with reinforcing steel.

3.14 INSULATED CASING SPACERS AND CASING END SEALS

A. Each length of pipe within the casing shall be supported and electrically isolated from the casing by the use of insulating spacers (supports). The number of casing spacers and the spacing between them shall be in accordance with the recommendations of the casing spacer manufacturer but no fewer than three (one at each end and one at the midpoint of the pipe) shall be used to support each section of pipe. The insulating spacers shall be of sufficient dimension to center the carrier pipe within the casing and to serve as runners to slide the carrier through the casing.

B. After the carrier pipe is installed within the casing, the Contractor shall test the electrical isolation between the casing and the carrier pipe. If the carrier pipe is not electrically isolated from the casing, the Contractor shall, at no cost to the Owner, remove the carrier pipe from the casing, replace any and all defective or damaged casing spacers and reinstall the carrier pipe in the casing. The Contractor shall retest the repaired electrical isolation. This process will continue until the casing is tested to be electrically isolated from the carrier pipe. Pipe to casing insulation that passes for effective isolation during the pre-backfill test but does not render positive isolation results during the acceptance testing must be repaired by the Contractor at no additional cost to the Owner. The Contractor shall provide the Engineer a minimum notice of one week prior to the completion of the installation of piping within a casing.

C. Install casing end seals at both ends of the casing after the casing isolation has been confirmed as effective. The casing end seals shall be installed in accordance with the written instructions of the end seal manufacturer.

3.15 EXCAVATIONS

A. The Contractor shall obtain all permits and approvals necessary to perform the excavations for installation of the anodes. The Contractor shall have all utility locations marked prior to starting any excavations.

B. All excavations shall be performed in a manner that avoids damage to any existing utilities or structures. Any utilities or structures damaged by the Contractor shall be the sole responsibility of the Contractor to repair at no additional cost to the Owner.

C. The backfilling and compaction of the excavations shall be performed in accordance with Charlotte Water Standards. Backfill material shall be compatible with the pipe coating system, such that the coating is not damaged by backfilling.

D. All surfaces shall be restored in accordance with Charlotte Water Standards.

E. Traffic control, in accordance with appropriate standards and project specifications, is the responsibility of the Contractor.

3.16 POST INSTALLATION TESTING

A. Prior to substantial completion, the Contractor will perform post installation testing of all corrosion control/corrosion monitoring systems via a qualified Cathodic Protection Engineer. The repair or replacement of any defective or improperly installed systems shall be the sole responsibility of the Contractor. Any and all repairs or replacement of defective or improperly installed corrosion control/corrosion monitoring systems shall be performed by the Contractor at no additional cost to the Owner.

B. The Contractor will provide periodic testing of the system throughout the project period via a qualified Cathodic Protection Engineer, scheduling tests and providing access to components to be tested. The Engineer will test installed components once per month, at the most. An Inspection and Test Program (ITP) should be utilized, including hold points for critical testing, to ensure proper installation and/or operation are present.

C. Acceptance test criteria (performed prior to CP connection/energization): The acceptance test criteria shall include the following:

1. Longitudinal pipe resistance measurements

The maximum acceptable span resistance shall be 115% or less of the summation of the following:

a. Number of pipe joints multiplied by the theoretical resistance of a joint bond.

b. Number of pipe segments multiplied by the resistance per pipe segment.

2. Insulator (insulated flanges, insulated couplings, insulated corporation stops, insulated casing spacers) effectiveness.

The acceptance criteria for insulators shall include the following three test procedures/criteria, all three of which must be met by each insulator for acceptance:

a. High frequency isolation tester: "Acceptable", "Satisfactory" or other similar direct meter reading, and

b. Electrical potential: Static potential difference across insulator of no less than 0.1 volt, and

c. Electrical potential/applied current: A positive potential shift on the side of the insulator where current is applied, and a negative potential shift on the side of the insulator opposite of where current is applied.

3. Test station wiring acceptance criteria shall be as follows:

a. Test wires attached to ductile iron and steel piping and/or casings shall have potentials between -0.50 to -0.65 volts with respect to a portable copper/copper sulfate reference electrode. Each of the test wires connected to the same structure at the same general location on piping shall also have the same potential values

b. Test wires attached to concrete piping shall have potentials between -0.20 to -0.50 volts with respect to a portable copper/copper sulfate reference electrode. Each of the test wires connected to the same structure or bonding plate at the same location on piping shall also have the same potential values.

c. Magnesium anode header cables shall have a potential between 1.55 and 1.75 volts with respect to a portable copper/copper sulfate reference electrode. Both ends of the magnesium anode header cable shall also have identical potential values.

d. Zinc anode header cables shall have a potential near 1.1 volts with respect to a portable copper/copper sulfate reference electrode. Both ends of the zinc anode header cable shall also have identical potential values.

e. Permanent copper/copper sulfate reference electrodes shall have a potential between -0.05 and +0.05 volt to a portable copper/copper sulfate reference electrode.

3.17 CLEAN-UP

A. The Contractor shall be responsible for clean-up and removal of all debris, extra material, and equipment utilized for installation of the corrosion control/corrosion monitoring system.

3.18 FINAL INSPECTION

A. A final inspection will be held for each project once construction and complete restoration has been completed. The Contractor SHALL ATTEND the final inspection. The Contractor shall be responsible for providing equipment and labor, as may be necessary, to conduct the final inspection and to provide a safe worksite. Deficiencies, if any, shall be noted for correction by the Contractor. The Contractor will schedule the work with the Inspector. Any and all corrective actions necessary to correct a deficiency noted at the final inspection shall be completed prior to final acceptance of the work and project.

END OF SECTION

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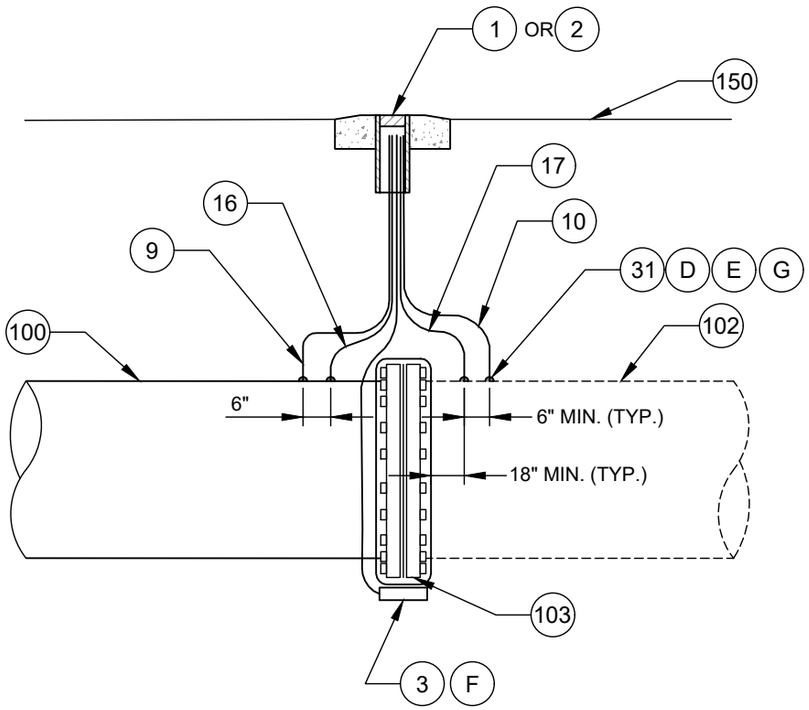
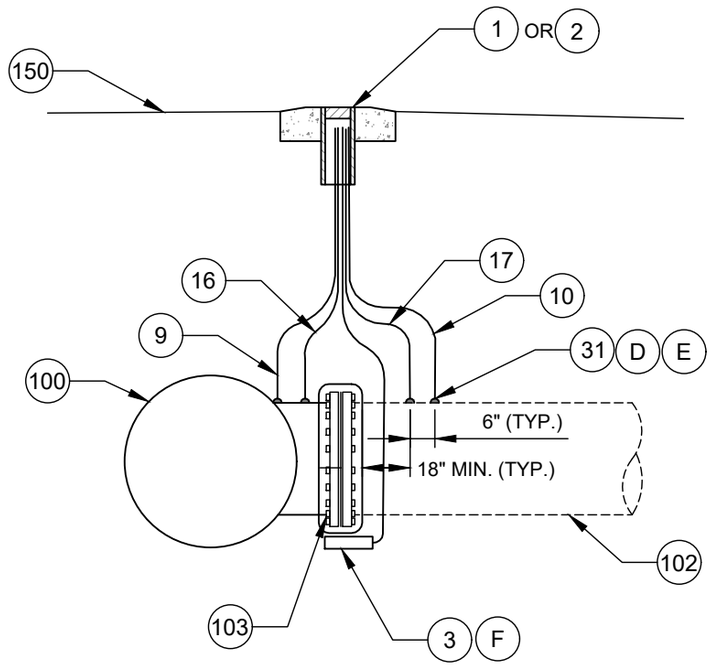


IN-LINE INSULATOR



TEE INSULATOR

DRAWING REFERENCE TABLE	
DWG	DWG NAME
5.2	CONCRETE PIPE BONDING
5.3	HORIZONTAL THERMITE WELD
5.5	STEEL BONDING PLATE FOR SPECIALLY LINED METALLIC MAIN
6.1	INSULATING FLANGE
8.1	STANDARD VALVE BOX
8.2	TEST POST ASSEMBLY
10.1	REFERENCE ELECTRODE AND COUPON PLACEMENT

WIRING SCHEDULE					
DESCRIPTION	TEST POST TERMINAL	AWG WIRE SIZE	TYPE OF INSULATION	COLOR OF INSULATION	TEST BOX 7 TERMINAL
NEW MAIN	3	#8	HMWPE	BLUE	2
	6	#10	THWN OR XLPE	BLUE	3
CONNECTING MAIN	5	#8	HMWPE	WHITE	5
	10	#10	THWN OR XLPE	WHITE	7
PERMANENT REFERENCE ELECTRODE	7	#14	HMWPE OR RHH-RHW	YELLOW	6

NO. DESCRIPTION:

1. TEST BOX.
2. TEST POST.
3. COPPER/COPPER SULFATE REFERENCE ELECTRODE.
9. AWG NO. 10 BLUE CABLE.
10. AWG NO. 10 WHITE CABLE.
16. AWG NO. 8 BLUE CABLE.
17. AWG NO. 8 WHITE CABLE.
31. THERMITE WELD.
100. NEW MAIN.
102. CONNECTING MAIN.
103. COATED INSULATING FLANGE.
150. FINISHED GRADE.

NOTES:

A. TEST STATIONS LOCATED ALONG PAVED ROADWAYS SHALL GENERALLY BE LOCATED 3' OUTSIDE OF THE EDGE OF PAVEMENT IN A NON-PAVED AREA. ROUTE ALL TEST WIRES AT A MINIMUM DEPTH OF 24" TO THE FINAL TEST STATION LOCATION. TEST STATION LOCATIONS SHALL BE FIELD ADJUSTED.

B. ROUTE WIRES IN 1 INCH PVC CONDUIT TO TEST BOX. INSTALL CABLE WARNING TAPE 18" ABOVE PVC CONDUIT.

C. MAINTAIN SUFFICIENT SLACK IN THE TEST WIRES SO THAT THE WIRES CAN EXTEND A MINIMUM OF 18" FROM THE TEST BOX.

D. THERMITE WELDS TO PCCP OR CBWCP SHALL BE MADE AT STEEL BONDING PLATES, SEE STANDARD DETAIL 5.2.

E. THERMITE WELDS TO SPECIALLY LINED STEEL AND DUCTILE IRON MAIN SHALL BE MADE AT STEEL BONDING PLATES, SEE STANDARD DETAIL 5.5.

F. FOR ADDITIONAL REFERENCE ELECTRODE INSTALLATION INFORMATION, SEE STANDARD DETAIL 10.1.

G. THERMITE WELD TO BE ATTACHED OUTSIDE OF FLANGE COATING AREA.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

CORROSION CONTROL

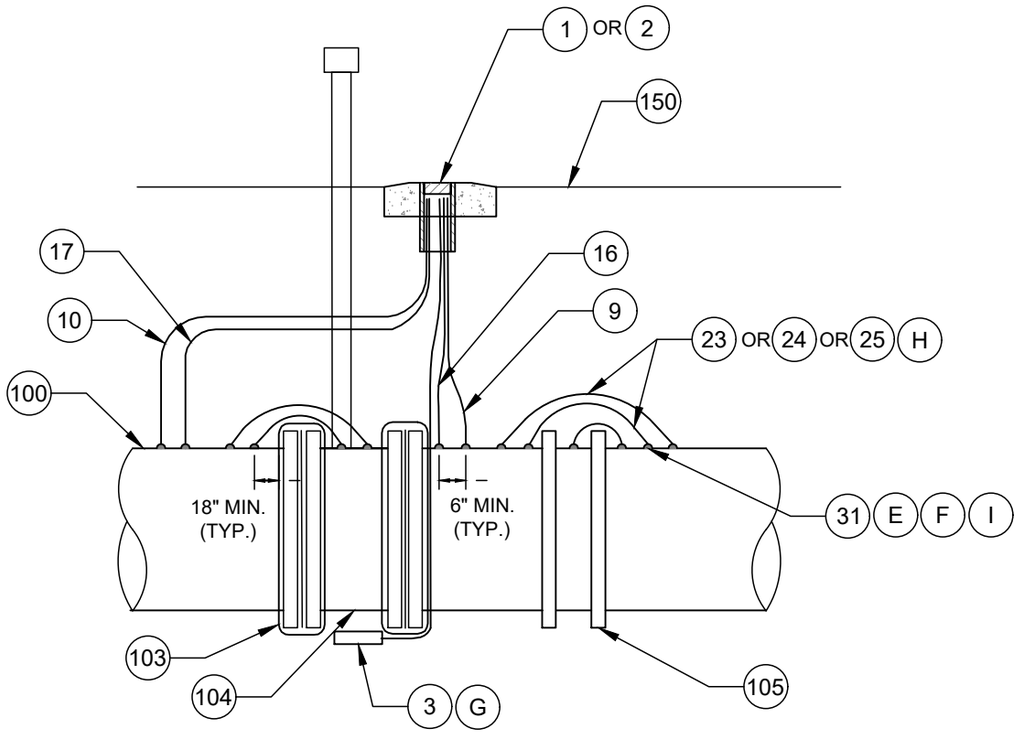
CORROSION CONTROL TYPE A1 TEST STATION (INSULATED FLANGE)

NO SCALE

VERSION 1.0

DATE 04/2024

DETAIL 18.1.1



DRAWING REFERENCE TABLE	
DWG	DWG NAME
5.1	METALLIC MAIN BONDING
5.2	CONCRETE PIPE BONDING
5.3	HORIZONTAL THERMITE WELD
5.5	STEEL BONDING PLATE FOR SPECIALLY LINED METALLIC MAIN
6.1	INSULATING FLANGE
8.1	STANDARD VALVE BOX
8.2	TEST POST ASSEMBLY
10.1	REFERENCE ELECTRODE AND COUPON PLACEMENT

WIRING SCHEDULE					
DESCRIPTION	TEST POST TERMINAL	AWG WIRE SIZE	TYPE OF INSULATION	COLOR OF INSULATION	TEST BOX 7 TERMINAL
NEW MAIN	3	#8	HMWPE	BLUE	2
	6	#10	THWN OR XLPE	BLUE	3
NEW MAIN	5	#8	HMWPE	WHITE	5
	10	#10	THWN OR XLPE	WHITE	7
PERMANENT REFERENCE ELECTRODE	7	#14	HMWPE OR RHH-RHW	YELLOW	6

NO. DESCRIPTION:

1. TEST BOX.
2. TEST POST.
3. COPPER/COPPER SULFATE REFERENCE ELECTRODE.
9. AWG NO. 10 BLUE CABLE.
10. AWG NO. 10 WHITE CABLE.
16. AWG NO. 8 BLUE CABLE.
17. AWG NO. 8 WHITE CABLE.
23. BOND CABLES, AWG 6, WHITE.
24. BOND CABLES, AWG 4, WHITE.
25. BOND CABLES, AWG 2, WHITE.
31. THERMITE WELD.
100. NEW MAIN.
103. COATED INSULATING FLANGE.
104. BUTTERFLY VALVE.
105. RESTRAINED COUPLING.
150. FINISHED GRADE.

NOTES:

A. INSTALL 0.1 OHM SHUNT BETWEEN TERMINALS #2 AND #5 (TEST BOX) OR TERMINALS #3 AND #4 (TEST POST).

B. TEST STATIONS LOCATED ALONG PAVED ROADWAYS SHALL GENERALLY BE LOCATED 3' OUTSIDE OF THE EDGE OF PAVEMENT IN A NON-PAVED AREA. ROUTE ALL TEST WIRES AT A MINIMUM DEPTH OF 24" TO THE FINAL TEST STATION LOCATION. TEST STATION LOCATIONS SHALL BE FIELD ADJUSTED.

C. ROUTE WIRES IN 1 INCH PVC CONDUIT TO TEST BOX. INSTALL CABLE WARNING TAPE 18" ABOVE PVC CONDUIT.

D. MAINTAIN SUFFICIENT SLACK IN THE TEST WIRES SO THAT THE WIRES CAN EXTEND A MINIMUM OF 18" FROM THE TEST BOX.

E. THERMITE WELDS TO PCCP OR CBWCP SHALL BE MADE AT STEEL BONDING PLATES, SEE STANDARD DETAIL 5.2.

F. THERMITE WELDS TO SPECIALLY LINED STEEL AND DUCTILE IRON MAIN SHALL BE MADE AT STEEL BONDING PLATES, SEE STANDARD DETAIL 5.5.

G. FOR ADDITIONAL REFERENCE ELECTORDE INSTALLATION INFORMATION, SEE STANDARD DETAIL 10.1.

H. CABLE SIZE DEPENDANT ON PIPE DIAMETER, SEE STANDARD DETAIL 5.1.

I. THERMITE WELD TO BE ATTACHED OUTSIDE OF FLANGE OR COUPLING COATING AREA.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

CORROSION CONTROL

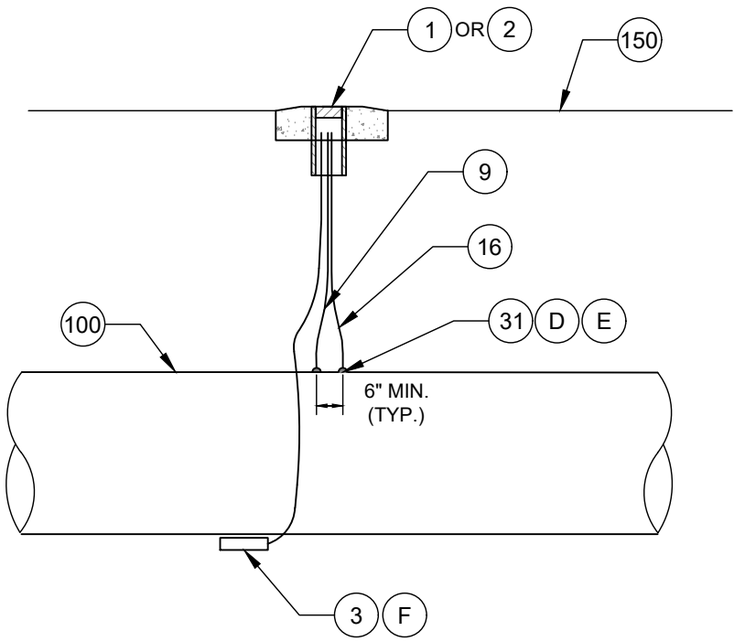
CORROSION CONTROL TYPE A2 TEST STATION (BUTTERFLY VALVE INSULATING FLANGE)

NO SCALE

VERSION 1.0

DATE 04/2024

DETAIL 18.1.2



NO. DESCRIPTION:

1. TEST STATION.
2. TEST POST.
3. COPPER/COPPER SULFATE REFERENCE ELECTRODE.
9. AWG NO. 10 BLUE CABLE.
16. AWG NO. 8 BLUE CABLE.
31. THERMITE WELD.
100. NEW MAIN.
150. FINISHED GRADE.

NOTES:

A. TEST STATIONS LOCATED ALONG PAVED ROADWAYS SHALL GENERALLY BE LOCATED 3' OUTSIDE OF THE EDGE OF PAVEMENT IN A NON-PAVED AREA. ROUTE ALL TEST WIRES AT A MINIMUM DEPTH OF 24" TO THE FINAL TEST STATION LOCATION. TEST STATION LOCATIONS SHALL BE FIELD ADJUSTED.

B. ROUTE WIRES IN 1 INCH PVC CONDUIT TO TEST BOX. INSTALL CABLE WARNING TAPE 18" ABOVE PVC CONDUIT.

C. MAINTAIN SUFFICIENT SLACK IN THE TEST WIRES SO THAT THE WIRES CAN EXTEND A MINIMUM OF 18" FROM THE TEST BOX.

D. THERMITE WELD TO PCCP AND CBWCP SHALL BE MADE AT STEEL BONDING PLATES, SEE STANDARD DETAIL 5.2.

E. THERMITE WELDS TO SPECIALLY LINED STEEL AND DUCTILE IRON MAIN SHALL BE MADE AT STEEL BONDING PLATES, SEE STANDARD DETAIL 5.5.

F. FOR ADDITIONAL REFERENCE ELECTRODE INSTALLATION INFORMATION, SEE STANDARD DETAIL 10.1.

DRAWING REFERENCE TABLE	
DWG	DWG NAME
5.2	CONCRETE PIPE BONDING
5.3	HORIZONTAL THERMITE WELD
5.5	STEEL BONDING PLATE FOR SPECIALLY LINED METALLIC MAIN
8.1	STANDARD VALVE BOX
8.2	TEST POST ASSEMBLY
10.1	REFERENCE ELECTRODE AND COUPON PLACEMENT

WIRING SCHEDULE					
DESCRIPTION	TEST POST TERMINAL	AWG WIRE SIZE	TYPE OF INSULATION	COLOR OF INSULATION	TEST BOX 7 TERMINAL
NEW MAIN	3	#8	HMWPE	BLUE	2
	6	#10	THWN OR XLPE	BLUE	3
PERMANENT REFERENCE ELECTRODE	7	#14	HMWPE OR RHH-RHW	YELLOW	6

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

CORROSION CONTROL

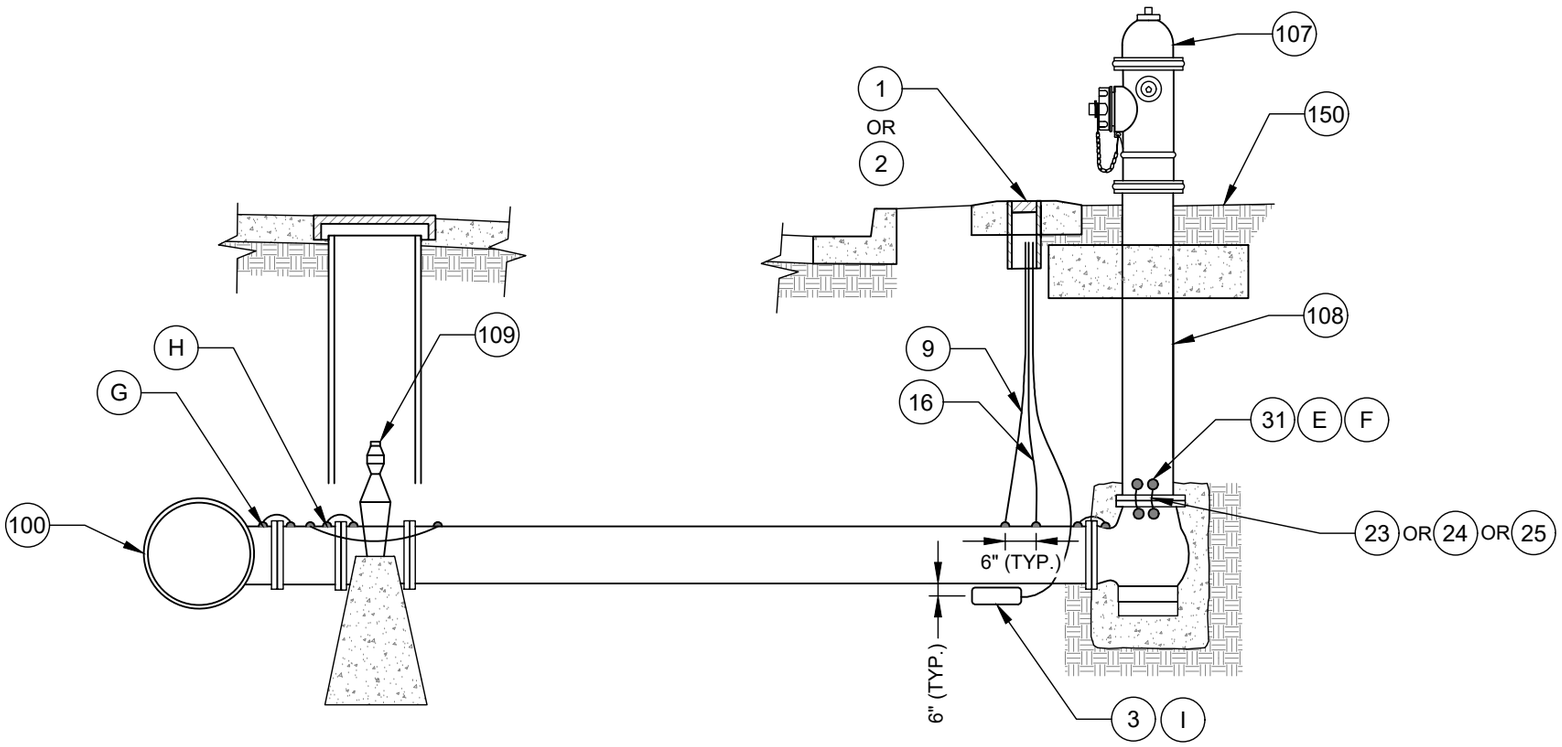
TYPE B1 TEST STATION (CORROSION MONITORING)

NO SCALE

VERSION 1.0

DATE 04/2024

DETAIL 18.2.1



NO. DESCRIPTION:

1. TEST BOX.
2. TEST POST.
3. COPPER/COPPER SULFATE REFERENCE ELECTRODE.
9. AWG NO. 10 BLUE CABLE.
16. AWG NO. 8 BLUE CABLE.
23. BOND CABLES, AWG NO. 6 WHITE.
24. BOND CABLES, AWG NO. 4 WHITE.
25. BOND CABLES, AWG NO. 2 WHITE.
31. THERMITE WELD.
100. NEW MAIN.
107. FIRE HYDRANT.
108. DIP RISER.
109. SHUT-OFF VALVE.
150. FINISHED GRADE.

NOTES:

A. MAINTAIN SUFFICIENT SLACK IN THE TEST WIRES SO THAT THE WIRES CAN EXTEND A MINIMUM OF 18" FROM THE TEST BOX. BOND ALL DUCTILE IRON COMPONENTS TOGETHER WITH AWG 6 HMWPE WIRES.

B. INSTALL BOND WIRES ON TOP OF MAIN OR FITTING WHERE POSSIBLE. INSTALL A MINIMUM OF TWO BOND CABLES ACROSS EACH MAIN JOINT.

C. BOND ALL HYDRANT PIPING ASSOCIATED WITH THE WATER MAIN.

D. INSTALL BOND CABLES ON HYDRANT RISER MAIN AND RISER ELBOW BEFORE INSTALLING RISER MAIN IN EXCAVATION.

E. THERMITE WELDS TO PCCP OR CBWCP SHALL BE MADE AT STEEL BONDING PLATES, SEE STANDARD DETAIL 5.2.

F. THERMITE WELDS TO SPECIALLY LINED STEEL AND DUCTILE IRON MAIN SHALL BE MADE AT STEEL BONDING PLATES, SEE STANDARD DETAIL 5.5.

G. BOND HYDRANT PIPING TO MAINLINE TEE, SEE STANDARD DETAIL 5.1.

H. BOND VALVE, SEE STANDARD DETAIL 5.1.

I. FOR ADDITIONAL REFERENCE ELECTRODE INSTALLATION INFORMATION, SEE STANDARD DETAIL 10.1.

DRAWING REFERENCE TABLE	
DWG	DWG NAME
5.1	METALLIC MAIN BONDING
5.2	CONCRETE PIPE BONDING
5.3	HORIZONTAL THERMITE WELD
5.4	VERTICAL THERMITE WELD
5.5	STEEL BONDING PLATE FOR SPECIALLY LINED METALLIC MAIN
8.1	STANDARD VALVE BOX
8.2	TEST POST ASSEMBLY
10.1	REFERENCE ELECTRODE AND COUPON PLACEMENT

WIRING SCHEDULE					
DESCRIPTION	TEST POST TERMINAL	AWG WIRE SIZE	TYPE OF INSULATION	COLOR OF INSULATION	TEST BOX 7 TERMINAL
NEW MAIN	3	#8	HMWPE	BLUE	2
	6	#10	THWN OR XLPE	BLUE	3
PERMANENT REFERENCE ELECTRODE	7	#14	HMWPE OR RHH-RHW	YELLOW	6

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

CORROSION CONTROL

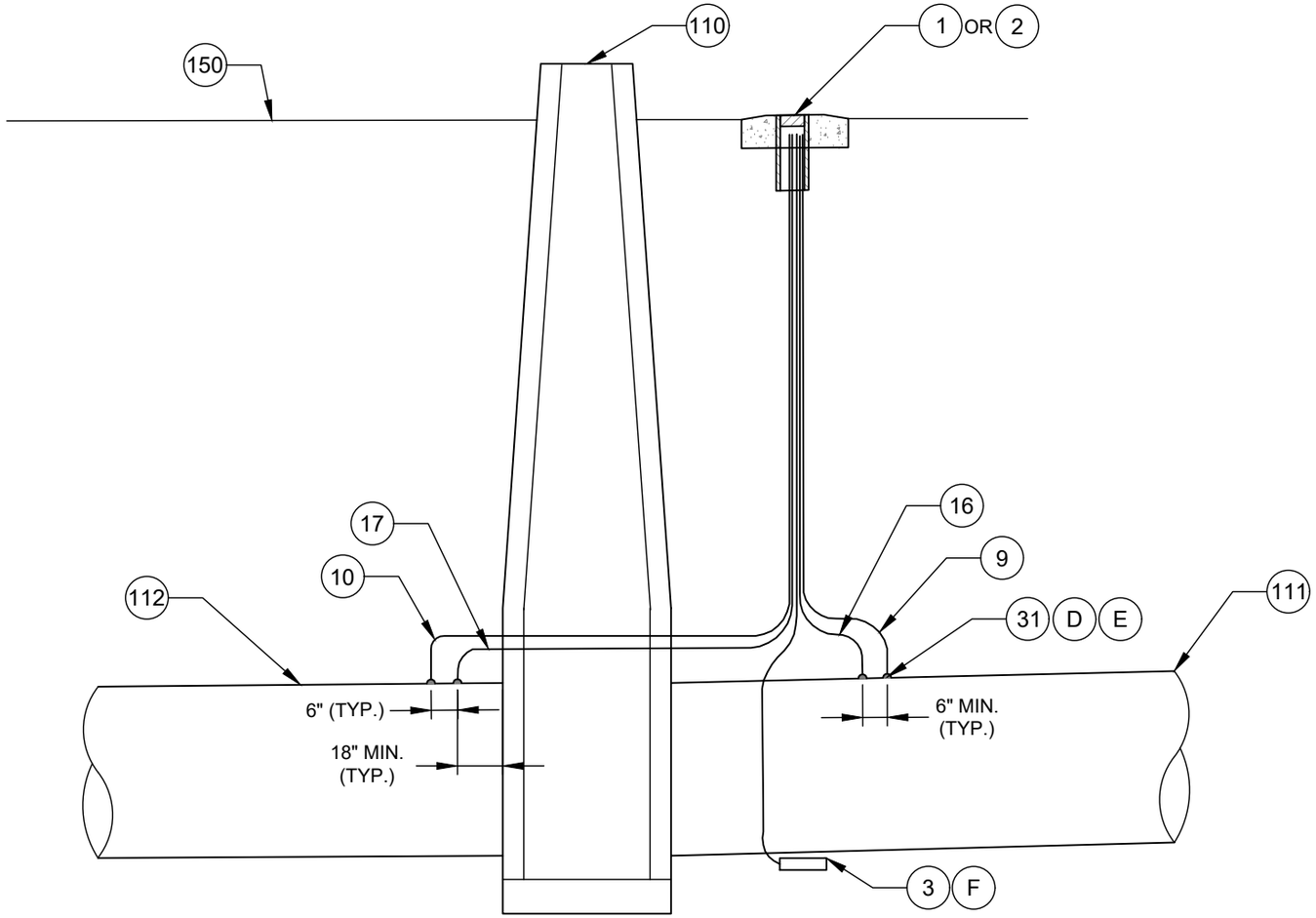
TYPE B2 TEST STATION (FIRE HYDRANT)

NO SCALE

VERSION 1.0

DATE 04/2024

DETAIL 18.2.2



NO. DESCRIPTION:

1. TEST BOX.
2. TEST POST.
3. COPPER/COPPER SULFATE REFERENCE ELECTRODE.
9. AWG NO. 10 BLUE CABLE.
10. AWG NO. 10 WHITE CABLE.
16. AWG NO. 8 BLUE CABLE.
17. AWG NO. 8 WHITE CABLE.
31. THERMITE WELD.
110. SANITARY MANHOLE.
111. SANITARY SEWER UPSTREAM.
112. SANITARY SEWER DOWNSTREAM.
150. FINISHED GRADE.

NOTES:

A. TEST STATIONS LOCATED ALONG PAVED ROADWAYS SHALL GENERALLY BE LOCATED 3' OUTSIDE OF THE EDGE OF PAVEMENT IN A NON-PAVED AREA. ROUTE ALL TEST WIRES AT A MINIMUM DEPTH OF 24" TO THE FINAL TEST STATION LOCATION. TEST STATION LOCATIONS SHALL BE FIELD ADJUSTED.

B. ROUTE WIRES IN 1 INCH PVC CONDUIT TO TEST BOX. INSTALL CABLE WARNING TAPE 18" ABOVE PVC CONDUIT.

C. MAINTAIN SUFFICIENT SLACK IN THE TEST WIRES SO THAT THE WIRES CAN EXTEND A MINIMUM OF 18" FROM THE TEST BOX.

D. TEST WIRES ONLY REQUIRED FOR DUCTILE IRON PIPING.

E. THERMITE WELDS TO SPECIALLY LINED DUCTILE IRON MAIN SHALL BE MADE AT STEEL BONDING PLATES, SEE STANDARD DETAIL 5.5.

F. FOR ADDITIONAL REFERENCE ELECTRODE INSTALLATION INFORMATION, SEE STANDARD DETAIL 10.1.

DRAWING REFERENCE TABLE	
DWG	DWG NAME
5.2	CONCRETE PIPE BONDING
5.3	HORIZONTAL THERMITE WELD
5.5	STEEL BONDING PLATE FOR SPECIALLY LINED METALLIC MAIN
8.1	STANDARD VALVE BOX
8.2	TEST POST ASSEMBLY
10.1	REFERENCE ELECTRODE AND COUPON PLACEMENT

WIRING SCHEDULE					
DESCRIPTION	TEST POST TERMINAL	AWG WIRE SIZE	TYPE OF INSULATION	COLOR OF INSULATION	TEST BOX 7 TERMINAL
SANITARY SEWER MANHOLE (UPSTREAM)	3	#8	HMWPE	BLUE	2
	6	#10	THWN OR XLPE	BLUE	3
SANITARY SEWER MANHOLE (DOWNSTREAM)	5	#8	HMWPE	WHITE	5
	10	#10	THWN OR XLPE	WHITE	7
PERMANENT REFERENCE ELECTRODE	7	#14	HMWPE OR RHH-RHW	YELLOW	6

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

CORROSION CONTROL

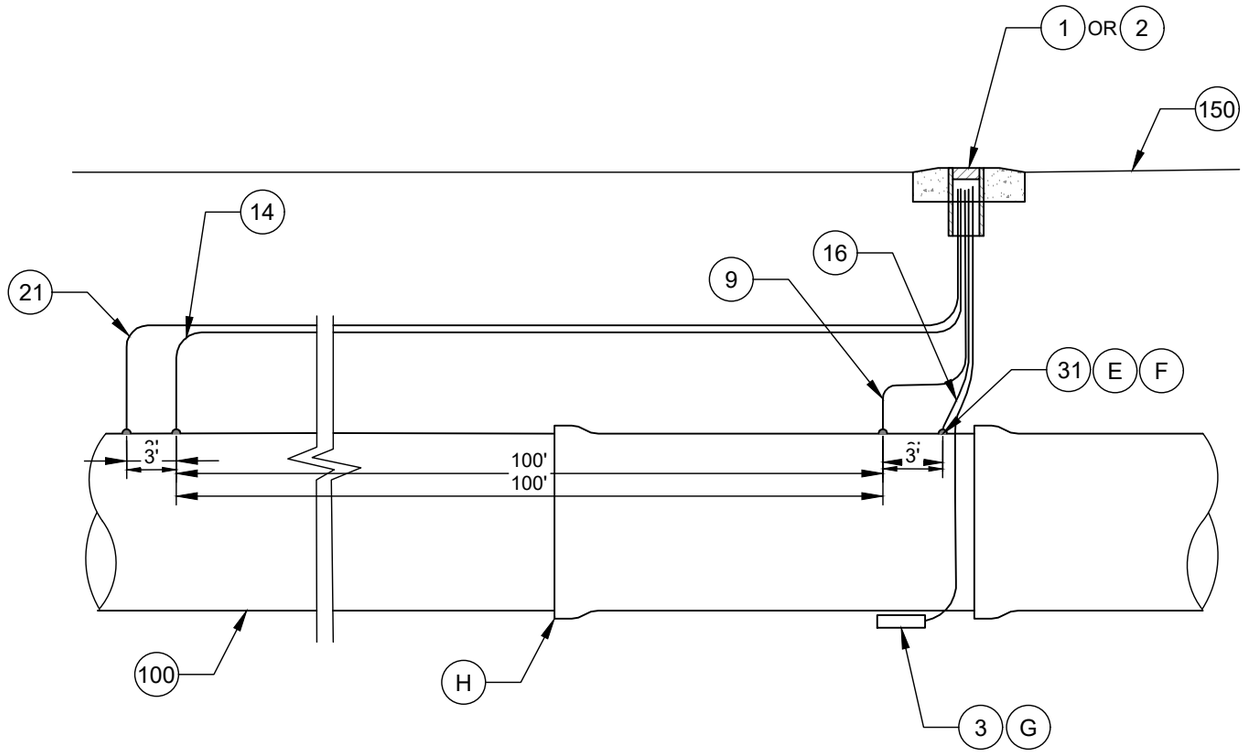
TYPE B3 TEST STATION (MANHOLE)

NO SCALE

VERSION 1.0

DATE 04/2024

DETAIL 18.2.3



NO. DESCRIPTION:

1. TEST BOX.
2. TEST POST.
3. COPPER/COPPER SULFATE REFERENCE ELECTRODE.
9. AWG NO. 10 BLUE CABLE.
14. AWG NO. 10 ORANGE CABLE.
16. AWG NO. 8 BLUE CABLE.
21. AWG NO. 8 ORANGE CABLE.
31. THERMITE WELD.
100. NEW MAIN.
150. FINISHED GRADE.

NOTES:

A. TEST STATIONS LOCATED ALONG PAVED ROADWAYS SHALL GENERALLY BE LOCATED 3' OUTSIDE OF THE EDGE OF PAVEMENT IN A NON-PAVED AREA. ROUTE ALL TEST WIRES AT A MINIMUM DEPTH OF 24" TO THE FINAL TEST STATION LOCATION. TEST STATION LOCATIONS SHALL BE FIELD ADJUSTED.

B. ORIENTATE IR DROP SO THAT IT DOES NOT CROSS A ROADWAY.

C. ROUTE WIRES IN 1 INCH PVC CONDUIT TO TEST BOX. INSTALL CABLE WARNING TAPE 18" ABOVE PVC CONDUIT.

D. MAINTAIN SUFFICIENT SLACK IN THE TEST WIRES SO THAT THE WIRES CAN EXTEND A MINIMUM OF 18" FROM THE TEST BOX.

E. THERMITE WELDS TO PCCP OR CBWCP SHALL BE MADE AT STEEL BONDING PLATES, SEE STANDARD DETAIL 5.2.

F. THERMITE WELDS TO SPECIALLY LINED STEEL AND DUCTILE IRON MAIN SHALL BE MADE AT STEEL BONDING PLATES, SEE STANDARD DETAIL 5.5.

G. FOR ADDITIONAL REFERENCE ELECTRODE INSTALLATION INFORMATION, SEE STANDARD DETAIL 10.1.

H. JOINTS TO BE ELECTRICALLY CONTINUOUS, SEE STANDARD DETAIL 5.1. JOINT BONDING NOT SHOWN FOR CLARITY.

DRAWING REFERENCE TABLE	
DWG	DWG NAME
5.1	METALLIC MAIN BONDING
5.2	CONCRETE PIPE BONDING
5.3	HORIZONTAL THERMITE WELD
5.5	STEEL BONDING PLATE FOR SPECIALLY LINED METALLIC MAIN
8.1	STANDARD VALVE BOX
8.2	TEST POST ASSEMBLY
10.1	REFERENCE ELECTRODE AND COUPON PLACEMENT

WIRING SCHEDULE					
DESCRIPTION	TEST POST TERMINAL	AWG WIRE SIZE	TYPE OF INSULATION	COLOR OF INSULATION	TEST BOX 7 TERMINAL
NEW TEST MAIN AT TEST BOX	3	#8	HMWPE	BLUE	2
	6	#10	THWN OR XLPE	BLUE	3
NEW MAIN AWAY FROM TEST BOX	5	#8	HMWPE	ORANGE	5
	10	#10	THWN OR XLPE	ORANGE	7
PERMANENT REFERENCE ELECTRODE	7	#14	HMWPE OR RHH-RHW	YELLOW	6

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

CORROSION CONTROL

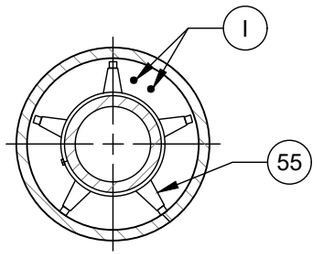
TYPE B4 TEST STATION (IR DROP)

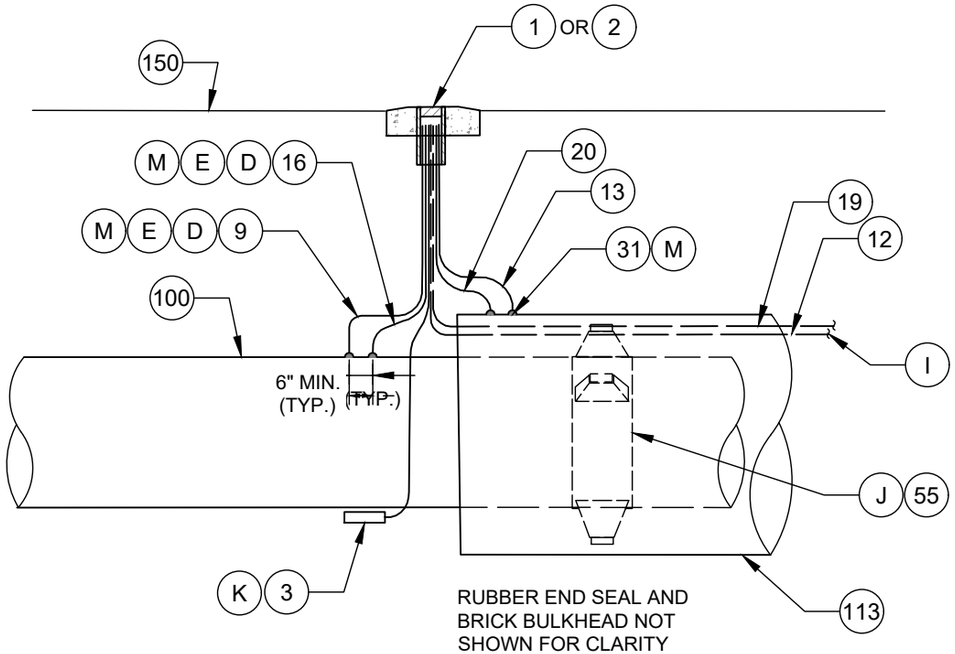
NO SCALE

VERSION
1.0

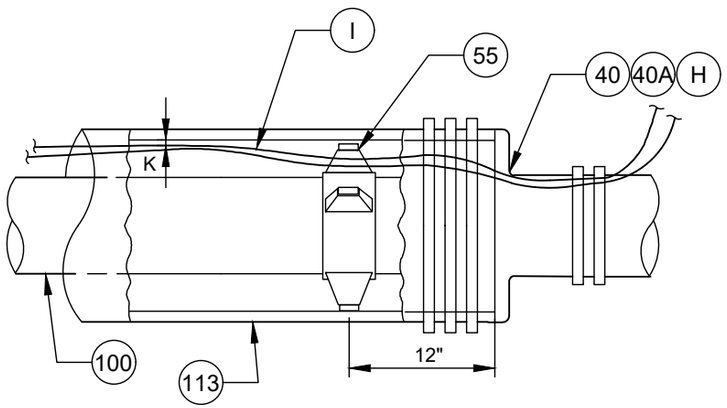
DATE
04/2024

DETAIL
18.2.4





RUBBER END SEAL AND BRICK BULKHEAD NOT SHOWN FOR CLARITY



TEST STATION AND CABLING NOT SHOWN FOR CLARITY

WIRING SCHEDULE					
DESCRIPTION	TEST POST TERMINAL	AWG WIRE SIZE	TYPE OF INSULATION	COLOR OF INSULATION	TEST BOX 7 TERMINAL
NEW MAIN	3	#8	HMWPE	BLUE	2
	6	#10	THWN OR XLPE	BLUE	3
CASING	5	#8	HMWPE	GREEN	7
	10	#10	THWN OR XLPE	GREEN	7
PERMANENT REFERENCE ELECTRODE	7	#14	HMWPE OR RHH-RHW	YELLOW	6
ADJACENT CASING TEST STATION	4	#8	HMWPE	RED	5
	11	#10	THWN OR XLPE	RED	5

NO. DESCRIPTION:

1. TEST BOX.
2. TEST POST.
3. COPPER/COPPER SULFATE REFERENCE ELECTRODE.
9. AWG NO. 10 BLUE CABLE.
12. AWG NO. 10 RED CABLE
13. AWG NO. 10 GREEN CABLE.
16. AWG NO. 8 BLUE CABLE.
19. AWG NO. 8 RED CABLE
20. AWG NO. 8 GREEN CABLE.
31. THERMITE WELD.
40. RUBBER END SEAL.
40A. BRICK BULKHEAD.
55. CASING ISOLATION SPACER, CONCENTRIC.
100. NEW MAIN.
113. CASING.
150. FINISHED GRADE.

NOTES:

A. TEST STATIONS LOCATED ALONG PAVED ROADWAYS SHALL GENERALLY BE LOCATED 3' OUTSIDE OF THE EDGE OF PAVEMENT IN A NON-PAVED AREA. ROUTE ALL TEST WIRES AT A MINIMUM DEPTH OF 24" TO THE FINAL TEST STATION LOCATION. TEST STATION LOCATIONS SHALL BE FIELD ADJUSTED.

B. ROUTE WIRES IN 1 INCH PVC CONDUIT TO TEST BOX. INSTALL CABLE WARNING TAPE 18" ABOVE PVC CONDUIT.

C. MAINTAIN SUFFICIENT SLACK IN THE TEST WIRES SO THAT THE WIRES CAN EXTEND A MINIMUM OF 18" FROM THE TEST BOX.

D. THERMITE WELDS TO PCCP OR CBWCP SHALL BE MADE AT STEEL BONDING PLATES, SEE STANDARD DETAIL 5.2.

E. THERMITE WELDS TO SPECIALLY LINED STEEL AND DUCTILE IRON MAIN SHALL BE MADE AT STEEL BONDING PLATES, SEE STANDARD DETAIL 5.5.

F. INSTALL CASING SPACERS IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS. HOWEVER, UNDER NO CIRCUMSTANCES SHALL A SECTION OF MAIN BE SUPPORTED WITH LESS THAN THREE INSULATED CASING SPACERS.

G. PRIOR TO BACKFILL, TEST TO VERIFY THAT ISOLATION BETWEEN PIPING AND CASING IS EFFECTIVE. IF ISOLATION IS NOT EFFECTIVE, REPAIR AS NECESSARY AND RETEST. THIS PROCESS SHALL CONTINUE UNTIL ISOLATION IS VERIFIED AS EFFECTIVE.

H. INSTALL CASING END SEALS AT EACH END OF CASING IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS AFTER BRICK BULKHEADS ARE INSTALLED.

I. ROUTE WIRES THROUGH CASING TO ADJACENT TEST STATION.

J. 1 INCH MINIMUM CLEARANCE BETWEEN MAXIMUM MAIN O.D. AND CASING I.D.

K. FOR ADDITIONAL REFERENCE ELECTRODE INSTALLATION INFORMATION, SEE STANDARD DETAIL 10.1.

L. TEST STATION TO BE INSTALLED AT EACH END OF CASING.

M. THERMITE WELD TO BE ATTACHED OUTSIDE OF CASING RUBBER END SEAL/COATING AREA.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

CORROSION CONTROL

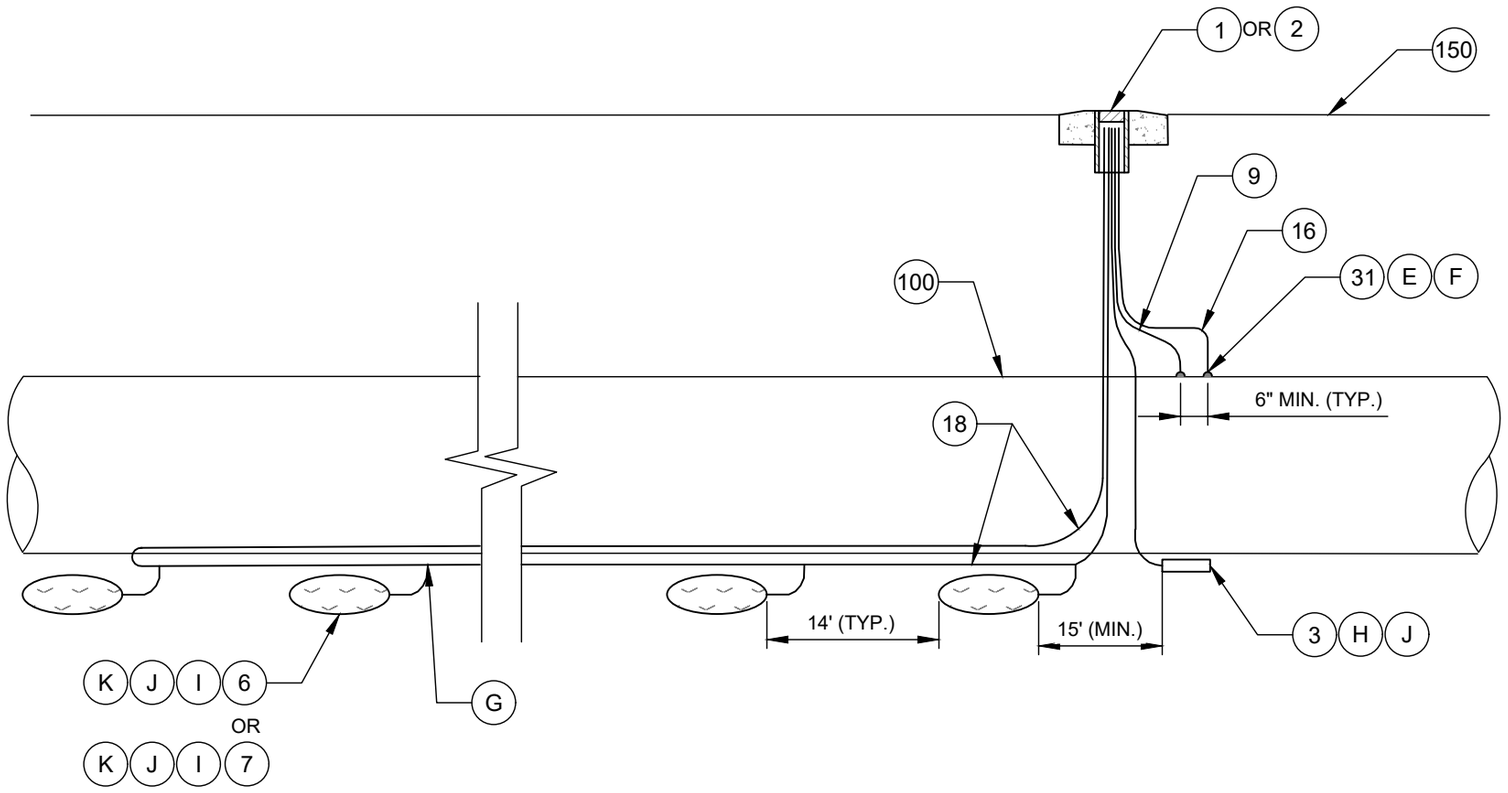
TYPE B5 TEST STATION (CASING)

NO SCALE

VERSION 1.0

DATE 04/2024

DETAIL 18.2.5



DRAWING REFERENCE TABLE	
DWG	DWG NAME
5.2	CONCRETE PIPE BONDING
5.3	HORIZONTAL THERMITE WELD
5.5	STEEL BONDING PLATE FOR SPECIALLY LINED METALLIC MAIN
8.1	STANDARD VALVE BOX
8.2	TEST POST ASSEMBLY
10.1	REFERENCE ELECTRODE AND COUPON PLACEMENT
10.2	PREPACKAGED ANODE PLACEMENT ON ONE SIDE OF MAIN

WIRING SCHEDULE					
DESCRIPTION	TEST POST TERMINAL	AWG WIRE SIZE	TYPE OF INSULATION	COLOR OF INSULATION	TEST BOX 7 TERMINAL
NEW MAIN	3	#8	HMWPE	BLUE	2
	6	#10	THWN OR XLPE	BLUE	3
ANODE HEADER CABLE	4	#8	HMWPE	BLACK	5
	4	#8	HMWPE	BLACK	5
PERMANENT REFERENCE ELECTRODE	7	#14	HMWPE OR RHH-RHW	YELLOW	6

NO. DESCRIPTION:

1. TEST BOX.
2. TEST POST.
3. COPPER/COPPER SULFATE REFERENCE ELECTRODE.
6. PREPACKAGED ANODE, MAGNESIUM.
7. PREPACKAGED ANODE, ZINC.
9. AWG NO. 10 BLUE CABLE.
16. AWG NO. 8 BLUE CABLE.
18. AWG NO. 8 BLACK CABLE.
31. THERMITE WELD.
100. NEW MAIN.
150. FINISHED GRADE.

NOTES:

A. INSTALL 0.1 OHM SHUNT BETWEEN TERMINALS #2 AND #5 (TEST BOX) OR TERMINALS #3 AND #4 (TEST POST).

B. TEST STATIONS LOCATED ALONG PAVED ROADWAYS SHALL GENERALLY BE LOCATED 3' OUTSIDE OF THE EDGE OF PAVEMENT IN A NON-PAVED AREA. ROUTE ALL TEST WIRES AT A MINIMUM DEPTH OF 24" TO THE FINAL TEST STATION LOCATION. TEST STATION LOCATIONS SHALL BE FIELD ADJUSTED.

C. ROUTE WIRES IN 1 INCH PVC CONDUIT TO TEST BOX. INSTALL CABLE WARNING TAPE 18" ABOVE PVC CONDUIT.

D. MAINTAIN SUFFICIENT SLACK IN THE TEST WIRES SO THAT THE WIRES CAN EXTEND A MINIMUM OF 18" FROM THE TEST BOX.

E. THERMITE WELDS TO PCCP OR CBWCP SHALL BE MADE AT STEEL BONDING PLATES, SEE STANDARD DETAIL 5.2.

F. THERMITE WELDS TO SPECIALLY LINED STEEL AND DUCTILE IRON MAIN SHALL BE MADE AT STEEL BONDING PLATES, SEE STANDARD DETAIL 5.5.

G. ANODE HEADER CABLE SPLICE (TYP.), SEE STANDARD DETAIL 9.1.

H. FOR ADDITIONAL REFERENCE ELECTRODE INSTALLATION INFORMATION, SEE STANDARD DETAIL 10.1.

I. FOR ADDITIONAL GALVANIC ANODE INSTALLATION INFORMATION, SEE STANDARD DETAIL 10.2.

J. ANODE AND REFERENCE ELECTRODE PLACEMENT SHOWN IS FOR REFERENCE ONLY - EXACT DEPTH/ELEVATION DEPENDENT ON DEISGN AND ACTUAL CONSTRUCTION. SEE STANDARD DETAILS 10.1 AND 10.2 FOR ADDITIONAL INFORMATION.

K. NUMBER OF ANODES TO BE SPECIFIED IN CORROSION PREVENTION DESIGN.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

CORROSION CONTROL

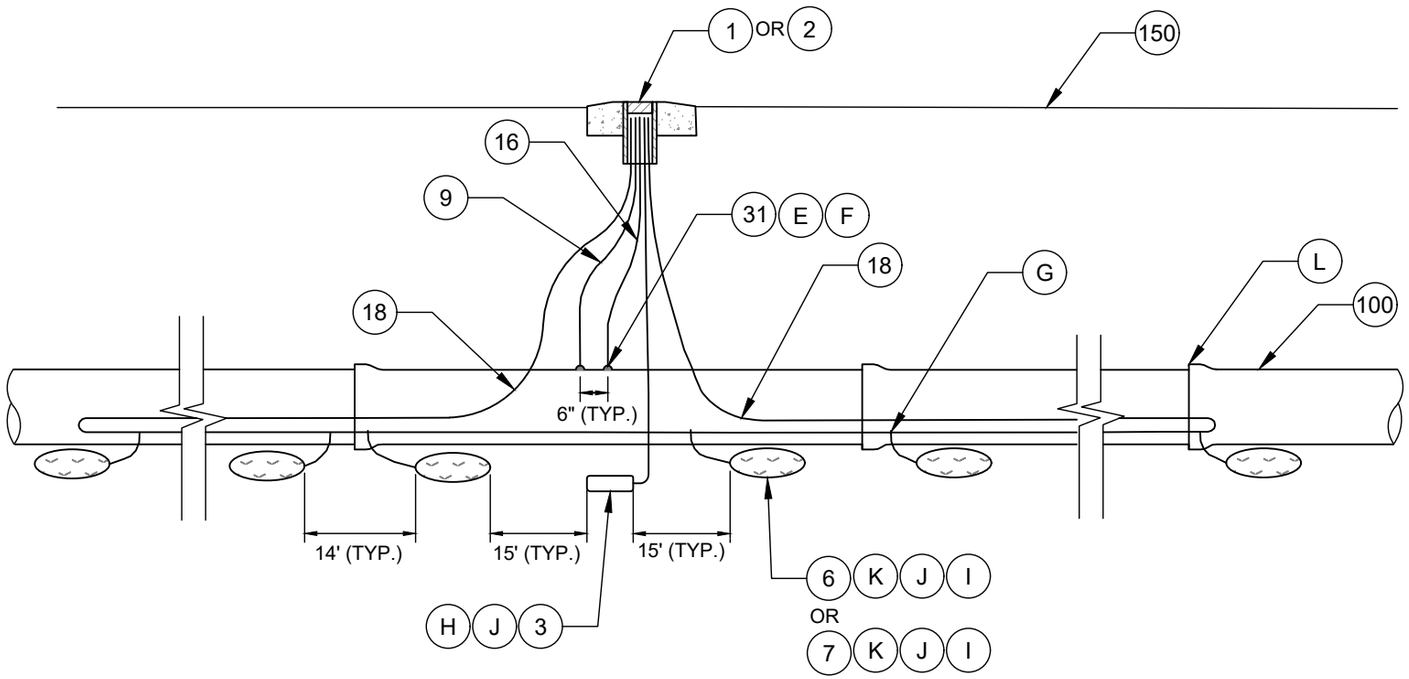
TYPE C1 TEST STATION (PREPACKAGED ANODES - END TS)

NO SCALE

VERSION 1.0

DATE 04/2024

DETAIL 18.3.1



NO. DESCRIPTION:

1. TEST BOX.
2. TEST POST.
3. COPPER/COPPER SULFATE REFERENCE ELECTRODE.
6. PREPACKAGED ANODE, MAGNESIUM.
7. PREPACKAGED ANODE, ZINC.
9. AWG NO. 10 BLUE CABLE.
16. AWG NO. 8 BLUE CABLE.
18. AWG NO. 8 BLACK CABLE.
31. THERMITE WELD.
100. NEW MAIN.
150. FINISHED GRADE.

NOTES:

A. INSTALL 0.1 OHM SHUNT BETWEEN TERMINALS #2 AND #5 (TEST BOX) OR TERMINALS #3 AND #4 (TEST POST).

B. TEST STATIONS LOCATED ALONG PAVED ROADWAYS SHALL GENERALLY BE LOCATED 3' OUTSIDE OF THE EDGE OF PAVEMENT IN A NON-PAVED AREA. ROUTE ALL TEST WIRES AT A MINIMUM DEPTH OF 24" TO THE FINAL TEST STATION LOCATION. TEST STATION LOCATIONS SHALL BE FIELD ADJUSTED.

C. ANODES PLACED AT SAME DEPTH AS THE BOTTOM OF MAIN AND AT A MINIMUM OF 12" FROM EDGE OF MAIN, SEE STANDARD DETAIL 10.2.

D. ROUTE WIRES IN 1 INCH PVC CONDUIT TO TEST BOX. INSTALL CABLE WARNING TAPE 18" ABOVE PVC CONDUIT.MAINTAIN SUFFICIENT SLACK IN THE TEST WIRES SO THAT THE WIRES CAN EXTEND A MINIMUM OF 18" FROM THE TEST BOX.

E. THERMITE WELDS TO PCCP OR CBWCP SHALL BE MADE AT STEEL BONDING PLATES, SEE STANDARD DETAIL 5.2.

F. THERMITE WELDS TO SPECIALLY LINED STEEL AND DUCTILE IRON MAIN SHALL BE MADE AT STEEL BONDING PLATES, SEE STANDARD DETAIL 5.5.

G. ANODE HEADER CABLE SPLICE (TYP.), SEE STANDARD DETAIL 9.1.

H. FOR ADDITIONAL REFERENCE ELECTRODE INSTALLATION INFORMATION, SEE STANDARD DETAIL 10.1.

I. FOR ADDITIONAL GALVANIC ANODE INSTALLATION INFORMATION, SEE STANDARD DETAIL 10.2.

J. ANODE AND REFERENCE ELECTRODE PLACEMENT SHOWN IS FOR REFERENCE ONLY - EXACT DEPTH/ELEVATION DEPENDENT ON DESIGN AND ACTUAL CONSTRUCTION. SEE STANDARD DETAILS 10.1 AND 10.2 FOR MORE INFORMATION.

K. NUMBER OF ANODES TO BE SPECIFIED IN CP DESIGN.

L. JOINTS TO BE ELECTRICALLY CONTINUOUS, SEE STANDARD DETAIL 5.1. JOINT BONDING NOT SHOWN FOR CLARITY.

DRAWING REFERENCE TABLE	
DWG	DWG NAME
5.1	METALLIC MAIN BONDING
5.2	CONCRETE PIPE BONDING
5.3	HORIZONTAL THERMITE WELD
5.5	STEEL BONDING PLATE FOR SPECIALLY LINED METALLIC MAIN
8.1	STANDARD VALVE BOX
8.2	TEST POST ASSEMBLY
10.1	REFERENCE ELECTRODE AND COUPON PLACEMENT
10.2	PREPACKAGED ANODE ON ONE SIDE OF MAIN

WIRING SCHEDULE					
DESCRIPTION	TEST POST TERMINAL	AWG WIRE SIZE	TYPE OF INSULATION	COLOR OF INSULATION	TEST BOX 7 TERMINAL
NEW MAIN	3	#8	HMWPE	BLUE	2
	6	#10	THWN OR XLPE	BLUE	3
ANODE HEADER CABLE	4	#8	HMWPE	BLACK	5
	4	#8	HMWPE	BLACK	5
PERMANENT REFERENCE ELECTRODE	7	#14	HMWPE OR RHH-RHW	YELLOW	6

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

CORROSION CONTROL

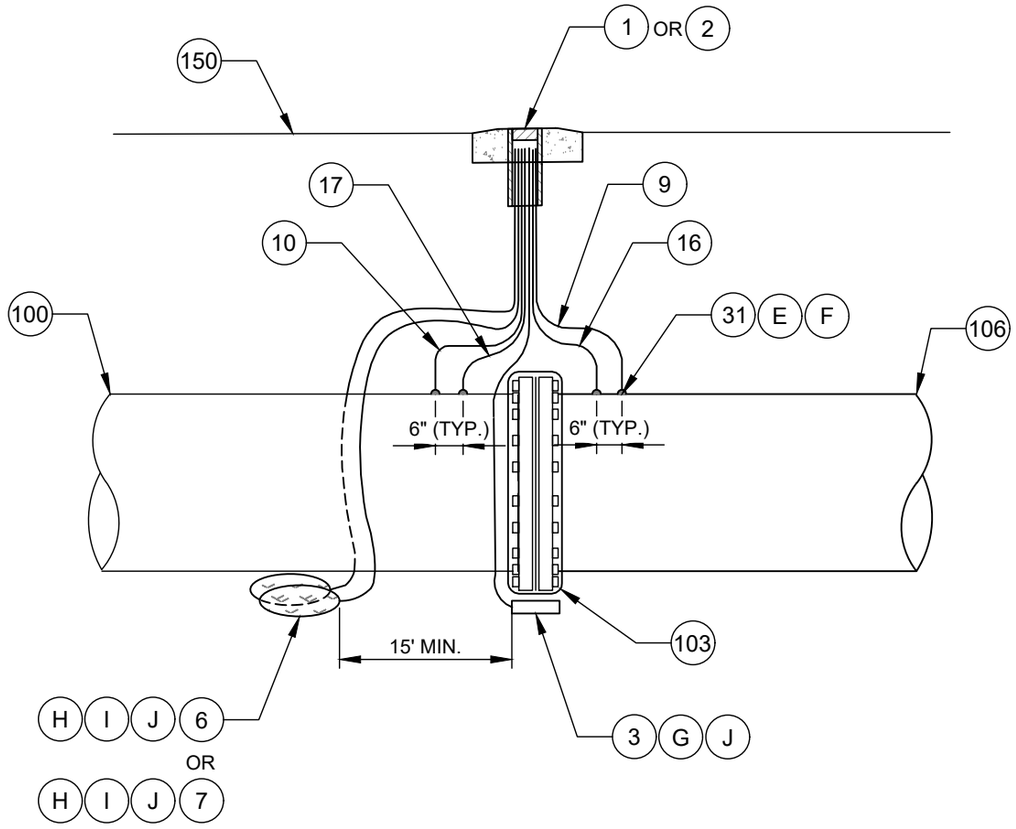
TYPE C2 TEST STATION (PREPACKAGED ANODES - CENTER TS)

NO SCALE

VERSION 1.0

DATE 04/2024

DETAIL 18.3.2



DRAWING REFERENCE TABLE	
DWG	DWG NAME
5.2	CONCRETE PIPE BONDING
5.3	HORIZONTAL THERMITE WELD
5.5	STEEL BONDING PLATE FOR SPECIALLY LINED METALLIC MAIN
6.1	INSULATING FLANGE
8.1	STANDARD VALVE BOX
8.2	TEST POST ASSEMBLY
10.1	REFERENCE ELECTRODE AND COUPON PLACEMENT
10.2	PREPACKAGED ANODE ON ONE SIDE OF MAIN

WIRING SCHEDULE					
DESCRIPTION	TEST POST TERMINAL	AWG WIRE SIZE	TYPE OF INSULATION	COLOR OF INSULATION	TEST BOX 7 TERMINAL
NEW MAIN	3	#8	HMWPE	BLUE	2
	6	#10	THWN OR XLPE	BLUE	3
EXISTING MAIN	5	#8	HMWPE	WHITE	7
	10	#10	THWN OR XLPE	WHITE	7
PERMANENT REFERENCE ELECTRODE	7	#14	HMWPE OR RHH-RHW	YELLOW	6
PREPACKAGED ANODE	4	#12	TW OR THHN	BLACK	5
	4	#12	TW OR THHN	BLACK	5

NO. DESCRIPTION:

1. TEST BOX.
2. TEST POST.
3. COPPER/ COPPER SULFATE REFERENCE ELECTRODE.
6. PREPACKAGED ANODE, MAGNESIUM.
7. PREPACKAGED ANODE, ZINC.
9. AWG NO. 10 BLUE CABLE.
10. AWG NO. 10 WHITE CABLE.
16. AWG NO. 8 BLUE CABLE.
17. AWG NO. 8 WHITE CABLE.
31. THERMITE WELD.
100. NEW MAIN.
103. COATED INSULATING FLANGE.
106. EXISTING MAIN.
150. FINISHED GRADE.

NOTES:

A. INSTALL 0.1 OHM SHUNT BETWEEN TERMINALS #2 AND #5 (TEST BOX) OR TERMINALS #3 AND #4 (TEST POST).

B. TEST STATIONS LOCATED ALONG PAVED ROADWAYS SHALL GENERALLY BE LOCATED 3' OUTSIDE OF THE EDGE OF PAVEMENT IN A NON-PAVED AREA. ROUTE ALL TEST WIRES AT A MINIMUM DEPTH OF 24" TO THE FINAL TEST STATION LOCATION. TEST STATION LOCATIONS SHALL BE FIELD ADJUSTED.

C. ROUTE WIRES IN 1 INCH PVC CONDUIT TO TEST BOX. INSTALL CABLE WARNING TAPE 18" ABOVE PVC CONDUIT.

D. MAINTAIN SUFFICIENT SLACK IN THE TEST WIRES SO THAT THE WIRES CAN EXTEND A MINIMUM OF 18" FROM THE TEST BOX.

E. THERMITE WELDS TO PCCP OR CBWCP SHALL BE MADE AT STEEL BONDING PLATES, SEE STANDARD DETAIL 5.2.

F. THERMITE WELDS TO SPECIALLY LINED STEEL AND DUCTILE IRON MAIN SHALL BE MADE AT STEEL BONDING PLATES, SEE STANDARD DETAIL 5.5.

G. FOR ADDITIONAL REFERENCE ELECTRODE INSTALLATION INFORMATION, SEE STANDARD DETAIL 10.1.

H. FOR ADDITIONAL GALVANIC ANODE INSTALLATION INFORMATION, SEE STANDARD DETAIL 10.2.

I. INSTALL ONE ANODE ON EACH SIDE OF PIPE.

J. ANODE AND REFERENCE ELECTRODE PLACEMENT SHOWN IS FOR REFERENCE ONLY - EXACT DEPTH/ELEVATION IS DEPENDENT ON DESIGN AND ACTUAL CONSTRUCTION. SEE STANDARD DETAILS 10.1 AND 10.2 FOR MORE INFORMATION.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

CORROSION CONTROL

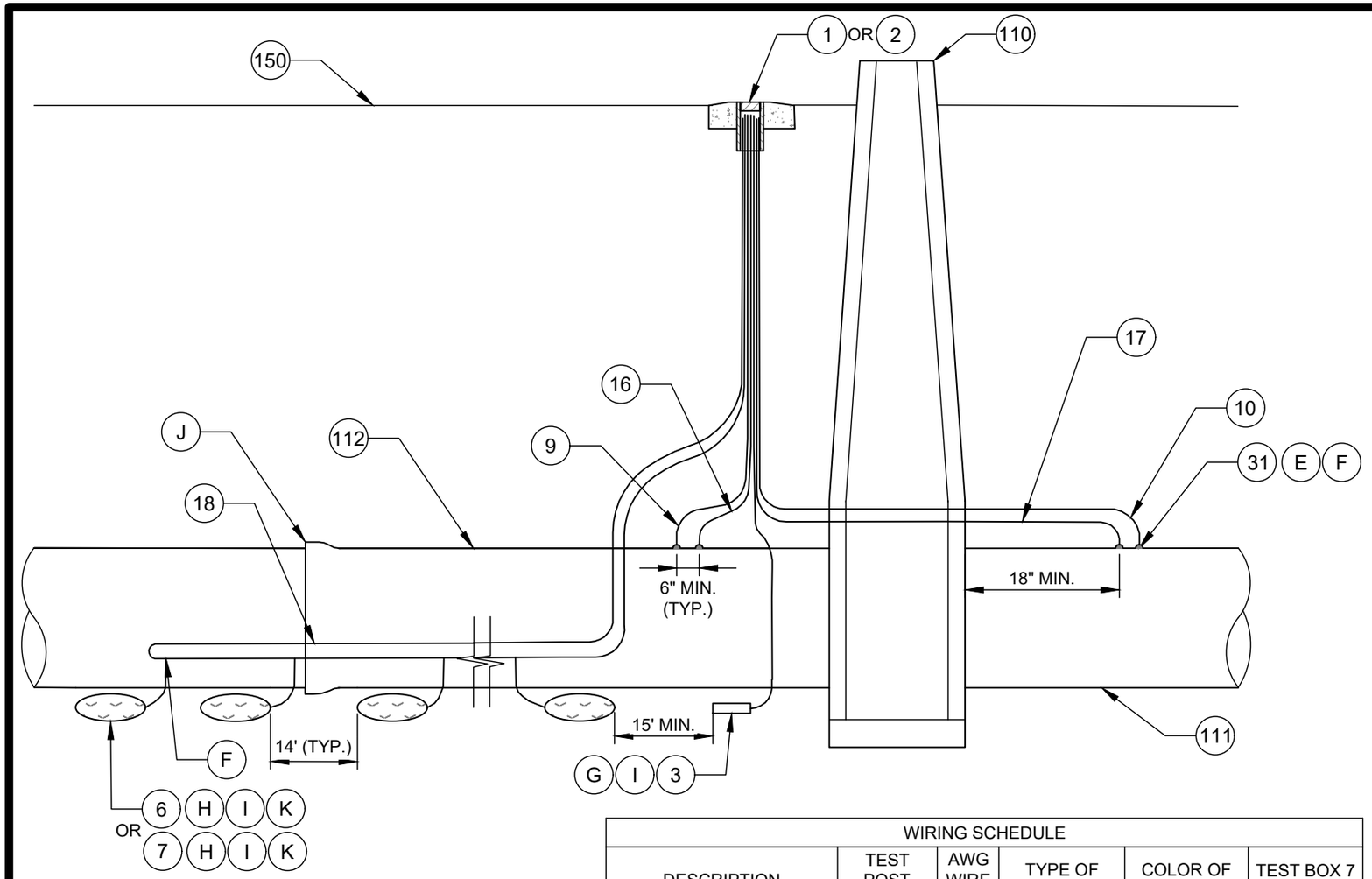
TYPE C3 TEST STATION (INSULATED FLANGE WITH ANODES)

NO SCALE

VERSION 1.0

DATE 04/2024

DETAIL 18.3.3



DRAWING REFERENCE TABLE	
DWG	DWG NAME
5.2	CONCRETE PIPE BONDING
5.3	HORIZONTAL THERMITE WELD
5.5	STEEL BONDING PLATE FOR SPECIALLY LINED METALLIC MAIN
8.1	STANDARD VALVE BOX
8.2	TEST POST ASSEMBLY
10.1	REFERENCE ELECTRODE AND COUPON PLACEMENT
10.2	PREPACKAGED ANODE ON ONE SIDE OF MAIN

WIRING SCHEDULE					
DESCRIPTION	TEST POST TERMINAL	AWG WIRE SIZE	TYPE OF INSULATION	COLOR OF INSULATION	TEST BOX 7 TERMINAL
SANITARY SEWER (UPSTREAM)	3	#8	HMWPE	BLUE	2
	6	#10	THWN OR XLPE	BLUE	3
SANITARY SEWER (DOWNSTREAM)	5	#8	HMWPE	WHITE	4
	10	#10	THWN OR XLPE	WHITE	7
ANODE HEADER CABLE	4	#8	HMWPE	BLACK	5
	4	#8	HMWPE	BLACK	5
PERMANENT REFERENCE ELECTRODE	7	#14	HMWPE OR RHH-RHW	YELLOW	6

NO. DESCRIPTION:

1. TEST BOX.
2. TEST POST.
3. COPPER/COPPER SULFATE REFERENCE ELECTRODE.
6. PREPACKAGED ANODE, MAGNESIUM.
7. PREPACKAGED ANODE, ZINC.
9. AWG NO. 10 BLUE CABLE.
10. AWG NO. 10 WHITE CABLE.
16. AWG NO. 8 BLUE CABLE.
17. AWG NO. 8 WHITE CABLE.
18. AWG NO. 8 BLACK CABLE.
31. THERMITE WELD.
110. SANITARY MANHOLE.
111. SANITARY SEWER (US).
112. SANITARY SEWER (DS).
150. FINISHED GRADE.

NOTES:

A. INSTALL 0.1 OHM SHUNT BETWEEN TERMINALS #2 AND #5, AS WELL AS BETWEEN TERMINALS #5 AND #4 (TEST BOX) OR BETWEEN TERMINALS #3 AND #4, A WELL AS BETWEEN TERMINALS #4 AND #5 (TEST POST).

B. TEST STATIONS LOCATED ALONG PAVED ROADWAYS SHALL GENERALLY BE LOCATED 3' OUTSIDE OF THE EDGE OF PAVEMENT IN A NON-PAVED AREA. ROUTE ALL TEST WIRES AT A MINIMUM DEPTH OF 24" TO THE FINAL TEST STATION LOCATION. TEST STATION LOCATIONS SHALL BE FIELD ADJUSTED.

C. ROUTE WIRES IN 1 INCH PVC CONDUIT TO TEST BOX. INSTALL CABLE WARNING TAPE 18" ABOVE PVC CONDUIT.

D. MAINTAIN SUFFICIENT SLACK IN THE TEST WIRES SO THAT THE WIRES CAN EXTEND A MINIMUM OF 18" FROM THE TEST BOX.

E. THERMITE WELDS TO SPECIALLY LINED DUCTILE IRON MAIN SHALL BE MADE AT STEEL BONDING PLATES, SEE STANDARD DETAIL 5.5.

F. ANODE HEADER CABLE SPLICE (TYP.), SEE STANDARD DETAIL 9.1.

G. FOR ADDITIONAL REFERENCE ELECTRODE INSTALLATION INFORMATION, SEE STANDARD DETAIL 10.1.

H. FOR ADDITIONAL GALVANIC ANODE INSTALLATION INFORMATION, SEE STANDARD DETAIL 10.2.

I. ANODE AND REFERENCE ELECTRODE PLACEMENT SHOWN IS FOR REFERENCE ONLY - EXACT DEPTH/ELEVATION DEPENDENT ON DESIGN AND ACTUAL CONSTRUCTION. SEE STANDARD DETAILS 10.1 AND 10.2 FOR MORE INFORMATION.

J. JOINTS TO BE ELECTRICALLY CONTINUOUS, SEE STANDARD DETAIL 5.1. JOINT BONDING NOT SHOWN FOR CLARITY.

K. NUMBER OF ANODES TO BE SPECIFIED IN CP DESIGN.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

CORROSION CONTROL

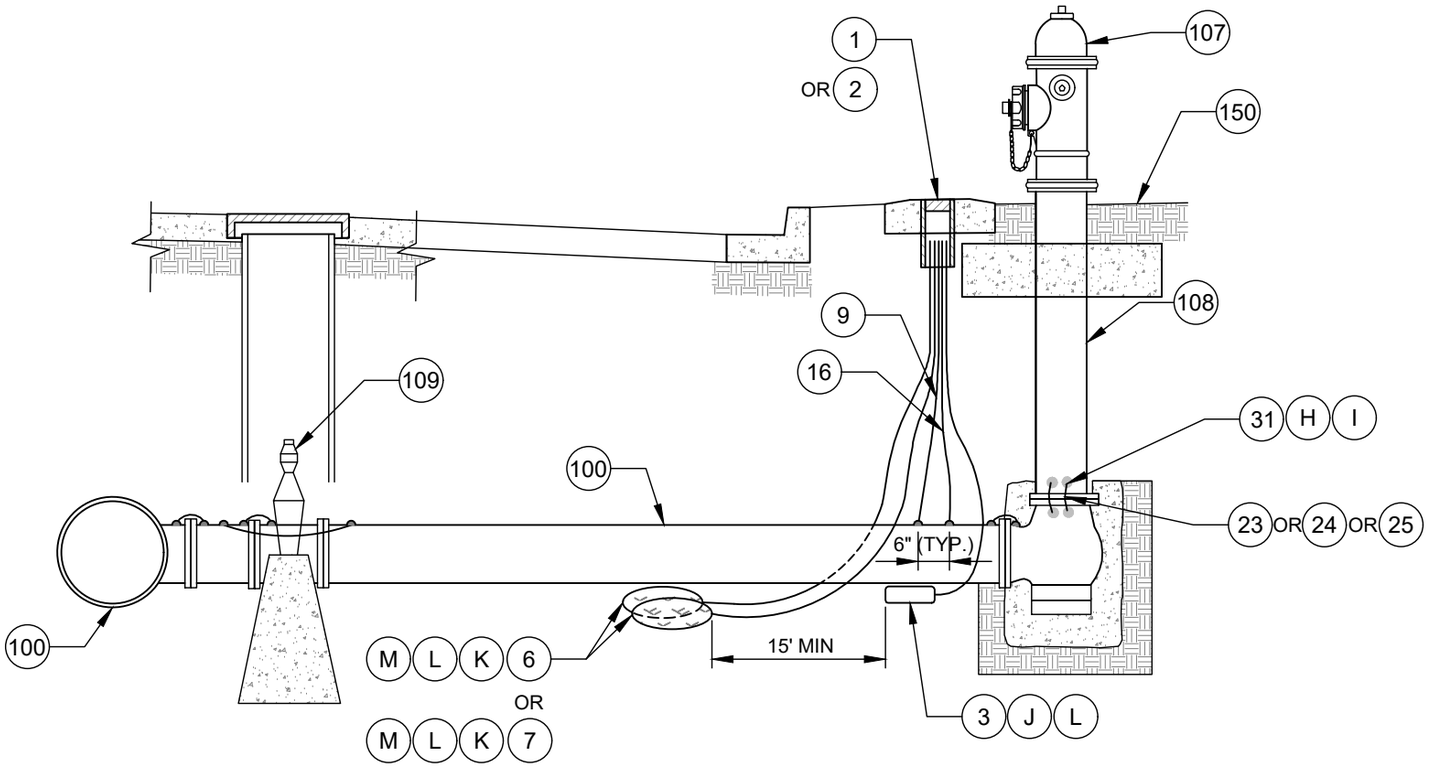
TYPE C4 TEST STATION (PREPACKAGED ANODES AT MANHOLE)

NO SCALE

VERSION
1.0

DATE
04/2024

DETAIL
18.3.4



DRAWING REFERENCE TABLE	
DWG	DWG NAME
5.1	METALLIC MAIN BONDING
5.2	CONCRETE PIPE BONDING
5.3	HORIZONTAL THERMITE WELD
5.5	STEEL BONDING PLATE FOR SPECIALLY LINED METALLIC MAIN
8.1	STANDARD VALVE BOX
8.2	TEST POST ASSEMBLY
10.1	REFERENCE ELECTRODE AND COUPON PLACEMENT
10.2	PREPACKAGE ANODE PLACEMENT ON ONE SIDE OF MAIN

WIRING SCHEDULE					
DESCRIPTION	TEST POST TERMINAL	AWG WIRE SIZE	TYPE OF INSULATION	COLOR OF INSULATION	TEST BOX 7 TERMINAL
NEW MAIN	3	#8	HMWPE	BLUE	2
	6	#10	THWN OR XLPE	BLUE	3
PREPACKAGED ANODE	4	#12	TW OR THHN	BLACK	5
	4	#12	TW OR THHN	BLACK	5
PERMANENT REFERENCE ELECTRODE	7	#14	HMWPE OR RHH-RHW	YELLOW	6

NO. DESCRIPTION:

1. TEST BOX.
2. TEST POST.
3. COPPER/COPPER SULFATE REFERENCE ELECTRODE.
6. PREPACKAGED ANODE, MAGNESIUM.
7. PREPACKAGED ANODE, ZINC.
9. AWG NO. 10 BLUE CABLE.
16. AWG NO. 8 BLUE CABLE.
23. BOND CABLES, AWG 6, WHITE.
24. BOND CABLES, AWG 4, WHITE.
25. BOND CABLES, AWG 2, WHITE.
31. THERMITE WELD.
100. NEW MAIN.
107. FIRE HYDRANT.
108. DIP RISER.
109. SHUT-OFF VALVE.
150. FINISHED GRADE.

NOTES:

A. INSTALL 0.1 OHM SHUNT BETWEEN TERMINALS #2 AND #5 (TEST BOX) OR TERMINALS #3 AND #4 (TEST POST).

B. MAINTAIN SUFFICIENT SLACK IN THE TEST WIRES SO THAT THE WIRES CAN EXTEND A MINIMUM OF 18" FROM THE TEST BOX.

C. BOND ALL DUCTILE IRON COMPONENTS TOGETHER WITH AWG NO. 6 HMWPE WIRES.

D. INSTALL BOND WIRES ON TOP OF MAIN OR FITTING WHERE POSSIBLE.

E. INSTALL A MINIMUM OF TWO BOND CABLES ACROSS EACH MAIN JOINT.

F. BOND ALL HYDRANT PIPING ASSOCIATED WITH THE WATER MAIN.

G. INSTALL BOND CABLES ON HYDRANT RISER MAIN AND RISER ELBOW BEFORE INSTALLING RISER MAIN IN EXCAVATION.

H. THERMITE WELDS TO PCCP OR CBWCP SHALL BE MADE AT STEEL BONDING PLATES, SEE STANDARD DETAIL 5.2.

I. THERMITE WELDS TO SPECIALLY LINED STEEL AND DUCTILE IRON MAIN SHALL BE MADE AT STEEL BONDING PLATES, SEE STANDARD DETAIL 5.5.

J. FOR ADDITIONAL REFERENCE ELECTRODE INSTALLATION INFORMATION, SEE STANDARD DETAIL 10.2.

K. FOR ADDITIONAL GALVANIC ANODE INSTALLATION INFORMATION, SEE STANDARD DETAIL 10.2.

L. ANODE AND REFERENCE ELECTRODE PLACEMENT SHOWN FOR REFERENCE ONLY - EXACT DEPTH/ELEVATION DEPENDENT ON DESIGN AND ACTUAL CONSTRUCTION. SEE STANDARD DETAILS 10.1 AND 10.2 FOR MORE INFORMATION.

M. INSTALL ONE ANODE ON EACH SIDE OF PIPE.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

CORROSION CONTROL

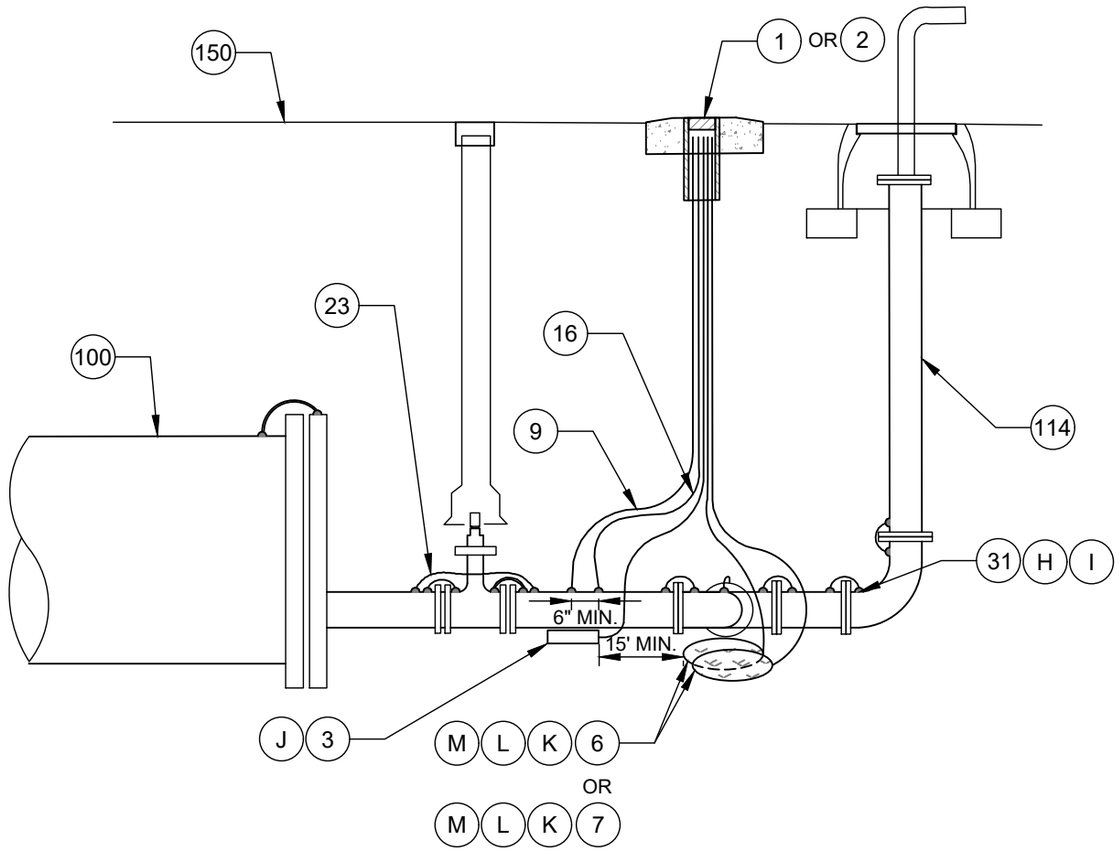
TYPE C5 TEST STATION (FIRE HYDRANT WITH ANODES)

NO SCALE

VERSION 1.0

DATE 04/2024

DETAIL 18.3.5



DRAWING REFERENCE TABLE	
DWG	DWG NAME
5.1	METALLIC MAIN BONDING
5.2	CONCRETE PIPE BONDING
5.3	HORIZONTAL THERMITE WELD
5.5	STEEL BONDING PLATE FOR SPECIALLY LINED METALLIC MAIN
8.1	STANDARD VALVE BOX
8.2	TEST POST ASSEMBLY
10.1	REFERENCE ELECTRODE AND COUPON PLACEMENT
10.2	PREPACKAGED ANODE PLACEMENT ON ONE SIDE OF MAIN

WIRING SCHEDULE					
DESCRIPTION	TEST POST TERMINAL	AWG WIRE SIZE	TYPE OF INSULATION	COLOR OF INSULATION	TEST BOX 7 TERMINAL
NEW BLOW-OFF PIPING	3	#8	HMWPE	BLUE	2
	6	#10	THWN OR XLPE	BLUE	3
PREPACKAGED ANODE	4	#12	TW OR THHN	BLACK	5
	4	#12	TW OR THHN	BLACK	5
PERMANENT REFERENCE ELECTRODE	7	#14	HMWPE OR RHH-RHW	YELLOW	6

NO. DESCRIPTION:

1. TEST BOX.
2. TEST POST.
3. COPPER/COPPER SULFATE REFERENCE ELECTRODE.
6. PREPACKAGED ANODE, MAGNESIUM.
7. PREPACKAGED ANODE, ZINC.
9. AWG NO. 10 BLUE CABLE.
16. AWG NO. 8 BLUE CABLE.
23. BOND CABLES, AWG 6, WHITE.
31. THERMITE WELD.
100. NEW MAIN.
114. BLOW-OFF PIPING.
150. FINISHED GRADE.

NOTES:

A. INSTALL 0.1 OHM SHUNT BETWEEN TERMINALS #2 AND #5 (TEST BOX) OR TERMINALS #3 AND #4 (TEST POST).

B. TEST STATIONS LOCATED ALONG PAVED ROADWAYS SHALL GENERALLY BE LOCATED 3' OUTSIDE OF THE EDGE OF PAVEMENT IN A NON-PAVED AREA. ROUTE ALL TEST WIRES AT A MINIMUM DEPTH OF 24" TO THE FINAL TEST STATION LOCATION. TEST STATION LOCATIONS SHALL BE FIELD ADJUSTED.

C. ROUTE WIRES IN 1 INCH PVC CONDUIT TO TEST BOX. INSTALL CABLE WARNING TAPE 18" ABOVE PVC CONDUIT.

D. MAINTAIN SUFFICIENT SLACK IN THE TEST WIRES SO THAT THE WIRES CAN EXTEND A MINIMUM OF 18" FROM THE TEST BOX.

E. BOND ALL DUCTILE IRON COMPONENTS TOGETHER WITH AWG NO. 6 HMWPE CABLES. INSTALL A MINIMUM OF TWO BOND CABLES ACROSS EACH DUCTILE IRON MAIN JOINT.

F. INSTALL BOND WIRES ON TOP OF DUCTILE IRON MAIN OR DUCTILE IRON FITTING WHERE POSSIBLE

G. INSTALL BOND CABLES ON HYDRANT RISER MAIN AND RISER ELBOW BEFORE INSTALLING RISER MAIN IN EXCAVATION.

H. THERMITE WELDS TO PCCP OR CBWCP SHALL BE MADE AT STEEL BONDING PLATES, SEE STANDARD DETAIL 5.2.

I. THERMITE WELDS TO SPECIALLY LINED STEEL AND DUCTILE IRON MAIN SHALL BE MADE AT STEEL BONDING PLATES, SEE STANDARD DETAIL 5.5.

J. FOR ADDITIONAL REFERENCE ELECTRODE INSTALLATION INFORMATION, SEE STANDARD DETAIL 10.1.

K. FOR ADDITIONAL GALVANIC ANODE INSTALLATION INFORMATION, SEE STANDARD DETAIL 10.2.

L. ANODE AND REFERENCE ELECTRODE PLACEMENT SHOWN IS FOR REFERENCE ONLY - EXACT DEPTH/ELEVATION DEPENDENT ON DESIGN AND ACTUAL CONSTRUCTION. SEE STANDARD DETAILS 10.1 AND 10.2 FOR MORE INFORMATION.

M. INSTALL ONE ANODE ON EACH SIDE OF PIPE.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

CORROSION CONTROL

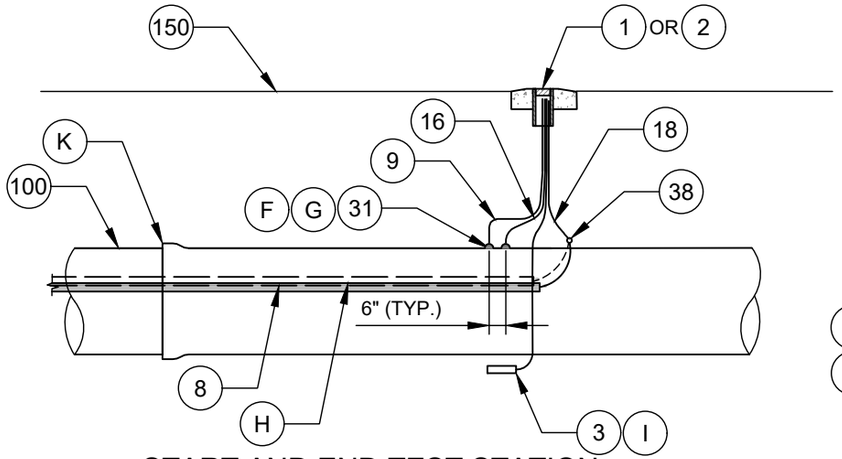
TYPE C6 TEST STATION (BLOWOFF WITH ANODES)

NO SCALE

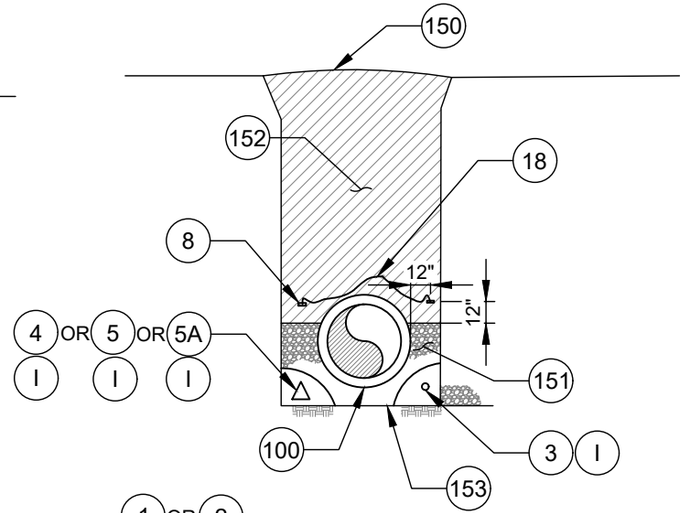
VERSION 1.0

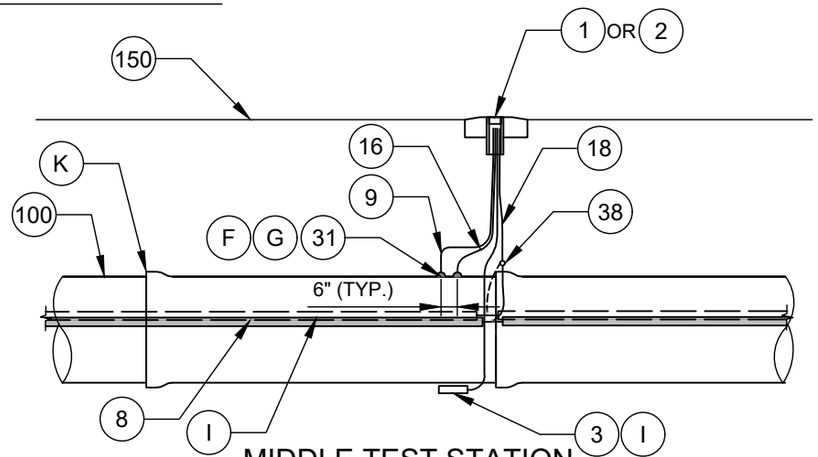
DATE 04/2024

DETAIL 18.3.6



START AND END TEST STATION





MIDDLE TEST STATION

DRAWING REFERENCE TABLE	
DWG	DWG NAME
5.2	CONCRETE PIPE BONDING
5.3	HORIZONTAL THERMITE WELD
5.5	STEEL BONDING PLATE FOR SPECIALLY LINED METALLIC MAIN
8.1	STANDARD VALVE BOX
8.2	TEST POST ASSEMBLY

WIRING SCHEDULE					
DESCRIPTION	TEST POST TERMINAL	AWG WIRE SIZE	TYPE OF INSULATION	COLOR OF INSULATION	TEST BOX 7 TERMINAL
NEW MAIN	3	#8	HMWPE	BLUE	2
	6	#10	THWN OR XLPE	BLUE	3
ANODE HEADER CABLE	4	#8	HMWPE	BLACK	5
PERMANENT REFERENCE ELECTRODE	7	#14	HMWPE OR RHH-RHW	YELLOW	6

NO. DESCRIPTION:

1. TEST BOX.
2. TEST POST.
3. COPPER/COPPER SULFATE REFERENCE ELECTRODE.
4. OPTIONAL AC COUPON.
5. DC COUPON, STEEL.
5A. DC COUPON, DI.
8. RIBBON ANODE, ZINC.
9. AWG NO. 10 BLUE CABLE.
16. AWG. NO 8 BLUE CABLE.
18. AWG NO. 8 BLACK CABLE.
31. THERMITE WELD.
38. CABLE SPLICE.
100. NEW MAIN.
150. FINISHED GRADE.
151. STONE BEDDING, PER CIVIL DETAILS.
152. BACKFILL, NATIVE TRENCH MATERIAL.
153. TRENCH BOTTOM.

NOTES:

A. INSTALL 0.1 OHM SHUNT BETWEEN TERMINALS #2 AND #5 (TEST BOX) OR TERMINALS #3 AND #4 (TEST POST).

B. TEST STATIONS LOCATED ALONG PAVED ROADWAYS SHALL GENERALLY BE LOCATED 3' OUTSIDE OF THE EDGE OF PAVEMENT IN A NON-PAVED AREA. ROUTE ALL TEST WIRES AT A MINIMUM DEPTH OF 24" TO THE FINAL TEST STATION LOCATION. TEST STATION LOCATIONS SHALL BE FIELD ADJUSTED.

C. ROUTE WIRES IN 1 INCH PVC CONDUIT TO TEST BOX. INSTALL CABLE WARNING TAPE 18" ABOVE PVC CONDUIT.

D. MAINTAIN SUFFICIENT SLACK IN THE TEST WIRES SO THAT THE WIRES CAN EXTEND A MINIMUM OF 18" FROM THE TEST BOX.

E. IN-LINE ANODE RIBBON SPLICE, WHERE NECESSARY, SHALL BE MADE AS SHOWN IN STANDARD DETAIL 9.1.

F. THERMITE WELDS TO PCCP OR CBWCP SHALL BE MADE AT STEEL BONDING PLATES, SEE STANDARD DETAIL 5.2.

G. THERMITE WELDS TO SPECIALLY LINED STEEL AND DUCTILE IRON MAIN SHALL BE MADE AT STEEL BONDING PLATES, SEE STANDARD DETAIL 5.5.

H. INSTALL RIBBON ANODES CONTINUOUSLY BETWEEN STATIONS TO NEXT TEST STATION, SEE CORROSION CONTROL LAYOUT FOR TYPE, AND SIZE OF ANODES. SEE STANDARD DETAIL 10.2 FOR PLACEMENT OF ANODES.

I. REFERENCE ELECTRODE AND COUPON SHALL BE SURROUNDED BY MINIMUM 12" OF NATIVE FILL OR CONDUCTIVE BACKFILL.

J. OPTIONAL COUPON(S). PLACE COUPON WITH THE BARE STEEL FACING UPWARD AND COVER THE PROBE WITH 6 INCHES TO 8 INCHES OF SELECT BACKFILL. IF AC AND DC COUPON ARE TO BE INSTALLED AT SAME LOCATION, COUPONS ARE TO BE INSTALLED ON OPPOSITE SIDES OF THE PIPELINE WITH MINIMUM UPSTREAM/DOWNSTREAM SEPARATION DISTANCE OF 40 INCHES. GALVANIC ANODES ARE TO BE PLACE A MINIMUM UPSTREAM/DOWNSTREAM SEPARATION OF 15 FEET FROM THE NEAREST AC OR DC COUPON.

K. JOINTS TO BE ELECTRICALLY CONTINUOUS, SEE STANDARD DETAIL 5.1. JOINT BONDING NOT SHOWN FOR CLARITY.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

CORROSION CONTROL

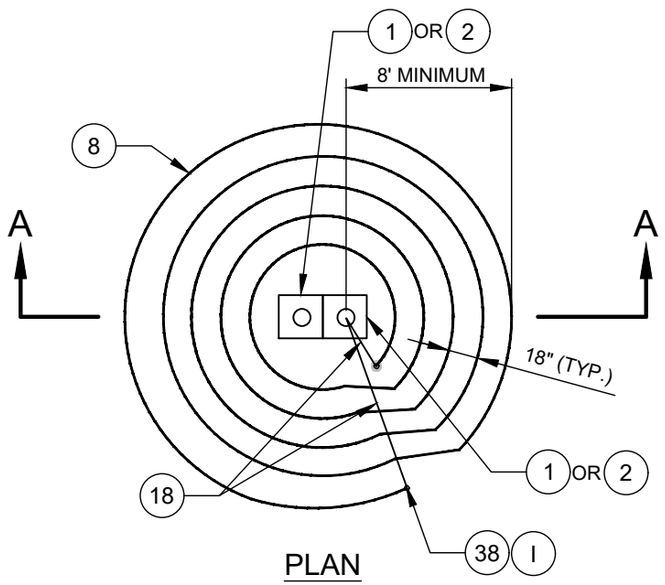
TYPE D1 TEST STATION (RIBBON ANODES)

NO SCALE

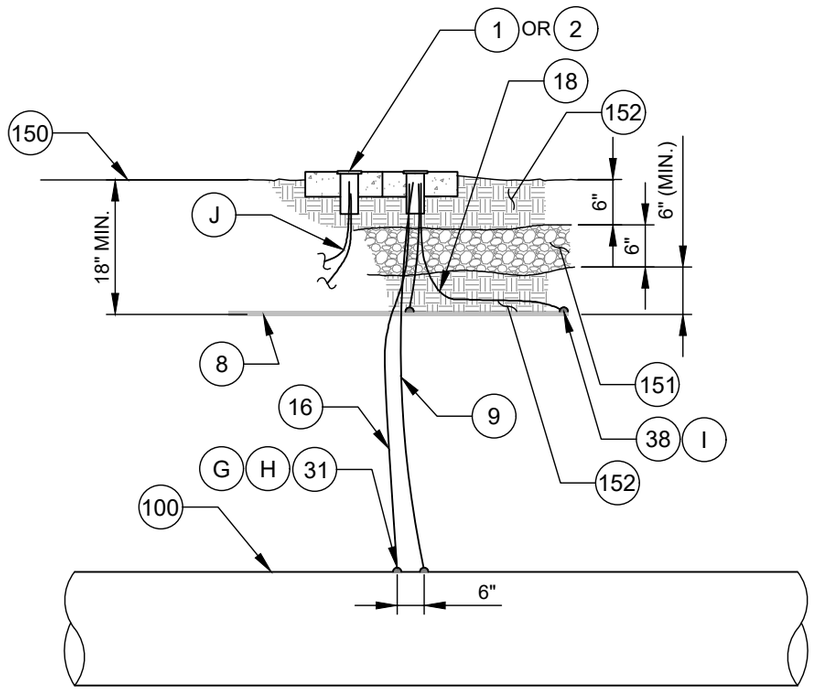
VERSION 1.0

DATE 04/2024

DETAIL 18.4.1



PLAN



SECTION "A-A"

DRAWING REFERENCE TABLE	
DWG	DWG NAME
5.2	CONCRETE PIPE BONDING
5.3	HORIZONTAL THERMITE WELD
5.5	STEEL BONDING PLATE FOR SPECIALLY LINED METALLIC MAIN
8.1	STANDARD VALVE BOX
8.2	TEST POST ASSEMBLY
9.1	CABLE SPLICE

WIRING SCHEDULE					
DESCRIPTION	TEST POST TERMINAL	AWG WIRE SIZE	TYPE OF INSULATION	COLOR OF INSULATION	TEST BOX 7 TERMINAL
NEW MAIN	3	#8	HMWPE	BLUE	2
	6	#10	THWN OR XLPE	BLUE	3
ANODE HEADER CABLE	4	#8	HMWPE	BLACK	5
	4	#8	HMWPE	BLACK	5

NO. DESCRIPTION:

1. TEST BOX.
2. TEST POST.
8. RIBBON ANODE, ZINC.
9. AWG NO. 10 BLUE CABLE.
16. AWG. NO 8 BLUE CABLE.
18. AWG NO. 8 BLACK CABLE.
31. THERMITE WELD.
38. CABLE SPLICE.
100. NEW MAIN.
150. FINISHED GRADE.
151. STONE BEDDING, PER CIVIL DETAILS.
152. BACKFILL, NATIVE TRENCH MATERIAL.

NOTES:

A. TEST STATIONS LOCATED ALONG PAVED ROADWAYS SHALL GENERALLY BE LOCATED 3' OUTSIDE OF THE EDGE OF PAVEMENT IN A NON-PAVED AREA. ROUTE ALL TEST WIRES AT A MINIMUM DEPTH OF 24" TO THE FINAL TEST STATION LOCATION. TEST STATION LOCATIONS SHALL BE FIELD ADJUSTED.

B. ROUTE WIRES IN 1 INCH PVC CONDUIT TO TEST BOX. INSTALL CABLE WARNING TAPE 18" ABOVE PVC CONDUIT.

C. MAINTAIN SUFFICIENT SLACK IN THE TEST WIRES SO THAT THE WIRES CAN EXTEND A MINIMUM OF 18" FROM THE TEST BOX.

D. INSTALL 0.01 OHM YELLOW SHUNT BETWEEN TERMINALS #2 AND #5 (TEST BOX) OR TERMINALS #3 AND TEST #4 (TEST POST).

E. IN-LINE ANODE RIBBON SPLICE, WHERE NECESSARY, SHALL BE MADE AS SHOWN IN STANDARD DETAIL 9.1.

F. THERMITE WELDS TO PCCP OR CBWCP SHALL BE MADE AT STEEL BONDING PLATES, SEE STANDARD DETAIL 5.2.

G. THERMITE WELDS TO SPECIALLY LINED STEEL AND DUCTILE IRON MAIN SHALL BE MADE AT STEEL BONDING PLATES, SEE STANDARD DETAIL 5.5.

H. AT FIRE HYDRANTS, VAULTS, AND OTHER APPURTENANCES, ZINC RIBBON ANODE SHALL BE COILED AROUND FIRE HYDRANT, VAULT, OR APPURTENANCE.

I. SPLICE ANODE HEADER CABLE TO END OF RIBBON ANODE, SEE STANDARD DETAIL 9.1.

J. TEST LEADS FOR ADJACENT TEST STATION WHERE APPLICABLE.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

CORROSION CONTROL

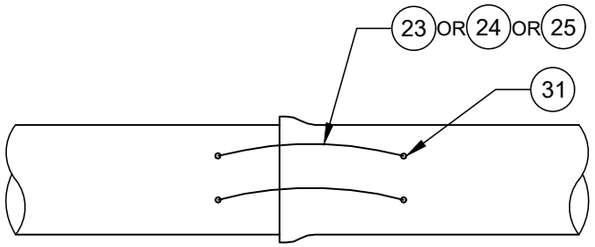
TYPE D2 TEST STATION (AC GROUND MAT)

NO SCALE

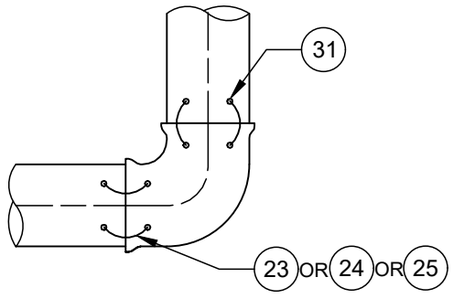
VERSION 1.0

DATE 04/2024

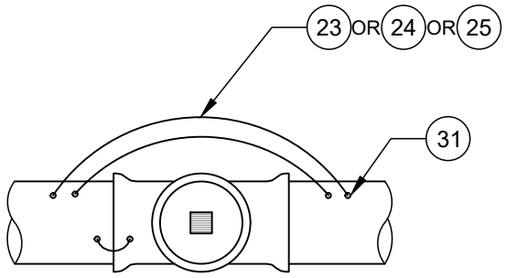
DETAIL 18.4.2



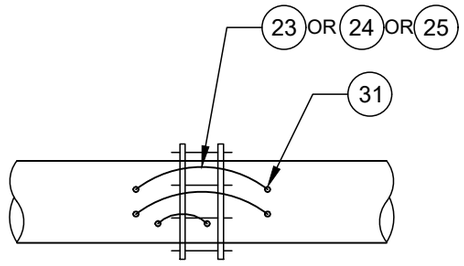
TYPICAL MAIN JOINT BOND



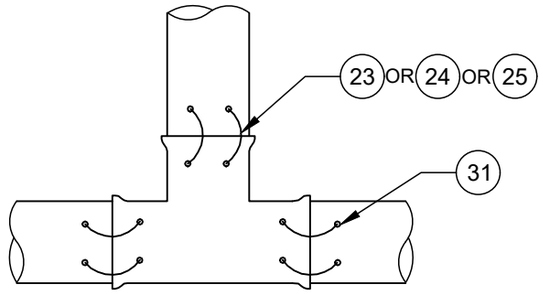
BEND, REDUCER, SOLID SLEEVE



VALVE



MECHANICAL COUPLING



TEE

DRAWING REFERENCE TABLE	
DWG	DWG NAME
5.2	CONCRETE PIPE BONDING
5.3	HORIZONTAL THERMITE WELD
5.4	VERTICAL THERMITE WELD
5.5	STEEL BONDING PLATE FOR SPECIALLY LINED METALLIC MAIN

NO. DESCRIPTION:

23. BOND CABLE, AWG 6, WHITE.
24. BOND CABLE, AWG 4, WHITE.
25. BOND CABLE, AWG 2,WHITE.
31. THERMITE WELD.

NOTES:

A. THERMITE WELD BONDING WIRES TO TOP OF MAIN OR FITTINGS.

B. THERMITE WELDS TO PCCP OR CBWCP SHALL BE MADE AT STEEL BONDING PLATES, SEE STANDARD DETAIL 5.2.

C. THERMITE WELDS TO SPECIALLY LINED STEEL AND DUCTILE IRON MAIN 4. SHALL BE MADE AT STEEL BONDING PLATES, SEE STANDARD DETAIL 5.5.

D. THERMITE WELDING FOR METALLIC PIPING AND/OR COMPONENTS. NON-CONDUCTIVE PIPE (I.E. PVC OR HDPE) NOT TO BE BONDED.

E. WIRE SIZE FOR BONDING JOINTS SHALL BE AS FOLLOWS:

MAIN SIZE	WIRE SIZE
LARGER THAN 36 INCHES	AWG NO. 2 HMWPE
16 INCHES TO 36 INCHES	AWG NO. 4 HMWPE
12 INCHES AND SMALLER	AWG NO. 6 HMWPE

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

CORROSION CONTROL

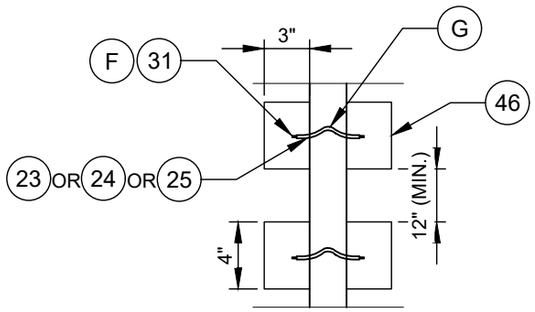
MAIN BONDING

NO SCALE

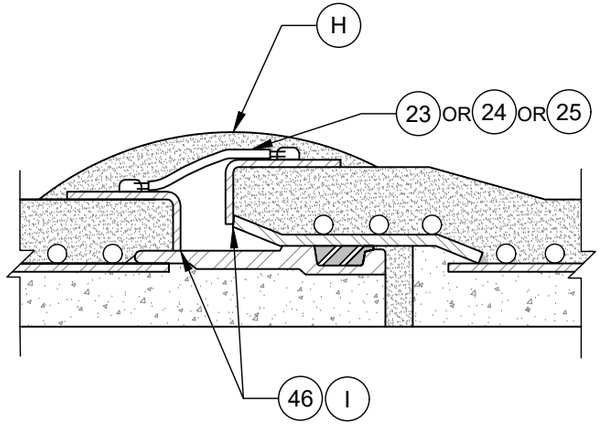
VERSION 1.0

DATE 04/2024

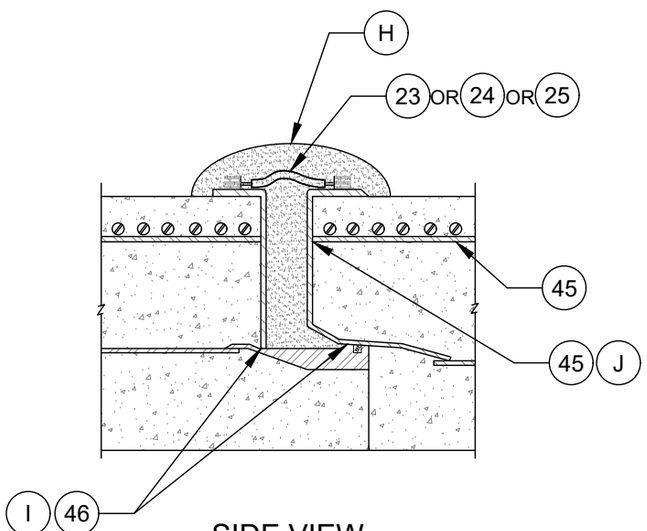
DETAIL 18.5.1



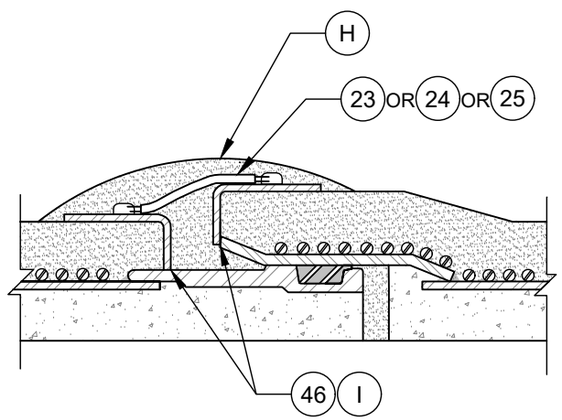
TOP VIEW



SIDE VIEW (CBWCP)



SIDE VIEW
EMBEDDED CYLINDER MAIN JOINT (PCCP)



SIDE VIEW
LINED CYLINDER MAIN JOINT (PCCP)

DRAWING REFERENCE TABLE	
DWG	DWG NAME
5.1	METALLIC MAIN BONDING
5.3	HORIZONTAL THERMITE WELD

NO. DESCRIPTION:

23. BOND CABLE, AWG 6, WHITE.
24. BOND CABLE, AWG 4, WHITE.
25. BOND CABLE, AWG 2, WHITE.
31. THERMITE WELD.
45. STEEL SHORTING STRAP.
46. STEEL BONDING PLATE.

NOTES:

A. BOND ALL MAIN JOINTS, INCLUDING THOSE ON MAIN, FITTINGS, VALVES, ETC., EXCEPT THOSE SPECIFIED TO BE INSULATED.

B. SEE STANDARD DETAIL 5.1 FOR BOND WIRE SIZE.

C. TWO STEEL SHORTING STRAPS REQUIRED PER MAIN SECTION FOR EMBEDDED CYLINDER MAIN. NO SHORTING STRAPS REQUIRED FOR LINED CYLINDER MAIN.

D. STEEL BONDING PLATES AND STEEL SHORTING STRAPS (IF REQUIRED) TO BE INSTALLED BY MAIN MANUFACTURER DURING MAIN FABRICATION.

E. THERMITE WELD STEEL BONDING PLATE AND COAT (TYP.) SEE STANDARD DETAIL 5.3.

F. LEAVE SLACK IN BONDING CABLE TO ALLOW FOR MOVEMENT.

G. GROUT AFTER BONDING IS COMPLETE AND COATED.

H. WELD STEEL BONDING PLATE TO JOINT RINGS.

I. WELD STEEL SHORTING STRAP TO STEEL BONDING PLATE.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

CORROSION CONTROL

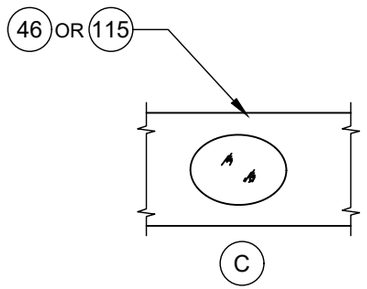
CONCRETE PIPE BONDING

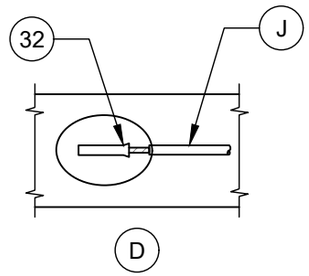
NO SCALE

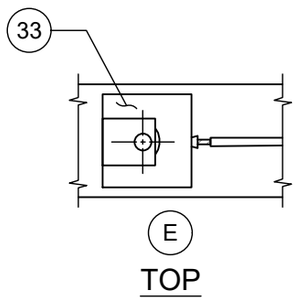
VERSION
1.0

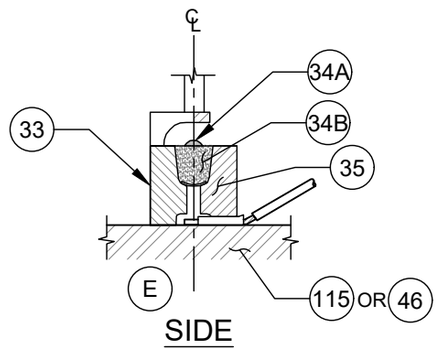
DATE
04/2024

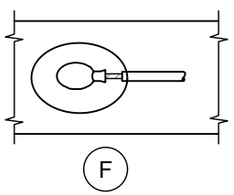
DETAIL
18.5.2

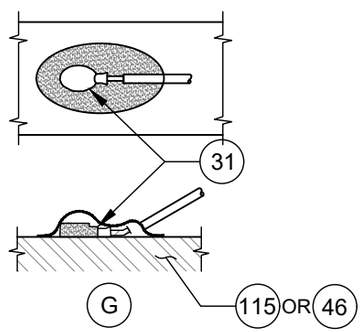












NO. DESCRIPTION:

31. THERMITE WELD.
32. THERMITE WELD ADAPTER SLEEVE, SIZE APPROPRIATE FOR CABLE.
33. THERMITE WELD GRAPHITE MOLD.
34A. THERMITE WELD STARTING POWDER.
34B. THERMITE WELD METAL POWDER.
35. THERMITE WELD METAL DISK.
46. STEEL BONDING PLATE.
115. STRUCTURE (MAIN OR FITTING).

NOTES:

A. THERMITE WELDS FOR STEEL AND DUCTILE IRON PIPE SHALL BE COATED WITH APPROVED COATING MATERIALS.

B. THERMITE WELDS FOR PCCP AND CBWCP SHALL BE COATED WITH TWO COATS OF MASTIC (10 MILS EACH) FOR A TOTAL OF 20 MILS AND EMBEDDED IN CONCRETE MORTAR.

C. CLEAN SURFACE TO BRIGHT METAL AT WELD LOCATION BY MECHANICAL GRINDER OR HAND FILES/RASPS. REMOVE JUST ENOUGH COATING TO ACCOMMODATE THE THERMITE WELD MOLD. ENSURE THERMITE WELD LOCATION IS NOT NEAR PIPELINE WELD SEAM.

D. STRIP APPROXIMATELY 1.5 INCHES OF INSULATION FROM WIRE AND INSTALL APPLICABLE ADAPTER SLEEVE.

E. ENSURE THERMITE WELD MOLD IS CORRECTLY SIZED FOR THE CABLE USED AND THERMITE WELD CHARGE IS APPROPRIATELY SIZED FOR THE PIPE MATERIAL AND WALL THICKNESS. PREHEAT EXPOSED THERMITE WELD AREA UNTIL A VISIBLE ABSENCE OF MOISTURE IS PRESENT (I.E. MOISTURE RING). HOLD GRAPHITE MOLD FIRMLY OVER ADAPTER SLEEVE WITH OPENING AWAY FROM OPERATOR - IGNITE STARTING POWDER.

F. LIGHTLY TAP EACH SIDE OF THE THERMITE WELD BUTTON WITH A BRASS HAMMER OR CHIPPING HAMMER TO REMOVE ANY SLAG AND VERIFY THE INTEGRITY OF THE WELD. THOROUGHLY CLEAN WELD AREA. ONLY ONE CHARGE IS PERMITTED FOR EACH WELD (REPEATING WELD IN SAME LOCATION PROHIBITED).

G. PRIME AND COAT ALL EXPOSED METAL AT WELD AREA.

H. THERMITE WELDING FOR METALLIC PIPING AND/OR COMPONENTS. NON-CONDUCTIVE PIPE (I.E. PVC OR HDPE) NOT TO BE BONDED.

I. PERSONNEL APPLYING THERMITE WELDS SHALL BE PROPERLY TRAINED AND COMPETENT AND USE APPROPRIATE SAFETY MEASURES.

J. CABLE CAN CONSIST OF ANY COLOR OF AWG #10, AWG #8, OR WHITE AWG #2, #4 OR #6 BONDING CABLE.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

CORROSION CONTROL

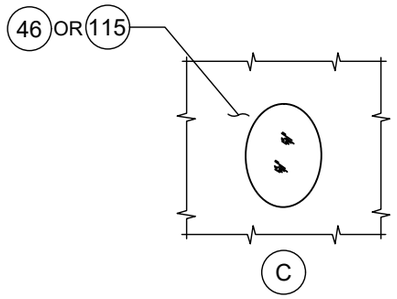
HORIZONTAL THERMITE WELD

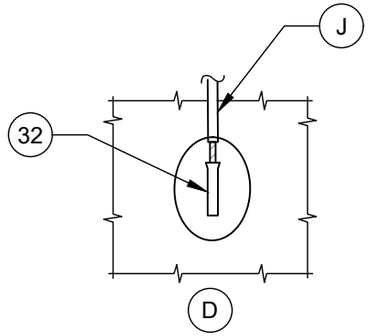
NO SCALE

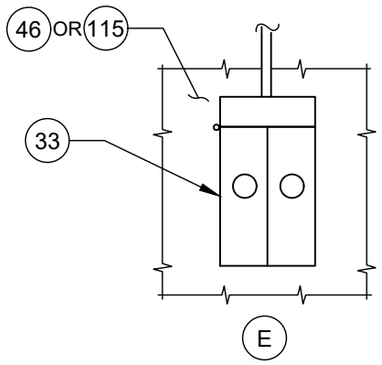
VERSION 1.0

DATE 04/2024

DETAIL 18.5.3







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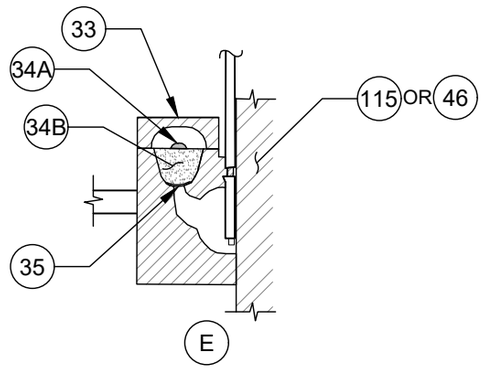

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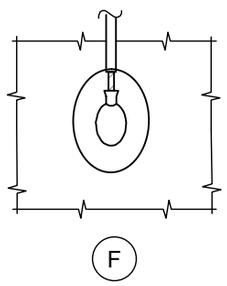
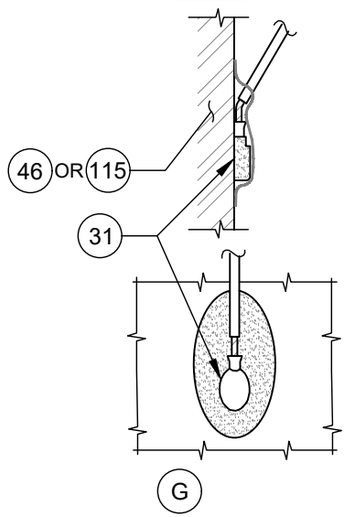




NO.	DESCRIPTION:
31.	THERMITE WELD.
32.	THERMITE WELD ADAPTER SLEEVE, SIZED APPROPRIATELY FOR CABLE.
33.	THERMITE WELD GRAPHITE MOLD.
34A.	THERMITE WELD STARTING POWDER.
34B.	THERMITE WELD METAL POWDER.
35.	THERMITE WELD METAL DISK.
46.	STEEL BONDING PLATE.
115.	STRUCTURE (MAIN OR FITTING).

NOTES:

A. THERMITE WELDS FOR STEEL AND DUCTILE IRON PIPE SHALL BE COATED WITH APPROVED COATING MATERIALS.

B. THERMITE WELDS FOR PCCP AND CBWCP SHALL BE COATED WITH TWO COATS OF MASTIC (10 MILS EACH) FOR A TOTAL OF 20 MILS AND EMBEDDED IN CONCRETE MORTAR.

C. CLEAN SURFACE TO BRIGHT METAL AT WELD LOCATION BY MECHANICAL GRINDER OR HAND FILES/RASPS. REMOVE JUST ENOUGH COATING TO ACCOMMODATE THE THERMITE WELD MOLD. ENSURE THERMITE WELD LOCATION IS NOT NEAR PIPELINE WELD SEAM.

D. STRIP APPROXIMATELY 1.5 INCHES OF INSULATION FROM WIRE AND INSTALL APPLICABLE ADAPTER SLEEVE.

E. ENSURE THERMITE WELD MOLD IS CORRECTLY SIZED FOR THE CABLE USED AND THERMITE WELD CHARGE IS APPROPRIATELY SIZED FOR THE PIPE MATERIAL AND WALL THICKNESS. PREHEAT EXPOSED THERMITE WELD AREA UNTIL A VISIBLE ABSENCE OF MOISTURE IS PRESENT (I.E. MOISTURE RING). HOLD GRAPHITE MOLD FIRMLY OVER ADAPTER SLEEVE WITH OPENING AWAY FROM OPERATOR - IGNITE STARTING POWDER.

F. LIGHTLY TAP EACH SIDE OF THE THERMITE WELD BUTTON WITH A BRASS HAMMER OR CHIPPING HAMMER TO REMOVE ANY SLAG AND VERIFY THE INTEGRITY OF THE WELD. THOROUGHLY CLEAN WELD AREA. ONLY ONE CHARGE IS PERMITTED FOR EACH WELD (REPEATING WELD IN SAME LOCATION PROHIBITED).

G. PRIME AND COAT ALL EXPOSED METAL AT WELD AREA.

H. THERMITE WELDING FOR METALLIC PIPING AND/OR COMPONENTS. NON-CONDUCTIVE PIPE (I.E. PVC OR HDPE) NOT TO BE BONDED.

I. PERSONNEL APPLYING THERMITE WELDS SHALL BE PROPERLY TRAINED AND COMPETENT AND USE APPROPRIATE SAFETY MEASURES.

J. CABLE CAN CONSIST OF ANY COLOR OF AWG #10, AWG #8, OR WHITE AWG #2, #4 OR #6 BONDING CABLE.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

CORROSION CONTROL

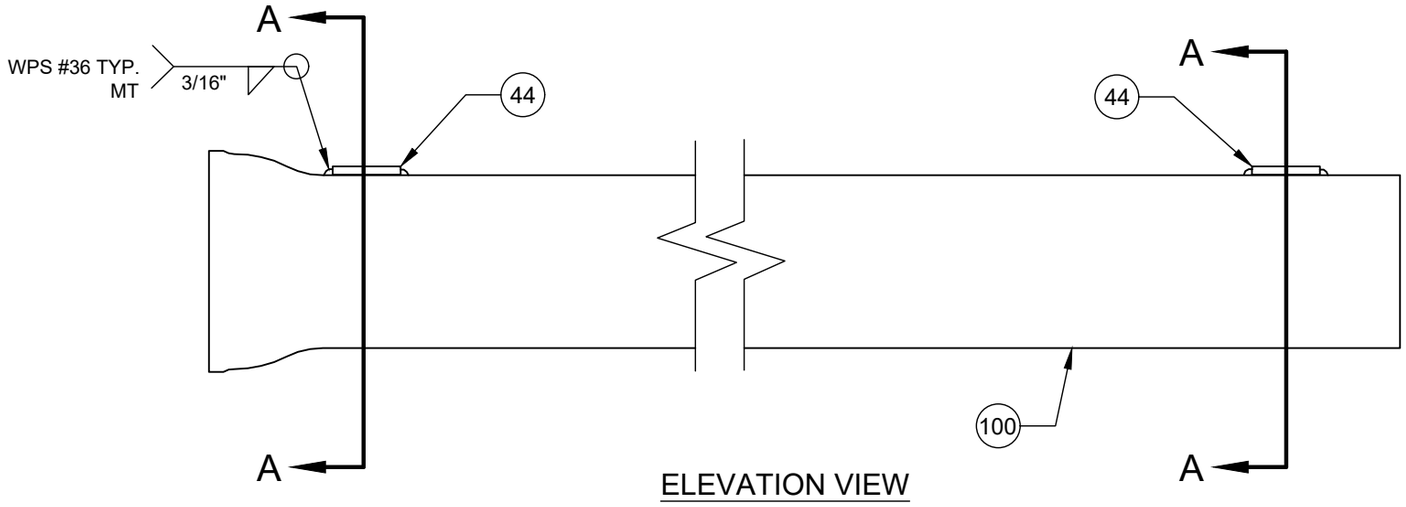
VERTICAL THERMITE WELD

NO SCALE

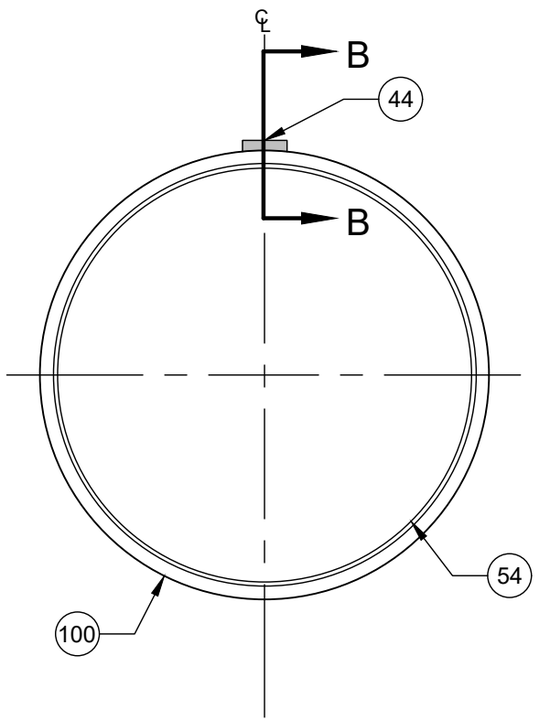
VERSION
1.0

DATE
04/2024

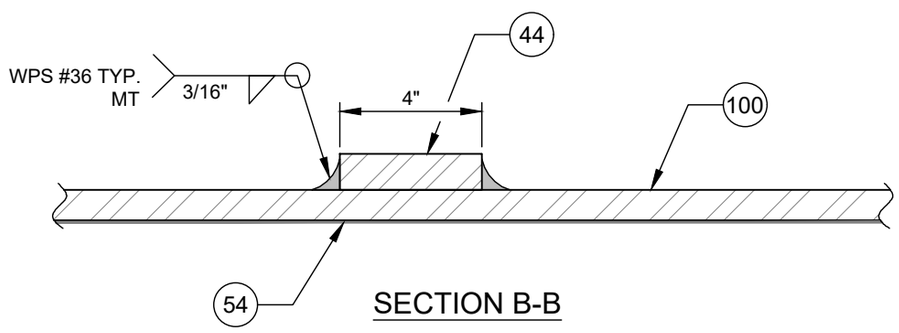
DETAIL
18.5.4



ELEVATION VIEW



SECTION A-A



SECTION B-B

NO.	DESCRIPTION:
44.	STEEL BONDING PLATE, 5/8" THICK, 4" X 4", ASTM A36-04.
54.	SPECIAL LINING (POLYURETHANE, POLYUREA, OR URETHANE LINING).
100.	NEW MAIN.

NOTES:

A. STEEL BONDING PLATES TO BE PROVIDED AT EACH END OF EACH SEGMENT OF MAIN (DUCTILE IRON ONLY).

B. STEEL BONDING PLATES TO BE FABRICATED WITH MAIN PRIOR TO INSTALLING SPECIAL LINING.

C. STEEL BONDING PLATES NOT REQUIRED FOR CEMENT MORTAR LINED MAIN.

D. STEEL BONDING PLATE QUANTITY FOR WELDED STEEL MAIN TO BE DETERMINED PRIOR TO MANUFACTURE OF PIPE. BONDING PLATES ONLY REQUIRED AT TEST LEAD AND NEGATIVE CABLE LOCATIONS.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

CORROSION CONTROL

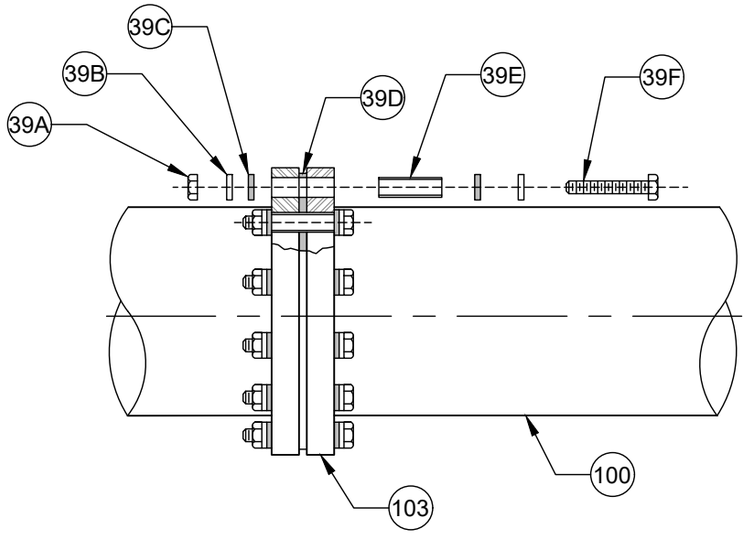
STEEL BONDING PLATE FOR SPECIALLY LINED METALLIC MAIN

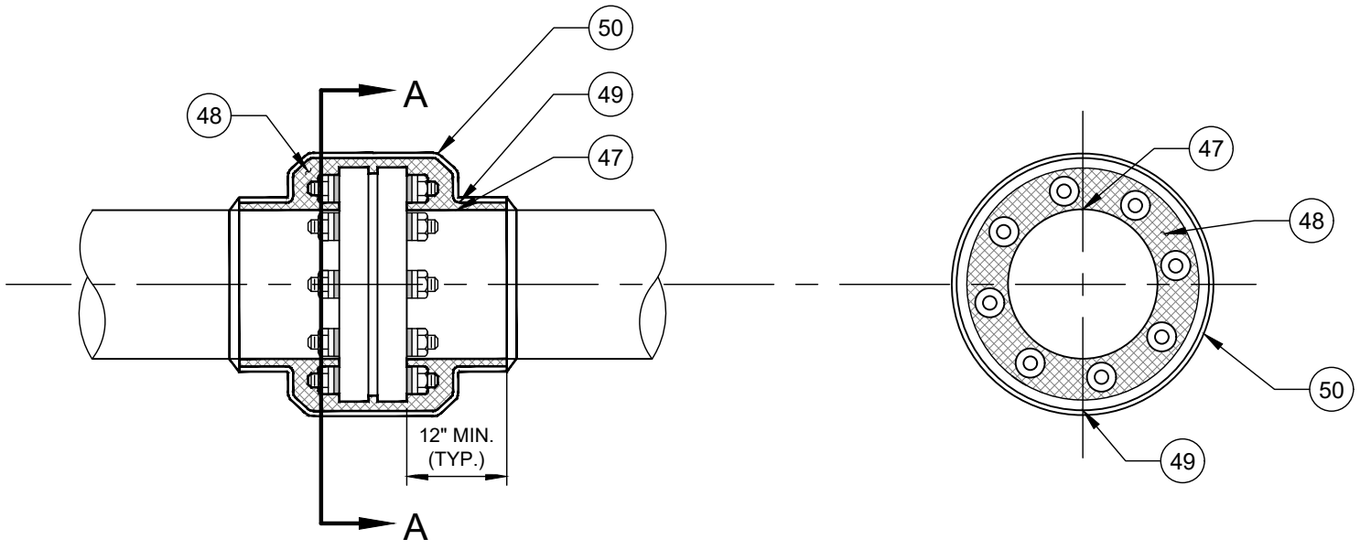
NO SCALE

VERSION
1.0

DATE
04/2024

DETAIL
18.5.5





SIDE VIEW

SECTION "A-A"

NO. DESCRIPTION:

39A. FLANGE NUT.
39B. STEEL WASHER.
39C. INSULATING WASHER.
39D. INSULATING GASKET.
39E. INSULATING SLEEVE.
39F. FLANGE BOLT.
47. COATING, PRIMER.
48. COATING, FILLER PUTTY.
49. COATING, INNERWRAP.
50. COATING, OUTERWRAP.
100. NEW MAIN.
103. INSULATING FLANGE.

NOTES:

A. AFTER ASSEMBLY, TEST TO VERIFY THAT ISOLATION IS EFFECTIVE. IF ISOLATION IS NOT EFFECTIVE, REPAIR AS NECESSARY AND RETEST. THIS PROCESS SHALL CONTINUE UNTIL ISOLATION IS VERIFIED AS EFFECTIVE.

B. AFTER VERIFYING EFFECTIVE ISOLATION, COAT THE ENTIRE FLANGE AND ALL EXPOSED METAL INCLUDING BOLTS, NUTS, AND WASHERS WITH FOUR COMPONENTS OF DENSO OR TRENTON WAX TAPE COATING SYSTEM. COATING SYSTEM SHALL EXTEND A MINIMUM OF 12" ON EITHER SIDE OF FLANGE, RE-COAT ACCORDING TO MANUFACTURER PROCEDURES.

C. ALL INSULATING FLANGES TO BE PROVIDED WITH TEST STATIONS, SEE STANDARD DETAILS 1.1, 1.2, AND 3.3.

D. INSULATING KITS NOT TO BE USED AT VALVES.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

CORROSION CONTROL

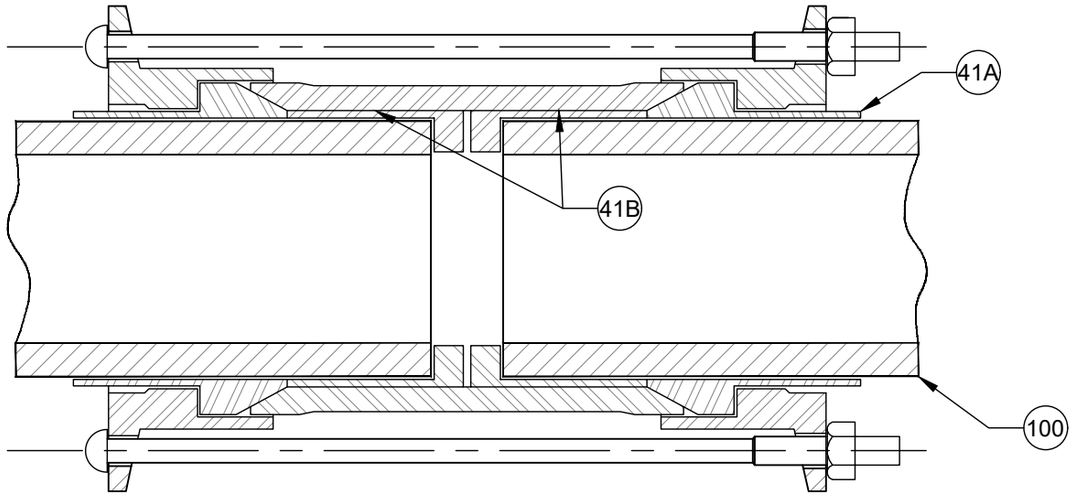
INSULATING FLANGE

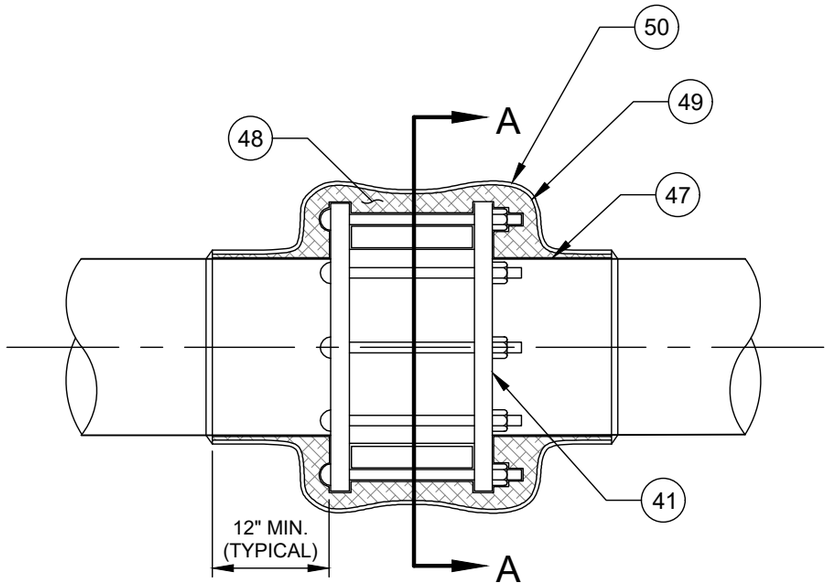
NO SCALE

VERSION
1.0

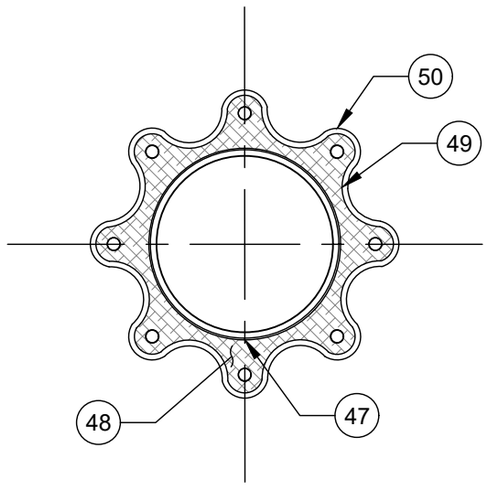
DATE
04/2024

DETAIL
18.6.1





SIDE VIEW



SECTION "A-A"

NO. DESCRIPTION:

41. INSULATING COUPLING.
41A. INSULATING GASKET.
41B. RUBBER INSULATOR.
47. COATING, PRIMER.
48. COATING, FILLER PUTTY.
49. COATING, INNERWRAP.
50. COATING, OUTERWRAP.
100. NEW MAIN.

NOTES:

A. AFTER ASSEMBLY, TEST TO VERIFY THAT ISOLATION IS EFFECTIVE. IF ISOLATION IS NOT EFFECTIVE, REPAIR AS NECESSARY AND RETEST. THIS PROCESS SHALL CONTINUE UNTIL ISOLATION IS VERIFIED AS EFFECTIVE.

B. AFTER VERIFYING EFFECTIVE ISOLATION, COAT THE ENTIRE COUPLING AND ALL EXPOSED METAL INCLUDING BOLTS, NUTS, AND WASHERS, WITH FOUR COMPONENTS OF DENSO OR TRENTON WAX TAPE COATING SYSTEM. COATING SYSTEM SHALL EXTEND A MINIMUM OF 12" ON EITHER SIDE OF COUPLING.

C. ALL INSULATING COUPLINGS TO BE PROVIDED WITH TEST STATIONS SIMILAR TO STANDARD DETAILS 1.1, 1.2, AND 3.3.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

CORROSION CONTROL

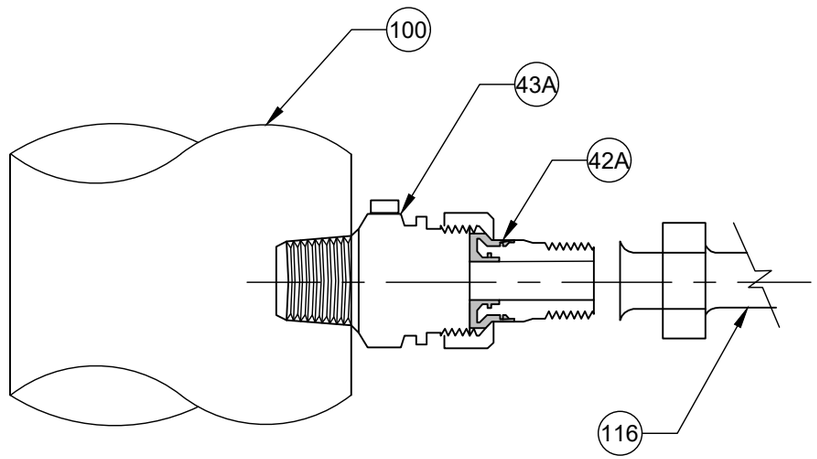
INSULATING COUPLING

NO SCALE

VERSION
1.0

DATE
04/2024

DETAIL
18.6.2



NO. DESCRIPTION:

42A. NYLON INSULATOR.
43A. CORPORATION STOP OR BRASS NIPPLE.
100. NEW MAIN.
116. SERVICE LINE OR AIR RELEASE.

NOTES:

A. AFTER ASSEMBLY, TEST TO VERIFY THAT ISOLATION IS EFFECTIVE. IF ISOLATION IS NOT EFFECTIVE, REPAIR AS NECESSARY AND RETEST. THIS PROCESS SHALL CONTINUE UNTIL ISOLATION IS VERIFIED AS EFFECTIVE.

B. AFTER VERIFYING EFFECTIVE ISOLATION, COAT THE ENTIRE CORPORATION AND ALL EXPOSED METAL WITH FOUR COMPONENTS OF DENSO OR TRENTON WAX TAPE COATING SYSTEM. COATING SYSTEM SHALL EXTEND A MINIMUM OF 12" ON EITHER SIDE OF CORPORATION.

C. TAP CONNECTION FOR MAINS > 30". SERVICE SADDLE (BOLTS AROUND MAIN) FOR PIPE < 30".

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

CORROSION CONTROL

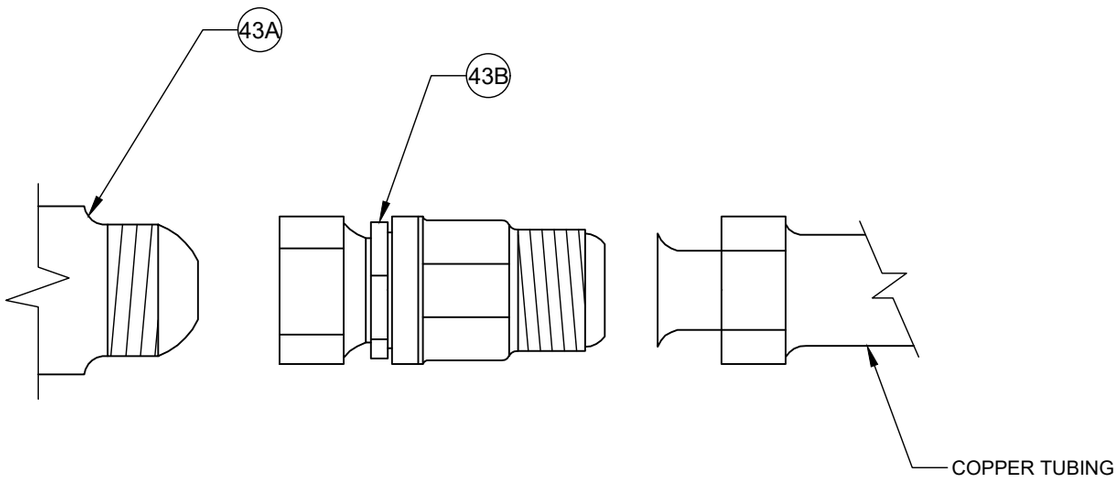
INSULATING CORPORATION

NO SCALE

VERSION
1.0

DATE
04/2024

DETAIL
18.6.3



NO.	DESCRIPTION:
43A.	CORPORATION STOP OR BRASS NIPPLE.
43B.	NYLON DIELECTRIC BUSHING.

NOTES:

A. AFTER ASSEMBLY, TEST TO VERIFY THAT ISOLATION IS EFFECTIVE. IF ISOLATION IS NOT EFFECTIVE, REPAIR AS NECESSARY AND RETEST. THIS PROCESS SHALL CONTINUE UNTIL ISOLATION IS VERIFIED AS EFFECTIVE.

B. AFTER VERIFYING EFFECTIVE ISOLATION, COAT THE UNION AND ALL EXPOSED METAL WITH FOUR COMPONENTS OF DENSO OR TRENTON WAX TAPE COATING SYSTEM. COATING SYSTEM SHALL EXTEND A MINIMUM OF 12" ON EITHER SIDE OF UNION.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

CORROSION CONTROL

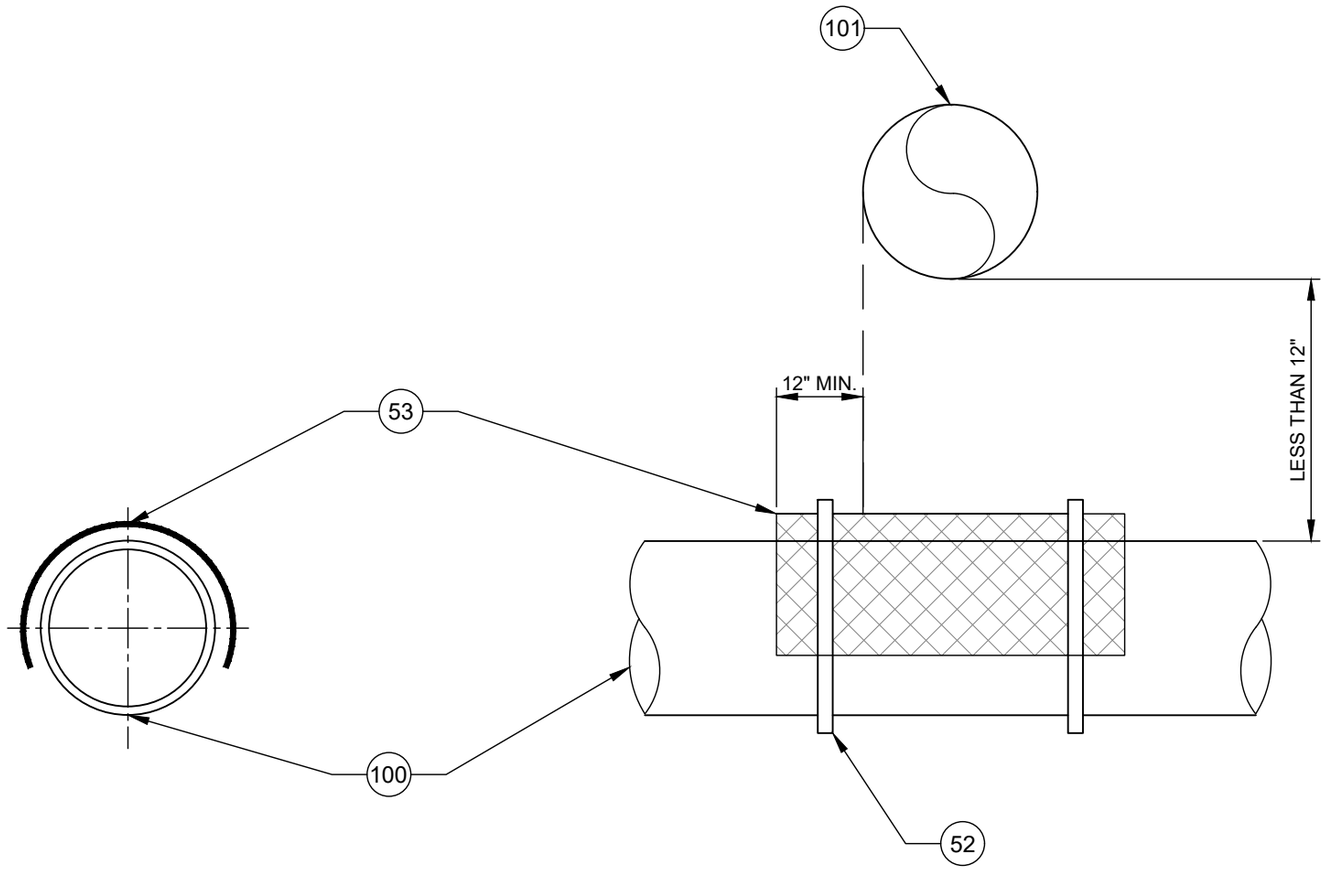
INSULATING UNION

NO SCALE

VERSION
1.0

DATE
04/2024

DETAIL
18.6.4



NO.	DESCRIPTION:
52.	COATING, POLYKIN JOINT WRAP TAPE.
53.	POLYETHYLENE MESH WEBBING PAD.
100.	NEW MAIN.
101.	EXISTING MAIN.

NOTES:

A. USE ONLY WHEN METALLIC MAINS ARE LESS THAN 12 INCHES APART.

B. INSTALL SEPARATOR IF EXISTING METALLIC PIPE IS WITHIN 12 INCHES IN ANY DIRECTION.

C. PAD SHALL EXTEND MINIMUM OF 12" PAST THE OUTSIDE DIAMETER OF THE CROSSING METALLIC MAIN/PIPE.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

CORROSION CONTROL

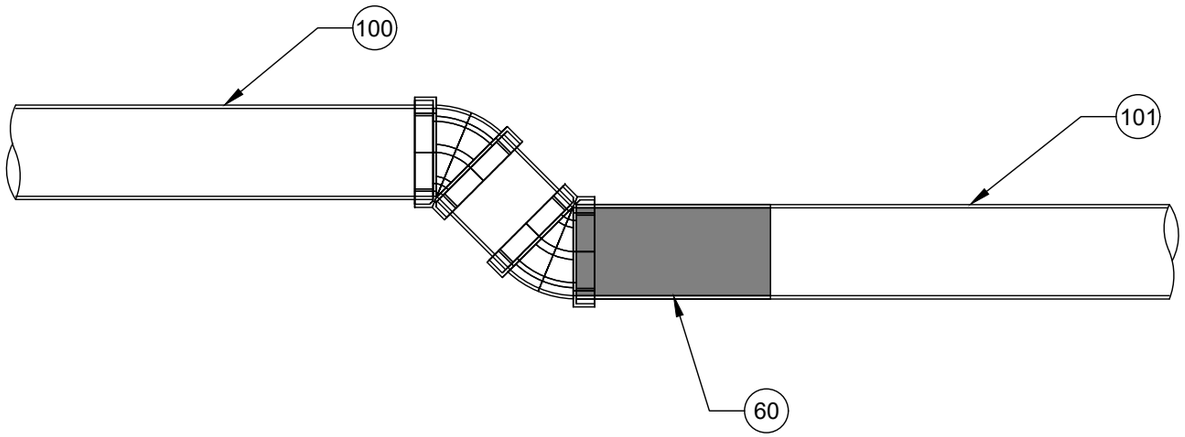
SEPARATOR TO AVOID ELECTRICAL CONTACT

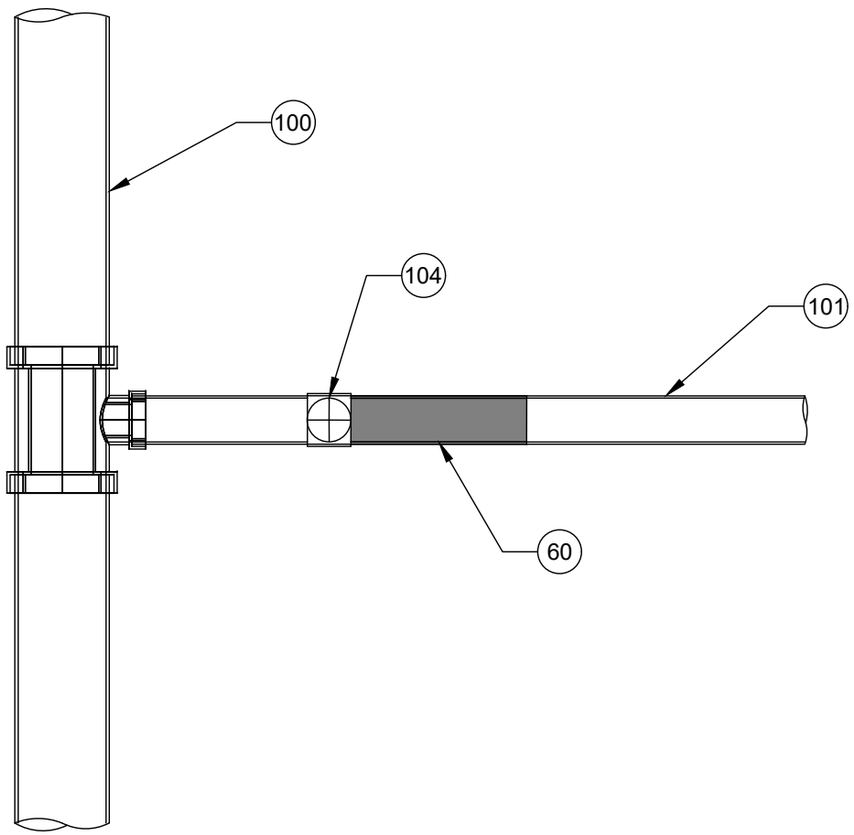
NO SCALE

VERSION
1.0

DATE
04/2024

DETAIL
18.6.5





NO.	DESCRIPTION:
60.	PVC PIPE FOR ELECTRICAL ISOLATION.
100.	NEW MAIN.
101.	EXISTING MAIN.
104.	BUTTERFLY VALVE.

NOTES:

A. PVC ISOLATION UTILIZED AS LONG LEAD ISOLATOR, WHERE HIGH CONDUCTIVITY SOILS AND/OR INTERNAL MEDIUM MAY PRESENT A PROBLEM WITH FLANGE ISOLATION EFFECTIVENESS.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

CORROSION CONTROL

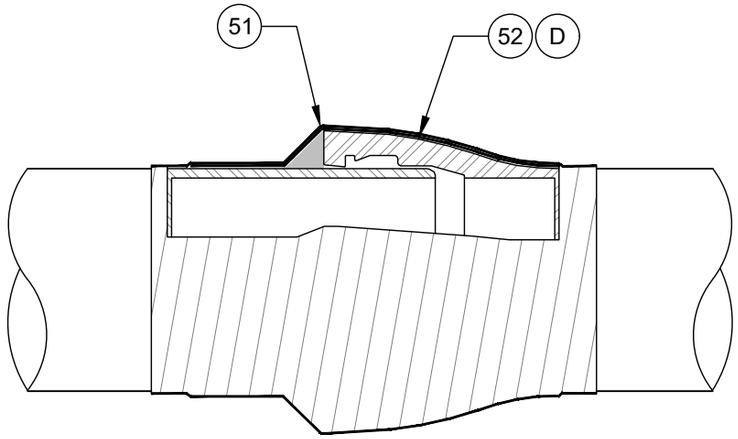
PVC FOR ELECTRICAL ISOLATION OF NEW METALLIC MAIN

NO SCALE

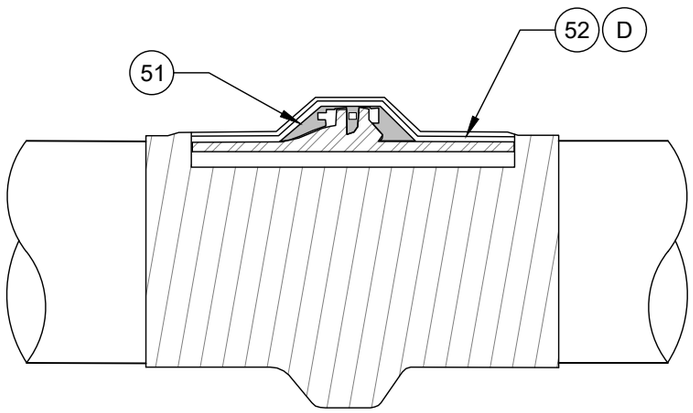
VERSION
1.0

DATE
04/2024

DETAIL
18.6.6



BELL AND SPIGOT JOINT



MECHANICAL OR MEGALUG JOINT

NO.	DESCRIPTION:
51.	COATING, POLYKIN FILLER TAPE.
52.	COATING, POLYKIN JOINT WRAP TAPE.

NOTES:

A. CLEAN JOINT OF ALL FOREIGN MATERIAL BY WIRE BRUSHING.

B. APPLY COATING PRIMER TO JOINT.

C. INSTALL FILLER TAPE AS SHOWN, AND FILL ALL VOIDS BETWEEN FLANGES AND BOLTS.

D. APPLY TWO LAYERS OF JOINT WRAP TAPE.

E. COAT MAIN FITTINGS IN A SIMILAR MANNER.

F. HEAT SHRINK SLEEVES WITH FILLER MATERIAL AS RECOMMENDED BY HEAT SHRINK SLEEVE MANUFACTURER MAY ALSO BE USED.

G. INSTALLER SHALL BE QUALIFIED AND COMPETENT.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

CORROSION CONTROL

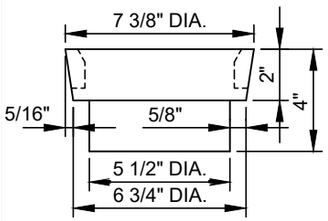
DUCTILE IRON JOINT COATING

NO SCALE

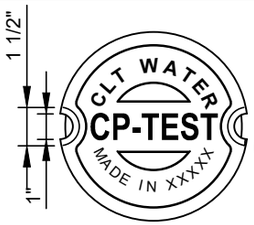
VERSION
1.0

DATE
04/2024

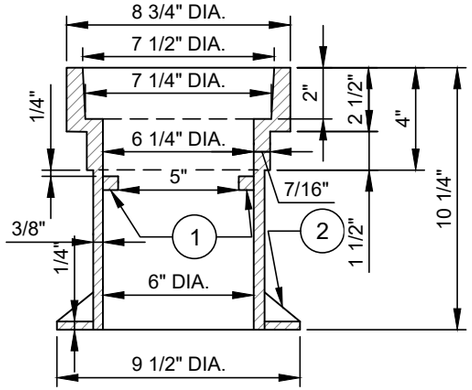
DETAIL
18.7.1



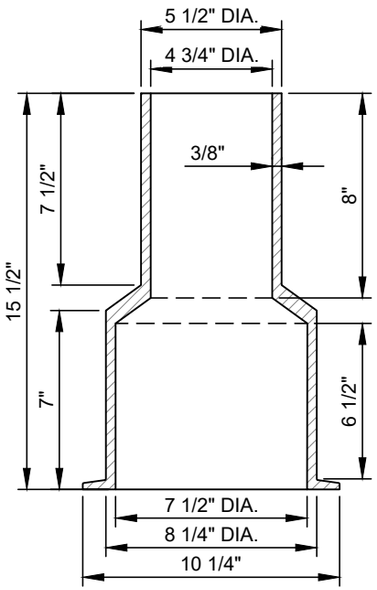
SIDE VIEW



TOP VIEW

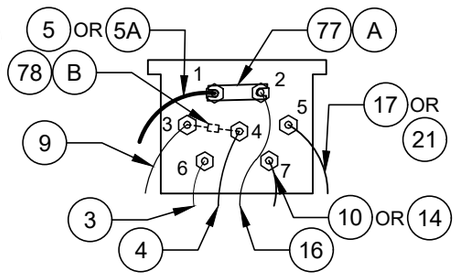


VALVE BOX - TOP SECTION
SECTION VIEW

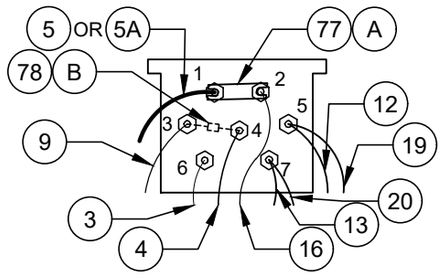


VALVE BOX - BOTTOM SECTION
SECTION VIEW

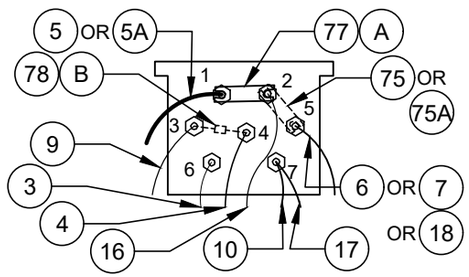
7 POST CONFIGURATION



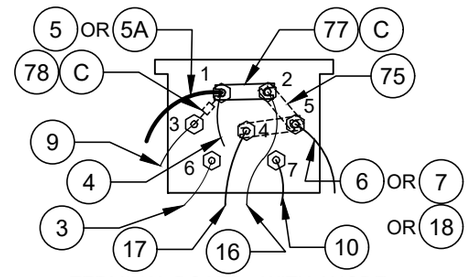
TERMINAL BOARD - NO ANODE
(DWGS 1.1, 1.2, 2.1, 2.2, 2.3, 2.4)



TERMINAL BOARD - CASING
(DWG 2.5)

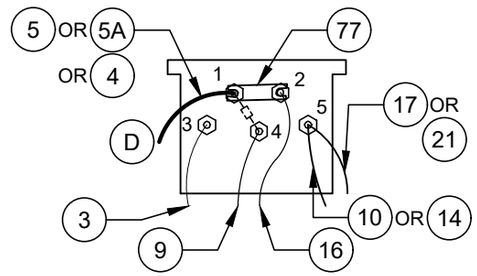


TERMINAL BOARD - WITH ANODE
(DWGS 3.1, 3.2, 3.3, 3.5, 3.6, 4.1, 4.2)

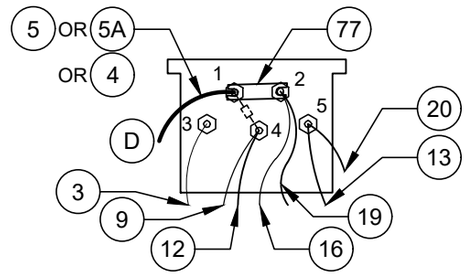


TERMINAL BOARD - WITH ANODE
(DWG 3.4)

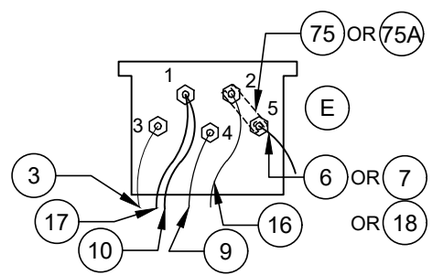
OPTIONAL 5 POST CONFIGURATION



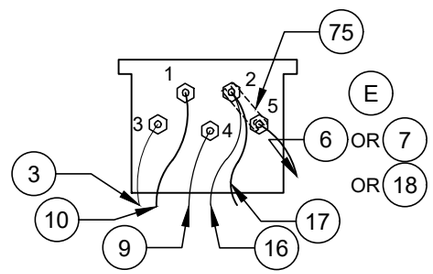
TERMINAL BOARD - NO ANODE
(DWGS 1.1, 1.2, 2.1, 2.2, 2.3, 2.4)



TERMINAL BOARD - CASING
(DWG 2.5)



TERMINAL BOARD - WITH ANODE
(DWGS 3.1, 3.2, 3.3, 3.5, 3.6, 4.1, 4.2)



TERMINAL BOARD - WITH ANODE
(DWG 3.4)

NO.	DESCRIPTION:
1.	VALVE BOX.
3.	COPPER/COPPER SULFATE REFERENCE ELECTRODE.
4.	OPTIONAL AC COUPON.
5.	DC COUPON, STEEL.
5A.	DC COUPON, DI.
6.	PREPACKAGED ANODE, MAGNESIUM.
7.	PREPACKAGED ANODE, ZINC.
9.	AWG NO. 10 BLUE CABLE.
10.	AWG NO. 10 WHITE CABLE.
12.	AWG NO. 10 RED CABLE.
13.	AWG NO. 10 GREEN CABLE.
14.	AWG NO. 10 ORANGE CABLE.
16.	AWG NO. 8 BLUE CABLE.
17.	AWG NO. 8 WHITE CABLE.
18.	AWG NO. 8 BLACK CABLE.
19.	AWG NO. 8 RED CABLE.
20.	AWG NO. 8 GREEN CABLE.
21.	AWG NO. 8 ORANGE CABLE.
75.	0.1 OHM SHUNT (WHERE REQUIRED).
75A.	0.01 OHM SHUNT (WHERE REQUIRED).
78.	3W, 10 OHM RESISTOR.

NOTES:

A. IF DC COUPON REQUIRED, ADD SHORTING BAR BETWEEN TERMINALS 1 AND 2 AND CONNECT DC COUPON CABLE TO TERMINAL 1.

B. IF AC COUPON REQUIRED, ADD RESISTOR BETWEEN TERMINALS 3 AND 4 AND CONNECT AC COUPON CABLE TO TERMINAL 4.

C. AC OR DC COUPON CAN BE INSTALLED (NOT BOTH). IF DC COUPON REQUIRED, ADD SHORTING BAR BETWEEN TERMINALS 1 AND 2 AND CONNECT DC COUPON CABLE TO TERMINAL 1. IF AC COUPON REQUIRED, ADD RESISTOR BETWEEN TERMINALS 3 AND 1 AND CONNECT AC COUPON CABLE TO TERMINAL 1.

D. AC OR DC COUPON CAN BE INSTALLED (NOT BOTH). IF DC COUPON REQUIRED, ADD SHORTING BAR BETWEEN TERMINALS 1 AND 2 AND CONNECT DC COUPON CABLE TO TERMINAL 1. IF AC COUPON REQUIRED, ADD RESISTOR BETWEEN TERMINALS 4 AND 1 AND CONNECT AC COUPON CABLE TO TERMINAL 1.

E. NO AC OR DC COUPON CONNECTION AVAILABLE.

CHARLOTTE WATER

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A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

CORROSION CONTROL

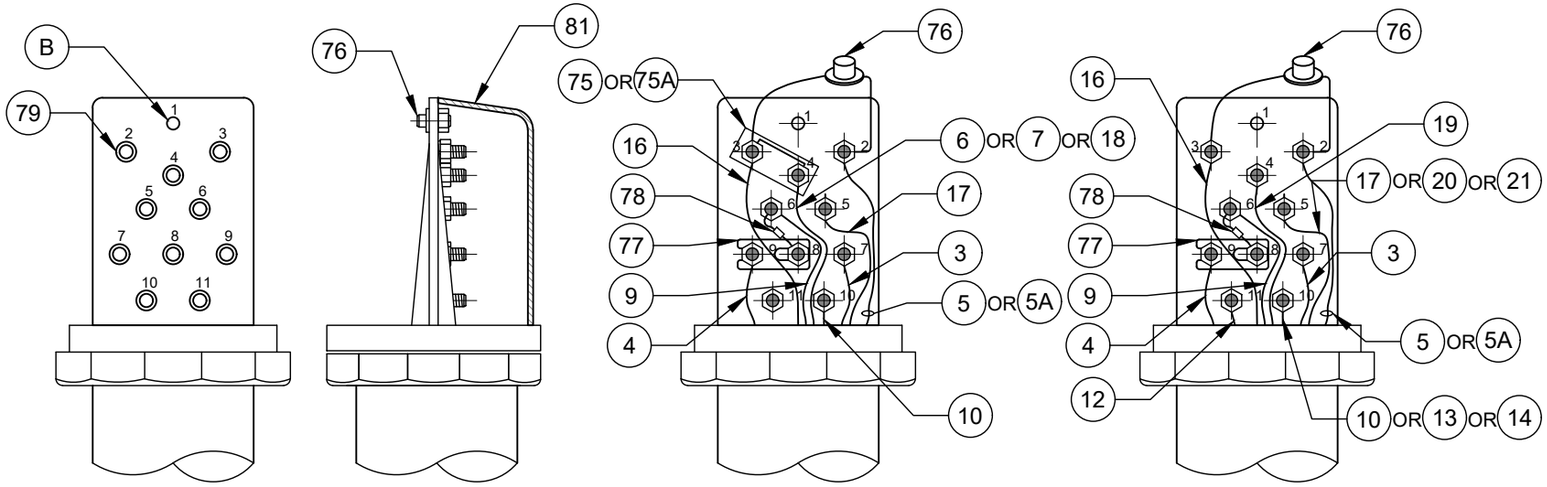
FLUSH MOUNT TEST BOX

NO SCALE

VERSION
2.0

DATE
01/2025

DETAIL
18.8.1



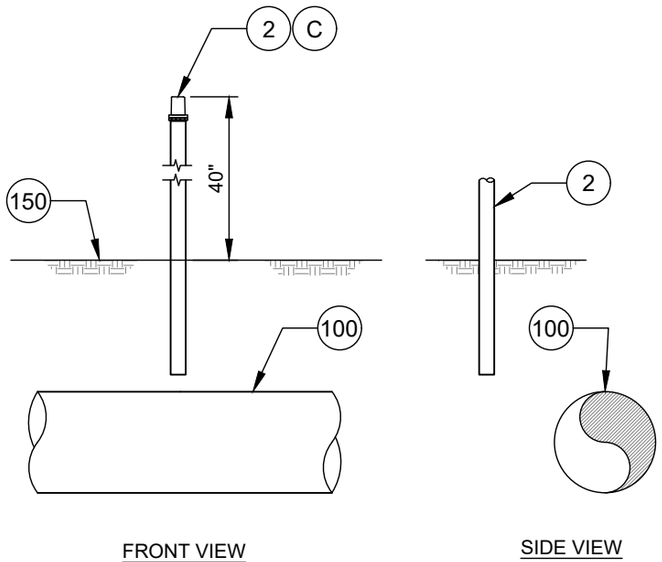
FRONT VIEW

SIDE VIEW (WITH SHOCK RESISTANT COVER SHOWN)

BACK VIEW - WITH ANODE (SHOCK RESISTANT COVER NOT SHOWN)

BACK VIEW - WITHOUT ANODE (SHOCK RESISTANT COVER NOT SHOWN)

TEST STATION HEAD



FRONT VIEW

SIDE VIEW

INSTALLATION OF AC AND DC COUPONS

TEST STATION TEST PROCEDURES AC/DC COUPON TEST STATION	
TEST	PROCEDURE
AC VOLTAGE CHECK	MEASURE AND RECORD THE AC VOLTAGE OF EACH TERMINAL WITH RESPECT TO A PORTABLE REFERENCE ELECTRODE BEFORE CONTINUING WITH TESTING.
PIPE-TO-SOIL POTENTIAL wrt Cu:CuS04	MEASURE THE POTENTIAL BETWEEN THE PIPE (TERMINAL #6) AND PERMANENT REFERENCE ELECTRODE (TERMINAL #7). COMPARE TO READING USING PORTABLE REFERENCE ELECTRODE.
COUPON CONNECTED (ON) POTENTIAL	MEASURE THE POTENTIAL BETWEEN THE COUPON (TERMINAL #2) AND REFERENCE ELECTRODE (TERMINAL #7)
COUPON DISCONNECTED (OFF) POTENTIAL	PUSH THE BUTTON TO DISCONNECT THE COUPON AND MEASURE THE POTENTIAL BETWEEN THE COUPON (TERMINAL #2) AND REFERENCE ELECTRODE (TERMINAL #7)
AC COUPON CURRENT DENSITY	MEASURE CURRENT TO THE AC COUPON BY MEASURING THE AC VOLTAGE BETWEEN THE AC COUPON (TERMINAL #9) AND THE PIPE (TERMINAL #6) ACROSS THE 10 OHM RESISTOR. CALCULATE AC CURRENT DENSITY (COUPON AREA = cm²)

NO. DESCRIPTION:

2. TEST POST ASSEMBLY.
3. COPPER/COPPER SULFATE REFERENCE ELECTRODE.
4. AC COUPON.
5. DC COUPON, STEEL.
5A. DC COUPON, DUCTILE IRON.
6. PREPACKAGED ANODE, MAGNESIUM.
7. PREPACKAGED ANODE, ZINC.
9. AWG NO. 10 BLUE CABLE.
10. AWG NO. 10 WHITE CABLE.
12. AWG NO. 10 RED CABLE.
13. AWG NO. 10 GREEN CABLE.
14. AWG NO. 10 ORANGE CABLE.
16. AWG NO. 8 BLUE CABLE.
17. AWG NO. 8 WHITE CABLE.
18. AWG NO. 8 BLACK CABLE.
19. AWG NO. 8 RED CABLE.
20. AWG NO. 8 GREEN CABLE.
21. AWG NO. 8 ORANGE CABLE.
75. 0.1 OHM SHUNT, RED, COTT MANUFACTURING.
75A. 0.01 OHM SHUNT, YELLOW, COTT MANUFACTURING.
79. BANANA PLUG TERMINAL (TYP.).
81. SHOCK RESISTANT BACK COVER (PART OF TEST POST ASSEMBLY).
100. NEW MAIN.
150. FINISHED GRADE.

OPTIONAL AC COUPON
4. AC COUPON.
77. COTT BONDING/SHORTING STRAP.
78. 3W, 10 OHM RESISTOR.

OPTIONAL DC COUPON
5. DC COUPON, STEEL.
5A. DC COUPON, DUCTILE IRON.
76. NORMALLY CLOSED PUSH BUTTON SWITCH, DIGI-KEY MSPF-101B OR EQUIVALENT.

NOTES:

A. TEST POST ASSEMBLY CAN BE SUPPORTED BY 4x4 POST FOR EXTRA STABILITY.

B. LOCATION OF PUSH BUTTON SWITCH (NOT SHOWN).

C. IF VISUAL IDENTIFICATION IS REQUIRED, THE ADDITION OF CLTW STICKERS OR LABELS SHOULD BE INSTALLED ON THE EXTERIOR OF THE TEST POST ASSEMBLY.

CHARLOTTE WATER

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A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

CORROSION CONTROL

TEST POST ASSEMBLY

NO SCALE

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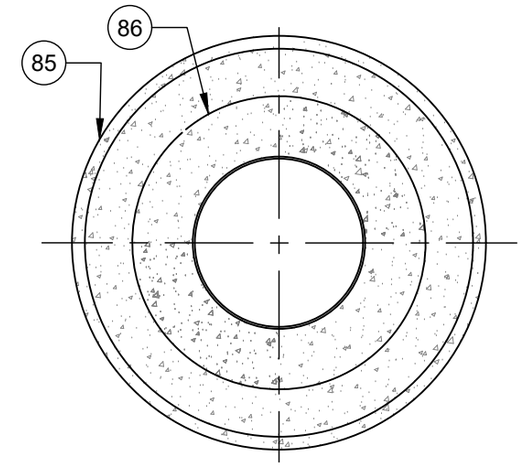
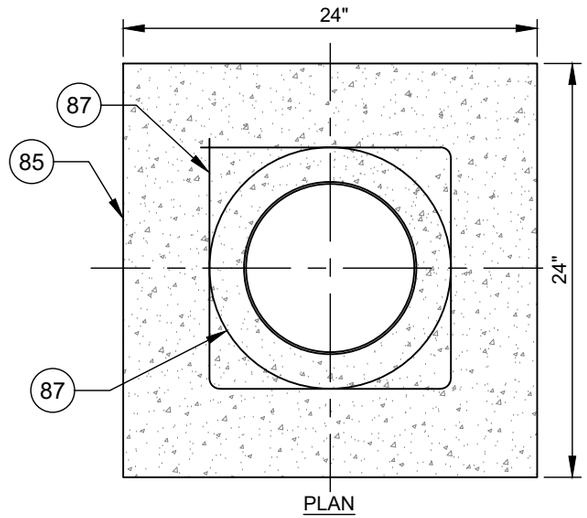
DETAIL 18.8.2

NO.	DESCRIPTION:
85.	CONCRETE GRADE RING.
86.	#4 REBAR - 17" DIAMETER.
87.	#4 REBAR - LENGTH = 56", OR ALTERNATE 14" DIAMETER.
150.	FINISHED GRADE.

TYPE A - GRADE RING
PRECAST ONLY



TYPE B - GRADE RING
PRECAST OR CAST IN PLACE



CHARLOTTE WATER

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STANDARD DETAILS

CORROSION CONTROL

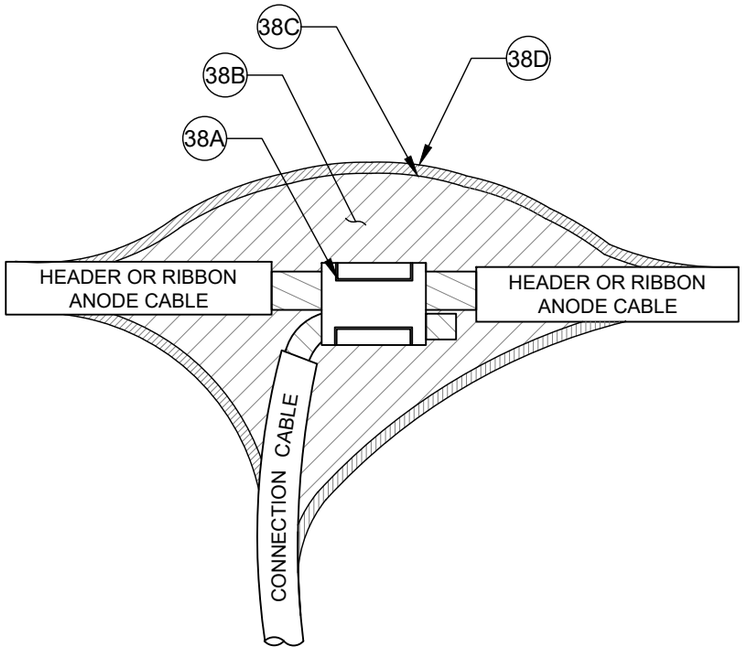
FLUSH MOUNT TEST BOX - CONCRETE GRADE RINGS

NO SCALE

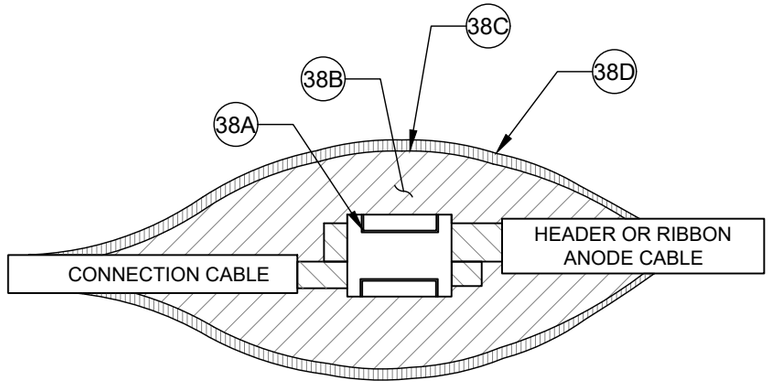
VERSION
1.0

DATE
04/2024

DETAIL
18.8.3



Y SPLICE CONNECTION
(3-WAY)



IN-LINE SPLICE CONNECTION
(2-WAY)

NO. DESCRIPTION:

38A. COPPER CRIMP CONNECTOR.
38B. SPLICING TAPE, SCOTCHFILL ELECTRICAL INSULATION PUTTY.
38C. SPLICING TAPE, 130C LINERLESS RUBBER SPLICING TAPE.
38D. SPLICING TAPE, SUPER 33+ VINYL ELECTRICAL TAPE.

NOTES:

A. THE 'LAYERED TAPE WRAP' IS THE PREFERRED METHOD. IT MAY ONLY BE USED BY QUALIFIED AND APPROVED PERSONNEL IF THESE TWO CONDITIONS (QUALIFIED AND APPROVED) ARE NOT MET, THE 'HEAT SHRINK WRAP' METHOD MUST BE USED.

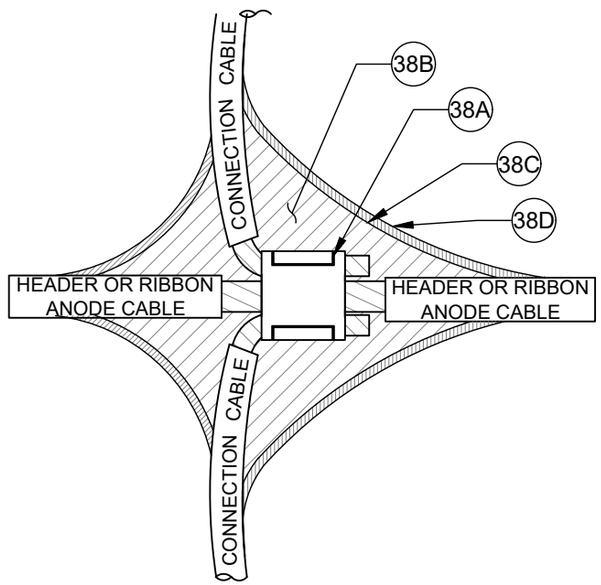
B. ITEMS 38B, 38C, AND 38D ARE MANUFACTURED BY 3M ELECTRICAL PRODUCTS DIVISION.

C. FINISHED SPLICE MUST BE COMPLETELY WRINKLE-FREE SMOOTH WATER TIGHT AND HARDNESS APPROACHING THAT OF CABLE JACKET(S).

D. CRIMP TOOL AND DIE TO BE APPROPRIATELY SIZED FOR CRIMP CONNECTOR.

PROCEDURE

STEP 1	REMOVE SUFFICIENT AMOUNT OF CABLE JACKET TO FACILITATE THE INSTALLATION OF THE APPROPRIATE SIZE COMPRESSON CRIMP CONNECTOR. NOTE: ALLOW FOR CRIMPING TOOL SPACE REQUIREMENT. DO NOT DAMAGE INNER COPPER CONDUCTOR.
STEP 2	CRIMP CABLES USING CORRECT SIZE CRIMP CONNECTORS, AND APPROPRIATE TOOL DIE SIZE.
STEP 3	WRAP ENTIRE EXPOSED METAL AND MINIMUM 1" OF CABLE JACKET USING `SCOTCHFIL' ELECTRICAL INSULATION PUTTY, ITEM 38B, PROVIDING A SMOOTH CONTOUR BASE FOR NEXT LEVEL OF MULTI-LAYER WRAPPING.
STEP 4	WRAP THE 130C RUBBER COMPOUND, ITEM 38C WITH A 50% OVERLAP, AS TIGHT AS POSSIBLE AROUND THE SPLICED AREA, PROVIDING A SMOOTH AND HARD CONTOUR A MINIMUM OF 1" OVER EACH CABLE JACKET.
STEP 5	APPLY MINIMUM OF THREE (3) COMPLETE LAYERS OF `SCOTCHFIL' VINYL ELECTRICAL TAPE, ITEM 38D. EACH LAYER TO EXTEND AT LEAST 0.5" PAST UNDERLYING LAYER ALONG EACH CABLE.



SPLICE CONNECTION
(4-WAY)

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A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

CORROSION CONTROL

ANODE HEADER CABLE SPLICE

NO SCALE

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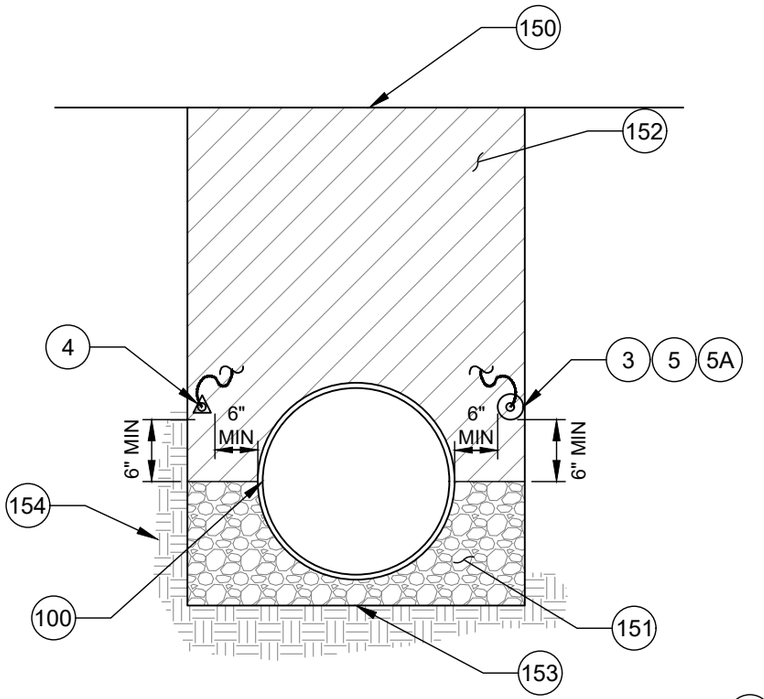
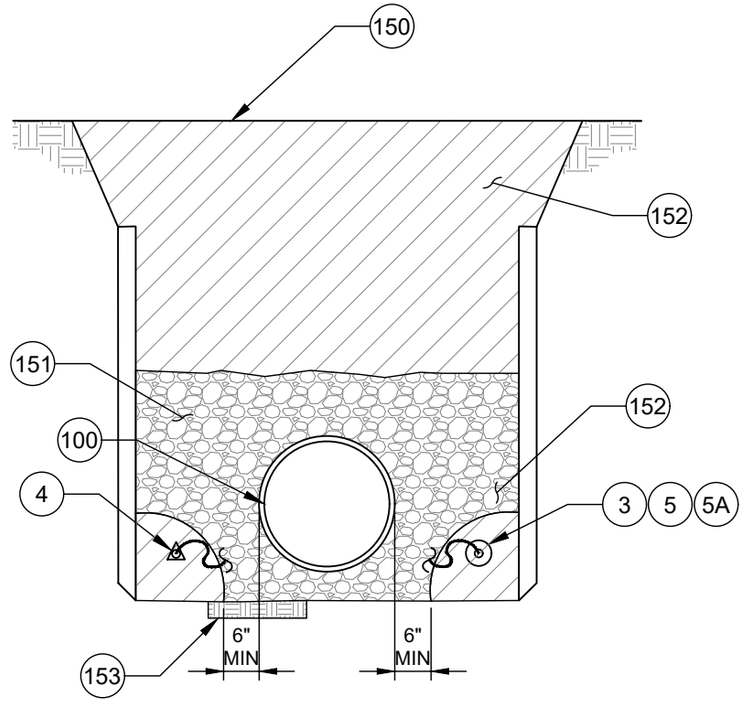
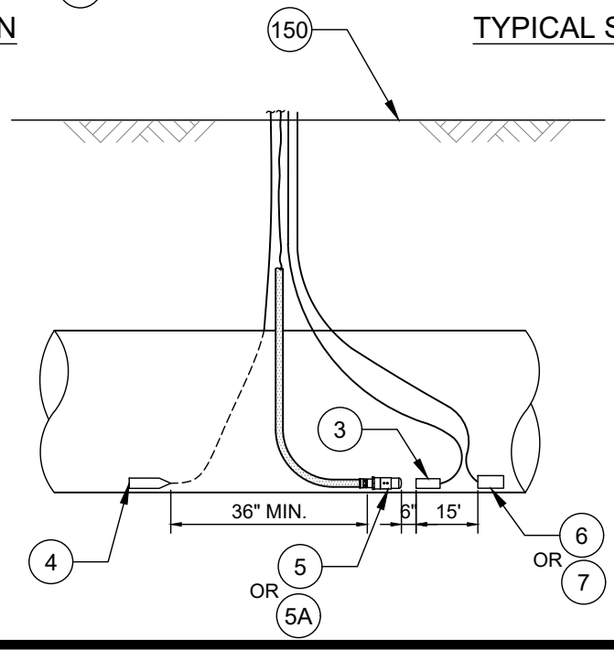
DETAIL 18.9.1



TYPICAL DI MAIN



TYPICAL STEEL MAIN



NO.	DESCRIPTION:
3.	COPPER/COPPER SULFATE REFERENCE ELECTRODE.
4.	OPTIONAL AC COUPON.
5.	DC COUPON, STEEL.
5A.	DC COUPON, DI.
6.	PREPACKAGED ANODE, MAGNESIUM.
7.	PREPACKAGED ANODE, ZINC.
100.	NEW MAIN.
150.	FINISHED GRADE.
151.	STONE BEDDING PER CIVIL DETAILS.
152.	BACKFILL, NATIVE TRENCH MATERIAL.
153.	TRENCH BOTTOM.
154.	UNDISTURBED TRENCH WALL.

NOTES:

A. BACKFILL REFERENCE ELECTRODE WITH NATIVE SOIL FOR A MINIMUM OF 6" ON ALL SIDES.

B. GALVANIC ANODES TO BE A MINIMUM 15' FROM NEAREST AC/DC COUPON OR REFERENCE ELECTRODE.

C. OPTIONAL COUPON(S). PLACE COUPON WITH THE BARE STEEL FACING UPWARD AND COVER THE PROBE WITH 6" TO 8" OF SELECT BACKFILL. IF AC & DC COUPON ARE TO BE INSTALLED AT SAME LOCATION, COUPONS ARE TO BE INSTALLED ON OPPOSITE SIDES OF THE PIPELINE WITH MINIMUM UPSTREAM/DOWNSTREAM SEPARATION DISTANCE OF 40'.

CHARLOTTE WATER

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STANDARD DETAILS

CORROSION CONTROL

REFERENCE ELECTRODE AND COUPON PLACEMENT

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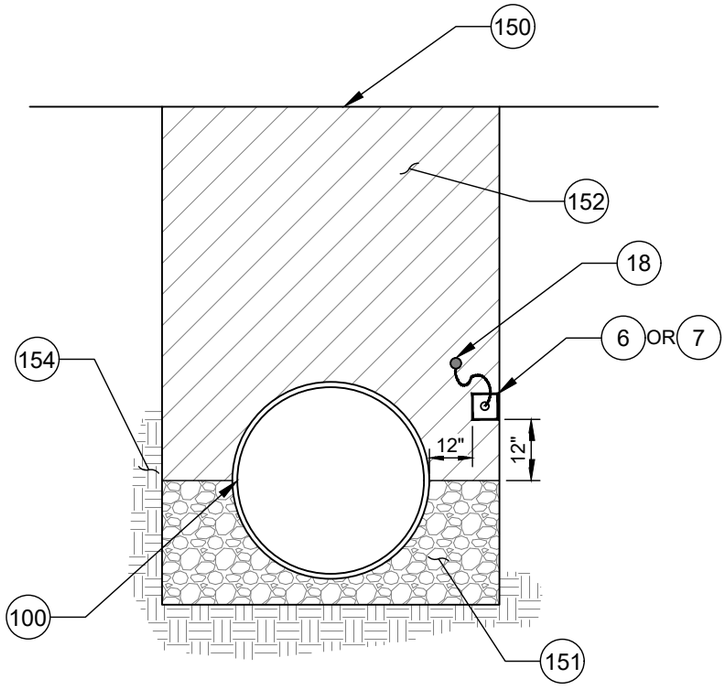
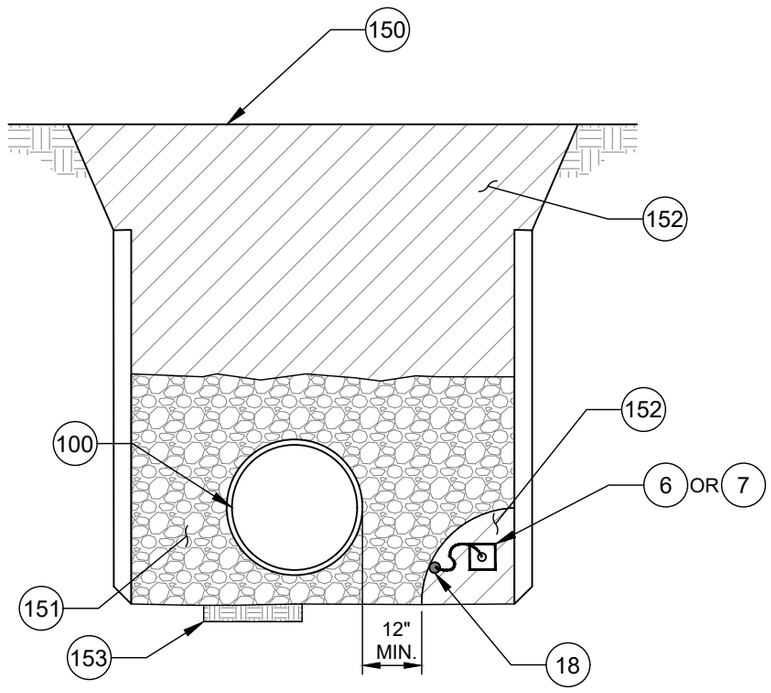
DATE 04/2024

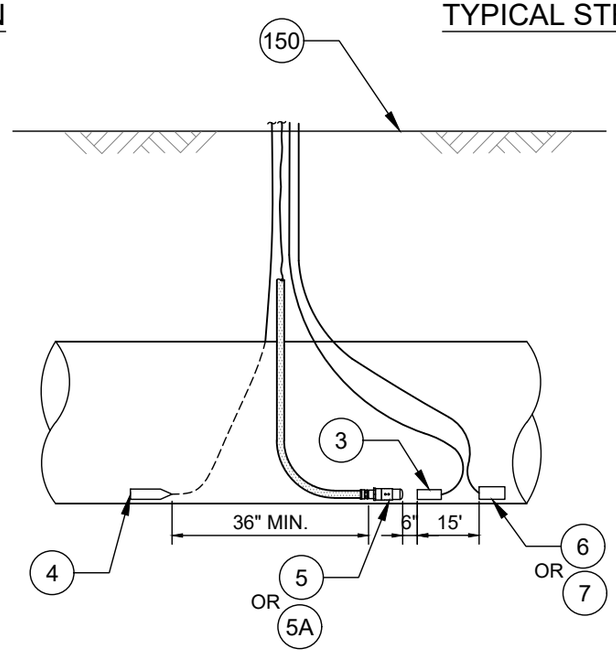
DETAIL 18.10.1



TYPICAL DI MAIN



TYPICAL STEEL MAIN



NO. DESCRIPTION:

3. COPPER/COPPER SULFATE REFERENCE ELECTRODE.
4. OPTIONAL AC COUPON.
5. DC COUPON, STEEL.
5A. DC COUPON, DI.
6. PREPACKAGED ANODE, MAGNESIUM.
7. PREPACKAGED ANODE, ZINC.
18. AWG NO. 8 BLACK CABLE.
100. NEW MAIN.
150. FINISHED GRADE.
151. STONE BEDDING PER CIVIL DETAILS.
152. BACKFILL, NATIVE TRENCH MATERIAL.
153. TRENCH BOTTOM.
154. UNDISTURBED TRENCH WALL.

NOTES:

A. INSTALL ANODES IN NATIVE SOIL BACKFILL. DO NOT BACKFILL ANODES WITH SAND OR STONE.

B. ANODE SHALL REMAIN MINIMUM OF 12" ABOVE SAND OR STONE BACKFILL (LEVEL IN DETAIL FOR REFERENCE ONLY AND MAY VARY ACCORDING TO ACTUAL DESIGN). TYPICAL DUCTILE IRON INSTALLS (PARTIAL STONE FILL) AND TYPICAL STEEL INSTALLS (STONE OVER PIPE) ARE SHOWN. IF NO STONE OR SAND FILL UTILIZED, ANODE CAN BE PLACED ON TRENCH BOTTOM.

C. ANODE SHALL REMAIN MINIMUM 12" FROM PIPE SURFACE.

D. FOR ANODE PLACEMENT ON BOTH SIDES OF PIPE (NOT SHOWN FOR CLARITY), REPEAT PROCEDURE FOR INITIAL ONE-SIDED INSTALLATION.

E. IF STONE OR SAND BACKFILL IS UTILIZED TO SURFACE, ANODE SHALL BE SURROUNDED BY MINIMUM OF 12" OF NATIVE FILL OR CONDUCTIVE BACKFILL (INCLUDING SIDES AND ENDS) AND REMAIN WITHIN 24" OF PIPE.

F. MAINTAIN A MINIMUM 12" CLEARANCE WHEN ROUTING ANODES AROUND VAULTS AND APPURTENANCES.

G. GALVANIC ANODES TO BE MINIMUM 15' FROM NEAREST AC/DC COUPON OR REFERENCE ELECTRODE.

CHARLOTTE WATER

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STANDARD DETAILS

CORROSION CONTROL

PREPACKAGED ANODE PLACEMENT ON ONE SIDE OF MAIN

NO SCALE

VERSION
1.0

DATE
04/2024

DETAIL
18.10.2

CHAPTER 19
SITE CLEARING

CHAPTER 19
SITE CLEARING

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3.6 Topsoil Stripping 7
3.7 Disposal Of Surplus And Waste Materials 7

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Stripping and stockpiling rock.
6. Removing above- and below-grade site improvements.
7. Disconnecting, capping or sealing, and abandoning site utilities in place.
8. Temporary erosion and sedimentation control.

1.2 DEFINITIONS

A. See Sections iii and iv of the Charlotte Water Water and Sewer Design and Construction Standards for common abbreviations and definitions, in addition to the following:

B. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

C. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.

D. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects larger than 2 inches (50 mm) in diameter; and free of weeds, roots, toxic materials, or other nonsoil materials.

E. Tree and plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.

F. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.3 MATERIAL OWNERSHIP

A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site and properly disposed.

1.4 SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.

1. Use sufficiently detailed photographs or video recordings.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plant designated to remain.

B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.5 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from property Owners and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed trafficways if required by Owner or authorities having jurisdiction.

B. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

C. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

D. Do not commence site clearing operations until temporary erosion- and sedimentation-control and tree and plant-protection measures are in place.

E. Tree and Plant Protection Zones: Provide protection zones for all trees and plants identified to remain prior to performing all clearing and grubbing activities.

F. Soil Stripping, Handling, and Stockpiling: Perform only when the soil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Chapter 20 of the Charlotte Water Water and Sewer Design and Construction Standards and Standard Details.

B. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged and that protection zones have been identified and enclosed.

C. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 EROSION CONTROL

A. Erosion Control is required for all projects regardless of the size of the project limits. Erosion control standards are as set forth by the city, town, or county in which the project is being constructed, but at minimum to the current and as amended the NCDEQ Erosion and Sediment Control Planning and Design Manual.

B. Erosion Control Devices:

1. Erosion control devices and procedures shall conform to the requirements of the Erosion Control Plan approved by the North Carolina Department of Environment and Natural Resources, including the appropriate reporting and documentation requirements. The Contractor shall also comply with the requirements outlined in the Clean Water Act Section 404 wetlands permit issued by the U.S. Army Corps of Engineers.

2. At a minimum, all erosion control devices (silt fence, sediment traps, diversion, etc.) will be installed as specified on the Plans and in these specifications. Where a device must be placed before construction, removed during construction and replaced following construction, no extra payment will be made for the removal and replacement operations. Temporary seeding and mulching must be done within fifteen (15) days of initial land disturbing activity. All cost associated with temporary seeding shall be included in the various pay items of the proposal.

3. All silt fences shall conform to Charlotte Mecklenburg Land Development Standard Details or Mecklenburg County Land Development Standards, whichever is more stringent. Supporting fence shall be steel hog wire fence as required by these standards. Posts shall be five (5) foot long steel posts only.

C. Protection of Existing Storm Drainage:

1. In addition to preventing and/or repairing any physical damage to existing storm drainage, the Contractor shall install silt filter bags, or use an approved erosion control device at existing catch basins to prevent sedimentation within said storm drainage. The Engineer may require the physical inspection of the storm drainage to determine the existence of sedimentation, which can be attributed to this construction and if existing, the Contractor will do all that which is necessary (flush, etc.) to return the storm drains to their original operating condition.

D. Superintendent and Crew Foreman Requirements:

1. In an effort to raise awareness of sediment and erosion control requirements and issues, it is the requirement of Charlotte Water that the Contractor's Superintendent and each crew foreman working on this contract must possess a current and valid Site Inspector Certification from the City of Charlotte/Mecklenburg County. This requirement applies to each crew foreman working for the prime contractor or any subcontractor that is performing construction activities on the project site. The contractor will submit a copy of each employee's certificate to the Engineer. The Superintendent's Certificate must be on file prior to Notice to Proceed. Each Foreman's Certificate must be on file within

30 days of Notice to Proceed. Ground disturbing activities will be prohibited until the requirements of this section are fulfilled.

2. The Site Inspector training course is offered through the Mecklenburg County Water Quality Program at 704-336-5500 and/or the City of Charlotte Land Development Division at 704-336.6692. Please request information on the Charlotte-Mecklenburg Certified Site Inspector (CMCSI) Certification Training Course. Each employee must complete the training class and successfully pass the Charlotte-Mecklenburg Certified Site Inspector (CMCSI) Certification Test. CMCSI Certificates are issued to those that pass the test and are valid for 2 years.

3.3 TREE AND PLANT PROTECTION

A. Protect all trees and plants as indicated on the plans and outside easement/rights-of-way.

B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations.

3.4 EXISTING UTILITIES

A. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others, unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Engineer and Owner not less than two days in advance of proposed utility interruptions.

2. Do not proceed with utility interruptions without Engineer's written permission.

3.5 CLEARING AND GRUBBING

A. The clearing work covered by this section consists of cutting, removing and properly disposing of vegetation and debris. Trees specifically identified on the plans to be preserved shall be adequately delineated and flagged by the Contractor, such that the balance of the work may be performed in a safe and harmless manner in the vicinity of preserved trees. Such tree preservation will be considered part of the work and shall be in conformance with applicable local codes and regulations. Clearing and grubbing shall be performed in areas as called for on the plans, the limits of which shall coincide with the construction limits.

B. The grubbing work covered by this section consists of removing and properly disposing of all surface vegetation and debris. Where the material being removed is high in organic matter content, such as root mat and other vegetative matter, it shall be considered vegetation and removed as part of the work of grubbing.

C. The work of clearing and grubbing shall also include the removal and satisfactory disposal of crops, weeds and other annual growth, fences, steps, walls, chimneys, column footings, other footings, foundation slabs, basements, other foundation components, signs, junked vehicles, and other rubble and debris, and the filling of holes and depressions. This work shall also be performed in all non-wooded areas within the construction limits, shown on the project plans upon which seeding and mulching, sprigging or sodding is to be performed.

D. As a part of the work of clearing and grubbing, the Contractor may be required to cut off and plug at the right of way or construction limits, as directed by the Engineer, any private water or sewer line intercepted during the construction of the project, as well as cut off and remove from the construction area any septic tank or portion thereof during the construction of the project.

E. Clearing and grubbing operations shall be completed sufficiently in advance of grading operations as may be necessary to prevent any of the debris from the clearing and grubbing operations from interfering with the excavation or pipe laying operations.

F. Where adjacent areas within the site but outside the limits of construction are disturbed as a result of clearing and grubbing activities, the Contractor shall remove all debris and restore to the original grades and equal or better condition.

G. The Contractor shall exercise caution to protect and maintain all existing utilities and underground works which are to remain. Any existing utilities or underground works which are to remain that are disturbed during construction shall be repaired as required by the utility owner and at the Contractor's expense.

H. The Contractor must comply with all local, state and federal laws, ordinances and regulations in the removal and disposal of clearing and grubbing of all vegetation, timber, waste and all surface debris that must be hauled from the Project Site. No burning of materials will be allowed on site. The Contractor shall properly dispose of all cleared materials at his expense, in conformance with all applicable local and state laws and ordinances with the exception of any materials to be reused or recycled as directed elsewhere in this contract.

I. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

    1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches (200 mm) and compact each layer to a density equal to adjacent original ground.

J. Unless otherwise specified, the entire permanent easement shall be cleared and all stumps, limbs and trash removed and disposed of at an approved location. When the sewer/water main line is installed in undeveloped/non-maintained areas (woods), stumps can be left flush with the ground if they are outside the trench excavation. Stumps must be removed from all maintained areas (yards, lawns, road rights-of-way, etc.).

K. Temporary construction easements shall be cleared unless otherwise noted in the Special Provisions or on the drawings. No clearing or grubbing may be performed in road rights-of-way without approval from Charlotte Water or Engineer. Additionally, no clearing or grubbing may be performed in road rights-of-way until the limits of clearing or grubbing have been approved by Charlotte Water or Engineer.

L. Useable timber and/or firewood may be left on adjoining property, off the permanent easement at the request of or with the consent of the property owner. Such requests must be in writing and must release Charlotte Water from any claims for improper disposal of timber.

M. The Contractor shall abide by all special conditions contained in the easement agreements for this project. When the easement agreement specifies stacking timber or firewood adjacent to the easement a written release is not required. The Contractor shall verify cut lengths of timber/firewood for such placement and location with the property owner.

N. At a minimum, fences removed during construction shall be replaced of the same material and to the same condition existing prior to the construction. If the removed fence was 12-foot or greater in width and did not have a gate installed, the Contractor shall install a gate when replacing the fence so as to maintain access across Charlotte Water easements.

O. The Contractor shall confine all his operations to the bounds as set forth in all easements unless prior written approval of the current property owner is obtained and submitted to the Engineer for their approval.

3.6 TOPSOIL STRIPPING

A. Stripping and Storage of Topsoil: All topsoil suitable for reuse, in the opinion of the Engineer, shall be stripped to its full depth, all topsoil to be moved shall be free of large stone, roots, brush, waste construction materials and other undesirable matter.

B. Topsoil stripping shall be accomplished from all topsoiled areas to be disturbed.

C. Existing lawn sods may be left to decompose with the topsoil. Heavier stands of weeds and grasses shall be removed as directed by the Engineer prior to the stripping operations.

D. The topsoil shall be kept separate from other excavated materials and stored in stockpiles, the location of which shall be as directed by the Engineer. Topsoil shall be stockpiled so that it shall not be subject to abnormal erosion and loss, and so that it does not impede the flow of drainage runoff. The directed locations of topsoil stockpiles will, when construction sequence permits, be located in areas that have previously been graded to design rough grade.

3.7 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off the easement.

B. Burning tree, shrub, and other vegetation waste is not permitted. Burning of other waste and debris is prohibited.

C. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

END OF SECTION

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CHAPTER 20
EXCAVATION AND BACKFILL

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EXCAVATION AND BACKFILL

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PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. General requirements for excavation, backfill, and compaction.

1.2 DEFINITIONS AND ABBREVIATIONS

A. See Sections iii and iv of the Charlotte Water Water and Sewer Design and Construction Standards for common abbreviations and definitions, in addition to the following listed herein.

B. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.

2. Final Backfill: Backfill placed over initial backfill to fill a trench.

C. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

D. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

E. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

F. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

G. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

H. Fill: Soil materials used to raise existing grades.

I. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that cannot be removed without drilling and blasting, wedging, sledging, cutting, or barring for its removal.

J. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

K. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

L. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

M. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.3 SUBMITTALS

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

1. Certification of compliance
2. Prior product acceptance test reports
3. Shipping tickets and purchase invoices

B. Product Certificates: Required for all products.

C. Qualification Data: For qualified testing agency.

D. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:

1. Classification according to ASTM D 2487.
2. Laboratory compaction curve according to ASTM D 698.

1.4 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall be responsible for the safe storage of materials furnished by or to them, and accepted by them and intended for the work, until they have been incorporated in the completed project. Handling and storage of all project materials are to be in compliance with the manufacturer's recommendations for handling and storage. The interior of all pipes, manholes and other accessories shall be kept free from dirt and foreign materials at all times.

B. Transportation of Materials and Equipment: The Contractor and their Suppliers are directed to contact the North Carolina Department of Transportation to verify axle load limits on State maintained roads (and bridges) which would be used for hauling of equipment and materials for this project. The Contractor and their Suppliers shall do all that is necessary to satisfy the Department of Transportation requirements and will be responsible for any damage to said roads which may be attributed to this project. All materials required to construct this project shall be furnished by the Contractor and shall be delivered and distributed at the site by the Contractor or their material supplier.

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

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

PART 2 - PRODUCTS

2.1 FILL MATERIALS

A. General: All fill material shall be non-plastic in nature and free of roots, vegetative mater, waste, construction material, rocks, organics, or other objectionable matter. Materials deemed unsuitable by the inspector shall be removed and replaced with suitable fill. Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Earth Backfill: Excavated earth material, finely divided and free of stones 3 inches or greater in any dimension to at least 3 feet above pipe top.

C. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487, Groups A-1, A-2-4, A-2-5, and A-3 according to AASHTO M 145, or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

D. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, Groups A-2-6, A-2-7, A-4, A-5, A-6, and A-7 according to AASHTO M 145, or a combination of these groups.

   1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

E. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940 with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

F. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 294; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.

G. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940 with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

H. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940 except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

I. Drainage Course: Narrowly graded mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and zero to 5 percent passing a No. 8 sieve.

J. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and zero to 5 percent passing a No. 4 sieve.

K. Sand: ASTM C 33 fine aggregate.

L. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

M. Granular Backfill:

   1. NCDOT Section 520, Type A aggregate.

N. Flowable Fill (Controlled Density Fill (C.D.F)):

1. Self-compacted, cementitious fill material consisting of cement, fly ash, fine aggregate and water. ASTM D 4832.
2. Strength: 50 psi minimum compressive strength at 28 days, and maximum compressive strength of 150 psi at 56 days.
3. Cement: Type I – Normal Portland type. Minimum 50 pounds per cubic yard.
4. Fly Ash: ASTM C618 Class F or C; loss on ignition less than 3 percent. No limit on quantity.
5. Fine Aggregate: ASTM C33 (normal weight aggregate). No limit on quantity.
6. Water: Potable; approximately 500 pounds per cubic yard.
7. Mix design to be reviewed by Engineer.

O. Subsoil:

1. Excavated and reused material. Local borrow material.
2. No on-site alluvial deposits or material containing organic matter.
3. Well-graded throughout to avoid lenses, pockets, streaks, or layers of material differing materially in texture or gradation.
4. Free of lumps larger than 3 inches, rocks larger than 2 inches, and debris.
5. Contains no more than 20 percent by weight passing No. 00 sieve.

P. Topsoil:

1. Excavated and reused material. Local borrow material.
2. Graded.
3. Free of roots, rocks larger than ½ inch, subsoil, debris, weeds, and foreign matter.
4. Contains no greater than 20 percent nor less than 5 percent organic matter.

Q. Class II Concrete:

1. Compressive Strength (7 Day): 2,800 psi.
2. Compressive Strength (28 Day): 3,600 psi.
3. Water/Cement Ratio (Maximum): 0.50 by weight.
4. Air Entrained: 6 percent, +- 1 percent.
5. Fly Ash Content: Maximum 25 percent of cement content.
6. Slump (Maximum): 4 inches (due to water).
7. Mid or High Range Water Reducer. Add at site to increase slump to 6 inches +- 1-1/2 inches.

R. Non-Shrink Grout: Pre-mixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 5,000 psi in 28 days; Master Builders Masterflow 713, or as approved.

PART 3 - EXECUTION

3.1 EXISTING UTILITIES

A. The Contractor will be required to excavate to determine the precise location of utilities, or other underground obstructions, which are shown on the Construction Plans. Such location and excavation shall be at least 1,000 feet ahead of construction or as noted in the project specific contract documents.

B. All utility owners will be notified prior to excavation as required by the 2013 Underground Damage Prevention Act, or most current edition, and all subsequent amendments to the Act. Owners who are members of NC811 / NC ONE-CALL may be notified in accordance with current NC811 / NC ONE-CALL procedures. Charlotte Water is a NC811 / NC ONE-CALL member. The Contractor will be fully responsible for damage to any utilities if the owners have not been properly notified as required by the Underground Damage Prevention Act.

C. Utility owners may, at their option, have representatives present to supervise excavation inthe vicinity of their utilities. The cost of such supervision, if any, shall be borne by the Contractor.

D. Conflicts with underground utilities may necessitate changes in alignment and/or grade of this construction. All such changes will be approved by the Engineer before construction proceeds.

E. When underground obstructions not shown on the Construction Plans are encountered, the Contractor shall promptly report the conflict to the Engineer.

F. Whenever a water or sewer main crosses under other utility lines (gas, telephone conduit, storm drain, etc.) there shall be 2 feet clearance between the top of the water/sewer and the bottom of the affected utility. In order to provide support to both utilities, stone bedding shall be used from 6-inches below the water/sewer to top of the other utility from one foot outside the utility trench. If this clearance is not possible, the sewer line shall be Ductile Iron Pipe from five foot outside the utility trench with a minimum length of 20 feet.

G. Whenever a water/sewer main crosses over other utility lines (water, storm drain, gas, encased or capped telephone conduit, etc.) the following will apply:

   1. For sewer lines - There shall be one foot clearance from the top of the utility to the bottom of the sewer. If this clearance is not possible the sewer line shall be ductile iron pipe from five (5) feet outside the utility trench with a minimum length of 20-feet. The DIP shall extend past the utility sufficient length to allow it to enter the trench box when installing next to the utility.

   2. In certain cases, Charlotte Water reserves the right to modify and require increased or decreased separations.

H. When the clearances listed in Section 3.1 cannot be met, minimum horizontal and vertical separations, in accordance with the most recent version of 15A NCAC O2T 0305, must be met at all times.

3.2 EXCAVATION, GENERAL

A. All excavations for pipe laying, manholes, piers, drainage ditches, grading and any other excavation required for the proper completion of this contract shall follow the requirements included herein.

B. Sloping of trench walls shall not be permitted in or adjacent to existing road rights-of-way. Shoring, shielding or trench boxes shall be required. Any over-excavation or void between the trench face and the shoring system shall be filled with granular material to maintain positive pressure on the soil face.

C. Tabulated data sheets shall be provided by the manufacturer of shoring and shielding systems used in cuts less than 20 feet deep. Tabulated data sheets shall be signed and sealed by a Professional Engineer and provided by the Contractor for Charlotte Water files. The Contractor is responsible for providing a Professional Engineer's approved trench design when the depth of cut exceeds 20 feet, as required by OSHA regulations. The Contractor will provide the trench designs/details (signed and sealed by a Professional Engineer registered in North Carolina) for Charlotte Water files.

D. Excavation within street rights-of-way shall be backfilled when left unattended for more than 1 hour unless otherwise approved by the controlling agency and the Engineer. If approved, un-backfilled excavations in street rights-of-way shall be barricaded and the excavation covered with structural steel plates. Excavations within sewer/water easements shall be backfilled, fenced or otherwise protected when left unattended for more than 1 hour. Fencing or other protection methods shall be designed to reasonably prevent people and large animals from entering the excavation.

E. Open Excavations: At a minimum, all requirements of the City of Charlotte Work Area Traffic Control Handbook (WATCH), and NCDOT requirements apply and must be followed depending on the jurisdiction having authority of the right-of-way. In addition, the following requirements apply:

   1. Unattended open excavations are prohibited, unless specifically approved by the Engineer. All excavations will be backfilled when unattended, unless 1-inch thick steel plates are placed on top of the excavation to completely seal off access to the trench. Steel plates must be recessed and flush with existing pavement. Interlocking concrete barriers are required at bore pits. Steel plates must be clearly marked to indicate project name, Contractor name, and contact information.

F. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be classified as earth and rock. Do not excavate rock until it has been classified and cross sectioned by Charlotte Water.

   1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; and soil, boulders, and other materials not classified as rock or unauthorized excavation.

      a. Intermittent drilling; blasting (if permitted); ram hammering; or ripping of material not classified as rock excavation is earth excavation.

   2. Rock excavation shall be defined as solid ledge rock that requires drilling and blasting, sledging, or barring for its removal. Soft, disintegrated rock that can be removed with a pick, track-hoe or hydraulic excavator and rock bucket shall not be classified as solid rock.

a. Boulders greater than one cubic yard in volume will also be considered rock excavation. Smaller boulders and soft rock which in the opinion of the Engineer can be excavated by the use of a track-hoe or hydraulic excavator and rock bucket, without undue delay, shall not be classified as rock.

b. Rock shall be removed to a minimum depth of six (6) inches below the pipe bell and to the trench widths specified for each size and type of pipe installed. Rock around structures shall be removed to the same twelve (12) inch minimum as measured between vertical planes around the structure, but only to a depth necessary to allow proper installation. Over excavation of rock, beyond that described above, due to removal methods, or for safety considerations, shall be the Contractor's responsibility.

c. When rock removal is necessary for pipeline installation either Type II or Type III bedding shall be installed as specified and directed by the Engineer.

d. All blasting shall be conducted in a manner as specified elsewhere in these Specifications.

G. Excavations at Edges of Tree- and Plant-Protection Zones:

1. Excavate by hand or with an air spade to indicated lines, cross sections, elevations, and subgrades. If excavating by hand, use narrow tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

2. Cut and protect roots according to requirements in Charlotte Water Standard Specifications.

3.3 EXCAVATION FOR UTILITY TRENCHES

A. Trench Excavation for Gravity Sewer Pipe: No more trench (50 LF) shall be opened in advance of the pipe laying than is necessary to expedite the work unless prior approval is given by the Engineer. No more trench (50 LF) shall remain open in the rear of the pipe laying than is necessary to expedite backfill and compaction processes unless prior approval is given by the Engineer. Backfill and compaction operations shall be an ongoing operation throughout the workday. Ground conditions and/or location requirements shall govern the amount of trench open at any one time as determined by the Engineer.

1. Trench Width: The maximum trench width shall be as indicated for each type of pipe specified. If the actual trench width exceeds the specified width, due to shoring methods, the contractor must obtain approval from the Engineer. Trench width shall be measured between faces of cut at the top of the pipe bell. If the Contractor varies from this requirement without prior approval of the Engineer, or if specified trench widths cannot be maintained, improved beddingand/or improved pipe material shall be installed as directed by the Engineer, and without additional compensation.

a. Pipe Size Diameter 4-inch to 16-inch: Maximum Trench Width equals nominal pipe size diameter plus 30 inches.

b. Pipe Size Diameter 18-inch to 30-inch: Maximum Trench Width equals nominal pipe size diameter plus 36 inches.

c. Pipe Size Diameter larger than 30-inch: Maximum Trench Width equals nominal pipe size diameter plus 42 inches.

d. Deviations to listed trench widths must be approved by the Engineer. Deviation from the maximum trench width will necessitate an increase in the stone bedding around the pipe and/or a change in the type or class of pipe being installed at the Contractor's expense.

2. Trench Bottom Conformation: The excavation shall be made to the elevations, grades, and lines shown on the Construction Plans unless otherwise approved by the Engineer. The trench bottom shall be excavated slightly above grade and cut down to the pipe grade by hand in the fine grading operation. The trench bottom shall be true and even with bell holes at each joint to provide the barrel of the pipe with soil and/or granular bedding (as applicable) support for its full length. This should prevent point loading at the bells. If the trench bottom is inadvertently cut below grade, the Contractor shall fill it to grade with approved granular bedding material and thoroughly tamped. Pipe depth and/or soil conditions may dictate a granular embedment as specified below. Such bedding shall also be shaped to allow adequate supportof the pipe along the full length of thebarrel.

3.4 EXCAVATION FOR STRUCTURES

A. The excavation shall be made to the lines, grades and elevations shown on the Plans and Standard Details. The area excavated shall be limited to no more than is necessary to allow the proper installation of the structure as determined by the Engineer. The excavation shall remain open no longer than is necessary to allow the proper and complete installation of the structure.

B. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch (25 mm). Do not disturb bottom of excavations intended as bearing surfaces.

3. Structure Pit Bottom Conformation: The pit bottom shall be true and even, and capable of supporting the structure as determined by the Engineer. If the pit bottom is inadvertently cut below grade, the Contractor shall fill it to the proper elevation with approved compacted granular material capable of continually maintaining adequate supportive strength.

3.5 EXCAVATION FOR BORE PITS

A. The excavation shall be controlled by the limits of the existing rights-of-way and easements and shall not exceed these without prior written approval of the current property owner. The excavation shall be made to the proper elevation, line and grade to install the casing pipe as shown on the construction plans. Sloping of the bore pit walls shall not be permitted within the road right-of-way, or directly adjacent to the road embankment. Shoring, shielding or bore pit box shall be required, unless approved by the controlling agency and the Engineer. Any over-excavation or void between the trench face

and the shoring system shall be filled with granular material to maintain positive pressure on the soil face. Bore pit excavations shall be protected with interlocking concrete traffic barrier walls to protect the work site and the public at large.

B. The pit bottom shall be true and even with adequate stabilization to maintain proper elevation and grade on the boring rig for the duration of the bore. The walls of the pit shall be shored to comply with OSHA requirements.

C. The bore pit shall not be left open overnight on roadways without specific approval from the agency having jurisdiction over the road right-of-way. If approval is obtained, concrete median barriers are required to be placed around the bore pit within the road right-of-way.

3.6 DEWATERING

A. The Contractor shall at all times provide and maintain ample means and equipment with which to remove and properly dispose of any and all water entering the excavation or other parts of the work and keep all excavations dry until such time as pipe laying and grading is completed and structures to be built therein are completed.

B. No water shall be allowed to rise around the pipe in unbackfilled trenches nor shall it be allowed to rise over masonry until the concrete or mortar has set (minimum 24 hours). All water pumped or drained from the work shall be disposed of in such a manner as to prevent siltation and erosion to adjacent property or other construction. Pre-treatment of dewatered ground water is required before discharge in accordance with NCDOT's Erosion and Sediment Control Design and Construction Manual, Section 3.7.

C. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

D. During any dewatering operations, signage and emergency contact information must be clearly visible where dewatering operations are taking place. Information to be indicated includes, at a minimum, name of project, Owner information, Contractor information, and 24/7 Contractor emergency contact information.

E. All dewatering activities shall be performed in compliance with provisions of Chapter 15, Offenses and Miscellaneous Provisions, of the Code of Ordinances for the City of Charlotte, NC.

3.7 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. All backfill shall be of a non-plastic nature free from roots, vegetative matter, waste, construction material, rock larger than 3/4 cubic foot, or other objectionable material. Small rock (less than 3/4 cubic foot) shall not exceed 10% of the fill material. Rock shall not be placed within 3-feet of the pipeline or within three feet of the finished grade. Rock larger than 3/4 cubic foot will not be permitted within the trench. No objectionable or unsuitable material will be allowed in the backfill. Backfill material shall be capable of being tamped

by mechanical tamps using relatively low velocity and heavy blows, sheepsfoot rollers or vibrating sheepsfoot rollers. The material shall have no tendency to flow or behave in a plastic manner under the tamping blows. Material deemed by the Engineer as unsuitable for backfill purposes shall be removed from the job site before backfilling operations begin.

D. When the Engineer determines that the material excavated from the trench is unsuitable for backfill because of the material type or because it contains excessive debris, rock or organics, it shall be removed from the project and replaced with a backfill material approved by the Engineer. When the moisture content of an otherwise suitable material is too high to achieve specified compaction, as determined by a moisture content and density test, the Contractor shall replace the material as necessary to meet backfill requirements. The wet material may be dried to optimum moisture content and used for backfill in subsequent phases of the project. Should an otherwise suitable material be found too dry to achieve compaction requirements, water may be added to the material to raise the moisture content to optimum.

E. Select backfill material and borrow material placed at the direction of the Engineer shall be as specified.

F. Backfill shall be accomplished immediately after the pipe is laid. In road rights-of-way, no more than fifty (50) feet of trench shall be open at any given period of time. In other easements, no more than two hundred fifty (250) feet of trench shall be open at any given period of time. Backfill of the trench shall commence immediately following pipe installation. This will be enforced in order to minimize the amount of open trench. Backfill and compaction activities will be continuous on-going operations. All excavations shall be completely backfilled at the end of each workday when construction is located adjacent to or within a road right-of-way. Backfill around pipe and to an elevation of one (1) foot above the pipe bell shall be done only by hand and in layers not exceeding six (6) inches with each and every layer thoroughly tamped. The first three (3) feet of fill shall be completely free of rocks. Successive layers of backfill shall be compacted in place as specified below.

G. Under no circumstances shall water be permitted to rise in unbackfilled trenches after the pipe has been placed. Should water rise in an unbackfilled ditch after the pipe has been placed, the Engineer may require the Contractor to remove the pipe, muck the trench and follow the procedure for either Type III or higher-class Granular Embedment when relaying the pipe.

   1. Backfill of trenches within utility rights-of-way: Trenches excavated outside existing roadway and railway right-of-way may be backfilled, above the initial one (1) foot, by mechanical means in layers up to twelve (12) inches thick unless otherwise directed by the Engineer.

   2. Backfill of trenches within road and railway rights-of-way: Trenches excavated within existing road and railway rights-of-way shall be backfilled in layers not to exceed six (6) inches and each successive layer shall be thoroughly tamped, as specified.

H. Backfill voids created by the removal of shoring and bracing with satisfactory soil.

I. Tracer Wire: Install tracer wire along pipe according to Charlotte Water Standard Details.

J. Warning Tape: Install warning tape directly above new piping 24 inches below finish grade. See Charlotte Water Standard Details for additional requirements.

3.8 COMPACTION

A. Compaction shall be attained by the use of mechanical tamps, sheepsfoot rollers or vibratory sheepsfoot rollers only. Each layer of backfill shall be placed loose and thoroughly compacted in place. Heavy rollers, vehicles or other equipment shall not be used for compacting pipeline and structure backfill nor allowed to cross over completed work except at points adjudged capable of adequately protecting the pipeline. Pneumatic tamps, gasoline ram type tamps, or vibrating tamps with sheepsfoot rollers will be required to meet the specifications of "Mechanical Tamp". Variances shall only be with the explicit approval of the Engineer.

1. Compaction Within Water or Sewer Easements: Trenches excavated outside existing road and railway rights-of-way shall be backfilled as hereinbefore specified and tamped thoroughly:

    a. All material shall have an in-place density of at least 85% of maximum dry density or as approved by the Engineer.

    b. Should any public or private roadways, service roads, drives, etc. be encountered during this construction, the Contractor shall comply with those compaction requirements specified below for work within road and railway rights-of-way.

2. Compaction Within Road and Railway Rights-of-Way: Unless otherwise approved by the controlling agencies, trenches excavated within existing road and railway rights-of-way and all structure excavation regardless of location shall be backfilled as hereinbefore specified and thoroughly tamped:

    a. Unless otherwise directed by the Engineer, all material from the bottom of trench to within twelve (12) inches of the subgrade shall have an in-place density of 95% of the maximum dry density as defined by a standard proctor curve for the material.

    b. All material within twelve (12) inches of the subgrade level shall have an in-place density of 100% of the maximum dry density.

    c. On roadway shoulders, all material shall have an in-place density of 95% of the maximum dry density. The Contractor shall remove and replace all material failing to meet these requirements with suitable material. The extent of this removal shall be determined by the Engineer.

B. Compaction Testing: Compaction testing is required and shall be performed by a third party. For developer donated projects, the developer's consultant engineer shall be responsible for providing soils compaction testing through a sub-contract with a Geotechnical/Materials testing company. Charlotte Water reserves the right to direct specific tests at specific locations and depths throughout the project. Based on the project type, roadway type, and the location of the excavation, the Soils Technician will be required to be on site only during actual backfill/compaction operations according to the following requirements:

North Carolina – DOT Right of Way	
Excavation Location	**Min. Testing Requirements**
Under existing or proposed pavement	2 hrs./day or 50% of backfill time
Outside of pavement but within 1:1 slope area	1.5 hrs./day or 40% of backfill time
Outside 1:1 slope area	1 hr./day or 30% of backfill time
In bore pits	At least 2 random location/depth tests
At structures or point excavations	At least 1 random location/depth test
In unstable soils or when directed by Charlotte Water	Full time testing as directed by Charlotte Water

Charlotte – DOT Right of Way or Private Roadways or Parking Lots	
Excavation Location	**Min. Testing Requirements**
Under existing or proposed pavement	2 hrs./day or 50% of backfill time
Outside of pavement but within 1:1 slope area	1 hr./day or 30% of backfill time
Outside 1:1 slope area	1 hr./day or 25% of backfill time
In bore pits	When required by Charlotte Water
At structures or point excavations	When required by Charlotte Water
In unstable soils or when directed by Charlotte Water	Full time testing as directed by Charlotte Water

Other Easements or Property	
Excavation Location	**Min. Testing Requirements**
Under existing or proposed pavement	1 hr./day or 40% of backfill time
Outside of pavement but within 1:1 slope area	1 hr./day or 20% of backfill time
Outside 1:1 slope area	1 hr./day or 10% of backfill time
In bore pits	When required by Charlotte Water
At structures or point excavations	When required by Charlotte Water
In unstable soils or when directed by Charlotte Water	As directed by Charlotte Water

Testing Depth Requirements		
Depth	**% of Total Project Tests**	
	Minimum	**Maximum**
At sub-grade	20%	50%
Top 1/3 of sewer trench	10%	75%
Mid 1/3 of sewer trench	10%	75%
Bottom 1/3 of sewer trench	10%	75%
Mid 1/3 of water trench	25%	75%

C. General Requirements: The Contractor shall be responsible for coordinating with the designated soils technician subcontractor to schedule soils testing in order to meet the Contractor's daily backfill and compaction schedule, and to meet location/depth/performance requirements as specified. Contractor is responsible for

adhering to any additional testing requirements by any and all agencies having jurisdiction over the work, including those agencies listed herein.

D. Should the soils technician sub-contractor not be on site during actual backfill/compaction operations to obtain any required tests, then the Contractor will excavate the backfilled trench to any required depths and at required random locations to permit testing to be completed at no additional cost.

E. Water and sewer main testing or activation will not be permitted until all in-place density requirements have been met. Any and all failing tests shall require corrective action by the Contractor, as necessary to obtain minimum soil density. Any and all failing tests shall require a corresponding retest, confirming passing results, after corrective actions by the Contractor.

F. The Contractor will be responsible for providing a safe work site necessary for Charlotte Water and/or soils technician sub-contractor to perform the tests in the excavation. The Contractor is responsible for insuring that the excavation complies with all OSHA safety standards before Charlotte Water and/or soils technician sub-contractor enters the excavation to perform the testing.

G. Records and Reports: Test report forms may include space for numerous tests at a project. The following minimum information shall be recorded and reported for each in place density test:

1. Project Data:
    a. Charlotte Water Project Name
    b. Charlotte Water Project Number
    c. Test Date
    d. Contractor’s Name,
    e. Inspector’s Name
    f. Foreman’s Name
    g. Soils Technician’s Name
2. Test Data:
    a. Location of Test/Re-Test, Elevation or Depth of Test, Wet Density (PCF), Dry Density (PCF), Moisture, Moisture (%), Proctor Number, Maximum Lab Density (PCF), Optimum Moisture, Percent Compaction, Tests Results (does/does not meet specifications), and any additional remarks.
    b. Proctor Test Reports: Proctor Test forms shall include required information according to ASTM D-698 or AASHTO T-99.
3. Distribution: Reports shall be distributed to the inspector and the contractor on site at the time of the field test. The original and copies of the standard proctor curves and supporting records shall be mailed and/or emailed (pdf version) by the testing firm to the Engineer as soon as all excavated trenches have met in-place density requirements.

END OF SECTION

CHAPTER 21
TUNNELING AND ENCASEMENT

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TUNNELING AND ENCASEMENT

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PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Miscellaneous Steel
2. Concrete
3. High Density Polyethylene (HDPE) Pipe

1.2 RELATED DOCUMENTS

A. All other requirements and provisions of the Charlotte Water, Water and Sewer Design and Construction Standards, apply to this section.

1.3 DEFINITIONS AND ABBREVIATIONS

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

1.4 SUBMITTALS

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

1. Product brochures
2. Catalog cut sheets
3. Shop drawings including dimensions and part/material lists
4. Certification of compliance
5. Prior product acceptance test reports
6. Reference contact data
7. Shipping tickets and purchase invoices

B. Provide product data for the following:

1. Miscellaneous Steel
2. Concrete
3. High Density Polyethylene (HDPE) Pipe

C. Shop Drawings

D. Product Certificates: Required for all products.

E. Qualification Data: For qualified testing agency.

F. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:

1. Classification according to ASTM D 2487.
2. Laboratory compaction curve according to ASTM D 698.

1.5 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall be responsible for the safe storage of materials furnished by or to them, and accepted by them and intended for the work, until they have been incorporated in the completed project. Handling and storage of all project materials are to comply with the manufacturer's recommendations for handling and storage. The interior of all pipes, manholes and other accessories shall be kept free from dirt and foreign materials at all times.

B. Transportation of Materials and Equipment: The Contractor and their Suppliers are directed to contact the North Carolina Department of Transportation to verify axle load limits on State maintained roads (and bridges) which would be used for hauling of equipment and materials for this project. The Contractor and their Suppliers shall do all that is necessary to satisfy the Department of Transportation requirements and will be responsible for any damage to said roads which may be attributed to this project. All materials required to construct this project shall be furnished by the Contractor and shall be delivered and distributed at the site by the Contractor or their material supplier.

C. Loading and Unloading Materials: All pipe and accessories shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Under no circumstances shall such materials be dropped. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground.

D. Responsibility for Materials on Site: In distributing the material at the site of the work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench. Each piece shall be redundantly chocked at each end to prevent movement or rolling. Pedestrian or vehicular traffic shall not be unduly inconvenienced in placing of material along the streets or right-of-way, as applicable.

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

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

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

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

1.6 QUALIFICATIONS

A. A Contractor performing boring and tunneling operations must have a “S(Boring and Tunneling” Classification as licensed by the North Carolina Board of General Contractors.

PART 2 - PRODUCTS

2.1 MISCELLANEOUS STEEL

A. Steel Encasement Pipe

1. Steel Encasement Pipe: Steel pipe shall be fully welded or seamless, smooth wall or spiralweld, consisting of Grade "B" steel as specified in ASTM A-139.
2. Minimum yield strength shall be 35,000 PSI; and pipe thickness shall be as specified for each individual job.
3. Pipe design shall be in accordance with AWWA M11 considering the following:
    a. Internal pressure
    b. External pressure
    c. Special physical loading
    d. Practical requirements
    e. Minimum wall thickness of 0.25 inch
4. All pipe shall be furnished with push-on joint pipe, or beveled ends prepared for field welding of circumferential joints. All burrs at pipe ends shall be removed.
5. Encasement pipe must be approved by the appropriate controlling agency (D.O.T., R.R., etc.) and the Engineer prior to ordering.
6. Permalok steel casing pipe may be used as an alternative steel casing pipe joining system. All steel used in the manufacture of Permalok steel pipe shall conform to the requirements of ASTM A-36, ASTM A515, grade 60 or ASTM A572, grade 42. All welding shall be performed by qualified welding operators in accordance with the requirements of ANSI/AWS D1.1. One reduced section tension test specimen shall be evaluated for each lot of 1000’ of each size and wall thickness and shall show a tensile strength not less than 95% of the minimum strength specified for the grade of steel used, unless waived by the purchaser. All Permalok pipe shall be clearly marked with the manufacturers’ name, manufacturer’s job number, customer name, O.D., wall thickness, and weight per foot.
7. Casing Spacers
    a. Bands: Casing spacer bands shall be made of High-Density Polyethylene (HDPE), UV resistant non-metallic virgin polypropylene, heavy duty two-piece #304 Stainless Steel (minimum 14 gauge), or fusion-bond epoxy coated Carbon Steel.
    b. Risers: HDPE, UV resistant non-metallic virgin polypropylene, #304 Stainless Steel, #10 gauge, or fusion-bond epoxy Carbon Steel.
    c. Liner: Ribbed PVC extrusion or Thermoplastic Rubber (TPR).

d. Runners: Integrally molded solid core, ultra-high molecular weight polymer, or glass reinforced plastic. All spacers shall have full length, integrally molded skids extending beyond the bell or mechanical joint of the carrier pipe.

e. Applicable Standards: The following standards apply as applicable: ASTM D-695, ASTM D-621, ASTM D-638, ASTM D-149/61, ASTM 149/64, ASTM B117.

f. Acceptable Manufacturers:

1) Raci Spacers of North America

2) CCI Pipeline Systems, LLC

3) BWM Company

4) Cascade Waterworks Mfg

5) Advance Products

6) Approved equal

8. End Seals

a. Provide one of the following end seals, as required by the project specific plans and construction documents:

1) Masonry Seals: Ensure drainage of encasement by leaving a 1-inch diameter weep hole in the seal of the lower end of the encasement. Clay or shale masonry shall meet the requirements of ASTM C62 Grade SW. Concrete brick masonry shall meet the requirements of ASTM C55 for Grade S-II, except that absorption of brick shall not exceed 10 lbs./cf. All masonry units shall be free from cracks and flaws with straight and parallel sides and square corners burned hard and true. Brick masonry mortar shall be Type S masonry cement meeting ASTM C270.

2) Watertight Rubber Seals: Provide wrap around or pull-on rubber end seals. Provide end seals by one of the following:

a) CCI Piping Systems, LLC

b) Garlock

c) Konex International

d) Approved equal

B. Structural Steel Tunnel Liner Plates

1. The tunnel liner plates shall be either the four (4) flange type (as approved for use within D.O.T. right-of-way) or the lap seam type (as approved for use within railroad right-of-way) fabricated to permit assembly of a continuous steel support system as the tunnel is excavated. Tunnel liner plates shall be fabricated from structural quality hot rolled, carbon steel sheets or plates conforming to the specifications of ASTM A-569.

The tunnel liner shall be designed in accordance with the requirements of Section 16- Division I and constructed to conform to Section 25-Division II of the current or interim AASHTO Standard Specifications for Highway Bridges.

Liner plates shall be galvanized in accordance with AASHTO M167 and fully bituminously coated in accordance with AASHTO M190. All hardware necessary to the tunneling operation shall be hot-dip galvanized in accordance with ASTM A-153 prior to bituminous coating application. Hardware shall conform to ASTM SpecificationA-307, Grade A.

The minimum mechanical properties of the flat steel plate before cold forming used forthe design of the tunnel liner shall be:

a. Minimum Tensile Strength of Liner Plates: 42,000 P.S.I.

b. Minimum Yield Strength of Liner Plates: 28,000 P.S.I.

c. Steel Liner Plates must be approved by the appropriate controlling agency (DOT, Railroad, etc.) and the Engineer prior to ordering. In case of conflict between design criteria of the appropriate controlling agency and Section 2.8.C of these technical specifications, the more stringent criteria of the requirements will apply. Gauge or thickness of liner plates will be as noted on the plans and elsewhere in these specifications.

d. Elongation, 2-inches = 30 percent

e. The moment of inertia shall be .042 inches to the 4th power per inch of width for four flange 12 gage liner plate.

C. Stainless Steel Straps and Anchors

1. Straps for concrete piers, inside drops, and outside drops: Stainless Steel ASTM A240 Type 304 or Type 304L.

2. Straps or painted carbon steel straps for vent pipes. Stainless Steel ASTM A240 Type 304 or Type 304L.

3. For stainless steel anchors, bolts, and washers (hardware): Stainless Steel ASTM A240 Type 316 or Type 316L.

4. Epoxy Adhesive Anchorage: Adhesive anchors shall consist of a two-component structural epoxy injection gel meeting the requirements of ASTM C881, stainless steel screen tubes of hollow base materials. Minimum adhesive anchor embedment shall be 4-inches (5-inches minimum for frame and cover) unless otherwise indicated. Provide epoxy adhesive anchors by Hilti Corporation HIT-HY 200, ITW Red Head A7+ Quick-Dure Adhesive, Powers Fasteners Pure 150-Pro Epoxy, or pre-approved equal.

a. Cartridge Injection Adhesive Anchors

1) Threaded steel rod inserts or reinforcing dowels, complete with nuts, washers, polymer or hybrid mortar adhesive injection system, and manufacturer’s installation instructions. Type and size as indicated on Drawings.

2) Interior and Exterior Use: As indicated on the Drawings, provide stainless steel anchors. Stainless steel anchors shall be AISI Type 316 stainless steel provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. All nuts shall conform to ASTM F594 unless

otherwise specified. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals.

3) When indicated on the project drawings, or specified by the Standard Details, deformed reinforcing dowels shall be A615 Grade 60.

b. Capsule Anchors

1) Threaded steel rod inserts and deformed reinforcing dowels with 45-degree chisel point, complete with nuts, washers, glass or foil capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, and manufacturer's installation instructions. Type and size as indicated on Drawings.

2) Interior and Exterior Use: As indicated on the Drawings, provide chisel-pointed stainless-steel anchors. Stainless steel anchors shall be AISI Type 316 stainless steel provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. All nuts shall conform to ASTM F594 unless otherwise specified. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals.

3) Deformed reinforcing dowels shall be A615 Grade 60, with 45-degree chisel-points at embedded end.

5. Anti-seize/anti galling lubricant: Apply anti-seize/anti-galling lubricant on all bolt and nut threads as recommended by manufacturer for each application. Install nuts and bolts on process piping using an anti-seize/anti-galling lubricant. Minimize seizing and galling by installing nuts at slow speeds to reduce friction heat and using clamps, not bolts, to pull joints together. If nut begins to bind before tightening the joint down, stop immediately. Wait a minute or two to allow any heat to dissipate and then back the fastener off. Inspect the threads for damage and remove any debris before proceeding with a new nut. Anti-seize/anti-galling lubricant shall be MRO Solutions LLC Solution 1000; Permatex Anti-Seize Lubricant, Finish Line Anti-seize Assembly Lube, USS Ultra Tef-Gel, Loctite Heavy Duty Anti-Seize, Loctite LB 771 by Henkel or pre-approved equal.

D. Steel Reinforcing For Concrete:

1. Bars: All reinforcement bars shall conform to the Standard Specifications for billet-steel bars for concrete reinforcement, ASTM A-615, or low alloy steel deformed and plain bars for concrete reinforcement, ASTM A-706. All bars shall be deformed and of structural Grade 60.

2. Wire: All reinforcement wire fabric shall conform to the Standard Specifications for welded steel wire fabric for concrete reinforcement, ASTM A-185 and steel wire, plain, for concrete reinforcement, ASTM A-82. Minimum yield strength shall be 65,000 PSI and minimum tensile strength shall be 75,000 psi.

E. Casing Vent Pipe

1. Vent Pipe: Unless otherwise specified, shall be located at each end of the casing pipe as shown on the Standard Details. The vent pipe shall be galvanized steel per ASTM A-53, Type E, Grade "B", Schedule 40.

2. All steel shall be Grade "B" only, with a minimum yield strength of 35,000 P.S.I.

3. Pipe design shall be in accordance with AWWA M11 considering the following:
    a. Internal pressure
    b. External pressure
    c. Special physical loading
    d. Practical requirements
    e. Minimum wall thickness of 0.25 inch
4. The steel pipe shall have an inside lining - minimum 20 mils dry film thickness of Induron Protecto 401, Tnemec Perma-Shield PL Series 431, or approved equal, or shall have fusion-bonded epoxy coating in accordance with AWWA C213. Surface preparation and supplication shall be as recommended by Induron or Tnemec. Lining applicator shall be an Induron or Tnemec approved certified applicator.
5. Outside surface of the pipe exterior coating shall be fusion-bonded epoxy coating in accordance with AWWA C213 as per Induron or Tnemec or approved equal. Surface preparation and application shall be as recommended by Induron or Tnemec or approved equal. The coating applicator shall be an Induron or Tnemec or approved equal certified applicator.
    a. Exterior coating shall be forest green or olive green, as approved by the Engineer.
6. Vent pipe shall be equipped with a screen to guard from insects, debris, and animals as indicated on the Standard Details. Screen shall be sized to fit and installed securely inside the hub or coupling of the vent pipe. Screen shall be constructed of 0.009” thick 316 stainless steel 18 x 18 mesh with 0.047” openings.

2.2 CONCRETE

A. Portland Cement: All concrete shall conform to the Standard Specifications for READY MIXED CONCRETE, ASTM C-94. An air-entraining admixture, conforming to ASTM C-260, shall be added to either Type II, or Type III Portland Cement. Fly Ash conforming to ASTM C-618 for Class F Fly Ash may be added to the concrete mix but shall not be considered as replacement for more than 25% of the cement therein (strengths shall not be less than hereinafter required). Type IL Portland-limestone cement, meeting ASTM C-595, shall be allowed in lieu of Type II Portland-cement.

1. Types III and IIIA Portland Cement shall only be used for manhole inverts, concrete encasement, concrete blocking, and/or as directed by the Engineer and shall conform to ASTM C-150.
2. Types II and IIA Portland Cement shall be used in precast manholes, cast in place structures, reinforced concrete piers and concrete as directed by the Engineer, and shall conform to ASTM C-150 except that Tricalcium Aluminate content shall not exceed 8%. Portland-limestone cement Type IL(MS), conforming to ASTM C-595, shall be allowed in lieu of Types II and IIA.

B. Aggregates: All aggregates used for concreting shall conform to ASTM C-33 and shall be checked daily for any variances in moisture content. Said variances shall be corrected and/or taken into consideration for each batch.

1. Coarse Aggregates: Shall be uniformly and evenly graded for each application in accordance with A.C.I. Standard 318. Unless otherwise approved, aggregate shall be sound, crushed, angular granitic stone. Flat or elongated aggregate or smooth round stones shall not be acceptable.

2. Fine Aggregates: Shall consist of natural sand, manufactured sand or a combination thereof. Fine aggregates shall conform to the sieve analysis as specified in paragraph 4.1 of ASTM C-33 except that the percent passing a No. 50 sieve shall not exceed 5% and the percent passing a No. 100 sieve shall be 0% as provided for in paragraph 4.2 of ASTM C-33.

C. Mix Design: Concrete shall be watertight, resistant to freeze-thaw cycles and moderate sulfate attack, abrasion resistant, workable, and/or finishable. These qualities may be met through the use of admixtures (if and only if approved in the mix design as hereinafter specified) conforming to the appropriate ASTM with the exception of the use of calcium chloride, which shall be limited to no more than 1% by cement weight - thoroughly mixed to insure uniform distribution within the mix. If the concrete is used with reinforcing steel, no calcium chloride will be allowed. The Contractor shall assume responsibility for concrete mixture. When required by the Engineer, and prior to beginning construction, the Contractor, at their expense, shall obtain from an approved commercial testing laboratory a design for a suitable concrete mix and submit same with their list of materials and material suppliers for approval. The concrete shall be proportioned to meet the following requirements: (Note: This mix does not apply "in total" to precast manhole or reinforced concrete pipe).

1. Compressive Strength: Minimum 3,600 psi
2. Water-Cement Ratio By Weight: Maximum 0.50
3. Slump: Minimum 3”, Maximum 5”
4. Superplastercizer Slump: 6” – 8”
5. Air Content (Entrained and Entrapped): Minimum 4%, Maximum 6%
6. Coarse Aggregate: ¾” - 1 ½” (as required by the application)

D. Curing Compound: All concrete curing compounds shall conform to the standard specifications for LIQUID MEMBRANE - FORMING COMPOUNDS FOR CURING CONCRETE, ASTM C-309, Type 2. Curing compounds shall be applied if forms are stripped when concrete is to remain exposed to atmosphere.

E. Grouts: All grouts shall be of a non-shrink nature (as may be achieved through additives or proportioning) and depending upon application range from plastic to flowable cement water paste. Testing as specified above for concrete may b e required for acceptance of grouts to include frequent checks for consistency by a time- of-flow measurement. Expansion grouts shall be either MasterFlow 648 epoxy grout by BASF, or 1428HP Grout by W.R. Meadows, or approved equal. Grouts shall be mixed (if applicable) and placed in accordance with the manufacturer's current recommendations, for each specific application. Expansion grouts shall be used only as directed by the Engineer. Acceptable range of testing requirements:

1. Compressive Strength: 10,500 psi to 12,500 psi.
2. Bond Strength: 1,350 psi to 1,700 psi.
3. Percent Expansion: + 0.025% to + 0.75%

F. Mortar: Mortar used in sanitary sewer manholes shall be hydraulic cement mortar in accordance with ASTM C-398. Mortar used in sewer manholes shall be Type M mortar in accordance with ASTM C-270.

G. Lightweight Cellular Concrete Fill: For Use In Annular Spaces Inside Casing Pipe And Tunneling Pipes.

1. Qualifications: The Contractor must be capable of developing a mix design, batching, mixing, handling, and placing cellular concrete. The Contractor shall be certified by the manufacturer of the foaming agent and regularly engaged in the production and placement of cellular concrete. The Contractor shall have fully qualified workers who are thoroughly trained and experienced in the production, placement and quality control of cellular concrete. Certificates verifying their qualifications and training will be required as part of the submittal for approval.

2. Conformance: Cellular concrete supplier must provide independent, third-party testing that confirms the proposed cellular concrete meets:

a. ASTM C495, Standard Test Method for Compressive Strength of Lightweight Insulating Concrete.

1) Slump: 10” to 11”
2) Air Content: 75%
3) Unit Weight: 28 - 35 PCF
4) Design Compressive Strength of 150 psi at 28 days or 80 psi at 56 days.

b. ASTM C666, modified Procedure B as per ACI 523.1 - Standard for freeze thaw cycles with relative dynamic modulus of elasticity (E) not less than 70% of its original value after 120 cycles.

3. Materials: Blast furnace slag shall conform to ASTM C 989. The percentage of blast furnace slag, if used, shall range from 20% to 30% depending on application. Fly ash, if utilized, must conform to ASTM C 618.

4. Foaming agents shall conform to the requirements of ASTM C 869 when tested in accordance with the provisions of ASTM C 796.

H. Flowable/Excavatable Fill (CLSM): Contractor shall furnish and place flowable fill i.e. controlled low strength (CLSM) backfill where shown in the drawings.

1. Cement: All cement used shall be Type II Portland cement which shall conform to the requirements of ASTM C150.

2. Fly Ash: ASTM C618, Class F.

3. Aggregates: Fine aggregate shall conform to the grading and quality requirements of ASTM C33. Coarse aggregate shall conform to the grading and quality requirements of ASTM C33 for size No. 476, No. 57, or No. 67.

4. Water: The batch mixing water and mixer washout water shall conform to the requirements of ASTM C94.

5. Flowable Fill Properties:

a. CLSM shall have a maximum fifty-six (56) day compressive strength of one hundred and fifty (150) psi when molded and cured as in conformance with ASTM D4832.

b. CLSM shall have a minimum cement content of fifty (50) pounds per cubic yard. The water-cementitious materials ratio of the mix shall not exceed three and one-half to one (3.5:1).

c. CLSM shall be air entrained to a total air content of approximately five percent (5%).

d. The minimum slump shall be six (6) inches and the maximum slump shall be eight (8) inches when tested in accordance with ASTM D6103.

e. Fine aggregate shall be between fifty percent (50%) and sixty percent (60%) by volume of the total aggregates in the CLSM mix.

f. The consistency of the CLSM slurry shall be such that the material flows easily into all openings between the pipe and the lower portion of the trench. When trenches are on a steep slope, a stiffer mix of slurry may be required to prevent excavatable flowable fill from flowing down the trench. When a stiffer mix is used, vibration shall be performed to ensure that the excavatable flowable fill slurry completely fills all spaces between the pipe and the lower portion of the trench.

2.3 HIGH DENSITY POLYETHYLENE (HDPE) PIPE

A. HDPE pipe, for open cut casing applications, 8-inch thru 30-inch in diameter shall be manufactured in accordance with AWWA C906 and ASTM F714. Polyethylene pipe shall be OD based Iron Pipe Size – IPS and Dimension Ratio (DR) 9.

B. Product Standard: AWWA C906 and ASTM F714.

C. Pipe Compound: PE 4710 resin conforming to ASTM D3350 with cell classification 445574C/E.

D. Pipe markings shall be as required by AWWA C906. Product markings shall be at intervals of not more than 5 feet. The minimum pipe markings shall be as follows:
1. Manufacture’s Name or Trademark and product record.
2. Nominal pipe size.
3. IPS
4. Dimension Ratio (“DR 9”) and pressure class.
5. AWWA C906.
6. Seal of testing agency that verified the suitability of the pipe.
7. Resin type/material code.
8. ASTM standard
9. Production date.
10. Color Identification requirements:
    a. Sewer: HDPE pipe shall be identified by a green stripe on exterior. Striping material shall be the same as the piping material.
    b. Water: HDPE pipe shall be identified by a blue stripe on exterior. Striping material shall be the same as the piping material.

E. Manufacturers: Performance Pipe, GF Piping Systems, JM Eagle, Driscoplex, WL Plastics or approved equal.

PART 3 - EXECUTION

3.1 TUNNELING OPERATIONS USING STRUCTURAL STEEL LINER PLATES

A. All plates shall be formed to provide circumferential flanged joints. Longitudinal joints may be flanged or offset lap seam type. All plates shall be punched for bolting on both longitudinal and circumferential seam or joints. Bolt spacing in circumferential flanges shall be in accordance with the manufacturer's standard spacing and shall be multiples of the plate length so that plates having the same curvature shall be interchangeable to permit staggering of the longitudinal seam. Bolt spacing at flanged longitudinal seams shall be in accordance with the manufacturer's standard spacing. For lapped longitudinal seams, bolt size and spacing shall be in accordance with the manufacturer's standard but not less than that required to meet the longitudinal seam strength requirements of the design specifications. All liner plates for the full length of a specified tunnel shall be either the flanged or the lapped seam type. The two types shall not be mixed in the same tunnel.

B. Liner plates shall be assembled in accordance with the manufacturer's instructions. Galvanized and coated plates shall be handled in such a manner as to prevent bruising, scaling, or breaking of the coating. Any plates that are damaged during handling or placing shall be replaced, except that small areas with minor damage may be repaired to the satisfaction of the Construction Engineer or their representative.

C. Galvanized surfaces shall be repaired by thoroughly wire brushing the damaged areas and removing all loose cracked coating, after which the cleaned areas shall be painted with two (2) coats of zinc rich paint as approved, and an acceptable bituminous coating restored.

D. When tunneling has proceeded a distance sufficient for placing one section of the tunnel liner, that section of liner will be placed before excavating further. Excavation shall be controlled so that the space outside the liner plate shall be held to a minimum of 2-inches. All voids between the liner plate and the tunnel wall shall be filled with 1:3 Portland cement grout, containing no more water than necessary, placed under sufficient pressure to fill all voids. Grout shall be placed through the grout holes provided in the top of the tunnel liner plates. Grout holes 2-inch in diameter shall be provided at no more than 4.5-foot centers or every third ring of plates to permit grouting as the erection of the tunnel liner progresses. At no time will the grouting operations be further than 10' from the front end or head of the tunnel construction.

E. At the end of each day's operations, the voids outside installed liner plates shall be grouted whether 10' or less. Grout will be forced into each grout hole. If the grout from one hole should flow along the liner plates so as to plug the next hole, the plug shall be opened by punching through the grout so that each hole may be used for grouting. The grouting operation will be continued at each hole until all spaces outside the liner plates are filled and no grout will flow.

F. The tunnel shall be constructed to the limits, grade and alignment shown on the Construction Plans. Excavation, without the use of jetting, shall be done in such a manner as to protect public and/or private property from damage. Prior to beginning any construction, the Contractor shall submit pit shoring and tunnel liner details for approval, and no tunneling may begin prior to approval of these details by the appropriate Controlling Agency. After approval of tunnel liner and pit shoring details, a five (5) day notice to the Controlling Agency, through the Construction Engineer, shall be provided as previously specified.

G. No blasting will be done without prior written approval of Charlotte Water and then only in strict accordance with all Federal, State, and Local laws, ordinances, rules, or regulations governing the storage and use of explosives.

H. The charges for the initial series of blasts should be placed in the triangle method. The second series should be placed in the radial method a minimum distance from the desired diameter of the tunnel. The triangular charges shall be set to go off first, with the radial charges to go off following a short interval or using the time-lag method.

I. Where rock is encountered before approaching the shoulder or pavement, the first four series of charges will be used in determining the amount of controlled blasting to be used before beginning any blasting beneath the railway or shoulders or pavement of the highway as applicable. If rock is encountered after tunneling progresses beneath the pavement or railway, the charges will initially be set at very low levels and increased in small increments until the proper amount of charge is determined.

J. In no case will an overshoot be permitted. If a boulder is encountered and removed by blasting or by other methods, a bulkhead will be formed immediately after removal of the boulder and the area filled with grout before proceeding with the tunneling operations.

K. If there is any indication of a vertical split in the rock formation, or any indication of settlement of the roadway or railway fill, all operations shall be stopped, and the Controlling Agency notified immediately. If the vertical split is not determined to be of too great a magnitude or too close to the rails/pavement, the split shall be filled with grout at a pressure specified by the Controlling Agency, allowed to set and tunneling operations may be continued.

L. If it is determined that the vertical split is too great of a magnitude or too close to the pavement or railway, the Controlling Agency shall determine the method to be used to correct the split. If settlement of the roadway or railway occurs, the Controlling Agency will advise the Owner and their Contractor of the proper steps to be taken to correct the settlement. If deemed necessary by the Controlling Agency, adequate warning devices (signs, flashers, etc.) accompanied by responsible flagmen shall be placed at a distance allowing any and all traffic time to stop safely before reaching the questionable area. At the option of the Controlling Agency, it may provide the necessary flagmen, warning devices, etc., at the Contractor's expense. Traffic shall be allowed over the questionable area only as directed by the Controlling Agency.

M. The Controlling Agency shall have full authority to inspect entire tunnel operation, require disposition of remedial measures, and to stop all work if, in its opinion, the work will cause any damage to the roadway/railway section or endanger traffic. In all instances the Controlling Agencies reserve the right to sample, test, and approve all materials used.

N. The completed liner shall consist of a series of structural steel liner plates assembled with staggered longitudinal joints. Liner plates shall have been fabricated to fit the cross section of the tunnel. All plates shall be connected by bolts on both longitudinal and circumferential seams or joints.

O. After tunneling operations have been completed the Contractor will install the carrier pipe in a manner approved by the Engineer. Cellular grout (maximum compressive strength less than 150 psi) or excavatable fill (maximum compressive strength less than 150 psi) will then be placed after completing installation of the pipe within the tunnel liner as directed by the Engineer and end enclosure walls installed as shown on the Construction Plans or Standard Details. Ends of the tunnel liner will be sealed with a twelve-inch (12”) masonry wall on each end. Weep holes will be provided on the downstream end for drainage - See

Standard Detail #18. The Contractor shall then remove the vertical shoring for pits (if ground conditions allow), surplus spoils, and material from the site. If ground conditions prevent the safe removal of the pit shoring, as determined by the pit design engineer or the Controlling Agency, the shoring shall remain in place. The top of the shoring shall be removed to a distance 2-feet below finish grade.

P. The site shall then be returned to its original condition, seeded, mulched, or restored as specified and left in a neat and satisfactory condition. Shoring material shall be removed in such a manner so as to avoid collapse and to allow proper backfill. The backfill shall be placed in accordance with these Specifications or the requirements of the Controlling Agency.

Q. The Contractor shall notify the Controlling Agency through the Engineer and acknowledgement shall be received a minimum of five (5) working days prior to beginning any work within roadway or railway rights-of-way. If required, 24-hours notice will be given prior to completion to allow the controlling agency to inspect the installation prior to backfill operations.

R. The Contractor will notify Charlotte Water, in writing, upon completion of the tunnel liner installation. Notification of completion of the tunnel operation will then be forwarded to the Controlling Agency. When the Controlling Agency is NCDOT, the Engineer will notify the Division Engineer, in writing, by letter with a copy to the attention of the State Design Services Engineer, North Carolina Department of Transportation, Division of Highways, Raleigh, North Carolina 27611.

S. The Contractor shall reimburse Charlotte Water and Charlotte Water shall reimburse the Division of Highways, or other Controlling Agency, should any settlement or damage result to the roadway within a period of one (1) year after completion of the tunneling operations.

3.2 DRY BORE WITHOUT STEEL ENCASEMENT

A. Bore Pits (or Tunnel Pits): Bore or tunnel pits shall be made safe, shored, well-marked, lighted, and not left unattended except as approved by the controlling agency. Requirements for stabilization and dewatering of bore pits shall be as specified in Sections 3.6 and 3.7 herein. The angle of repose method (sloping pit walls) for creating a safe working area shall not be used.

B. Installation: Continuous checks shall be made as to the elevation, grade and alignment of each successive section of encasement as well as the tracks (rails) upon which the boring rig travels.

C. Boring operations shall be continuous to their completion, and unnecessary or prolonged stoppages shall not be allowed.

D. In the event an obstruction is encountered during the boring and jacking operations, the auger is to be withdrawn and the bored hole stabilized before reapplying to the Controlling Agency for permission to open cut, bore at an alternate location, or install a tunnel.

E. Installation shall be to the limits specified by the Controlling Agency and/or as delineated in their encroachment issued to the City. (Copy of the encroachment agreement must be kept at the site throughout boring operations).

F. The Controlling Agency shall have full authority to require remedial measures and/or to stop all work if, in its opinion, said work will cause any damage to the roadway/railway section or endanger traffic. In all instances the Controlling Agencies reserve the right to sample, test, and approve all materials and methods used.

G. The Contractor shall notify the Controlling Agency through the Construction Engineer and acknowledgement shall be received a minimum of five (5) working days prior to beginning any work within roadway or railway rights-of-way. If required, 24-hours notice will be given prior to completion.

3.3 DRY BORE WITH STEEL ENCASEMENT

A. Bore Pits (or Tunnel Pits): Bore or tunnel pits shall be made safe, shored, well-marked, lighted, and not left unattended except as approved by the controlling agency. Requirements for stabilization and dewatering of bore pits shall be as specified in Sections 3.6 and 3.7 herein. The angle of repose method (sloping pit walls) for creating a safe working area shall be prohibited.

B. Pits adjacent to roadways shall be protected using interlocking precast concrete traffic barrier walls. Subject to approval of the Engineer, pits protected by existing traffic barrier walls or steel guardrails may not require temporary concrete traffic barrier walls.

C. Pits within the 1:1 slope distance from the edge of pavement, or greater than 20 in depth, or when required by the Engineer or the Controlling Agency shall be designed by a geotechnical/structural Professional Engineer. The Contractor shall be responsible for providing a pit design and details signed and sealed by a Professional Engineer licensed in North Carolina, and subject to approval of the Controlling Agency.

D. The pits and shoring shall be removed (if ground conditions allow) at the conclusion of construction. If ground conditions prevent the safe removal of the pit shoring, as determined by the pit design engineer or the Controlling Agency, the shoring shall remain in place. The top of the shoring shall be removed to a distance 2-feet below finish grade.

E. Installation: Smooth wall or spiral weld steel pipe may be jacked through dry bores slightly larger than the pipe, bored progressively ahead of the leading edge of the advancing pipe as spoil is mucked by the auger back through the pipe. As the dry boring operation progresses, each new section of encasement pipe shall be fully and completely butt-welded to the section previously jacked into place. Continuous checks shall be made as to the elevation, grade and alignment of each successive section of encasement as well as the tracks (rails) upon which the boring rig travels.

1. Steel encasement pipe shall have minimum thickness as provided below as specified by the controlling agencies. The actual thickness required must be calculated based on site conditions and actual depth of cover.

PIPE DIMENSIONS, INCHES PIPE TYPE - STEEL STANDARD - ASTM A 53 AND A 139				
Carrier Pipe Size (inches)	Casing Pipe Minimum Thickness (inches)			Minimum Tunnel Size (inches)
	Casing Pipe Size (inches)	NCDOT	Rail Roads	
4	12	0.250	0.250	36
6	12	0.250	0.250	36
8	18	0.250	0.312	48
10	20	0.250	0.344	48
12	24	0.250	0.375	48
16	30	0.312	0.469	48
18	30	0.312	0.469	48
24	36	0.375	0.532	54
30	48	0.500	0.750	60
36	54	0.500	0.781	72
42	60	0.500	0.844	84
48	66	0.625	0.938	90
54	72	0.625	1.000	96

F. If voids are encountered or occur outside the encasement pipe, grout holes shall be installed in the top section of the encasement pipe at ten (10) foot centers and the voids filled with Portland Cement grout at sufficient pressure to prevent settlement in the roadway/railway. The water-cementitious materials ratio of the mix shall not exceed three and one-half to one (3.5:1).

G. Boring operations shall be continuous, around the clock, to their completion, and unnecessary or prolonged stoppages shall not be allowed.

H. In the event an obstruction is encountered during the boring and jacking operations, the auger is to be withdrawn and the excess pipe is to be cut off, capped, and filled with 1:3 Portland Cement Grout at sufficient pressure to fill all voids before reapplying to the

Controlling Agency for permission to open cut, bore at an alternate location, or install a tunnel.

I. Installation shall be to the limits specified by the Controlling Agency and/or as delineated in their encroachment issued to the City. (Copy of the encroachment agreement must be kept at the site throughout boring operations).

J. The completed casing installation shall be such as to prevent the formation of a waterway under the road or railbed. Ends of the casing shall be sealed with eight-inch (8") solid brick masonry walls. Weep holes will be provided on the downstream end for drainage. Ends of casing may also be sealed with synthetic rubber end seals.

K. The Controlling Agency shall have full authority to require remedial measures and/or to stop all work if, in its opinion, said work will cause any damage to the roadway/railway section or endanger traffic. In all instances the Controlling Agencies reserve the right to sample, test, and approve all materials and methods used.

L. The Contractor shall notify the Controlling Agency through the Engineer and acknowledgement shall be received a minimum of five (5) working days prior to beginning any work within roadway or railway rights-of-way. If required, 24-hours notice will be given prior to completion to allow the controlling agency to inspect the installation prior to backfill operations.

M. Casing Spacers/Isolators: Upon completion of the installation of the steel casing pipe, casing spacers/isolators shall be installed on any carrier pipe passing through the steel casing pipe. They shall be designed to support the weight of the carrier pipe filled with water and to protect the carrier pipe and electrically isolate the carrier pipe from the casing. Casing spacers shall be installed at each end of the pipe, within 2 feet of the joint, and at intervals not greater than seven (7) feet, as determined by the spacer manufacturer, based on pipe diameter and loads.

3.4 STEEL CASING INSTALLATION BY TUNNEL AND JACK METHOD

A. The Contractor will provide all materials equipment and labor necessary to guarantee the complete installation of a steel casing as shown on the construction plans. The Contractor will provide an installation method acceptable to the Controlling Agency based on the conditions encountered. The Contractor shall be responsible for determining the site conditions based on his own investigations prior to construction. See Dry Bore With Steel Encasement – Bore Pits, above, for pit requirements.

B. The casing shall be installed by jacking, with simultaneous removal of spoil. The spoil removal shall not proceed more than 18-inches ahead of the casing. The diameter of the excavated hole shall be no larger than necessary to keep the casing moving freely and lubricant may be used to reduce the jacking forces. Casing sections shall be joined by full and complete butt welds. The butt weld shall be watertight and shall develop 100 percent of the strength of the steel pipe wall. Permalok steel casing pipe may be used as an alternative steel casing pipe joining system.

C. The completed casing installation shall be such as to prevent the formation of a waterway under the road or railbed. Ends of the casing shall be sealed with eight-inch (8-inch) solid brick masonry walls. Weep holes will be provided on the downstream end for drainage. Ends of casing may also be sealed with synthetic rubber end seals - See Standard Details.

D. The Controlling Agency shall have full authority to inspect entire operation, require disposition of remedial measures, and to stop all work if, in its opinion, the work will cause any damage to the roadway/railway section or endanger traffic.

E. The Contractor shall notify the Controlling Agency through the Engineer and acknowledgement shall be received a minimum of five (5) working days prior to beginning any work within roadway or railway rights-of-way. If required, 24-hours notice will be given prior to completion to allow the controlling agency to inspect the installation prior to backfill operations.

F. After the casing is jacked in place, 2-inch grout holes shall be used to pump a 1:3 Portland cement grout to fill the void outside the casing. Sufficient pressure should be applied to force grout out of the adjacent grout hole. Grout holes shall be a maximum of ten feet apart at the top of the casing.

The casing size and thickness shall be as shown on the Plans or Special Provisions.

G. Casing Spacers/Isolators: Upon completion of the installation of the steel casing pipe, casing spacers/isolators shall be installed on any carrier pipe passing through the steel casing pipe. They shall be designed to support the weight of the carrier pipe filled with water and to protect the carrier pipe and electrically isolate the carrier pipe from the casing. Casing spacers shall be installed at each end of the pipe, within 2 feet of the joint, and at intervals not greater than 7 feet, as determined by the spacer manufacturer, based on pipe diameter and loads.

H. Casing End Seals: The ends of the casing pipe shall be sealed with synthetic rubber casing end seals or solid brick masonry walls, as specified, as shown on the Standard Details, and as approved by the Controlling Agency.

3.5 STEEL ENCASEMENT

A. Casing installation within NCDOT Rights-of-Way shall conform to provisions of approved utility encroachment agreements for the project. Unless specifically indicated otherwise by the encroachment agreement, the annular void between carrier pipes and casing pipes 24 inches in diameter or larger shall be pumped with flowable fill; grout; or Class III, Class IV or Class V select materials in accordance with NCDOT Standard Specifications for Roads and Structures Section 1540 Encasement 1540-3 (E).

B. Interpretation of soil investigation reports and data, investigating the site and determination of the site soil conditions prior to bidding is the sole responsibility of the Contractor. Any subsurface investigation by the Bidder or Contractor must be approved by the appropriate authority having jurisdiction over the site. Rock and/or water, if encountered, shall not entitle the Contractor to additional compensation.

C. Casing construction shall be performed so as not to interfere with, interrupt or endanger roadway surface and activity thereon, and minimize subsidence of the surface, structures, and utilities above and in the vicinity of the casing. Support the ground continuously in a manner that will prevent loss of ground and keep the perimeters and face of the casing, passages and shafts stable. The Contractor shall be responsible for all settlement resulting from casing operations and shall repair and restore damaged property to its original or better condition at no cost To Charlotte Water.

D. Face Protection: The face of the excavation shall be protected from the collapse of the soil into the casing.

E. Casing Design: Design of the bore pit and required bearing to resist jacking forces is the responsibility of the Contractor. The excavation method selected shall be compatible with expected ground conditions. The lengths of the casing shown on the Drawings are the minimum lengths required. The length of the casing may be extended for the convenience of the Contractor, at no additional cost to Charlotte Water.

F. Groundwater Control

1. See requirements for Dewatering in the Excavation and Backfill specifications of the Charlotte Water, Water and Sewer Design and Construction Standards.

2. The Contractor shall control the groundwater throughout the construction of the casing.

3. Methods of dewatering shall be at the option and responsibility of the Contractor. Maintain close observation to detect settlement or displacement of surface facilities due to dewatering. Should settlement or displacement be detected, notify the Engineer immediately and take such action as necessary to maintain safe conditions and prevent damage.

4. When water is encountered, provide and maintain a dewatering system of sufficient capacity to remove water on a 24-hour basis keeping excavations free of water until the backfill operation is in progress. Dewatering shall be performed in such a manner that removal of soil particles is held to a minimum.

G. Safety

1. Provide all necessary bracing, bulkheads and shields to ensure complete safety to all traffic, persons and property at all times during the work. Perform the work in such a manner as to not permanently damage the roadbed or interfere with normal traffic over it.

2. Observe all applicable requirements of the regulations of the authorities having jurisdiction over this site. Conduct the operations in such a manner that all work will be performed below the level of the roadbed.

3. Perform all activities in accordance with the Occupational Safety and Health Act of 1970 (PL-596), as amended, applicable regulations of the Federal Government, OSHA 29CFR 1926.650, 29CFR 1926.651, 29CFR 1926.652, and 29CFR 1926.800, and applicable criteria of ANSI A10.16 (latest edition), "Safety Requirements for Tunnels, Shafts, and Caissons".

H. Boring and Jacking

1. Bore Pits and Receiving Pits

a. Conduct boring and jacking operations from a pit excavated at one end of the section to be bored. Where conditions and accessibility are suitable, place the pit on the downstream end of the bore.

b. The pit shall be rectangular and excavated to a width and length required for ample working space.

c. The walls of the pit shall be properly shored on all sides in compliance with OSHA requirements. Pit sheeting shall be timber or steel piling of ample strength to safely withstand all structural loadings of whatever nature due to site and soil conditions. Keep preparations dry during all operations. Perform pumping operations as necessary.

d. The bottom of the pit shall be firm and unyielding to form an adequate foundation upon which to work. In the event the pit bottom is not stable, excavate to such additional depth as required and place a gravel sub-base or a concrete sub-base if directed by the Engineer due to soil conditions.

2. Jacking Rails and Frame

a. Set jacking rails to proper line and grade within the pit. Secure rails in place to prevent settlement or movement during operations. The jacking rails shall cradle and hold the casing pipe on true line and grade during the progress of installing the casing.

b. Place backing between the heels of jacking rails and the rear of the pit. The backing shall be adequate to withstand all jacking forces and loads.

c. The jacking frame shall be of adequate design for the magnitude of the job. Apply thrust to the end of the pipe in such a manner to impart a uniformly balanced load to the pipe barrel without damaging the joint ends of the pipe.

3. Boring and jacking of casing pipes shall be accomplished by the dry auger boring method without jetting, sluicing or wet-boring.

4. Auger the hole and jack the casing through the soil simultaneously.

5. Bored installations shall have a bored-hole diameter essentially the same as the outside diameter of the casing pipe to be installed.

6. Execute boring ahead of the casing pipe with extreme care, commensurate with the rate of casing pipe penetration. Boring may proceed slightly in advance of the penetrating pipe and shall be made in such a manner to prevent any voids in the earth around the outside perimeter of the pipe. Make all investigations and determine if the soil conditions are such as to require the use of a shield.

7. As the casing is installed, check the horizontal and vertical alignment frequently. Make corrections prior to continuing operation. For casing pipe installations over 100 feet in length, the auger shall be removed, and the alignment and grade checked at minimum intervals not greater than 60 feet.

8. Any casing pipe damaged in jacking operations shall be repaired, if approved by the Engineer, or removed and replaced at Contractor's own expense.

9. Lengths of casing pipe, as long as practical, shall be used except as restricted otherwise. Joints between casing pipe sections shall be Permalok® joints or full circumference butt joints with complete joint penetration, single groove welds, for the entire joint circumference, in accordance with the American Welding Society (AWS) recommended procedures. Prior to welding the joints, the Contractor shall ensure that both ends of the casing sections being welded are square.

10. The Contractor shall prepare a contingency plan allowing the use of a casing lubricant, such as bentonite, in the event excessive frictional forces jeopardize the successful completion of the casing installation.

11. Once the jacking procedure has begun, it should be continued without stopping until completed, subject to weather and conditions beyond the control of the Contractor.

12. Care shall be taken to ensure that casing pipe installed by boring and jacking method will be at the proper alignment and grade.

13. The Contractor shall maintain and operate pumps and other necessary drainage system equipment to keep work dewatered at all times.

14. Adequate sheeting, shoring and bracing for embankments, operating pits and other appurtenances shall be placed and maintained to ensure that work proceeds safely and expeditiously. Upon completion of the required work, the sheeting, shoring and bracing shall be left in place, cut off or removed, as designated by the Engineer.

15. All surplus material shall be removed from the right-of-way and the excavation finished flush with the surrounding ground.

16. Grout backfill shall be used for unused holes or abandoned pipes.

I. Ventilation and Air Quality: Provide, operate and maintain for the duration of casing project a ventilation system to meet safety and OSHA requirements.

J. Installation of Pipe

1. After construction of the casing is complete, and has been accepted by the Engineer, install the pipeline in accordance with the Drawings and Specifications.

2. Check the alignment and grade of the casing and prepare a plan to set the pipe at proper alignment, grade and elevation, without any sags or high spots.

3. The pipe shall be supported within the casing by use of casing spacers sized to limit radial movement to a maximum of 1-inch. Provide a minimum of three (3) casing spacers per nominal length of pipe. Casing spacers shall be attached to the pipe at maximum seven (7) foot intervals. Casing spacers shall also be provided within two feet of each end of the carrier pipe within the casing.

K. End Seals

1. Masonry/Brick End Seals

a. Close the ends of the casing pipe with masonry brick and mortar seal, minimum 8-inches thick, at both ends of casing.

b. Leave a weephole opening at the bottom of the lowest bulkhead end for drainage of the annular space.

2. Lightweight Cellular Concrete Fill (For casings only)

a. Prior to installation, the ground surface shall be cleared of organic topsoil, debris, sharp objects, and trees. Tree stumps shall be either removed or cut to the level of the ground surface. All wheel tracks or ruts in excess of 3 in. (75 mm) in depth shall be graded smooth or otherwise filled with soil to provide a reasonable smooth surface.

b. The lightweight cellular concrete fill shall be placed according to the approved installation procedures provided by the manufacturer.

c. There shall be no standing water in the area to be filled. If necessary, dewatering shall be continuous during the time the lightweight cellular concrete fill is constructed. Lightweight cellular concrete fill shall not be placed during or when periods of precipitation are expected unless placed in an enclosed, covered area and the ground water is diverted away from the lightweight cellular concrete fill.

d. If any items are to be encased in the fill, the items shall be set to the final location both horizontally and vertically prior to installation of the lightweight cellular concrete fill.

e. Mixing and placement of the lightweight cellular concrete fill shall be done as follows:

1) After mixing, the materials shall be promptly placed in the final location.

2) No mechanical vibration of the lightweight cellular concrete fill shall be permitted.

3) The material shall be placed to prevent segregation. Intermediate lifts shall be placed horizontal while only the top lift shall be sloped to grade. The final surface elevation of the lightweight cellular concrete fill shall be within ±1.5 inches of the plan elevation.

4) Limit the area of placement to the volume that can be placed within 1 hour, up to the maximum lift height. Stagger placements such that the vertical joints are at least 10 ft (3 m) apart.

5) The cellular concrete shall be placed with a hose. The discharge hose length shall not exceed 800 ft (244 m) in length. Discharge from the hose shall not be allowed to flow more than 30 ft (9 m) from where it is deposited to its final position.

6) Heavy construction equipment or other unusual loading of the lightweight cellular concrete fill shall not be permitted.

7) Construction activities on any recently placed lift will not be permitted until at least 12 hours has elapsed and a minimum compressive strength of 8 psi has been achieved. However, if any work on the recently placed lightweight cellular concrete fill resulting in cracking or indentations of more than an 0.125 inch, the contractor shall discontinue construction, revise their wait time, mix strength or equipment used and submit to the Engineer for approval.

8) Sawing or ripping of the lightweight cellular concrete fill for utilities, drains or other conflicts will be by methods approved by the Engineer of Record and lightweight cellular concrete fill Manufacturer.

f. Where required, formwork should be designed and installed to withhold cellular concrete and may require lining with poly sheeting or similar impermeable membrane to prevent leakage.

g. Cellular concrete may be placed during freezing conditions, provided measures are taken to prevent damage to the cellular concrete until sufficient strength has been attained. Care should be taken to avoid freezing before initial set. Cellular concrete must not be placed during heavy or prolonged precipitation.

h. Concrete can be placed with a maximum slope of 1%. Slopes greater than 1% will require profiling by creating steps for the Cellular Concrete with formwork or can be mechanically graded to slopes in excess of 1% by means of grader, bulldozer or milling machine.

L. Sheeting Removal: Remove sheeting used for shoring from the shaft and off the job site. The removal of sheeting, shoring and bracing shall be done in such a manner as not to

endanger or damage either new or existing structures, private or public properties and also to avoid cave-ins or sliding in the banks.

M. Coatings: Unless otherwise shown on the construction plans, casing pipe installed under State and/or City maintained roadways shall not require a protective coating.

3.6 CONCRETE PLACEMENT

A. Ready mix concrete will not be accepted without the inspector receiving the plant dispatch ticket.

B. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by the Engineer.

D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

E. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.

2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.

3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

F. Forms: Forms may be made of wood, plywood, metal, or any other material approved by the Engineer. Forms shall be mortar tight, of material strong enough to resist noticeable deflection or bulging between supports, and the interior dimensions of the forms shall be such that the finished concrete shall be of the form and dimensions shown on the Plans. The design of the forms shall consider the effect of vibration of concrete as it is placed and also the rate of speed at which the forms will be filled. Forms shall be coated with a lubricant as approved by the Engineer. Mechanical vibrators, of an approved type, and continuous spading and/or rodding of concrete shall be used to produce proper contact of concrete with forms and reinforcing steel in piers and with forms and pipe in monolithic inverts insuring a compact, dense and impervious artificial stone of uniform texture.

G. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days. Maximum temperature in concrete after placement shall

not exceed 160°F (70°C). Maximum temperature difference between center and surface of placement shall not exceed 35°F (19°C).

2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

4. Do not place concrete until the foundation, the adequacy of the forms, the placing of reinforcement and other embedded items have been inspected and approved.

5. Place concrete in daylight unless an approved lighting system is provided.

6. Remove all debris from the interior of forms in preparation for placing concrete. Moisten earth or base course surfaces on which concrete is to be placed immediately before placing concrete. Do not place concrete on excessively wet or frozen surfaces.

7. Place concrete in its final position in the forms within the time stipulated in Subarticle 1000-3(E) of NCDOT'S 2024 Standard Specifications for Roads and Structures.

ELAPSED TIME FOR PLACING CONCRETE		
Air or Concrete Temperature, whichever is higher.	Maximum Elapsed Time	
	No Retarding Admixture Used	Retarding Admixture Used
90°F or above	30 minutes	1 hr. 15 minutes
80°F through 89°F	45 minutes	1 hr. 30 minutes
79°F or below[A]	60 minutes	1 hr. 45 minutes
70°F through 79°F[B]	60 minutes	1 hr. 45 minutes
69°F or below[B]	1 hr. 30 min	2 hr. 15 minutes

8. Place concrete to avoid segregation of the materials and the displacement of the reinforcement. Thoroughly work the concrete during placement. Bring mortar against the forms to produce a smooth finish, substantially free from water and air pockets or honeycombs.

9. Do not place concrete when the air temperature, measured at the location of the concrete operation in the shade away from artificial heat, is below 35°F unless permission is otherwise granted by the Engineer. When such permission is granted, uniformly heat the aggregates and water to a temperature no higher than 150°F. Place the heated concrete at a temperature of at least 55°F and no more than 80°F.

10. All concrete shall be protected from freezing by the Contractor during the initial 7 days of curing. The Contractor shall submit an anti-freezing plan for review. Frozen concrete shall be removed and replaced at the Contractor's expense.

H. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

I. Finishing: Provide the type of finish required by the contract directly applicable to the work being constructed

1. Ordinary Surface Finish: Remove all form ties or metal spacers to a depth of at least 1 inch below the surface of the concrete and clean and fill the resulting holes or depressions with grout. Metal devices with exposed cross-sectional area not exceeding approximately 0.05 sq. inches on surfaces permanently in contact with earth fill may be broken off flush with the surface of the concrete.

Remove all fins caused by form joints and other projections. Remove stains and discoloration. Clean all pockets and fill with grout as directed. Thoroughly soak the surface of all concrete with water before the application of a grout repair.

Use grout consisting of one part cement and two parts sand. Use cement from the same source as originally incorporated in work. Cure the grout for at least 3 days. After the grout has thoroughly hardened, rub the patch with a carborundum stone as required to match the texture and color of the adjacent concrete.

On surfaces that are to be backfilled or surfaces that are enclosed, the removal of form marks, fins and pockets; the rubbing of grouted areas to uniform color; and the removal of stains and discoloration will not be required.

2. Sidewalk Finish: Strike off fresh concrete and compact until a layer of mortar is brought to the surface. Finish the surface to grade and cross section with a float, trowel smooth and finish with a broom.

3. Rubbed Finish: After the ordinary surface finish has been completed, thoroughly wet and rub the entire surface. Use a coarse carborundum stone or other equally good abrasive to bring the surface to a smooth texture and remove all form marks. Carefully stroke the surface with a clean brush to finish the paste formed by rubbing. Alternatively, spread the paste uniformly over the surface and allow it to take a reset. Finish by floating with a canvas, carpet-faced or cork float or rub down with dry burlap.

4. Float Finish: Finish the surface with a rough carpet float or other suitable device leaving the surface even but distinctly sandy or pebbled in texture.

J. Curing: Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

a. Water.

b. Continuous water-fog spray.

c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

   a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.

   b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.

   c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

   a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

K. Flowable Fill

1. Use straps, soil anchors or other approved means of restraint to ensure correct alignment when flowable fill is used as backfill for pipe or where flotation or misalignment may occur.

2. Protect flowable fill from freezing for a period of 36 hours after placement.

3. Place flowable fill to the designated fill line without vibration or other means of compaction.

4. Flowable fill may be placed during freezing conditions, provided measures are taken to prevent damage to the cellular concrete until sufficient strength has been attained. Care should be taken to avoid freezing before initial set. Cellular concrete must not be placed during heavy or prolonged precipitation.

5. Take all necessary precautions to prevent any damages caused by the hydraulic pressure of the fill during placement prior to hardening. Provide the means to confine the material within the designated space.

L. Testing: The following tests will be performed by a Testing Laboratory selected by Charlotte Water to ensure the concrete quality. The costs for performing the tests will be paid for by Charlotte Water when the test results are in conformity with the specifications below. For Developer Donated projects, testing shall be performed by a third party and paid for by the developer. However, those which show no conformity, or a failure will be paid for by the Contractor. It shall be the responsibility of the Contractor to properly inform the Testing Laboratory as to when the concrete will be placed into the forms. For developer projects,

the testing laboratory shall be approved by the Engineer and shall be a sub consultant to the developer's consulting engineer. All cost of testing shall be paid by the developer.

1. Compressive strength in accordance with ASTM C-31 and ASTM C-39. Test cylinders which are formed in the field will be left in the field until compression testing (7-day, 14-day, 28-day) is completed thereby more closely approximately the curing conditions of the field placed concrete.
2. Slump Test in accordance with ASTM C-143.
3. Air Content Test in accordance with either ASTM C-173 or ASTM C-231.
4. A strength test shall be the average of the strengths of at least two 6 x 12 in. cylinders or at least three 4 x 8 in. cylinders made from the same sample of concrete and tested at 28 days or at test age designated for f'c.
5. Cellular concrete unit weight testing shall be in accordance with ASTM C496, ASTM C796 and ASTM C869.
6. The testing agency performing acceptance testing shall comply with ASTM C1077.
7. Samples for preparing strength test specimens of each concrete mixture placed each day shall be taken in accordance with (a) through (c):
    a. At least once a day.
    b. At least once for each 150 CY of concrete.
    c. At least once for each 5,000 SF of surface area for slabs or walls.
8. Engineer shall be consulted if exemption from testing is requested.

3.7 OPEN CUT HDPE CASING PIPE

A. HDPE Pipe (Open Cut Installation of Casing Pipe Only): HDPE pipe shall be installed with a minimum of 3.0 feet of cover and a maximum of 20 feet of cover. Buried HDPE pipe and fittings shall be installed in accordance with ASTM D2321 or ASTM D2774 for pressure systems and AWWA Manual of Practice M55 Chapter 7.

1. Trenching:
    a. Trench Length: The length of open trench required for fused pipe sections should be such that bending and lowering the pipe into the ditch does not exceed the manufacturer's minimum recommended bending radius and result in kinking.
    b. Trench Width: Trench widths shall be in accordance with Section 3.2 per Chapter 11 Gravity Sanitary Sewer Specifications of the Charlotte Water Water and Sewer Specifications.
    c. The trench width at pipe grades for pipes 24-inch diameter and greater shall be sized to accommodate the butt-fusion equipment necessary to fuse the HDPE pipe size as shown on the plans.
    d. Open cut installation of HDPE casing pipe shall be installed with Type III or greater stone bedding.
2. When HDPE SDR 9 casing pipe is used for open cut casing installations, the minimum thickness and clearances shall be as shown in the following table:

Minimum Requirements for Open Cut HDPE Casing Pipe			
Carrier Pipe Size (inches)	Casing Pipe Size (OD, inches)	Casing Pipe Minimum Thickness (inches)	Casing Pipe Average ID (inches)
6	18	2.000	13.760
8	20	2.222	15.289
12	26	2.899	19.875

3. Repairs:

   a. Defective or damaged pipe including leaking joints shall be removed and replaced with sound new pipe. Pipe re-connections shall be made, and joint leaks repaired, using repair sleeves pre-approved by the Engineer.

   b. Pipe that is sound and otherwise acceptable, but will not pass the deflection test, will be exposed and the bedding materials removed and replaced. Re-rounding of the pipe by mechanical means, without uncovering the pipe shall typically not be approved. If re-rounding is approved by the Engineer, any device used for re-rounding shall be subject to approval by the Engineer. Over-deflection of the pipe near the joint will be corrected by excavation only.

   c. Repairs shall be limited to one repair between manholes. Deficiencies in excess of these limitations shall be corrected by relaying the section of pipe.

END OF SECTION

TUNNELING AND ENCASEMENT DETAILS
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21.2 TUNNELING AND JACK AND BORE DETAILS – OPTION 2

21.3 TUNNELING AND JACK AND BORE DETAILS – OPTION 3

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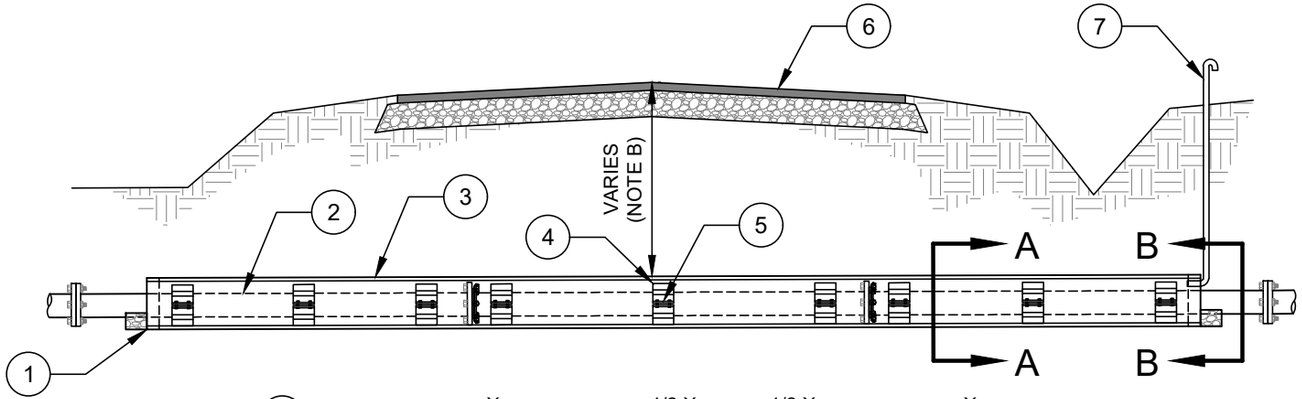
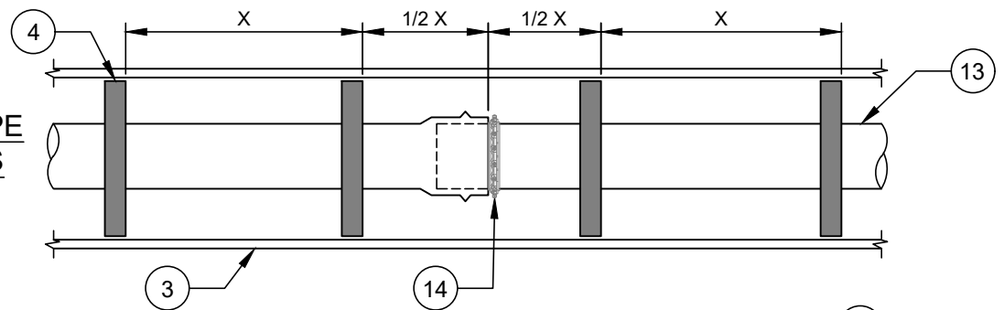
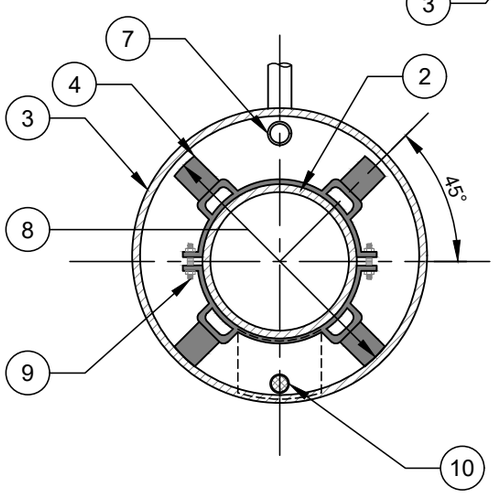
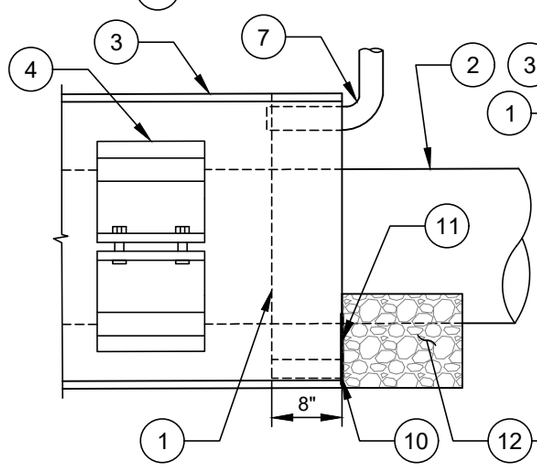


PVC CARRIER PIPE REQUIREMENTS

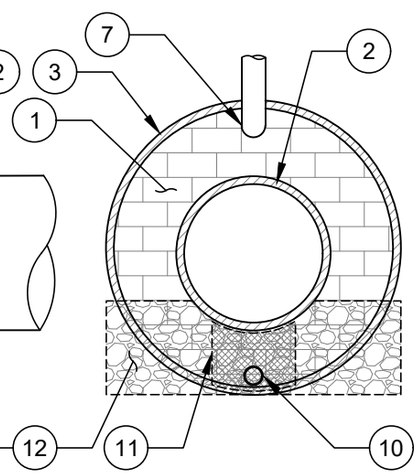




SECTION A-A
CASING DETAIL



SECTION B-B
ELEVATION VIEW
END SEAL DETAIL



SECTION B-B
END SEAL DETAIL

NO.	DESCRIPTION:
1.	8" BRICK AND MORTAR, OR OTHER APPROVED MATERIALS, END SEAL WITH 1 INCH DIAMETER WEEP HOLE AT BOTTOM OF END SEAL (ON BOTH ENDS OF ENCASEMENT).
2.	DIP, FRP, OR RJ PVC CARRIER PIPE.
3.	CASING PIPE WITH WALL THICKNESS PER PLANS. (OR JACKING PIPE WHICH MAY ALSO BE THE CASING PIPE FOR A PERMANENT PRODUCT PIPE).
4.	CASING SPACER. SEE TECHNICAL SPECIFICATIONS.
5.	NORMAL SPACING FOR CASING SPACERS IS 3 PER 18' LENGTH OF PIPE, ONE SUPPORT AT EACH END AND A SUPPORT AT THE CENTER (UNLESS THE MANUFACTURER REQUIRES MORE DUE TO LOAD LIMITATIONS OF THE CASING SPACER).
6.	STREET.
7.	2" GALVANIZED VENT PIPE AT HIGH END OF SEWER MAINS ONLY (ONLY WHEN DIRECTED BY CLTW ENGINEER).
8.	CASING SPACER DIAMETER SHALL EQUAL THE INSIDE DIAMETER OF ENCASEMENT PIPE LESS 1 INCH.
9.	3/4" DIAMETER STAINLESS STEEL BOLTS.
10.	1" DIAMETER WEEP HOLE.
11.	NON-WOVEN FILTER FABRIC OVER WEEP HOLE.
12.	#57 STONE IN NON-WOVEN FILTER FABRIC BAG PLACED SNUG OVER THE WEEP HOLE.
13.	RESTRAINED JOINT IN BELL (RJIB) DR14 PVC PIPE.
14.	BELL STOP AT THE PIPE BELL HOME MARK. MEGA-STOP SERIES 5000 OR APPROVED EQUAL.

NOTES:

A. FIELD MODIFY AS REQUIRED TO PROVIDE DESIGN SLOPE IN CARRIER PIPE.

B. DEPTH AS NECESSARY TO MEET MINIMUM COVER AND/OR MINIMUM UTILITY SEPARATION REQUIREMENTS.

C. TRACER WIRE SHALL BE INSTALLED PER CLTW TRACER WIRE DETAILS AND SPECIFICATIONS AS APPLICABLE.

D. REFER TO SPECIFICATIONS FOR CORROSION PROTECTION MEASURES.

E. REFER TO SPECIFICATIONS AND APPROPRIATE STANDARD DETAILS FOR CATHODIC PROTECTION.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

TUNNELING AND ENCASEMENT

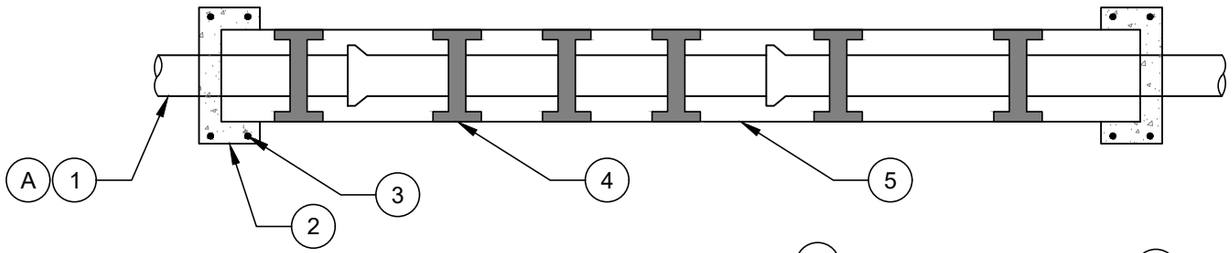
TUNNELING AND JACK AND BORE DETAILS - OPTION 1

NO SCALE

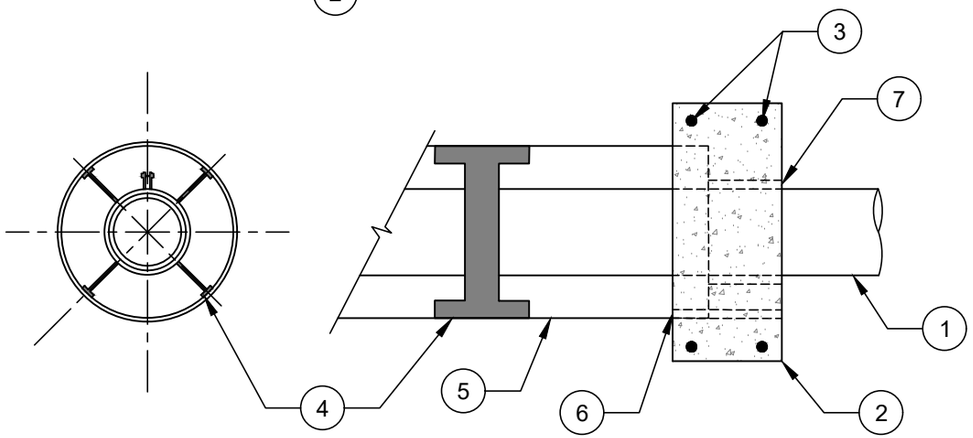
VERSION 1.0

DATE 04/2024

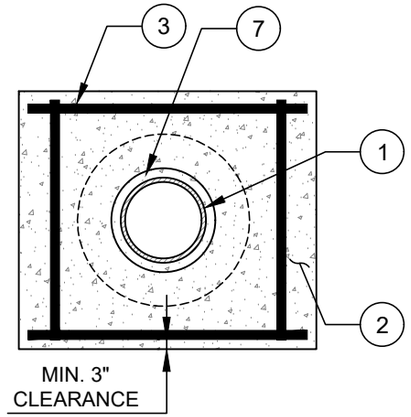
DETAIL 21.1



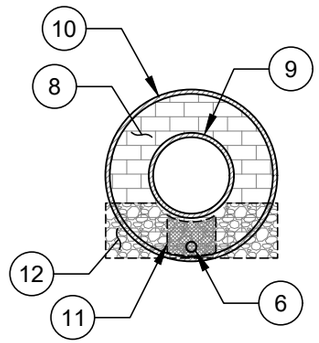
CASING DETAIL



ELEVATION VIEW
END SEAL DETAIL



END SEAL DETAIL



END SEAL DETAIL
(BRICK AND MORTAR OPTION)

NO.	DESCRIPTION:
1.	CARRIER PIPE.
2.	3,600 PSI CONCRETE SQUARE PLUG (EACH END).
3.	(2) - #4 REBAR RINGS.
4.	CASING SPACERS (MIN. 3 PER PIPE SEGMENT) OR APPROVED EQUALS. REFER TO TECHNICAL SPECIFICATIONS FOR SPECIFIC CASING SPACERS.
5.	STEEL ENCASEMENT PIPE.
6.	1" DIAMETER WEEP HOLE.
7.	WRAP PIPE W/ 1" THICK INSULATION.
8.	8" BRICK AND MORTAR, OR OTHER APPROVED MATERIALS, END SEAL WITH 1" DIAMETER WEEP HOLE AT BOTTOM OF END SEAL (ON BOTH ENDS OF ENCASEMENT).
9.	DIP, FRP, PVC, OR HDPE RJ CARRIER PIPE. HDPE USED ONLY IF SMALL DIAMETER AND WHERE ANNULAR GROUTING IS NOT REQUIRED.
10.	CASING PIPE WITH WALL THICKNESS PER PLANS. (OR JACKING PIPE WHICH MAY ALSO BE THE CASING PIPE FOR A PERMANENT PRODUCT PIPE).
11.	NON-WOVEN FILTER FABRIC OVER WEEP HOLE.
12.	#57 STONE IN NON-WOVEN FILTER FABRIC BAG PLACED SNUG OVER THE WEEP HOLE.

NOTES:

A. ALL PIPE SHALL BE RESTRAINED JOINT.

B. DEPENDING ON TYPE OF ROADWAY CROSSED, CELLULAR CONCRETE FILL MAY BE REQUIRED IN THE ANNULAR SPACE BETWEEN THE CARRIER PIPE AND THE TUNNEL/CASING PIPE (PERMIT DEPENDENT).

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

TUNNELING AND ENCASEMENT

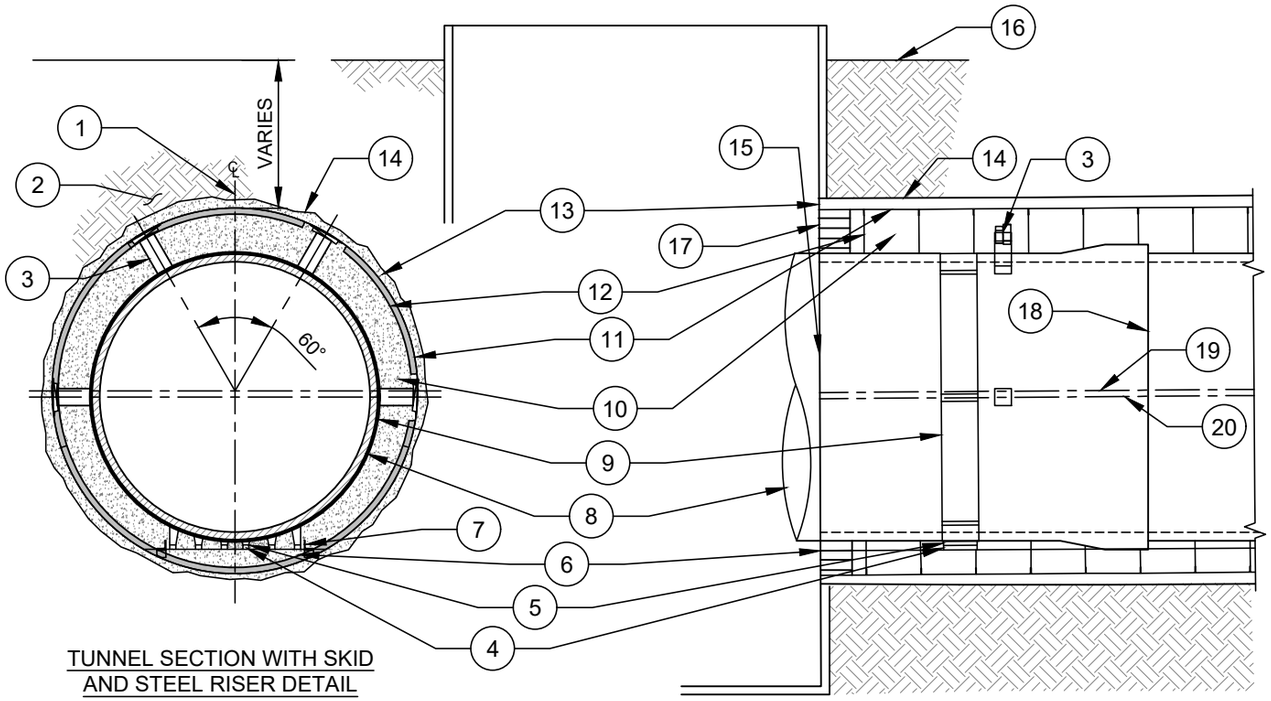
TUNNELING AND JACK AND BORE DETAILS - OPTION 2

NO SCALE

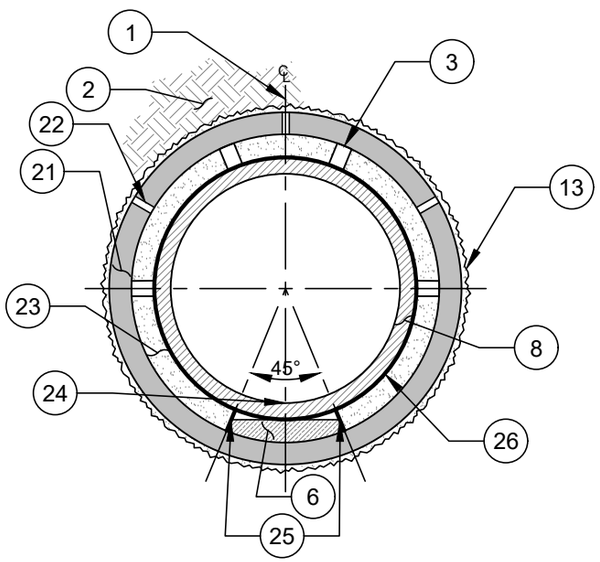
VERSION
1.0

DATE
04/2024

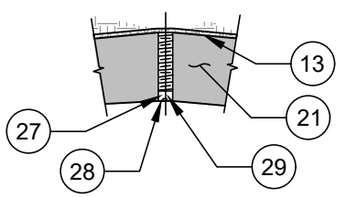
DETAIL
21.2



TUNNEL SECTION WITH SKID AND STEEL RISER DETAIL



TUNNEL SECTION WITH SOLID RAILS DETAIL



GROUT HOLE DETAIL

NOTES FOR TUNNEL CONSTRUCTION:

a. ALL ALTERNATE CONSTRUCTION MEANS AND METHODS SHALL BE SUBMITTED TO THE ENGINEER FOR REVIEW AND APPROVAL PRIOR TO INITIATING CONSTRUCTION.
b. STRICTLY ADHERE TO SPECIFICATION FOR GROUTING BEHIND TUNNEL LINER PLATES.
c. CAUTION: NO GROUTING SHALL BE PERFORMED WITHOUT NOTIFYING ENGINEER AT LEAST FOUR (4) HOURS IN ADVANCE. FOLLOWING NOTIFICATION, GROUTING MAY PROCEED.
d. A MINIMUM OF THREE (3) CASING SPACERS PER JOINT OF PIPE SHALL BE PROVIDED.
e. REFER TO TECHNICAL SPECIFICATIONS FOR SPECIFIC CASING SPACER.
f. EACH PIPE JOINT INSIDE TUNNEL CASING SHALL BE TESTED WITH JOINT TESTER PRIOR TO GROUTING. DEFECTIVE JOINTS SHALL BE REPAIRED AS APPROVED BY THE ENGINEER.
g. FOR SEWER PROJECTS, CONTRACTOR SHALL ESTABLISH, RECORD, AND SUBMIT TO ENGINEER FOR APPROVAL PRIOR TO FINAL GROUTING DATA SHOWING HORIZONTAL ALIGNMENT AND GRADE OF CARRIER PIPE WITHIN TUNNEL.
h. ONCE THE INTERNAL CELLULAR GROUTING BEGINS, WORK SHALL BE CONTINUOUS UNTIL COMPLETED.
i. CARRIER PIPE MAY BE INSTALLED FROM EITHER END OF TUNNEL EXCEPT:
  i.a. JOINTS (BELLS AND SPIGOTS) SHALL BE ORIENTED BELLS UPSTREAM.
  i.b. JOINTS SHALL BE PULLED/PUSHED IN PLACE ONE JOINT AT A TIME TO ALLOW PROPER BLOCKING.
j. CELLULAR GROUTING OF VOID BETWEEN TUNNEL AND CARRIER PIPE SHALL BE DONE FROM UPSTREAM END OF TUNNEL.

NO.	DESCRIPTION:
1.	CENTERLINE OF LINER AND CARRIER PIPE.
2.	UNDISTURBED EARTH.
3.	BLOCKING OR TREATED WOOD BLOCKING WITH WEDGES (TYPICAL 4 RADIAL LOCATIONS EACH PIPE LENGTH). SEE NOTE C.
4.	GLASS REINFORCED POLYMER SKID SIZE & NUMBER TO BE DETERMINED BY SPACER MANUFACTURER. (SEE NOTE B, c).
5.	WELDED STEEL RISER (TYP.) (SEE NOTE B, b).
6.	CONCRETE INVERT.
7.	STEEL CONTINUOUS ANGLE GUIDE (TYP. OF 2).
8.	CARRIER PIPE.
9.	PAINTED STEEL SECTIONAL BAND WITH PVC LINING APPLIED TO THE INNER SURFACE (SEE NOTE B, a).
10.	FILL VOID BETWEEN TUNNEL LINER AND CARRIER PIPE WITH CELLULAR GROUT (SEE NOTE C).
11.	STEEL PLATE TUNNEL LINER.
12.	FLANGE LINE OF STEEL TUNNEL LINER PLATES.
13.	PRESSURE GROUT FILLED ANNULAR SPACE OUTSIDE OF TUNNEL LINER/PLATES OR CASING AFTER INSTALLATION.
14.	TUNNEL.
15.	TUNNEL ACCESS SHAFT.
16.	EXISTING GROUND SURFACE.
17.	8" MASONRY BULKHEAD (TYP.) EACH END.
18.	PIPE JOINT.
19.	CENTERLINE OF LINER.
20.	CENTERLINE OF CARRIER PIPE.
21.	JACKING PIPE, GALVANIZED TUNNEL LINER, OR STEEL CASING.
22.	2" DIAMETER MIN. GROUT PORTS. ALTERNATE 10, 12, AND 2 O'CLOCK POSITIONS.
23.	GROUTED ANNULAR SPACE WITH LIGHTWEIGHT CELLULAR LOW PRESSURE GROUT (CELLULAR CONCRETE ONLY) TO COMPLETELY FILL TUNNEL EXCAVATION.
24.	CARRIER PIPE INVERT LOCATION AS SHOWN ON PLAN SHEETS.
25.	SOLID RAILS OR EQUIVALENT.
26.	MORTAR BAND.
27.	AFTER GROUTING, SEAL ALL GROUT HOLES WITH RECESSED PIPE PLUG. INSTALL PLUG FLUSH WITH INSIDE OF PIPE, FILL ANY VOIDS WITH DRY PACK MORTAR AND INSTALL LINING PATCH OVER GROUT HOLE IN ACCORDANCE WITH SPECIFICATIONS.
28.	RECESSED 1 INCH MINIMUM.
29.	2" MIN. DIAMETER THREADED NIPPLE WITH RECESSED FIBERGLASS PIPE THREAD.

NOTES:

A. ALL PIPE SHALL BE RESTRAINED JOINT.
B. CASING SPACERS CONSIST OF a) STEEL SECTIONAL BAND WITH FLEXIBLE PVC LINER ON THE INNER SURFACE b) STEEL RISERS WELDED TO STEEL BAND SECTIONS c) GLASS REINFORCED POLYMER SKIDS CONNECTED TO THE RISERS. CASING SPACERS TO BE SUPPLIED AS READY TO INSTALL UNITS BY THE MANUFACTURER. THE NUMBER OF SPACERS PER PIPE SECTION SHALL BE A MINIMUM OF 3 (BASED ON 18-20 FT PIPE SEGMENTS), OR AS REQUIRED BY THE MANUFACTURER BASED ON ALLOWABLE LOAD. ALL SPACERS SHALL BE EQUALLY SPACED ALONG THE PIPE.
C. BLOCKING TO BE INSTALLED AS SHOWN TO PREVENT ANY MOVEMENT IN THE CARRIER PIPE DURING CELLULAR GROUTING OF THE SPACE BETWEEN THE TUNNEL LINER/CASING PIPE AND THE CARRIER PIPE.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
TUNNELING AND ENCASEMENT

TUNNELING AND JACK AND BORE DETAILS - OPTION 3

NO SCALE

VERSION 1.0

DATE 04/2024

DETAIL 21.3

CHAPTER 22
ASPHALT PAVING

CHAPTER 22
ASPHALT PAVING

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PART 1 - GENERAL

1.1 SUMMARY

A. Asphalt paving base course, binder course, and wearing course.

1.2 RELATED DOCUMENTS

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

1.3 DEFINITIONS AND ABBREVIATIONS

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

1.4 REFERENCES

A. North Carolina Department of Transportation (NCDOT) “Standard Specifications for Roads and Structures,” latest edition.

B. Charlotte Land Development Standards Manual (CLDSM), latest edition.

C. Charlotte Department of Transportation (CDOT) Utility Right of Way Management Program Standards and Provisions.

1.5 SUBMITTALS

A. Material Certificates: Provide copies of materials certificates signed by material producer and Contractor, certifying that each material item complies with, or exceeds, specified requirements.

B. The Contractor shall submit to the Engineer and/or directly to CDOT/NCDOT a detailed traffic control plan for performing all phases of the work within one week prior to performing the work in residential roads and two weeks prior to working in major thoroughfares. The traffic control plan shall be specific to each road and the water/sewer infrastructure proposed for installation. The traffic control plan shall be modified as necessary in the field to accommodate unforeseen traffic control issues and problems and safety concerns. No work shall begin until the traffic control plan is reviewed and approved by the Engineer, Charlotte Water, CDOT and/or NCDOT, or the appropriate town controlling agency. The Contractor shall coordinate directly with CDOT and NCDOT or appropriate town controlling agency and advise the Engineer of all coordination efforts, correspondence, submittals and status.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with NCDOT or CLDSM standard specifications.

B. Obtain materials from same source throughout.

C. Saw cutting of edges of existing pavement is necessary for pavement addition and renovation. This work will be performed by the more stringent method as either specified by NCDOT standard specifications Section 250-2, Pavement Removal and Disposal, or as indicated in this specification under Part 3, Execution.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Do not place asphalt mixture when ambient air or base surface temperature is less than 40 degrees F, or surface is wet or frozen.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Asphalt Cement: in accordance with NCDOT standard specifications.

B. Binder: In accordance with NCDOT standard specifications.

C. Tack Coat: In accordance with NCDOT standard specifications.

2.2 AGGREGATE MATERIALS

A. Base: General Aggregate Base Course in accordance with NCDOT standard specifications.

PART 3 - EXECUTION

3.1 GENERAL

A. All removal and restoration of pavement and road surfaces will be in accordance with the specifications approved by the Superintendent of Streets of the City of Charlotte or of the North Carolina Department of Transportation, or appropriate town/city controlling agency, whichever applies. Where jurisdiction of the road cannot reasonably be determined, Charlotte Water, at its discretion, may require removal and restoration to the specifications of the NCDOT.

B. All restored bituminous and concrete pavements shall be placed to existing cross-section and ride quality. Restored pavement will in all instances be flush and level with existing pavement at the sawed edges, and at existing gutter lines where applicable unless otherwise approved by the Engineer. When pavement repairs do not meet the above criteria or are not performed in a workmanship manner as determined by the Engineer, Superintendent of Streets of the City of Charlotte, North Carolina Department of Transportation, or appropriate town/city controlling agency, whichever applies, the contractor will remove and re-perform the restoration as specified.

C. When cuts are to be made in street rights-of-way under maintenance by the City of Charlotte, the Contractor shall contact the Superintendent of Streets or his designated representative before each separate pavement cut is made and secure a Street Cut permit.

D. Pavement will be replaced as follows. In all pavement cuts either the permanent pavement or a temporary pavement consisting of 1" of black asphaltic concrete (later to be replaced permanently) will be placed immediately upon completion of the subgrade unless otherwise approved by the Engineer.

1. Specifications for Cutting Pavement: Unless otherwise approved or required, concrete pavement shall be removed to the nearest expansion or contraction joint. The Contractor will contact the Superintendent of Streets and/or D.O.T.'s District

Engineer for a determination of the limits of concrete replacement and location of joints. Where sawed joints are allowed, the depth of the sawed cut shall be at least one (1) inch and shall extend at least 1/5 of the depth of the concrete. More depth may be required if necessary to prevent damage to surrounding pavement.

Bituminous pavement shall be cut in a smooth and straight line. Sawing is required on asphaltic concrete. The width of the existing pavement left between the edge of the utility cut/patch ditch and the existing edge of the pavement or the front line of the gutter, shall be at least 2 feet. The pavement cut shall be a straight line based on the widest point that pavement must be removed. Jagged offset edges shall not be allowed. Residual strips of pavement less than 2 feet in width must be removed and replaced. Existing pavement shall be removed on each side of the trench for at least 12 inches beyond top of trench.

The Contractor shall remove and replace pavement which, in the opinion of the Engineer, has been cracked or displaced by the operation of the Contractor.

2. Specification For Restoring Concrete Pavement: The concrete used to restore pavement shall have a minimum 28-day compressive strength of 3600 P.S.I. The concrete as placed shall conform to the shape, grade, and finish of the existing pavement and will be one (1) inch deeper than the original pavement including base, but in no instance less than six (6) inches.

3. Specification For Restoring Asphalt Pavement: All material above the sub-base level shall be hot-mix bituminous concrete conforming to North Carolina Department of Transportation Standard Specifications for Roads and Structures for both mix design and placement. The asphalt pavement as placed shall be one (1) inch deeper than the original pavement including the aggregate base, but in no instance less than six (6) inches within private roads, parking lots, driveways or alley ways, nine and one half (9.5) inches within City or town-maintained roadways or thirteen (13) inches within state-maintained roadways. The asphalt shall be placed in lifts not greater than 4 inches and shall be 6” B25.0C base course and 4” I19.0C intermediate course. The last three (3) inches in either instance shall be three (3) inches of S9.5C Surface Course, placed in two (2) lifts of 1.5 inches. Surface course S9.5C asphalt pavement resurfacing will be placed with paving machines and/or rollers of a size and type currently approved by the North Carolina Department of Transportation for use on resurfacing contracts.

If a bituminous surfacing overlays a concrete base, the Contractor, at the option of the Engineer, shall replace the concrete to its original thickness, or to a level 2 inches below the finished surface. The Engineer may direct the Contractor to omit all concrete and to replace the pavement with bituminous materials.

Tack coats shall be employed with each lift. Tack coats shall be placed on both horizontal and vertical surfaces (pavement cuts or face of concrete gutters).

Under normal conditions, asphalt base course and intermediate course will be placed in pavement cuts at the end of each workday. The final surface course shall be replaced weekly or within five days following completion of pipeline construction along a continuous section of pavement. During inclement weather, the Engineer may permit the use of temporary asphalt (cold mix) to seal the trench until permanent asphalt can be placed.

4. Use of Steel Plates to Cover Open Excavations: When a temporary excavation, vault or manhole within the Clear Zone is proposed to be left open, it shall not be

exposed to errant vehicles (or pedestrians and other conditions as determined by NCDOT). If a temporary excavation, vault, or manhole is left exposed during any period appropriate traffic control measures are absent, the Encroaching Party shall install a minimum Grade 36 steel plate without deformation to cover the hole. The steel plate must be placed and anchored to prevent displacement and shall be designed large enough to span the excavation and exceed it by a minimum of 15 inches on all sides of the excavation. The steel material meeting NCDOT Standards. For spans or trench widths less than 5'-3", the steel plate thickness shall be determined by Steel Plate Thickness Table below. For spans or trench widths greater than 5'-3", the design of the steel plate must be sealed by a North Carolina licensed Professional Engineer. If the steel plate is exposed to continuous traffic, the design must meet the AASHTO LRFD HL-93 loading criteria and appropriate signage must be installed in advance of the job site in accordance with the MUTCD for a bump and slippery when wet conditions.

a. Steel Plate Thickness

1) Maximum Clear Span or

Trench Width Minimum	Total Plate Thickness
1'-11"	3/4"
3'-5"	1"
5'-3"	1 3/4"

3.2 EXAMINATION

A. Verify compacted subgrade is dry and ready to support paving and imposed loads.

B. Verify gradients and elevations of base are correct.

3.3 TACK COAT

A. Apply tack coat in accordance with NCDOT standard specifications.

B. Apply tack coat to contact vertical surfaces of curbs, gutters and drainage structures.

C. Coat surfaces of manhole and catch basin frames with oil to prevent bond with asphalt paving. Do not tack coat these surfaces.

3.4 ERECTION TOLERANCES

A. Flatness: Maximum variation of 1/4 inch measured with 10-foot straight edge.

B. Scheduled Compacted Thickness: Within 1/4 inch.

C. Variation from Indicated Elevation: Within 1/2 inch

3.5 FIELD QUALITY CONTROL

A. Take samples and perform tests in accordance with NCDOT standard specifications.

3.6 PROTECTION OF FINISHED WORK

A. Immediately after placement, protect paving from mechanical injury or until surface temperature is less than 140 degrees.

3.7 WORK WITHIN THE Charlotte Department of Transportation RIGHT-OF-WAY

A. The Contractor's project manager, superintendents and/or foremen must be certified by the Charlotte Department of Transportation (CDOT) to perform any excavation work in CDOT roads. CDOT provides the certification through periodic certification courses. The Contractor and all subcontractors (as necessary) shall obtain the certification prior to performing any excavation in CDOT roads. The Contractor shall contact CDOT for certification course schedules and times.

B. A Street Cut Permit is required to perform excavation work in CDOT roads. The Contractor shall be responsible for providing the Owner with the required information associated with each street cut in order to properly obtain a valid Street Cut Permit from CDOT, including entering data in the required spreadsheet format. All information provided by the Contractor must be accurate and up to date (including the proposed schedules to perform the work). The Contractor shall obtain a copy of the latest revision of the "CDOT Street Maintenance Division, Regulations and Fee Schedule, Procedures for Working in Asphalt and Concrete Pavements" and maintain in their possession at all times when working in any CDOT Right-of-Way. All policies/procedures set forth in this document shall be adhered to at all times.

C. A CDOT Right of Way Use Permit, per the 2007 Right of Way Use Ordinance is required for any work within any CDOT right of way, even if all work is outside the pavement. The Right of Way Use Permit is in addition to the Street Cut Permit.

D. CDOT requires that all excavations in CDOT roads be paved by the end of each workday. The Contractor shall abide by this requirement and shall schedule the work activities as necessary to maintain compliance. If CDOT waives this requirement for any portion of the project, the Contractor shall obtain approval of the deviation from CDOT in writing. CDOT offers to perform pavement and concrete restoration for contractors. The Contractor may contact CDOT for current pricing for such work.

E. CDOT does not allow the use of their right-of-way for overnight storage of equipment and/or material. The Contractor shall abide by this requirement and shall schedule the work activities as necessary to maintain compliance. If CDOT waives this requirement for any portion of the project, the Contractor shall obtain approval of the deviation from CDOT in writing. CDOT may require the use of water filled barriers, drums, cones, etc. as a condition of this deviation.

F. All work necessary to adhere to CDOT's requirements for work in CDOT roads as specified herein shall be considered incidental to the work unless stated otherwise in project specific contract documents.

3.8 WORK WITHIN THE NORTH CAROLINA DEPARTMENT OF TRANSPORTATION RIGHT-OF-WAY

A. An encroachment agreement (or similar agreement) will be required when work occurs within the North Carolina Department of Transportation (NCDOT) rights-of-way. In such case, Charlotte Water will obtain the encroachment permit.

B. The Contractor shall hold onsite at all times, all certifications required by the NCDOT for working in their road right-of-way, including traffic control, excavation, etc.

C. The Contractor shall perform all work within the NCDOT rights-of-way in accordance with any project specific encroachments issued by NCDOT and these specifications. A copy

of the project specific encroachment agreement(s) shall be kept at the construction site at all times.

D. The Contractor is hereby advised that the encroachment shall govern over the Construction Plans as to pipeline location unless otherwise approved by the Engineer.

E. The Contractor will notify the NCDOT District Engineer at 980-523-000 and Charlotte Water three (3) business days prior to commencing any construction within the Department's right-of-way.

F. The Contractor is required to maintain all traffic, furnish all barricades and flashers, flagmen and pilot cars when necessary. Refer to the TRAFFIC CONTROL section of these specifications for additional requirements.

G. Open trenches are prohibited between dusk and dawn and at designated peak traffic hours unless special permission is received from the Department of Transportation's Division Engineer.

H. When cutting of pavement is permitted, only one-half of the road width shall be opened at any time. Full traffic flow is to be maintained between dusk and dawn and at other peak hours of traffic as required by the encroachment agreement or other Special Provision.

I. The Contractor and his suppliers are directed to contact the North Carolina Department of Transportation to verify axle load limits on State maintained roads and bridges which will be used for hauling of equipment or materials for this project. The Contractor and his suppliers shall do all that is necessary to satisfy the Department of Transportation requirements and will be responsible for any damage to roads and bridges resulting from this project.

3.9 NCDOT REQUIRED TRAINING FOR FLAGGERS AND WORK ZONE SUPERVISORS

A. In accordance with the NCDOT approved encroachment (11-046-N) included within these contract documents, “Effective July 1, 2010, all flagging operations within NCDOT Rights of Way require qualified and trained Work Zone Flaggers.” Also, “Effective July 1, 2011, qualified and trained Work Zone Traffic Control Supervisors will be required on Significant Projects.”

B. Training for this certification is provided by NCDOT approved training sources and by private entities that have been pre-approved to train themselves. Contact NCDOT at 919-814-5000 for approved training sources.

C. Charlotte Water also requires the contractor’s flaggers to be a NCDOT Qualified Work Zone Flagger and that the contractor’s Project Superintendent be a NCDOT Qualified Work Zone Supervisor who must be on the project site at all times. Both individuals need to have their NCDOT issued training card with them at all times on the project site.

3.10 TRAFFIC CONTROL

A. Warning signs, barricades and flagmen must be provided in accordance with the City of Charlotte Department of Transportation's "Work Area Traffic Control Handbook" (WATCH) and the North Carolina Department of Transportation's "Uniform Traffic Control Devices" at all times and places necessary.

B. The Contractor shall provide all appropriate signing and barricades and shall provide flaggers at all times and places necessary. Occupants must be notified a minimum of

two (2) hours in advance of private drive closings. Closure time will be limited to a maximum of 2 hours.

C. The Contractor will be required to furnish, maintain and relocate temporary precast concrete barriers to be placed around bore pits for safety precautions and in accordance with N.C. Department of Transportation requirements. The barriers shall be connected with pin type, tongue and groove or other system that ensures the continuity of the barrier installation.

D. No roads shall be closed for construction activities. At least one lane of traffic will be safely maintained at all times when construction is in progress. Access to businesses and residences along the roads shall be maintained at all times. All lanes will be open when work is suspended for one hour or longer.

E. The Contractor shall provide all appropriate signage and barricades and shall provide flag persons at all times and places necessary. Traffic control will be strictly enforced while also providing fire and police protection to the area and access to drives while construction is in progress. Occupants must be notified a minimum of two (2) hours in advance of private drive closings. Closure time will be limited to a maximum of 2 hours. Where businesses have only one means of access, the Contractor shall provide an alternative means of access or perform work during hours when the business is closed.

F. Traffic will be maintained on all streets or private drives throughout the work. All matters related to traffic maintenance must be done in a manner approved by the City of Charlotte Department of Transportation and the North Carolina Department of Transportation. Warning signs and devices will be placed in advance of all construction activity in accordance with the City of Charlotte Department of Transportation's "Work Area Traffic Control Handbook" and the North Carolina Department of Transportation's "Uniform Traffic Control Devices.

G. A minimum of one lane of traffic must be maintained (safely) when construction is in progress. All lanes of traffic must be maintained (safely) at all times when construction is not in progress.

3.11 ASPHALT PAVEMENT

A. Unless project specific requirements direct otherwise, all asphalt pavement installed shall conform to the requirements of North Carolina Department of Transportation. When SUPERPAVE asphalt pavement is referenced, the following information is provided for reference:

1. Subgrade: ABC or CABC
2. B 25.0 C (3.0" – 5.5" Lift)
3. I 19.0 C (2.5" – 4.0" Lift)
4. S 9.5 C (1.5"-2.0" Lift)
5. Binder PG Grade 64-22
6. Binder PG Grade 70-22
7. Binder PG Grade 76-22

B. Under the SUPERPAVE mix design, the first letter of the mix type indicates the type of mix (Surface, Intermediate, and Base), the number indicates the nominal aggregate size in millimeters, and the letter at the end indicates the level of traffic loading (measured in

ESALs) which the mix is designed to carry. Traffic loading A represents lower traffic counts, and D represents extremely high traffic counts. The Binder is the asphalt binding agent (liquid asphalt cement) used in the mix. Binder PG Grade 64-22 should always be used with patch work, unless S9.5C, S12.5C, S12.5D, or I19.0D is specified.

C. In the absence of a project specific specification or a project specific encroachment, with more detailed asphalt paving requirements, use the following minimum standard:

D. The bituminous asphalt pavement shall be a minimum of one (1) inch deeper than the original pavement structure including stone base, but in no instance less than:

Pavement Type	**Minimum Asphalt Depth (inches)**
Driveway, private road or parking lot	Six (6)
City or Town maintained residential roadway	Nine and a half (9.5)
City or Town maintained minor or major thoroughfare	Ten (10)
NCDOT Secondary Roadway (SR #)	Thirteen (13)
NCDOT thoroughfare (NC #, US # or I #)	Thirteen (13)

Course Type	**Single Lift Thickness – (min-max)**	**Current NCDOT Standard SUPERPAVE**
Intermediate Course	1.5-inch - 2.0-inch lifts	I19.0C
Base Course	2.5-inch - 4.0-inch lifts	I19.0B
Base Course	3.0-inch - 5.5-inch lifts	B25.0C
Overlay (When Required)	1.5-inch - 1.5-inch lifts	S9.5C

E. The pavement shall consist of Base Courses as required to obtain the minimum depth requirements. The last 3 inches shall consist of two (2) 1.5-inch lifts of a Surface Course. Overlays shall only be used when directed by the Engineer. Tack coats shall be employed with each lift. Tack coats shall be placed on both horizontal and vertical surfaces (pavement cuts or face of concrete gutters). Minimum total asphalt depth shall be as specified above.

F. On non-NCDOT pavement cuts smaller than 35 square feet, the pavement may be patched with full depth S 9.5 C provided that it is placed in lifts not greater than indicated above. Minimum total asphalt depth shall be as specified above.

3.12 PAVEMENT MARKING PAINT

A. Marking paint shall be a ready mixed type of paint product with spraying consistency suitable for use as reflective pavement markings on Portland cement concrete or bituminous pavement. The paint may be either one of the following two types:

1. A type in which glass beads are dropped by suitable pressurized means into the wet paint as it is applied to the pavement (hereinafter designated as the drop-on type), or

2. A type which combines the characteristics of premix and drop-on paints, i.e., having beads mixed in the paint and also requiring some beads to be dropped on the paint at the time of application by suitable pressurized means (hereinafter designated as the combination type).

3. After application to the pavement and proper drying, the marking paint under traffic shall comply with the following requirements:

a. Shall not be slippery when wet.

b. Shall not deteriorate by contact with sodium chloride, calcium chloride, mild alkalis or acids, cinders or other ice control materials, or by contact with oil drippings from vehicles.

c. Shall have a uniform cross section.

B. The paint shall be suited to application by means of spray-type pavement marking equipment, and when used with such equipment shall be capable of producing a solid, full width line of the required thickness.

C. The paint, when applied with its complement of glass beads to a concrete or bituminous pavement surface under normal field conditions at the required rate and at air temperatures above 50ºF and relative humidities less than 70%, shall dry sufficiently hard within 30 minutes after application so that there will be no pick-up, displacement, or discoloration under traffic.

D. The paint shall conform to U.S. Federal Specification Number (TT-P-115E) or its latest revision for standard yellow or white paint. The paint shall not contain any organic coloring matter and shall not discolor in sunlight.

E. Glass beads used in marking paint shall be a minimum of 80% true spheres and shall meet the following gradation requirements:

1. For beads premixed in the paint:

U.S. Standard Sieve Size	% Passing
No. 40	100
No. 60	80-100
No. 100	30-50
No. 200	0-5

2. For drop-on beads:

U.S. Standard Sieve Size	Minimum	Maximum
Passing #20		100%
Passing #20 and Retained on #30	5%	10%
Passing #30 and Retained on #50	40%	80%
Passing #50 and Retained on #80	10%	40%
Passing #8	0%	5%

F. The glass beads shall flow freely through the pressurized dispensing equipment in any weather suitable for marking the pavement.

G. The Contractor shall furnish a material certification demonstrating compliance with this specification for temporary pavement marking paint, including the glass beads used with the paint.

H. Construction Methods:

1. General: All marking paint shall be installed in accordance with the manufacturer's installation instructions, unless otherwise specified herein. All surface preparation, including surface cleaning and surface pretreatment, shall be done by the

Contractor in accordance with the manufacturer's recommendations, subject to the approval of the Engineer.

2. The pavement markings shall be applied as soon as the pavement has cooled enough to support traffic and shall be in place for sections surfaced by the end of each day's operation, unless otherwise approved by the Engineer and the controlling agency.

3. Pre-marking Requirements: The Contractor shall lay out and install all markings in their final proposed location and position prior to actual placement of the pavement markings. The pavement marking shall not be installed until pre-markings have been approved by the Engineer.

4. Lateral Deviation Requirements: Lines shall be of the length and longitudinal placement as shown on the plans, or to replace existing markings, or as directed by the Engineer and the controlling agency. The Contractor shall provide sufficient control points to serve as guides for application of markings. The marking shall be straight or of uniform curvature and shall conform uniformly with tangents, curves, and transitions. The finished lines shall be free from waviness. In judging waviness, the lateral deviation of the finished line shall not exceed ½ inch from the proposed location alignment at any point.

5. Any greater deviation may be sufficient cause for requiring the Contractor to remove and correct such markings at no cost to the Department.

6. Pavement Marking Paint Application and Equipment Requirements:

   a. All pavement marking lines shall be applied with one pass of the pavement marking equipment.

   b. The pavement shall be dry and free of glaze, oil, dirt, grease, or other foreign contaminants. The paint shall be applied only on clean, dry pavements, and at road surface temperatures above 50ºF and below 160ºF.

   c. Application equipment shall be so constructed as to assure continuous uniformity in the thickness and width of the stripe and shall be equipped with a cut-off device remotely controlled to provide clean square stripe ends when "skip" lines are being applied.

   d. The paint and beads shall be applied at the rate of 16.5 gallons per mile of 4-inch continuous stripes (wet film thickness of 15 mils). When the combination type paint is used at least 3½ pounds of glass beads per gallon of paint shall be premixed into the paint prior to application and drop-on glass beads shall be applied at the rate of 1½ to 3 pounds per gallon of paint. Drop-on beads shall be applied to drop-on type paint at the rate of at least 6 pounds per gallon of paint.

   e. Beads applied to the surface of the completed marking paint shall be applied by an automatic pressurized bead dispenser attached to the liner in such a manner that the beads are dispensed almost instantly upon the wet painted line. The pressurized bead dispenser shall be equipped with an automatic cut-off control synchronized with the cut-off of the paint. The beads shall be spread uniformly over the entire surface of the paint.

7. The Contractor shall protect the marking until dry by placing guarding or warning devices as necessary. In the event any vehicle crosses the wet marking, such

marking shall be reapplied, and tracks made by the moving vehicles shall be removed by the Contractor.

END OF SECTION

ASPHALT PAVING DETAILS
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22.1 PAVEMENT REPAIR DETAIL

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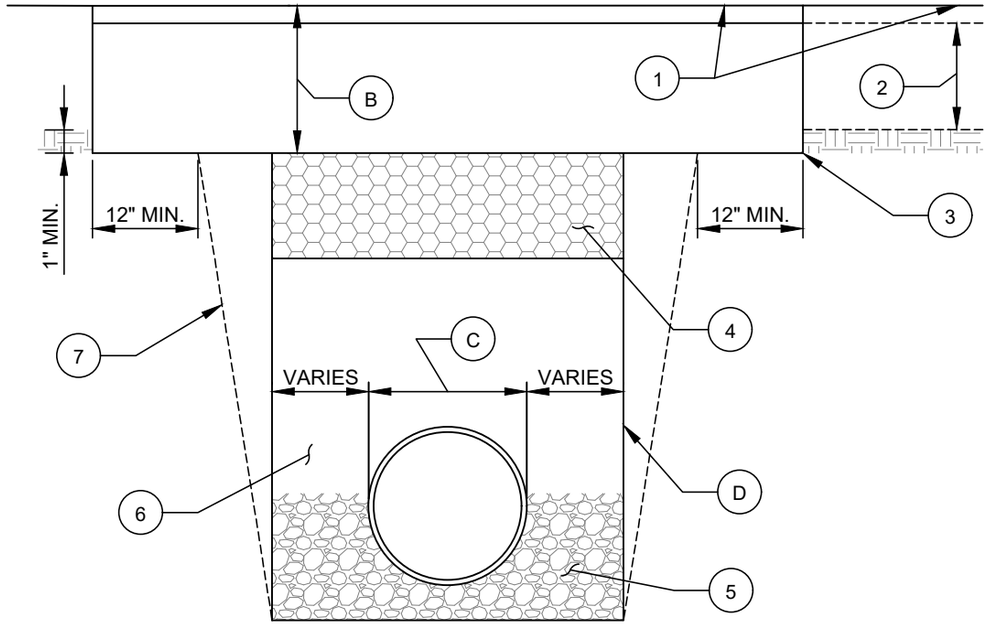
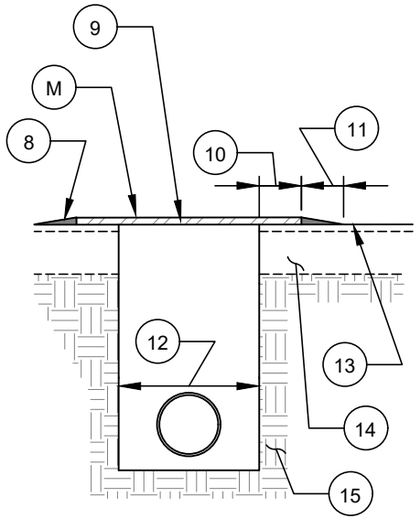
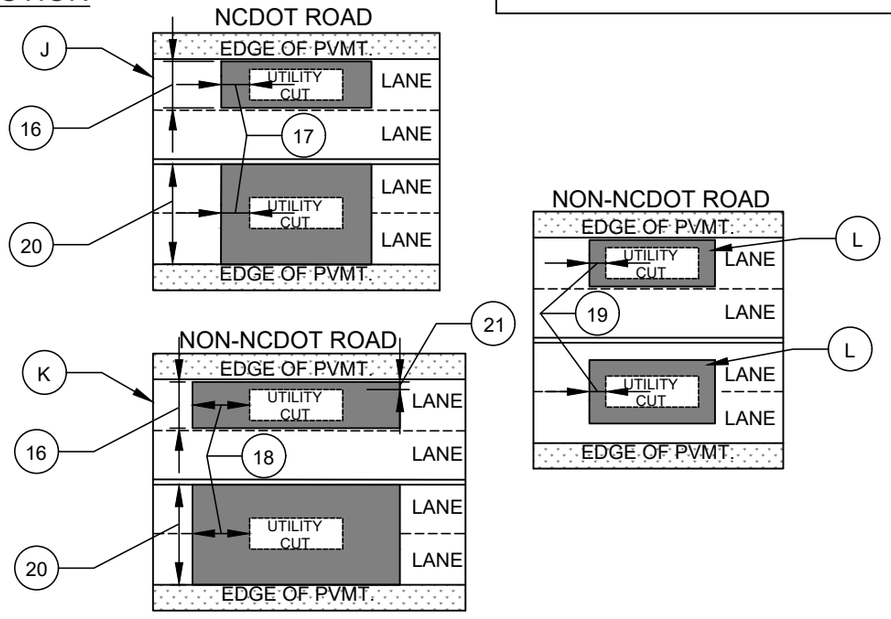


ELEVATION SECTION



STEEL PLATE INSTALLATION



MILLING AND RESURFACING REQUIREMENTS

NO.	DESCRIPTION:
1.	1.5" S9.5B OR S9.5C SURFACE COURSE.
2.	EXISTING ASPHALT, CONCRETE, OR CABC BASE.
3.	PAVEMENT SUBGRADE.
4.	12" COMPACTED ABC STONE AT 100% DENSITY.
5.	#57 WASHED BEDDING STONE.
6.	SELECT BACKFILL OR CLTW. APPROVED BACKFILL MATERIAL AT 95% DENSITY.
7.	TRENCH FAILURE LINE.
8.	TEMPORARY ASPHALT WEDGE (ALL AROUND).
9.	STEEL PLATE ON TOP OF EXISTING ASPHALT.
10.	12" MIN. PLATE OVERLAP.
11.	12" MIN.
12.	EXCAVATION SPAN.
13.	EXISTING ASPHALT.
14.	BASE/SUBGRADE.
15.	ORIGINAL GROUND.
16.	ONE LANE WIDTH
17.	NCDOT - 15' RESURFACING.
18.	NON-NCDOT - (LESS THAN 2 YR. OLD) 50' RESURFACING.
19.	NON-NCDOT - (2-5 YR. OLD) 5' RESURFACING.
20.	BOTH LANES WIDTH.
21.	5' WIDTH.

NOTES:

A. ALL PAVEMENT REPAIRS ARE SUBJECT TO APPROVAL BY CITY OF CHARLOTTE DOT, NCDOT, AND/OR GOVERNING AGENCY AS APPLICABLE.

B. SEE SPECIFICATIONS. MINIMUM 9.5" BITUMINOUS ASPHALT PAVEMENT IN THOROUGHFARES, AND MINIMUM 6.5" BITUMINOUS ASPHALT PAVEMENT IN RESIDENTIAL STREETS, ALLEYS, PARKING LOTS, AND DRIVEWAYS. MAXIMUM 4" PAVEMENT LIFTS FOR I19.0B, 19.0C, AND 5.5 INCHES FOR B25.0B OR B25.0C. TACK COAT REQUIRED BETWEEN EACH PAVEMENT LIFT. TACK COAT SHALL BE ASPHALT BINDER (350°F TO 400°F) OR EMULSIFIED ASPHALT (130°F TO 160°F). PAVEMENT LIFTS PLACEMENT TEMPERATURE SHALL BE MINIMUM OF 225°F AND MAXIMUM OF 350°F. MINIMUM SURFACE AND AIR TEMPERATURE SHALL BE 35°F FOR BASE OR INTERMEDIATE LIFT AND 40°F FOR SURFACE LIFT.

C. NOMINAL PIPE DIAMETER.

D. COMPACTION REQUIREMENTS INCLUDE: BITUMINOUS ASPHALT PAVEMENT - 92% DENSITY, WITHIN 12" OF PAVEMENT SUBGRADE - 100% DENSITY - STANDARD PROCTOR, REMAINING TRENCH DEPTH - 95% DENSITY-STANDARD PROCTOR.

E. ALL CONCRETE AND ASPHALT PAVEMENT, INCLUDING DRIVEWAYS, TO BE CUT WITH A SAW OR MILLED FULL DEPTH.

F. WHERE EXISTING CONCRETE PAVEMENT IS OVERLAID WITH ASPHALT, I19.0 OR B25.0 MAY BE SUBSTITUTED FOR CONCRETE, AS A BASE MATERIAL, WITH THE APPROVAL OF THE CONTROLLING AGENCY.

G. SEE DETAILED SPECIFICATIONS FOR TRENCH WIDTH.

H. PROPOSED THICKNESS OF PAVEMENT SHALL BE 1 INCH DEEPER THAN EXISTING (MIN.) INCLUDING ABC BASE COURSE.

I. SEE SPECIFICATIONS FOR STEEL PLATE REQUIREMENTS. STREET MAINTENANCE SHALL BE NOTIFIED WHEN A PLATE WILL BE IN USE. PLATE SHALL BE MARKED WITH SOME TYPE OF IDENTIFIER. PLATE SHALL BE TACKED ON ALL FOUR CORNERS WITH HOT MIX ASPHALT AND RAMPED TO SMOOTH TRANSITION AND PREVENT SHIFTING. PLATES REMAINING IN THE ROADWAY FOR MORE THAN 7 DAYS REQUIRE COUNTERSINKING (MAY BE REQUIRED DURING WINTER MONTHS AT ANY TIME). PLATES SHALL BE GRADE A36 STEEL WITH A MINIMUM THICKNESS OF 1 INCH. FOR TRAFFIC SAFETY, PLATES MAY ONLY BE USED OVER COMPACTED BACKFILLED TRENCHES.

J. NCDOT - ANY PAVEMENT CUT IN A TRAVEL LANE REQUIRES THAT ONE LANE WIDTH TO BE MILLED AND RESURFACED FOR A MINIMUM OF 15' EACH SIDE OF THE PAVEMENT CUT.

K. NON-NCDOT (FOR PAVEMENT LESS THAN 2 YEARS OLD) - SHALL BE MILLED AND RESURFACED FOR A MINIMUM OF 50' EACH SIDE OF THE PAVEMENT CUT ALONG THE LANE AND 5' ON THE SIDES OF THE PAVEMENT CUT.

L. NON-NCDOT (FOR PAVEMENT BETWEEN 2 AND 5 YEARS OLD) - SHALL BE MILLED AND RESURFACED FOR A MINIMUM OF 5 FEET ON ALL 4 SIDES OF THE PAVEMENT CUT.

M. CDOT REQUIRES STEEL PLATES TO BE FLUSH WITH FINISH GRADE SITTING IN A MILLED RECESS IN THE PAVEMENT, DURING WINTER MONTHS.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS
ASPHALT PAVING

PAVEMENT REPAIR DETAIL

NO SCALE

VERSION 1.0

DATE 04/2024

DETAIL 22.1

CHAPTER 23
GENERAL RESTORATION

CHAPTER 23
GENERAL RESTORATION

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PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. General Restoration.

1.2 RELATED DOCUMENTS

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

1.3 DEFINITIONS AND ABBREVIATIONS

A. See Sections iii and iv of the Charlotte Water Water and Sewer Design and Construction Standards for common abbreviations and definitions, in addition to the following:

B. Finish Grade: Elevation of finished surface of planting soil.

C. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

D. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

E. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See drawing designations for planting soils.

F. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 SUBMITTALS

A. Qualification Data: For landscape Installer.

B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

C. Product Certificates: For fertilizers, from manufacturer.

D. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf establishment.

B. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.

C. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

D. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network:

1. Landscape Industry Certified Technician - Exterior.
2. Landscape Industry Certified Lawncare Manager.
3. Landscape Industry Certified Lawncare Technician.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with appropriate certificates.

1.7 FIELD CONDITIONS

A. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 PLANTING PERIOD: SEPTEMBER 15 – MARCH 1

A. Maintained/Established Lawns or road rights-of-way:

6# Kentucky Fescue No. 31 or Alta Tall Fescue or as requested by the property owner

2# Rye Grain or alternate seed as requested by the property owner

30# Fertilizer (10-10-10)

100# Pelletized Lime

12# Superphosphate

2# Reliant Hard Fescue

B. Open Field (Anything other than an established lawn):

4# Kentucky Fescue No. 31
2# Reliant Hard Fescue
2# Rye Grain
20# Fertilizer (5-10-10)
100# Pelletized Lime
12# Superphosphate

C. Open Field For Slopes 2:1 or greater or areas subject to erosion:

2# Kentucky Fescue No. 31
2# Reliant Hard Fescue
4# Sericea Lespedeza (Unscarified)
2# Rye Grain
30# Fertilizer (5-10-10)
100# Pelletized Lime
12# Superphosphate

D. The Engineer will be consulted prior to seeding for a determination of appropriate seed mixture. All rates are in pounds per 1000 square feet and any rates listed above may be cut by 1/2 for temporary erosion control measures only. Unless otherwise required by the North Carolina Department of Transportation or the Engineer, seeding within road rights-of-way will be as specified for established lawns.

2.2 PLANTING PERIOD: FEBRUARY 1 – OCTOBER 15

A. Maintained/Established Lawns or road rights-of-way:

8# Kentucky Fescue No. 31 or as requested by the property owner
2# Reliant Hard Fescue
30# Fertilizer (10-10-10)
100# Pelletized Lime
12# Superphosphate

B. Open Field (Anything other than an established lawn):

6# Kentucky Fescue No. 31
2# Reliant Hard Fescue
2# Sudangrass (May, June, and July only)
20# Fertilizer (5-10-10)
100# Pelletized Lime
12# Superphosphate

C. Open Field For Slopes 2:1 or greater or areas subject to erosion:

2# Kentucky Fescue No. 31

2# Reliant Hard Fescue

4# Sericea Lespedeza (Scarified)

2# Sudangrass (May, June, and July only)

20# Fertilizer (5-10-10)

100# Pelletized Lime

12# Superphosphate

D. The Engineer will be consulted prior to seeding for a determination of appropriate seed mixture. All rates are in pounds per 1000 square feet and any rates listed above may be cut by 1/2 for temporary erosion control measures only. Unless otherwise required by the North Carolina Department of Transportation or the Engineer, seeding within road rights-of-way will be as specified for established lawns. Contractor shall save all seed and fertilizer tags and fiber mulch bags for the Engineer to verify compliance with the application rates and specifications. Tags and bags shall be provided to the Engineer at intervals determined by the Engineer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.

2. Protect grade stakes set by others until directed to remove them.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.2 GENERAL

A. All surfaces and structures (both public and private) within and adjacent to the construction operations shall be restored to a condition comparable to that existing prior to construction or as specified in the special provisions.

B. All surplus materials shall be disposed of in a manner acceptable to the Engineer, and the construction area shall be left in a neat condition, with special attention called to proper drainage, smoothness of surface, and general clean up. No machinery or equipment shall be left or stored on the job site after the project is completed.

C. Unless otherwise specified, complete restoration to include fertilizing, seeding, and mulching of any and all areas disturbed during construction shall be completed within thirty (30) working days following the initial ground disturbing activity.

1. Water meters, valve boxes, drain pipes, and other structures encountered shall be reset or re-laid to match or clear surface grade and/or water main pipe grade as applicable.

2. All shoulder areas shall be restored, stabilized, and maintained to their original condition. Concrete, asphalt, gravel, and dirt walks, drives and roadways are to be replaced to their original shape and serviceability. Unless otherwise approved by the Engineer all areas (shoulders, side streets, drive, parking areas, etc.) which exhibit a gravel surface at the time of construction will be re-graveled with a minimum depth of six (6) inches of C.A.B.C stone compacted-in-place for the width and length of the disturbed area and then feathered gradually into the existing cross section. When a driveway is finished with other than C.A.B.C stone, a one-inch finish coating to match existing gravel gradation and appearance shall be placed. The Contractor should note that all existing side streets and drives which are either dirt or gravel will be restored as specified for graveled areas.

3. Refuse Burial: The Contractor shall not bury rock, broken concrete/asphalt, construction material, timber, etc. within the street right-of-way or water main/sewer main easement.

4. Rip-Rap: The Contractor shall place stone rip-rap as specified in those areas subject to severe water action where directed by the Engineer. Placement of rip-rap as shown on the Construction Plans shall be considered a guide only, with final determination made at the time of construction by the Engineer. Either the addition or deletion of quantities may be required. Stone rip-rap will be placed as indicated on the Standard Details immediately following pipe installation and will be installed no steeper than a 2:1 slope except when specifically approved by the Engineer. Rip-rap shall not be placed in the creek bed. Grading will be required as necessary to insure continuous even flow. In locations where a creek bank is eroded near the sewer line the Contractor will be required to place compacted fill material along the creek bank in order to maintain 3' of cover over the sewer line in all directions. This is to be done before the rip-rap is placed. The rip-rap installation shall include all earthwork necessary to stabilize the creek bank and to provide cover for the sewer line. Final grade and rip-rap placement shall not reduce the cross sectional area of the creek and shall not reduce the flow capacity of the creek.

5. Jute Netting/Erosion Blanket: The Contractor shall install jute netting or Erosion Control Blanket in areas subject to high runoff velocities, areas subject to concentrated runoff and on steep slopes as shown on the plans and/or as directed by the Engineer.

6. Fertilizing, Seeding, and Mulching: Established lawns and landscaped areas damaged by construction shall be restored to their former condition by seeding, unless the type and condition of the existing sod warrants it being cut, removed, preserved, and replaced. All areas, regardless of previous condition, damaged by construction shall be fertilized, seeded, and mulched as outlined below.

7. Seed Bed Preparation: The seed bed shall be prepared by pulverizing the soil in an approved manner to a depth of three (3) inches for field conditions or slopes that are 3:1 or flatter and to a depth of one (1) to three (3) inches, as determined on site for slopes steeper than 3:1. The soil shall be tilled until a well pulverized, firm, reasonably uniform seed bed is prepared conforming substantially to ground elevations as shown on the Plans and/or as existed prior to construction. The disturbed area shall blend uniformly into adjacent topography. Good surface drainage must be provided, allowances for settlement made and ground elevations adjusted accordingly. Visible ponding will not be allowed. All stones, roots, sticks, rubbish, and other objectionable material shall be removed.

8. Soil Improvements: Soil additives shall be incorporated in an approved manner into the topsoil at the following rates:

   a) Fertilizer - 20 pounds per 1000 square feet of 5-10-10 fertilizer generally and 30 pounds per 1000 square feet of 10-10-10 fertilizer for established lawn areas.

   b) Pelletized Lime - 100 pounds per 1000 square feet.

   c) Superphosphate (0-20-0) - 12 pounds per 1000 square feet.

9. Seeding: Seeding must be done within thirty (30) calendar days after the initial ground disturbing activity:

   a) The seed bed must be in good, friable condition and not muddy or hard at the time seeding is performed.

   b) Seed shall be applied at the rate specified and raked or tilled into the topsoil with the resulting furrows running across the natural slope of the ground. Under no circumstances will any tilling activity be allowed parallel with said slope. Slopes steeper than 3:1 shall require the use of hydraulic seeding unless otherwise specifically approved by the Engineer.

10. Mulching: After fertilizing, seeding and raking, dried straw shall be spread uniformly over the area at a rate of 90 pounds per 1000 square feet. Approximately 1/4 of the ground should remain visible to avoid smothering seedlings. The straw shall be sprayed with liquid asphalt to bond it together and anchor it in place within road right-of-way and areas subject to erosion:

    a) Liquid asphalt, thinned with kerosene, shall be used during freezing weather and shall be either rapid or medium curing. It shall be applied at a rate of 200 gallons per ton of straw or approximately 9 gallons per 1000 square feet.

    b) Emulsified asphalt, thinned with water shall be used when temperatures are less severe, shall be rapid curing only, and shall be applied at a rate of 150 gallons per ton of straw or approximately 7 gallons per 1000 square feet.

11. Maintenance: The Contractor shall maintain the seeded areas until there is a uniform growth three (3) inches high. Maintenance shall consist of watering, weed and pest control within established lawns, fertilization, erosion repair, reseeding and all else necessary to establish a vigorous healthy and uniform stand of grass. All areas and spots which do not show a uniform stand of grass, for any reason, shall be treated repeatedly until a uniform stand is attained:

3.3 WORK WITHIN NORTH CAROLINA DEPARTMENT OF TRANSPORTATION RIGHTS-OF-WAY

A. An encroachment agreement (or similar agreement) will be required when work occurs within the North Carolina Department of Transportation (NCDOT) rights-of-way. In such case, Charlotte Water will obtain the encroachment permit.

B. The Contractor shall hold all certifications required by the NCDOT for working in their road rights-of-way.

C. The Contractor shall perform all work within the Department of Transportation right-of-way in accordance with any project specific encroachments issued by NCDOT and these

specifications. A copy of the project specific encroachment agreement(s) shall be kept at the construction site at all times.

D. Proper signing before, during, and after construction in conformance with the manual on Uniform Traffic Control Devices for Streets and Highways will be required. In addition, warning signs as related to soft and/or low shoulders and broken pavement may be required by the Engineer.

E. Piling and/or storage of excavated material upon the pavement and on some types of shoulders is prohibited unless special permission is granted by the Department of Transportation's Division Engineer. Any material spilled, tracked or placed on the pavement is to be cleaned and damaged pavement repaired subject to stoppage of all work by Charlotte Water.

3.4 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Charlotte Water's property.

C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

D. Remove nondegradable erosion-control measures after grass establishment period.

3.5 CONSTRUCTION IN WETLAND AREAS

A. If a permit is required for work in wetlands, Charlotte Water will obtain the permit. All work shall be performed in accordance with requirements of such permits.

B. Pre-construction contours are to be restored.

C. Stabilization is required immediately on completion of each individual crossing.

D. Restoration to include seeding with wetland plant seed mix (rye grass and fescue prohibited – See SEEDING AND MULCHING section below). In addition, the contractor shall install Bare Root/Containerized Vegetation Plantings outside of the 10' wide permanent maintenance corridor as noted below.

1. Bare Root/Containerized Vegetation Planting List (Outside 10’ wide permanent maintenance corridor)

Scientific Name	Common Name	Stratum
Acer rubrum	Red Maple	Tree
Fraxinus pennsylvanica	Green Ash	Tree
Liriodendron tulipfera	Tulip Poplar	Tree
Liquidambar styraciflua	Sweet Gum	Tree
Ulmus americana	American Elm	Tree
Salix Nigra	Black Willow	Tree
Acer negundo	Box Elder	Tree
Asimina triloba	Paw paw	Tree
Aronia arbutifolia	Red Chokeberry	Shrub
Cephalanthus occidentalis	Buttonbush	Shrub
Cornus amomum	Silky Dogwood	Shrub

Notes:

1. No Species can comprise more than 20% of the total.
2. A minimum 2 tree and 2 shrub species is required.
3. Plantings should be spaced 300 plants per acre.

2. Bare Root/Containerized Vegetation Planting Notes (Outside 10’ wide permanent maintenance corridor)

a. General: In order to establish vegetation in temporary impact areas bare root and containerized vegetation will be planted as required in these Special Provisions.

b. Materials: Initial vegetation material will be provided by the contractor. The contractor is responsible for correctly installing and maintaining vegetation material. Vegetation material will consist of bare root trees and/or shrubs and containerized trees and/or shrubs. Container material will be in quart, gallon, and three-gallon plastic containers.

c. Preparation: Planting should take place between November 15 and May 15. Immediately following delivery to the project site, all plants with bare roots, if not promptly planted, shall be heeled-in in constantly moist soil or sawdust in a manner consistent with generally accepted horticultural practices. While plants with bare roots are being transported to and from heeling-in beds, or are being distributed in planting beds, or are awaiting planting after distribution, the contractor shall protect the plants from drying out by means of wet canvas, burlap, or straw, or by other means acceptable to Inspector and appropriate to weather conditions and the length of time the roots will remain out of the ground.

d. Installation: Soil in the area of shrub and tree plantings shall be loosened to a depth of at least 5 inches.

e. Bare root vegetation may be planted in a hole made by a mattock, dibble, planting bar, or other means approved by Inspector. Rootstock shall be planted in a vertical position with the root collar approximately ½ inch below

the soil surface. The planting trench or hole shall be deep and wide enough to permit the roots to spread out and down without J-rooting. The plant stem shall remain upright.

f. Soil shall be replaced around the transplanted vegetation and tamped around the shrub or tree firmly to eliminate air pockets.

E. The topsoil (top 6") shall be stripped and stockpiled outside the wetland area. After pipeline installation, the ground surface shall be returned to original grade with top 6" to 12" of the trench consisting of original topsoil from the trench.

F. Excess material must be removed to upland areas immediately upon completion of utility pipeline.

G. Anti-seep collars shall be placed where indicated on Contract Plans.

3.6 SEEDING AND MULCHING

A. The Contractor shall furnish all labor, materials, equipment, and incidentals necessary to place topsoil and to finish grade all unpaved areas disturbed by the work; to place sod; to apply seed, mulch, lime, and fertilizer; and to water and maintain all seeded areas as specified herein including all areas disturbed by the Contractor's support and secondary operations.

B. Materials:

1. Topsoil shall be fertile, friable, natural soil, free from stones larger than 1-1/2 inches in maximum dimension, roots and sticks larger than 1/2 inch in diameter, weeds, grass, and leaves and shall be obtained from naturally well drained areas. It shall not contain toxic material harmful to plant growth or have a pH beyond the range of 6.0 to 6.5. Existing topsoil shall be stockpiled and shall be used for restoration, but the Contractor shall furnish additional topsoil at no additional cost to the Owner if needed to meet the quantity required.

2. Fertilizer shall be 10-10-10 grade with controlled-release nitrogen. It shall be delivered to the site in the original unopened bags, each showing the manufacturer's guaranteed analysis. Store fertilizer so that when used it shall be dry and free flowing.

3. Lime shall be ground dolomitic limestone containing not less than 85 percent calcium and magnesium carbonates.

4. Seed shall be from the same or previous year's crop; each variety of seed shall have a percentage of germination not less than 90, a percentage of purity not less than 85, and shall have not more than 1 percent weed content.

5. The seed shall be furnished and delivered premixed in the proportions specified below. A manufacturer's certificate of compliance to the specified mixes shall be submitted by the manufacturer for each seed type. These certificates shall include the guaranteed percentages of purity, weed content and germination of the seed, and also the net weight and date of shipment. No seed may be sown until the Contractor has submitted the certificates.

6. Seed shall be delivered in sealed containers bearing the dealer's guaranteed analysis.

7. Mulch shall be clean small-grain straw.

C. Seeding and mulch shall be applied according to the following plan:

1. Topsoil shall be placed to a minimum depth of 5 inches for seeded areas and 4 inches for sodded areas.
2. Lime shall be applied at the rate of 1-1/2 tons per acre in lawn areas only.
3. Fertilizer shall be applied at the rate of 600 pounds per acre in lawn areas only.

D. Special Native Seed Mix (Wetlands): Charlotte Water has committed to minimizing impacts within SWIM buffer areas by sponsoring development of a custom native seed mix. Seeding and mulching of the disturbed area(s) (PID 13) shall be accomplished using the seed mix and procedures described below:

1. Seed mix:

Common Name (Scientific Name)	% of Mix Weight	lb
Black-eyed Susan (Rudbeckia hirta)	15%	11.25
Deertongue 'Tioga' (Dichanthelium clandestinum)	3%	2.25
Swamp Sunflower (Helianthus angustifolius)	9%	6.75
Partridge pea (Chamaecrista fasciculata)	12%	9.00
Pennsylvania smartweed (Polygonum pennsylvanicum)	6%	4.50
Plains coreopsis (Coreopsis tinctoria)	9%	6.75
River oats (Chasmanthium latifolium)	3%	2.25
Switch grass (Panicum virgatum)	3%	2.25
Rye grain (Secale cereale)	30%	22.50
Foxtail Millet (Setaria italica)	10%	7.50
Total	100%	75.00

2. Planting Schedule/Application Rate: Seed mix to be applied at a rate of 75 pounds per acre.
3. Substitutions: Up to three substitutions may be made to the seed mix to compensate for species that are unavailable from suppliers at the time of planting. Virginia wild rye is a suitable substitute for Deertongue "Tioga" at this time but this substitution will be reviewed for availability prior to ordering of seed mix.
4. Scheduling: The Contractor will contact suppliers for the seed mix a minimum of three (3) weeks in advance of the estimated planting date to ensure arrival of the mix in time for planting.
5. No fertilizer, lime, or other soil amendments should be applied before or after seeding. When hydroseeding, no fertilizer, lime, or other soil amendments will be added to the slurry.

E. The custom seed mix may be obtained from the following Suppliers:

1. Ernest Conservation Seeds (1-800-873-3321)
2. Adams-Briscoe Seeds (770-775-7826); or
3. C.P. Daniels (1-800-822-5681)

F. Installation:

1. No seeding should be undertaken in windy or unfavorable weather, or when, in the opinion of the Engineer, the ground is saturated, frozen, or too dry.

2. The subgrade of all areas to be topsoiled and seeded shall be raked, and all rubbish, sticks, roots, and stones larger than 1-1/2 inches shall be removed. Topsoil shall be spread and graded to finished grade. No topsoil shall be spread in water or while the ground is frozen or muddy.

3. All seeded areas shall be rolled with a ridged roller such as a “cultipacker” prior to mulching.

4. The Contractor shall keep all seeded and sodded areas watered and protected from disturbance. Watering and rainfall combined shall provide at least 1 inch of water per week. Water source shall be from stream or tank truck. Reseeding shall be done until a good, healthy, uniform growth is established over the entire area seeded.

5. On slopes, the Contractor shall provide against washouts by using fabric matting. Any washout which occurs shall be re-graded and reseeded until good growth is established. Matting shall be North American Green Type C 125 BN or equal.

G. Maintenance:

1. The Contractor shall maintain all seeded and sodded areas in a condition acceptable to the Engineer until final acceptance of the Contract. Maintenance shall include, but not be limited to, mowing, removal of extraneous material, repair of seeded areas, irrigation, and weed control. Protection shall be provided for all seeded and sodded areas against trespassing and damage. Slopes shall be protected from damage due to erosion, settlement, and other causes and shall be repaired promptly if damage occurs.

2. Mowing in lawn areas shall be scheduled so as to maintain a grass height of 3 to 4 inches. At no time shall the average grass height exceed 6 inches. Areas seeded with Restoration Seed Mix shall not be mowed.

3. In lawn areas, the Contractor shall leave a 2-foot-wide buffer at the edge of stream banks which will not be mowed.

4. Weeds shall be treated with an appropriate weed killer and shall at no time cover more than 5 percent of the seeded area. No weed killer shall be applied within 10 feet of stream banks.

5. In lawn areas, fertilizer shall be applied uniformly to the established sod at a rate of 600 pounds per acre on one occasion when directed by the Engineer. No fertilizer shall be applied where Restoration Seed Mix is to be used.

6. All seeded and sodded areas shall be inspected on a regular basis and any necessary repairs or reseedings shall be made promptly and as directed by the Engineer.

H. Warranty Period:

1. This specification will be deemed to have been met when all unpaved areas disturbed by the work have a thick, healthy stand of growing target vegetation with no thin or bare spots at the time of overall Contract completion.

2. This condition shall continue for one year after Contract completion and shall be subject to the one-year warranty period of the Contract as specified in the General Conditions. Adverse weather conditions shall not be an excuse for not meeting this requirement.

3. At the end of the warranty period, inspection will be made by the Engineer. Seeded and sodded areas not demonstrating satisfactory stands, as specified below and determined solely by the Engineer, shall be renovated, reseeded or sodded as specified, and maintained through one growing season, meeting all requirements as specified herein.

4. After all necessary corrective work has been completed, the Engineer shall certify in writing the final acceptance of the seeded and sodded areas.

5. A satisfactory stand of vegetation will be defined as a section of vegetation that is healthy and growing, is at least 3 inches tall, and has:

   a. No bare spots larger than 1 square foot.

   b. No more than 10 percent of total area with bare spots larger than 0.5 square foot.

   c. Not more than 15 percent of total area with bare spots larger than 6 inches square.

   d. Not more than 5 percent weed cover.

6. In the event that the Contractor has properly applied the custom native seed mix, in accordance with the provided specifications and the mix fails to establish a vigorous healthy and uniform stand of grass, the Contractor shall be required to reseed the areas.

3.7 REPLACING SODDED AREAS

A. Contractor shall replace and restore all damaged sod. The restored areas must be acceptable to both the property owner and the Engineer. The Contractor will be required to replace sod as outlined below and as directed by the Engineer.

B. The Contractor will match exactly the species of the existing grass including providing strongly rooted (2" minimum thick root mat), certified sod, not less than 2 years old and free of weeds and undesirable native grasses. Sod must be capable of growth when planted. If sod cannot be matched exactly, strip sod blocks (with mechanical sod cutters) from construction area, then re-plant. The Contractor will plant sod in holding areas and maintain by fertilizing, watering and mowing like a permanent installation. Sod will be stripped only 24 hours prior to pipe installation. Sod blocks must meet the same criteria for health and growth capability as new sod.

C. The Contractor will be required to grade lawn areas to a smooth, even surface with loose, uniformly fine texture, roll and rake, remove ridges and fill depressions to meet finish grades, add suitable topsoil to any portion or the entire area which does not meet finished grades, limit fine grading to areas which can be planted in the immediate future, moisten prepared lawn areas before planting lawn, and restore prepared areas to specified condition if eroded or otherwise disturbed, after fine grading prior to planting.

D. The Contractor will lay sod within 24 hours from time of stripping. The sod will be laid to form a solid mass with tightly fitted joints with ends and sides of sod strips butted, not overlapped. Strips are to be staggered to offset joints in adjacent courses. Work will be

performed from boards to avoid damage to subgrade or sod. The sod will be tamped or rolled lightly to ensure contact with subgrade. The Contractor will work sifted soil into minor cracks between pieces of sod, remove excess to avoid smothering adjacent grass and water sod with fine spray immediately after planting so that entire sod blocks are moist but not soggy.

E. Begin maintenance of lawns immediately after planting and continue for 30 days or until established. Maintain lawn by watering and other operations such as rolling, regrading and replanting as required to establish a smooth, acceptable lawn, free of eroded or bare areas.

F. Sodded lawn will be acceptable provided requirements, including maintenance, have been complied with, and healthy, well rooted, even colored, viable lawn is established, free of weeds, open joints, bare areas, and surface irregularities, to the satisfaction of the Engineer and property owner. Construction activity will be limited to the road right-of-way or Charlotte Water Easement at this location and equipment, materials or excavated materials will be restricted to the area of sod removal. The contractor shall also protect adjacent areas from damage.

3.8 FENCE REPLACEMENT

A. Existing fences that are disturbed during construction shall be repaired or replaced to a condition equal to or better than the original unless a release is obtained from the property owner and submitted to the Engineer. All fences shall be replaced immediately after construction has cleared the fence line. The costs to remove and replace the existing fences shall be considered incidental to the work and shall be included in the various unit prices bid. If the existing fence is not salvageable and a new section required, as agreed to by the Engineer prior to any work in the area and prior to removing the existing fence, a price shall be negotiated and payment made from the contingency item, as approved and directed by the Engineer. If the Contractor does not obtain the Engineer's approval for new fence material prior to removing the existing fence, the Contractor will be responsible for installing the new fence at no cost to the Owner.

3.9 MAILBOX/STREET SIGN REPLACEMENT

A. The Contractor, along with the Inspector, will measure all mailboxes and street signs horizontally from edge of pavement and vertically from finish ground prior to removal. The Contractor and Inspector will log these measurements at each location to ensure proper replacement. Street signs shall be replaced immediately after construction at that location. Mailboxes shall be replaced by the end of the business day or no more than 2 hours after removal.

END OF SECTION

GENERAL RESTORATION DETAILS
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23.1 STREAM BANK STABILIZATION USING TURF REINFORCEMENT MATS (TRM)

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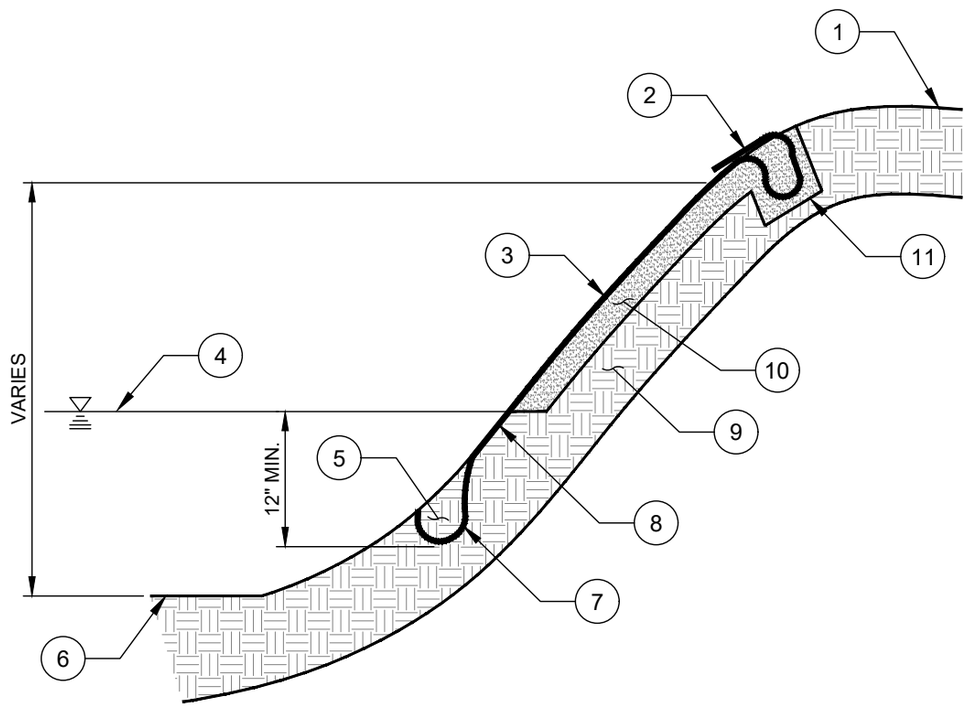

NO.	DESCRIPTION:
1.	EXISTING TOP OF BANK.
2.	ANCHOR TRM AT TOP OF CREEK BANK PER MANUFACTURER'S INSTRUCTIONS.
3.	TURF REINFORCEMENT MAT (TRM).
4.	WATER LEVEL.
5.	ANCHOR TRENCH.
6.	CREEK BED BACKFILLED, COMPACTED, AND RETURNED TO NATURAL GRADE.
7.	ANCHOR TRM BELOW WATER LEVEL PER INSTALLATION INSTRUCTIONS PROVIDED BY THE MANUFACTURER.
8.	EXTEND TRM A MINIMUM OF 12" BELOW WATER LEVEL.
9.	COMPACTED SUBGRADE.
10.	SOIL UNDERNEATH MAT AND SOIL USED AT ANCHORS TO BE SEEDED WITH RIPARIAN SEED MIXTURE TO THE TYPICAL WATER LEVEL.
11.	ANCHOR TRENCH.

NOTES:

1. REFER TO THIS DETAIL FOR RESTORATION AND STABILIZATION OF STREAM BANKS IMPACTED BY SEWER CONSTRUCTION. THIS DETAIL APPLIES WHEN INSTALLING SEWERS UNDER STREAMS AND WHEN INSTALLING AERIAL SEWER CROSSINGS. THE WIDTH OF THE STREAM RESTORATION SHALL BE LIMITED TO THE CONSTRUCTION EASEMENT UNLESS OTHERWISE APPROVED/ DIRECTED BY THE SEALING ENGINEER/OWNER. IN SOME CASES, THE WIDTH FOR RESTORATION AND STABILIZATION MAY NEED TO BE EXTENDED BEYOND THE EASEMENT WIDTH FOR PROPER STABILIZATION.
2. THE CREEK CROSSING AND BANK RESTORATION/ STABILIZATION ARE GOVERNED BY STATE AND FEDERAL PERMITS. CONTRACTOR TO ABIDE BY ALL CONDITIONS OF THE PERMITS.
3. THE CREEK SHALL BE DIVERTED AROUND THE SITE WHEN CROSSING THE STREAM AND WHEN STABILIZING THE STREAM BANKS UP TO THE TYPICAL WATER LEVEL.
4. AFTER INSTALLING THE NEW SEWER, THE CREEK BOTTOM AND BANKS SHALL BE BACKFILLED WITH CLEAN, DRY SOIL AND THOROUGHLY COMPACTED. THE CREEK BOTTOM AND BANKS SHALL BE RETURNED TO THEIR NATURAL, PRE-CONSTRUCTION GRADES AND CONFIGURATIONS.
5. TRMS SHALL BE USED TO STABILIZE THE DISTURBED CREEK BANKS FROM THE TOP OF THE BANK TO APPROXIMATELY 12 INCHES BELOW THE TYPICAL WATER LEVEL AS SHOWN.
   PRIOR TO INSTALLING THE TRMS, PROVIDE 2 TO 3 INCHES OF CLEAN TOPSOIL SUITABLE FOR GROWING GRASS ON THE STREAM BANKS ABOVE THE TYPICAL WATER LEVEL. RAKE, GRADE AND SMOOTH THE TOPSOIL AND APPLY LIME AND FERTILIZER AS RECOMMENDED. SEED WITH A RIPARIAN SEED MIXTURE SUITABLE FOR THIS AREA AND SPECIFIC SITE/GROWING CONDITIONS.
   NOTE: SOME TRM MANUFACTURERS RECOMMEND SEEDING AND SOIL FILLING OF THE MAT AFTER INSTALLING THE TRM FOR OPTIMAL PERFORMANCE OF THE TRM. CONTRACTOR SHALL FOLLOW THE MANUFACTURER'S RECOMMENDATIONS ON SEEDING.
   THE TRMS SHALL BE INSTALLED OVER THE PREPARED STREAM BANKS TO THE LIMITS SHOWN. THE MATS SHALL BE LANDLOK BY PROPEX, VMAX3 BY TENSAR, OR APPROVED EQUAL. THE CONTRACTOR SHALL SELECT THE APPROPRIATE TRM/PRODUCT FOR PERMANENT STABILIZATION OF THE STREAM BANK AT THE SPECIFIC SLOPE OF BANK. THE CONTRACTOR SHALL SUBMIT THE PROPOSED TRM PRODUCT TO THE SEALING ENGINEER FOR REVIEW AND APPROVAL, INCLUDING ALL PRODUCT INFORMATION SHEETS AND INSTALLATION INSTRUCTIONS.
   INSTALL THE TRMS IN STRICT ACCORDANCE WITH THE MANUFACTURER'S REQUIREMENTS. ANCHOR THE MATS AT THE TOP AND BOTTOM USING TERMINAL ANCHOR TRENCHES -COMPACT SOIL FIRMLY IN ANCHOR TRENCHES AND SEED THE TOP TRENCH WITH THE RIPARIAN SEED MIXTURE. OVERLAP THE MATS AS NECESSARY AND STAPLE THE MATS DOWN AS SPECIFIED. KEY ALL OTHER EDGES OF THE MATS SECURELY INTO THE CREEK BANKS PER MANUFACTURER'S INSTRUCTIONS.
6. NOTE: THIS DETAIL ILLUSTRATES A TYPICAL INSTALLATION OF A TRM PRODUCT. INSTALLATION REQUIREMENTS AND DETAILS WILL VARY BY MANUFACTURER. INSTALLATION SHALL BE IN STRICT ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS.

CHARLOTTE WATER

CHARLOTTE WATER
A CITY OF CHARLOTTE DEPARTMENT
STANDARD DETAILS

GENERAL RESTORATION

STREAM BANK STABILIZATION USING TURF REINFORCEMENT MATS (TRM)

NO SCALE

VERSION 1.0

DATE 04/2024

DETAIL 23.1

APPENDICES

APPENDICES

Appendix A Domestic Meter Selection Guidelines
Appendix B Extension Policy

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APPENDIX A
DOMESTIC METER SELECTION GUIDELINES

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CHARLOTTE WATER

CHARLOTTE WATER DOMESTIC METER ASSEMBLY SELECTION GUIDELINES

doesn't account for head loss

The following calculation methods shall be used to calculate domestic water demand flow:

- **Residential Developments (Single Family/Multi-Family)**
  - IAPMO (International Association of Plumbing and Mechanical Officials) Water Demand Calculator
- **Commercial Developments**
  - AWWA M-22 Manual

The following table shall be completed and included on all plan submittals including 1.5" and larger domestic water services:

Domestic Water Demand Calculation Results:			
	Demand Flow (gpm)	Corresponding Meter (CLT Water Meter Chart)	Proposed Meter
Meter - 1			
Meter - 2			
Meter - 3			

New Service Connection and System Development fees may be referenced in the "Service Connections" section of the Charlotte Water Website.

Backflow requirements may be referenced in the "Backflow Prevention" section of the Charlotte Water Website.

- Service line head loss from water main through backflow may be referenced in **AWWA M-22 – Third Edition – Figure 5-2**.
- Steps for determining pipe, meter and other fitting sizes may be referenced in **AWWA M-22 – Third Edition – Figure 5-3**.

Split service allowances:

- Split services are not allowed on 1-inch and larger short side services. Short side services 1-inch and larger shall connect directly to the public water main.
- Split services are not allowed from dedicated domestic service lines 1-inch and larger.
  - This includes, but not limited to, ultrasonic meters intended and sized for domestic use only.
- Split services are allowed from combination fire/domestic service lines and dedicated fire lines.
  - This includes, but not limited to, ultrasonic meters intended and sized for both, domestic and fire use.

***Fire protection demand determinations are outside the scope of these guidelines and should be calculated appropriately by the design Engineer.*

CHARLOTTE WATER

***Service lines/meter locations subject to City Code/State requirements and CLT Water design standards and specifications.*

Select Meter in below chart that achieves calculated domestic demand flow per methods indicated above. Calculated demand flow shall not exceed selected maximum rate for continuous operations (gpm).

DOMESTIC RESIDENTIAL/COMMERCIAL

Meter Size/Type	**Safe Maximum Operating Capacity** (gpm) (AWWA)	**DESIGN FOR: Maximum Rate for Continuous Operations** (gpm) (AWWA/Manufacture Specs)
4-inch FMCT w/1-inch	700	*15
6-inch FMCT w/1.5-inch	1600	*35
8-inch FMCT w/2-inch	2800	*40
10-inch FMCT w/2-inch	4400	*45
12-inch FMCT w/2-inch	4400	*45
1.5-inch Positive Displacement	**100	50
2-inch Positive Displacement	**160	80
3-inch Compound (Class II)	***350	175
4-inch Compound (Class II)	***600	300
3-inch Ultrasonic	500	500
6-inch Compound (Class II)	***1350	675
4-inch Ultrasonic	880	880
8-inch Compound (Class II)	***1600	900
6-inch Ultrasonic	1400	1400
8-inch Ultrasonic	2800	2800
10-inch Ultrasonic	4500	4500
12-inch Ultrasonic	5500	5500

* FMCT Crossover Point

** Operation at this flow rate should not exceed 10 percent of usage, or 2 hr in a 24-hr period

*** Safe maximum operating capacity is the maximum flow rate for intermittent service and should not exceed 33 percent usage (8hr/day)

- **1.5-inch minimum required for 6 or more multi-family units**
- **1-inch minimum required for 3 – 5 multi-family units (single parcel, i.e. triplex/quadraplex)**
- **5/8" may serve up to 2 units (single parcel, i.e. duplex)**

Domestic Meter Sizing Examples:

Multi-Family Residential (Use Latest Version IAPMO Water Demand Calculator):

40 Unit Complex with 40 2-Bath

2 Bath Units (40)

Fixture	Count
Combination Bath/Shower	80
Faucet, Lavatory	80
Water Closet, Gravity Tank	80
Dishwasher	40
Faucet, Kitchen Sink	40
Clothes Washer	40

- Peak Domestic Demand: **32.7 gpm**
  - Minimum Meter Size Options:
    - Dedicated Domestic Only (cannot split services)
      - 1.5-inch
    - Dedicated Fire
      - Fire line appropriately sized to meet fire flow demand
    - Domestic/Fire Combination (can split services)
      Note: Plumbing requires individual backflow preventers at private fire hydrants
      - Ultrasonic sized to meet fire flow demand
      - 6-inch or larger FMCT sized to meet fire flow demand

120 Unit Complex with 40 1-Bath, 40 2-Bath and 40 3-Bath

1 Bath Units (40)

Fixture	Count
Combination Bath/Shower	40
Faucet, Lavatory	40
Water Closet, Gravity Tank	40
Dishwasher	40
Faucet, Kitchen Sink	40
Clothes Washer	40

2 Bath Units (40)

Fixture	Count
Combination Bath/Shower	80
Faucet, Lavatory	80
Water Closet, Gravity Tank	80
Dishwasher	40
Faucet, Kitchen Sink	40
Clothes Washer	40

3 Bath Units (40)

Fixture	Count
Combination Bath/Shower	120
Faucet, Lavatory	120
Water Closet, Gravity Tank	120
Dishwasher	40
Faucet, Kitchen Sink	40
Clothes Washer	40

Total Units Served by meter

Fixture	**Count**
Combination Bath/Shower	**240**
Faucet, Lavatory	**240**
Water Closet, Gravity Tank	**240**
Dishwasher	**120**
Faucet, Kitchen Sink	**120**
Clothes Washer	**120**

- Peak Domestic Demand: **60.9 gpm**
  - Minimum Meter Size Options:
    - Dedicated Domestic Only (cannot split services)
      - 1.5-inch
    - Dedicated Fire
      - Fire line appropriately sized to meet fire flow demand
    - Domestic/Fire Combination (can split services)
      Note: Plumbing requires individual backflow preventers at private fire hydrants
      - Ultrasonic sized to meet fire flow demand

CHARLOTTE WATER

500 Unit Complex with 200 2-Bath and 300 3-Bath

2 Bath Units (200)

Fixture	Count
Combination Bath/Shower	400
Faucet, Lavatory	400
Water Closet, Gravity Tank	400
Dishwasher	200
Faucet, Kitchen Sink	200
Clothes Washer	200

3 Bath Units (300)

Fixture	Count
Combination Bath/Shower	900
Faucet, Lavatory	900
Water Closet, Gravity Tank	900
Dishwasher	300
Faucet, Kitchen Sink	300
Clothes Washer	300

Total Units Served by meter

Fixture	**Count**
Combination Bath/Shower	**1300**
Faucet, Lavatory	**1300**
Water Closet, Gravity Tank	**1300**
Dishwasher	**500**
Faucet, Kitchen Sink	**500**
Clothes Washer	**500**

- Peak Domestic Demand: **177.3 gpm**
  - Minimum Meter Size Options:
    - Dedicated Domestic Only (cannot split services)
      - 3-inch Ultrasonic
      - 3-inch Compound
    - Dedicated Fire
      - Fire line appropriately sized to meet fire flow demand
    - Domestic/Fire Combination (can split services)
      Note: Plumbing requires individual backflow preventers at private fire hydrants
      - Ultrasonic sized to meet fire flow demand
        - 3-inch Ultrasonic (minimum per domestic needs)

Commercial (Reference Latest Edition AWWA – M22 Manual):

- Peak Domestic Demand: **700 gpm**
  - Minimum Meter Size Options:
    - Dedicated Domestic (cannot split services)
      - 4-inch Ultrasonic
      - 6-inch Compound
    - Dedicated Fire
      - Fire line appropriately sized to meet fire flow demand
    - Domestic/Fire Combination (can split services)
      Note: Plumbing requires individual backflow preventers at private fire hydrants
      - Ultrasonic sized to meet fire flow demand
        - 4-inch Ultrasonic (minimum per domestic needs)

REQUENTLY ASKED QUESTIONS

What is the purpose of domestic meter sizing guidelines?

- Starting July 1, 2021, Charlotte Water will offer ultrasonic meter installations for water services between 3 and 12-inches. Ultrasonic meters offer domestic and domestic/fire combination services through one single measuring device (no bypass meter). Charlotte Water's Customer Service Team piloted a program for the replacement of aging large meter services as well as targeted replacements of FMCT's that were being incorrectly used to supply domestic water through the fire-side service with ultrasonic meters. These ultrasonic meters provide increased accuracy in water demands and associated billing and are now ready for new water service installations. Because of the variety of meters now available, Charlotte Water Staff has provided guidance for those involved in sizing meters following the recommendations of AWWA standards. For questions regarding the guidance, please, reach out to Charlotte Water's New Services Team: CLTWaterNewServices@charlottenc.gov.

Why are maximum continuous operational rates so low for FMCT meters?

- The FMCT flow rates indicated in the chart are the points in which the crossover between the small meter and large meter begins. The crossover range increases incrementally for each FMCT. Meter reading accuracy is decreased by up to 15% when flow rates are within this crossover range.

What is an Ultrasonic Meter?

- A combination domestic/fire rated meter with a single body assembly. It's extremely accurate with all-digital technology and no moving parts or crossover.

APPENDIX B
EXTENSION POLICY

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III. CHARLOTTE-MECKLENBURG UTILITIES EXTENSION POLICY

A. PURPOSE

The purpose of this policy ("Policy") is to establish the method to be used for the orderly and financially sound extension of the public water and sewer system. This Policy is applicable to the entire Charlotte-Mecklenburg Utilities ("Utilities") service area. All extensions of water and sewer mains shall be dependent on adequate capacity within the existing system, approved funding for Utilities' participation and receipt of all required permits and approvals.

B. FACILITIES PROVIDED BY UTILITIES

Utilities will provide certain basic components of the water and sewer system. These components include treatment facilities, water pumping stations, major and/or regional wastewater lift stations, water storage tanks, wastewater interceptor and trunk mains, and major water transmission mains. The purpose of these facilities is to treat, store, and convey water and wastewater throughout the service area. These facilities will be constructed and/or improved according to a Capital Improvements Program ("CIP") which is reviewed and approved annually by the Charlotte City Council.

Utilities administers several programs described later in this Policy intended to provide smaller water and sewer mains along publicly maintained streets where individual customers may connect to receive service. Water or sewer mains may be constructed along existing, publicly maintained streets within the Utilities service area. *Publicly maintained streets* shall mean NC DOT SR numbered roads, NC or US numbered highways, or municipal streets which are eligible for Powell Bill Funds (For purposes of this Policy, all references to "street" shall be construed to refer to "publicly maintained street," unless otherwise expressly provided). In areas where there are existing, public utilities in streets which do not satisfy this definition and extensions are requested, Utilities shall review each such request on a case-by-case basis taking into consideration the merits of each case, among other factors.

This Policy is intended to provide water and sewer service connections within publicly maintained streets when this is feasible. Except as noted in section III(D)(3), when this is not feasible, water mains or sewer mains and associated service connections may be located within access/water/sewer easements when Utilities determines that the criteria set forth below are satisfied. (The portion of this Policy providing for water or sewer lines in access/water/sewer easements is not a separate or independent extension policy. It is intended to apply only as an alternative to other portions of this Policy which provide for the extension of water or sewer lines within publicly maintained streets. Compliance with all other provisions of the applicable extension policy is required.)

- No suitable publicly maintained street exists or is proposed for construction where the proposed water and/or sewer system can be located and no other practical, acceptable means of providing public water and sewer service to residents exists as determined by Utilities.
- The access/water/sewer easement width is at least 40' plus additional temporary construction easement as needed and is determined by Utilities to be suitable for the construction, re-construction, operation and maintenance of the proposed water and/or sewer system.

- The access/water/sewer easement is in a location and alignment that is most likely to be used as a publicly maintained street should one be built in the future;
- The access/water/sewer easement is donated to Utilities cleared of trees, shrubs, structures, wells, septic systems and any other known obstacles that could conflict with or prevent the design, construction, re-construction, operation, and/or maintenance of the proposed water and/or sewer system and is provided at no cost to Utilities. Otherwise, the grantor(s) of the access/water/sewer easement must agree to pay the full costs to clear the easement and remove the obstacles. Utilities should not be subjected to any costs for the design, construction, re-construction, operation or maintenance of the water or sewer lines in access/water/sewer easements that would not be expected if the lines were to be placed in a publicly maintained street.
- In the event conditions in the access/water/sewer easement are discovered at any time during the project that will result in unreasonable or unusual cost increases, environmental impact, or disruption to the public Utilities may terminate the project without further obligation to provide service.
- Utilities is required only to restore travel surfaces and ground conditions within the access/water/sewer easement and any temporary construction easement to a condition similar to that existing prior to construction/re-construction of the proposed water and/or sewer system and is not required to improve or expand pavement, structures, drainage facilities, or landscaping features at any time during or after the construction of the proposed water and/or sewer system. If work of this type is required by applicable law or to allow water and/or sewer construction, re-construction, operation, and maintenance, the easement grantor(s) must agree to be responsible for the costs of this work.;
- The access/water/sewer easement must expressly provide that public access to the access/water/sewer easement can only be restricted in a manner that is substantially similar to restrictions to the use of publicly maintained streets.
- The access/water/sewer easement grantor(s) must agree to keep the access/water/sewer easement free from structures, fences, gates, barricades, wells, septic systems, trees landscaping, or other conditions or obstacles that could impede or limit vehicular or equipment access required to construct, re-construct, operate or maintain the installed water and/or sewer system.
- The access/water/sewer easement must provide access to water and/or sewer service for multiple, individually owned parcels of land that will have individually metered services.
- Utilities may not be subjected to any requirements or restrictions for the design, construction, re-construction, operation or maintenance of the water and/or sewer system within the access/water/sewer easement that are not typical and customary in publicly maintained streets.
- Waiver and release of liability is provided to Utilities against claims for damages that result from the design, construction, re-construction, operation, or maintenance of the proposed water and/or sewer system in the access/water/sewer easement and any overlying or adjacent travel surfaces, paved or unpaved, or any other features within the easement including damage that may occur from heavy equipment used to construct, re-construct, operate or maintain the water and sewer system;
- Utilities will not be financially responsible for the removal or relocation of the water or sewer mains, services, or appurtenances as may be needed for future changes in land use, roadway construction (including changes in horizontal and/or vertical alignment), regrading the access/water/sewer easement or adjacent lands, or other activity that may conflict with Utilities' continued rights to re-construct, operate and maintain said water or sewer facilities.

- No other utilities, piping or cables, underground or overhead, public or private, will be permitted within the access/water/sewer easement except with prior, written approval by Utilities.
- Public water and sewer facilities constructed within an access/water/sewer easement are owned by the City of Charlotte and subject to the same ordinances, regulations, and policies as other water and sewer facilities.
- The access/water/sewer easement will be in form and substance acceptable to Utilities and shall contain such provisions as Utilities determines are reasonably necessary or convenient to provide for the implementation of this Policy.
- The property subject to the access/water/sewer easement must be the primary vehicular access for all property subject to the easement, provided that this requirement can be waived by Utilities for a parcel that has alternative access but provides necessary access to one or more other parcels

Water or sewer service will not be extended to property located beyond Mecklenburg County without the express approval of the Director of Utilities. Utilities is under no obligation to provide water or sewer service to property located outside Mecklenburg County, except as expressly approved by the Director. Utilities may refuse to extend services to property located outside Mecklenburg County or may choose to provide water or sewer services to such property under such terms and conditions as may be approved by the Director of Utilities.

C. EXTENSION OF SERVICE REQUIRED BY ANNEXATION

All cities or towns must meet certain service requirements for newly annexed areas as prescribed by state law. Since Utilities is a part of Charlotte city government, Charlotte is required to extend major water and sewer facilities to involuntarily annexed areas so that involuntarily annexed property owners can secure water and sewer service as required by applicable law.

The major lines extended as part of involuntary annexation provide water lines for basic fire protection and installation of interceptor, trunk sewer mains, or common force mains required to extend sewer service to each publicly maintained (at the effective date of the involuntary annexation) street for sewer lines. Street main extensions are not provided under this Policy as part of involuntary annexation except as expressly required by law. In addition, water or sewer facilities will not be extended upon involuntary annexation to serve all or any portion of a residential subdivision subject to covenants, conditions, or other restrictions recorded in the Mecklenburg County Public Registry to the effect that sewer service in such subdivision is to be provided exclusively by means (including, but not limited to, septic tank systems) other than sewer service from a governmental authority (including Utilities) or public utility.

D. PROGRAMS FOR EXTENSION OF SERVICE

1. General Provisions

Upon completion and final acceptance by Utilities of all facilities constructed under this Policy, such facilities will become the property of the City of Charlotte ("City") and the City will be responsible for their operation and maintenance.

Utilities funds shall not be used for construction of any Facility which does not offer the reasonable expectation of being feasible unless such Facility is required to fulfill statutory requirements or to maintain service to existing customers. Feasibility is determined based

on the following: the construction of the Facility is expected to generate revenue; service level Improvement; and/or environmental benefits which are in a favorable proportion to the total cost of the project.

All construction of water and sewer facilities must be performed by utility contractors properly licensed in North Carolina and approved by Utilities

All contracts for extension of mains are subject to approval by Charlotte City Council or by the Charlotte City Manager or his designee where allowed by law. All extensions are subject to review approval, and regulation by local, state and/or federal agencies as required by law.

The size, depth, and location of the mains extended will be determined or approved by Utilities based on prevailing industry standards and normal service requirements. In the event facilities designed in this manner will not satisfy the applicant's needs the applicant may withdraw the application. If the application is withdrawn, the applicant forfeits costs incurred by Utilities up to the date of withdrawal..

This Policy is intended to provide sewer mains that are capable of serving the ground floor of most buildings when the ground floor is approximately at street level and where the distance from the structure to the street, topography, other utilities, structures, natural features or other conditions does not make gravity service unfeasible. Utilities does not guarantee that any customer, and particularly customers who have basements or buildings substantially lower than the street, can be served without pumping by the property owner.

This Policy is intended to provide that the water pumping and distribution system be designed and operated to provide flow rates and pressures that meet standard fire protection requirements at the time the water mains are designed and constructed for existing land uses and construction methods. In the event that higher flow rates or pressures are required due to changes in land use, differing construction types, changes in fire code requirements, or other circumstances, Utilities will endeavor to work with the customer to satisfy the new requirements. While each case will be evaluated on its individual merits and public benefits, it may become necessary for the customer to bear some or all of the costs incurred to satisfy the higher level of service.

This Policy is intended to provide for the construction of water and sewer mains sized to provide long term service as described in the CIP. If an extension is requested which conflicts with or is in the same location as a project identified in the CIP or needs assessment, Utilities shall decide whether to extend the facility as described in the CIP/Needs Assessment or a smaller or temporary main. The decision shall be made with the following considerations:

Funding availability from other sources
Impact of expenditure on appropriated funds for this program
Physical space and/or constraints of installation
Quality of service
Time required to provide requested service
Other considerations unique to the circumstances

Installed facilities that are smaller than those identified in the CIP or the Needs Assessment or that are smaller than required for long term service shall be funded solely

by the applicant with no opportunity or consideration for reimbursement from Utilities. However, in all cases, Utilities retains the discretion to require appropriately sized mains be extended to serve the area. Except as otherwise expressly authorized by this Policy, this Policy shall not be construed to authorize refunding the additional cost of mains larger than those needed for the applicant's site.

The applicant must complete an application for service and pay all applicable charges at the time an extension of the system is requested except when the extension is being made exclusively under the provisions of a Reimbursable Program or is being donated to Utilities. An applicant for an extension may not cancel an application for service or extension request once the applicable fees have been paid. Neither connection fees, capacity charges, nor the applicant's share of 50/50 extensions are refundable.

2. Reimbursable Programs

Capital facilities which are normally provided by Utilities (described in section II) but are not in place may be financed by a customer in order to expedite the construction of such facilities. Upon completion and final acceptance of the Facility, the customer will be reimbursed for eligible costs of the project according to the procedures and schedules described below.

If a customer wishes to expedite a project which is included in the Charlotte City Council approved CIP, a 5-Year Reimbursement Program is available. If a customer wishes to expedite construction of facilities which are not included in the CIP but which would normally be provided by Utilities, a 15-Year Reimbursement Program is available. To utilize either of these programs, the customer is required to enter into a contract with the City of Charlotte. This contract provides that Utilities will design, either with staff or by consultant, the requested Facility, acquire any necessary rights of way and permits and construct the facility either with City staff or through public bids in accordance with North Carolina General Statutes. The customer is required to pay a deposit at the time he or she executes the contract. The deposit amount should be sufficient to pay the cost of design and right of way acquisition and shall be established by Utilities. When the construction cost is determined, either from public bids or from Utilities work order, the customer is required to make available to Utilities the balance of funds to construct the project. The customer may make cash payment to Utilities or utilize an approved letter of credit (See section VI).

Under the 5-Year Reimbursement Program, the contracting customer is reimbursed all of the eligible funds he has deposited for the project. The amount reimbursed will not include any interest, carrying charges, financing costs, or other funds other than the actual face value amounts deposited by the customer. The customer will receive 20% of the eligible deposited amount in each of five annual payments. The first annual payment will be made one year from the date Utilities accepts the total project as complete and available for activation.

The customer will be required to pay any acreage fees which are applicable, including those resulting from his project. Acreage fees are not eligible for reimbursement.

Under the 15-Year Reimbursement Program the contracting customer is not guaranteed total reimbursement of eligible deposited funds. The reimbursement payments are made annually beginning one year from the date Utilities activates the total project. The Utilities

activation date begins the 15 year reimbursement period. The amount of each annual reimbursement payment will be the sum of collected acreage fees attributable to the project and 35% of sewer or water user fees which result directly from the project and are collected that year. The acreage fee is equal to the total actual cost of the project divided by the area which Utilities expressly designates at the time the contract is established to be ultimately tributary to the line. Acreage fees are applicable only to wastewater facilities. See section VII-B of this document for information on application of acreage fees to wastewater lift stations.

User fees are the periodic charges to customers for actual service received. User fees do not include connection charges or other one-time charges which are made in order to establish service. Reimbursable user fees on water mains will be based only on customers who have service connections directly off the main extended under the 15-Year reimbursement program and customers on donated mains which connect to that main. If the reimbursable main is extended through any method other than donation, user fees from the new extension will not be reimbursed to the original customer. If donated mains connect a reimbursable water main to an existing main, Utilities will determine the area on which to base user fee reimbursement based on an engineering judgment of the water flow direction under normal circumstances. Reimbursable user fees on sewer mains will be based on service connections directly to the reimbursable main and on service connections on donated sewer mains which connect to that main. If the reimbursable main is extended through any method other than donation, user fees from the new extension will not be reimbursed to the original customer. Annual payments to the customer will continue for 15 years or until the actual eligible face value amount deposited by the customer has been repaid, whichever occurs first.

3. Street Main Extension Program

This Street Main Extension Program ("Street Main Extension") provides for Utilities funded extension of water and sewer mains to serve existing single family residential dwellings or existing vacant lots which are zoned for single family residential construction and that are not regulated through the subdivision development process. Application of the Street Main Extension is subject to availability of funds and other qualifications described below. Applications are accepted and projects initiated on a first come, first served basis.

This Street Main Extension is only available to renters or owners of qualifying residential dwellings or vacant lots. It is not available to child-care facilities, retail establishments, medical buildings, churches, non-profit organizations, other governmental units, commercial buildings, industrial facilities, or any new construction or new development which is not single family residential in nature.

The Street Main Extension is not intended to be used to change the manner whereby an existing customer receives water or sewer service.

Extensions under this Street Main Extension must average at least one applicant per 1000 feet of main.

To ensure fair and equitable use of available funds, Utilities may, at its discretion, limit projects to a maximum of 1000 feet. An applicant can apply for water and sewer extensions simultaneously provided that funds are available and all requirements are satisfied for each extension.

In the event the applicant is determined to require an extension greater than 1000', the portion of the main in excess of the 1000' maximum can be offered under the 50/50 program provided that funds are available in that program and that the applicant meets all requirements of both programs at the time application is made, including the applicants share of the 50/50 cost.

Extensions of mains greater than 1000' for documented public health hazards can be made in combination with this program; for example, this program can be combined with the health hazard program to increase the distance a main is extended to 2000'. The first 1000' will be funded under the Health Hazard Elimination program. See section IV-E.

This program is applicable to low-pressure sewer systems only in zones designated by Utilities to be served in this manner where such systems are previously established.

This program may be combined with 5-year or 15-year reimbursable programs or other extension programs provided that the applicant satisfies all requirements for such programs at the time of application. This option requires the same applicant to apply for both programs simultaneously.

In the event that the funds appropriated for any fiscal year are not adequate to satisfy the requests received by Utilities, City Council may, at its discretion, appropriate additional funds to this program. If adequate funds are not available when an application is made for an extension, the customer will be offered any other available, funded, programs for which the required extension will qualify. If no other programs are available, or if the customer declines to use another program, the customer will be required to reapply when/if additional funds are appropriated.

Funds from this program can be used for planning, design, inspection, construction, and any other necessary expense directly related to the administration and implementation of this program.

If an extension requested under this program is of such a short length that mobilization costs are excessively high and/or the termination of the requested extension is not at an advantageous location, Utilities may at its discretion, continue the extension beyond the distance requested by the applicant. Funding will be from this program.

Procedures for initiating and utilizing this program are described in section G below.

4. 50/50 Extension Program

This program provides for shared funding of water and sewer street main extensions. Under this program, Utilities will fund 50% of the cost of eligible extensions when one or more customers provide the other 50%. Application of this program is subject to availability of funds and other qualifications described below.

The basis for determining the project cost will be the average cost per foot actually incurred during the previous fiscal year for similarly-sized projects.

An applicant can apply for water and sewer extensions simultaneously provided that funds are available and all requirements are met for each extension.

This program is applicable to low-pressure sewer systems only in zones designated by Utilities to be served in this manner where such systems are herein established.

This program may be combined with 5-year or 15-year reimbursable programs or other extension programs provided that the applicant satisfies all requirements for such programs at the time of application.

This program is available for the extension of mains requested by applicants which do not qualify under the provisions of the street main extension program or when funds are not available in that program. The applicant is responsible for determining whether other property owners who could utilize the extension will participate in funding the applicant share. Utilities will not consider the application complete until funds sufficient to cover 50% of the estimated cost are received.

Procedures for initiating and utilizing this program are described in Section G below.

5. Extension Program to Eliminate Public Health Hazards

This program provides for Utilities funding of water and sewer street main extensions for the purpose of providing access to public utilities when the system in place has failed and is resulting in a public safety, environmental or health risk to the occupant and/or the general public.

The applicant will be required to pay applicable connection fees and capacity charges at the time the extension request is made.

The maximum length for extension of mains under this program is 1000 feet.

To ensure fair and equitable use of available funds, subsequent applications for extension of uncompleted mains which will result in a project greater than 1000' funded under this program will not be accepted until the originally requested main is available for use. An applicant can apply for water and sewer extensions simultaneously provided that funds are available and all requirements are met for each extension.

This program is applicable to low-pressure sewer systems only in zones designated by Utilities to be served in this manner where such systems are previously established.

This program may be combined with 5-year or 15-year reimbursable programs or other extension programs provided that the applicant satisfies all requirements for such programs at the time of application and pays all applicable fees.

This program is only available to existing residential dwellings.

The applicant must furnish evidence from County Health officials that a health hazard exists in order to qualify for this program. Failure of mechanical equipment does not constitute a health hazard. Dry wells or unused septic tanks do not constitute a health hazard. This program cannot be used for new construction or when a mobile home or other structure is moved onto a new site. Homes which are not occupied or are not eligible for a certificate of occupancy for any reason other than lack of sanitary sewer service are not eligible for this program. Utilities shall have the authority to determine if the intent of this paragraph is met.

Revenues from user charges can be used to finance bond programs or to fund this program directly. Charlotte City Council shall establish the funding level of this program annually with approval of the Capital Improvement Program and/or operating budget.

Procedures for initiating and utilizing this program are described in Section G below.

6. Applicant Funded Non-Reimbursable Extension Program

This program allows the applicant to fund 100% of the cost of water or sewer extensions which are to be constructed by Utilities forces or by contracts administered by Utilities. This program is applicable to extensions which do not qualify for any other extension programs under this Policy, if an applicant chooses this program in lieu of another, or in the event funds are not available from Utilities for other programs.

This program is applicable to low-pressure sewer systems only in zones designated by Utilities to be served in this manner.

Each applicant is required to pay connection and capacity charges in addition to the applicants cost of the extension.

Procedures for initiating and utilizing this program are described in section G below.

7. Extension of Facilities by other Public Agencies

Any extensions requested by other City departments or by other governmental units within the Utilities service area may be (but are not required to be) processed within the same guidelines as though an individual customer had applied. Previously approved agreements with Mecklenburg County, Davidson, Cornelius, Huntersville, Pineville, Matthews, and Mint Hill created other financing options which these governments may utilize.

8. Extension of Service For New Development

Utilities will not participate in the cost of street main extensions which are required strictly for subdivision of land. All such projects will be financed wholly by the developer of the land. Utilities will agree by contract to own and maintain water distribution and wastewater collection systems if these systems are designed and constructed in accordance with prevailing Utilities standards and specifications and if the existing Utilities system has adequate capacity to sustain the new development. Such contract agreements must be obtained prior to construction of the system.

Utilities has the sole discretion in approving main sizes to meet development and system needs. When larger mains are required for system needs, no portion of the additional cost is eligible for reimbursement from Utilities except for extensions constructed under the 5-Year and 15-Year Reimbursable programs.

Capacity charges are required for each service installed.

Under no circumstances shall construction begin prior to approval of the contract, issuance of all required permits, and proper notification of Utilities. Notification requirements are detailed in the contract.

If the new development contains drainage patterns that will need to be utilized to provide sanitary sewer service to existing streets, roads, or other property, Utilities will require that the owner of the property being developed record permanent rights of ways for such facilities.

E. SERVICE CONNECTIONS

1. General Provisions

All customers desiring water or sewer service are required to make formal application for each service and to pay all applicable fees and/or charges at the time application is made.

Water services larger than 1-inch cannot be installed without payment of a meter deposit and an application to Utilities designating the party who is financially responsible for water used from that service.

A 3/4" or 1" water service connection consists of the connection to a public water main of a service line, a meter box, and stubbed connection point for the applicant's private plumber to connect to. Larger water service connections consist of the connection to a public water main of a service line, a meter box or vault, piping to the property line, and a valve at the property line.

In-ground irrigation systems installed after July 1, 2009, are required by state statute to be separately metered. Utilities offers customers two options for metering residential irrigation systems.

- Separate service option – A new, separate service is installed consisting of the connection to a public water main of a service line, a meter box, and stubbed connection point where the applicant's private plumber or irrigation contractor may connect. An approved backflow prevention device must be installed by the customer on the customer's side of the irrigation meter.Split service option – A new service line is connected from the existing service line on the Utilities' side of the water meter. The new service line will be connected to a separate, dedicated irrigation meter and stubbed connection point where the customer's private plumber or irrigation contractor may connect. An approved backflow prevention device must be installed by the customer on the customer's side of the irrigation meter.

Utilities does not guarantee minimum water pressure or flow rates will be available to operate irrigation and/or plumbing fixtures. The customer should carefully consider the impacts that a split service option may have on available water pressure and flow rates.

A sewer service (or lateral) connection consists of the connection to a public sewer main or manhole of a service line which is extended to the street right of way line or to the sewer right of way line if the public sewer main is not at the street. The applicant is responsible for the cost of connecting their private plumbing system at that point.

All water and sewer service connections shall be constructed in accordance with the Code of Ordinances of the City of Charlotte and with all applicable building and plumbing codes.

Sanitary sewer service connections will be installed at a depth that is practical and alleviates the need for extensive or unusual construction or safety methods. Utilities does not guarantee that the depth of all sewer service connections will allow gravity flow connections. If pumping is required, the pumping equipment and installation is the responsibility of the customer and must be completed in accordance with all applicable regulations and ordinances.

Commercial, industrial, fire line, or irrigation services will be subject to requirements of the City and Utilities including industrial waste and/or backflow provisions.

2. Fees/Charges

Customers applying for a new water or sewer service or extension are subject to one or more of the charges shown below.

a. Connection Charge - This charge is based on the average actual cost incurred by Utilities to construct similar size service connections during the previous fiscal year.

b. Capacity Charge - This charge is to recover from new customers a portion of the incremental cost of providing capacity in the treatment facilities, transmission mains, major outfalls and sewer trunks which have been constructed to allow for new development and expansion of the system. This charge is calculated each year based on the actual book value for these facilities as shown in the City's General Ledger and the system treatment capacity reflected in that value. Dividing the book value by the system treatment capacity yields a system cost per gallon per day. This cost per gallon is multiplied by the average daily consumption of residential customers to obtain the capacity charge for water and sewer separately for customers with 3/4" water services. This charge is then multiplied by the relative capacity of other meter sizes to determine the capacity charge for other size meters. The sewer charge is also based on the relative capacity of the water meter. Wastewater only customers will pay a capacity charge based on the capacity of their private water supply, except that all single family, residential wastewater only customers will pay the same capacity charge as a 3/4" meter customer. Capacity charges apply to separate irrigation meters and to split service irrigation meters and are calculated using methodology similar to that for residential water service connections.

c. Meter deposit - This is a security deposit which varies according to both water meter size and the nature of the customer (i.e; restaurant, warehouse, etc.). Meter deposits are not required of single family residential customers.

d. Discounts available - If a customer applies for water or sewer service in conjunction with a water or sewer extension and the service can be installed on the extension as it is constructed then the connection fee will be discounted 10%. No discount or reductions apply to capacity charges. Utilities will establish a time period prior to the beginning of construction during which other eligible customers may receive the 10% connection fee discount.

e. Acreage fees - Acreage fees are not charged to an individual applying for service to a single, single-family residential dwelling on a lot of 1 acre or less.

Any other type of applicant will be required to pay any acreage fees if they are applicable to their site. Utilities will determine and advise the applicant of the liability for acreage fees and such fees will be paid prior to the work being undertaken. Utilities will not pay acreage fees for any extensions which are made with Utilities funds, nor will acreage fees be assessed for costs of extensions funded solely with Utilities funds.

f. Sewer deposit - A sewer deposit is required when application is made for sewer only service; i.e., the applicant receives water service from a private well, community water system, or source other than Utilities. This is a security deposit similar to the meter deposit required for water service. Sewer deposits are not required of single family residential customers.

The following chart defines when each of the different charges is applicable:

{PRIVATE } TYPE SERVICE	CONNECTION FEE	CAPACITY FEE	DEPOSIT*
New service not installed as part of donated system	Yes Paid at time of application	Yes Paid at time of application	Yes Paid at time of application
New service installed by developer as part of donated system	No	Yes	Yes
Replacement service of same size	Yes Paid at time of application	No	No
Replacement service of larger size	Yes Paid at time of application	Partial - difference between sizes paid with application	Yes
Replacement service of smaller size	Yes Paid at time of application	No No refund of previous charges	No
Fire Line	Yes Paid at time of application	Yes Paid at time of application	Yes
Irrigation Service	Yes Paid at time of application	Yes Paid at time of application	Yes
Partial tap completion ("Paving tap")	Partial based on estimated cost to complete the tap	Yes Paid at time of application	Yes
Fire Hydrant Meter	No	No	Yes

* Note: Deposits do not apply to residential customers

F. LETTER OF CREDIT FOR REIMBURSABLE PROGRAM FINANCING

Customers who are utilizing reimbursable programs to expedite projects may use Letters of Credit as a financing method in lieu of cash payment to Utilities. This method can only be used for projects estimated to cost $100,000 or more. The customer may elect to render to the City a non-recourse, commercial letter of credit from a bank insured by the Federal Deposit Insurance Corporation and having full-service banking facilities in Mecklenburg County in lieu of advancing other funds sufficient to pay for the entire project. Said letter of credit shall unequivocally guarantee payment by said bank to the City at such times and in such amounts as the City shall determine is reasonably necessary or convenient to have the necessary funds on hand for retainage and payments to any contractor awarded the contract to construct the extension requested by the Customer. If such an alternative is selected by the Customer, the following conditions shall apply:

1. This financing alternative must be selected, including the designation of the bank to be used, at the time a Customer requests a contract with the City for an extension.

2. A form provided by City must be used as the letter of credit, with a schedule of payment incorporated therein which is approved by the Director of Utilities. If the Customer proposes to use any variation of the form, the Customer will be required to pay the City's reasonable attorney fees in retaining experienced private counsel to review and advise the City and Utilities on the terms of the proposed letter of credit, and any related documents, and to recommend such changes, alterations or additions thereto as may be in the best interests of the City and Utilities. The City shall have the sole discretion in the selection of said counsel. The Customer shall be required to advance the estimate of such fees, as determined by the City, at the time this financing alternative is selected. Any excess funds advanced by the Customer for attorney fees shall be refunded. If the estimate of attorney fees is insufficient, the Customer shall advance the additional amount required prior to approval by the City of the extension contract. The form and contents of a Customer-proposed letter of credit and any related documents shall be approved by the City Council and shall contain such provisions as the City Council shall determine to be necessary to protect the interests of the City and Utilities. Said proposed letter of credit shall also incorporate a schedule of payment approved by the Director of Utilities. If the Customer does not accept any changes required by the City Council and if the attached form is not acceptable to the Customer, the financing alternative set forth in this sub-section shall no longer apply.

3. The City Manager is authorized to approve changes to the form letter of credit and to the estimated cost of projects qualifying for this alternative financing plan.

4. The Finance Director may refuse to accept a letter of credit from any bank: that has refused or failed for any reason to honor a draft on any letter of credit issued to the City; or if the Finance Director determines in his/her sole and absolute discretion that it is not in the City's best interests to accept a letter of credit from such bank for any reason. By seeking to use this alternative financing plan, a customer and any bank issuing or proposing to issue a letter of credit hereunder agree and acknowledge that: acceptance of a letter of credit is within the City's sole and absolute discretion; no customer is entitled in any manner to use this alternative financing plan as a matter of right; and neither the City nor any employee, officer or agent thereof shall be liable for any damage, loss, injury or claim

of any kind whatsoever arising out of the City's failure or refusal to accept an issued or proposed letter of credit, regardless of the circumstances under which such failure or refusal occurs.

G. INITIATION/UTILIZATION OF EXTENSION PROGRAMS

A customer seeking to obtain water and/or sewer service must follow the procedure outlined below.

1. Request water and/or sewer service from Utilities . The request should identify the specific property to be served, the type of service requested (i.e,, single or multi-family residential, irrigation, commercial, institutional, industrial, etc.), and any special capacity requirements or other specialized needs .

2. If necessary, Utilities will study the availability of the service requested and will respond to the customer with information about costs, schedule, or other issues within a reasonable period of time.

3. The Customer formally initiates application for service by paying applicable extension costs and/or connection and capacity charges.

4. Utilities shall complete design and construction including acquisition of permits, encroachments, and/or rights of way. The expected time for completion of extensions of minor (less than 1000' of 8" or smaller) mains along existing streets is less than 180 days from the receipt of the customer's complete payment. It is recognized, however, that there may be instances when, due to workload or inability to obtain permits, encroachments, or rights of way, or other reasons additional time may be required. In no event is a projected schedule binding upon Utilities or the City of Charlotte.

   The projected schedule for completion of larger extensions will be determined prior to undertaking the extension. The projected schedule is established as a goal and is not binding upon Utilities or the City of Charlotte.

H. WASTEWATER LIFT STATIONS

It is Utilities' policy to minimize the need for wastewater lift stations and to limit their construction within the system. The basis for this policy is that lift stations can cause disproportionate expense to provide service to a limited customer base and that failure of lift stations poses significant environmental risks.

It is recognized, however, that there are situations where lift stations are a feasible solution for providing service. Utilities will consider on a case by case basis requests to accept new lift stations in the situations described below.

1. The lift station can be eliminated by a project or combination of projects, all of which are included for funding in the approved 5-Year CIP.

2. The lift station can be eliminated by a project being done under a reimbursable program and the funds have actually previously been made available to Utilities for construction.

3. The new development is in an area designated by Utilities for service by low pressure sewer systems and the proposed lift station size and location is in accordance with the "Lake Area Sewer Study (1990)" plan.

4. The proposed lift station is at an appropriate location and has adequate capacity or expansion capacity to serve as a permanent or long term facility and gravity service is cost prohibitive or not possible due to other circumstances. Approved locations typically require the ability to serve multiple parcels of land and are not single site lift stations.

5. The construction of the proposed lift station would include elimination of one or more existing lift stations or treatment plants.

6. The construction of the proposed lift station would facilitate significant progress toward achievement of land use goals and strategies described by current, officially approved planning documents and no other reasonable options are available for service.

In all cases, the receiving system must have available transportation and treatment capacity to carry the proposed lift station discharge. Any upgrades required will be the responsibilities of the applicant requesting the lift station.

Construction of a wastewater lift station may require the customer to pay acreage fees. Acreage fees will be charged for the actual basin in which the lift station is located and for the basin which receives the discharged flow from the lift station. In either case, acreage fees are applicable only when sewer mains downstream of the lift station or its discharge point have been constructed through a reimbursable program and the contract has not been paid in full. Acreage fees will be charged to an applicant constructing a lift station when sewer mains further downstream within the same basin as the lift station are not actually receiving the applicant's flow but would be if the applicant would have constructed an extension of these mains instead of constructing the lift station.

I. OTHER CONSIDERATIONS

1. Acquisition of Other Systems

Utilities will, as the opportunity arises, consider the acquisition of other water/sewer systems which can be incorporated into the Utilities system.

2. No Guarantee of Level of Service

Utilities does not warrant nor guarantee that the capacity, volume, pressure, or quantity of service provided will be adequate to meet the needs of any customer other than typical single family residential service. The customer is responsible for judging the adequacy of service for their intents and purposes prior to applying for service from Utilities.

The current level of service provided in any part of the water or sewer system which may be above that required to provide normal, domestic service is not guaranteed for any time in the future.

Utilities accepts customers on a first come, first served basis. Completion of studies or cost estimates for provision of service do not constitute any obligation or intent of Utilities to reserve capacity. The applicant's request for or receipt of such studies does not guarantee the applicant's ability to secure water or sewer service.

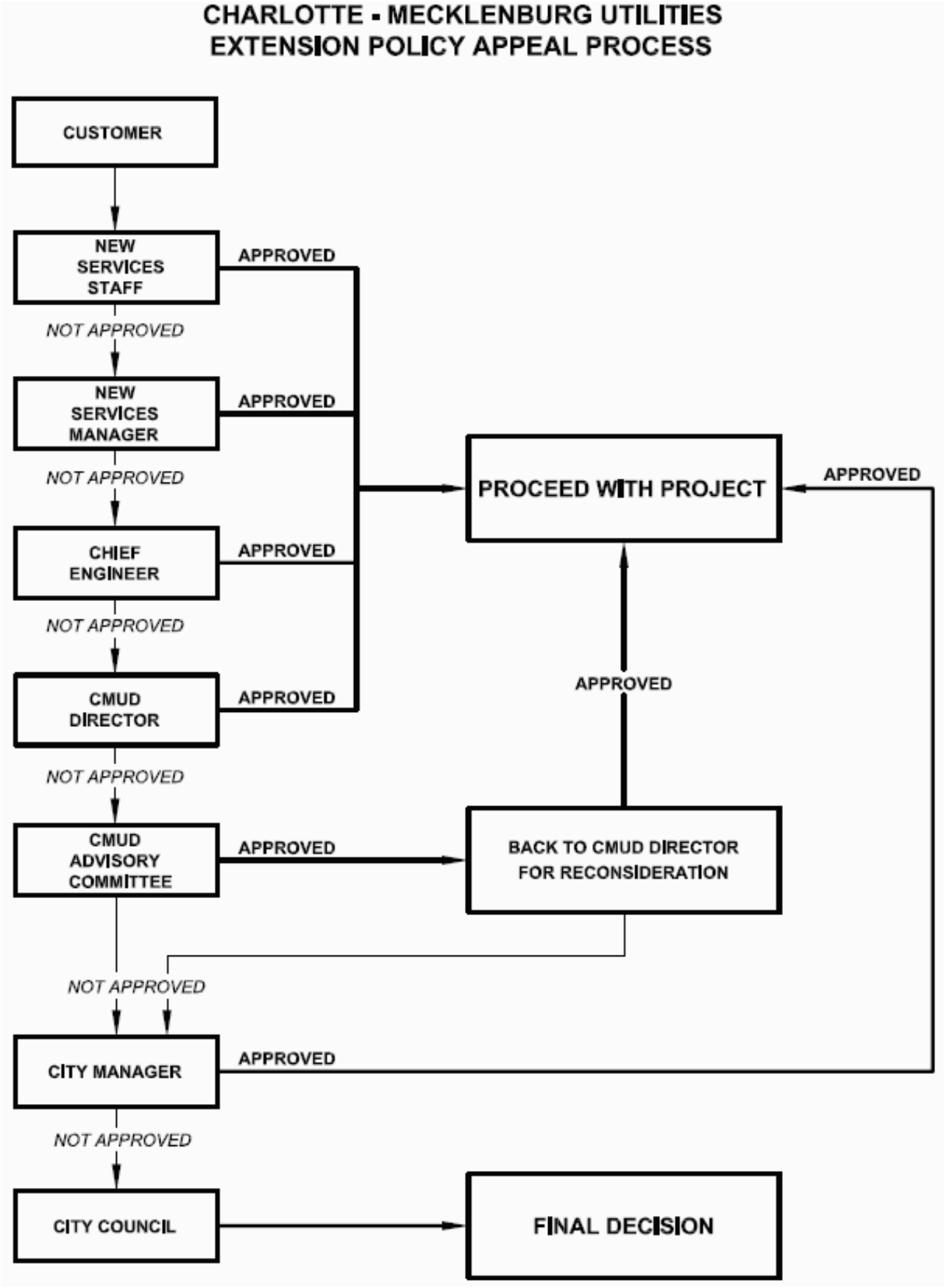
3. Financial Assistance

a. The financial assistance program as approved by the City Council as part of this Policy and in effect on January 1, 2010 shall remain in effect until and unless revised by Utilities as authorized in subsection (b) of this section.

b. Utilities is authorized to revise the financial assistance program from time to time and to administer said program for qualified property owners to assist with the cost of connecting to the system. Utilities shall give notice of a revision to said program to the City Council and to the Utilities Advisory Committee at least 10 days in advance of the effective date of such revision. Further approval by the City Council or the Committee is not required for such revisions to take effect. Without limiting the foregoing, Utilities shall have the right to establish and modify the qualifying criteria for any applicable financial assistance. Property owners qualifying for financial assistance are not guaranteed assistance. A copy of the financial assistance program shall be maintained and made available for public inspection and copying in the office of the Director of Utilities and in the office of the City Clerk for the City of Charlotte.

4. Process for Appeal

This policy has been approved by the Utilities Advisory Committee and adopted by the Charlotte City Council for implementation by Utilities and the City Manager. It is City Council's intent that Utilities apply the provisions of this policy equitably to all customers and potential customers. It is recognized that there may be situations where disagreements may develop concerning equitable treatment. In those cases, the customer may pursue the appeal process outlined on the attached chart. The burden is on the customer to demonstrate inequitable application of this Policy.


CHARLOTTE - MECKLENBURG UTILITIES
EXTENSION POLICY APPEAL PROCESS
CUSTOMER
NEW SERVICES STAFF
APPROVED
NOT APPROVED
NEW SERVICES MANAGER
APPROVED
NOT APPROVED
CHIEF ENGINEER
APPROVED
NOT APPROVED
CMUD DIRECTOR
APPROVED
NOT APPROVED
CMUD ADVISORY COMMITTEE
APPROVED
NOT APPROVED
CITY MANAGER
APPROVED
NOT APPROVED
CITY COUNCIL
PROCEED WITH PROJECT
APPROVED
APPROVED
BACK TO CMUD DIRECTOR FOR RECONSIDERATION
FINAL DECISION

J. DEFINITIONS

Access/water/sewer easement - A permanent easement signed by the owners of all property subject to such easement that provides for: continuous and unrestricted, public vehicular and pedestrian access to the properties subject to said easement; and the construction, re-construction, operation, maintenance and repair of one or more water and/or sewer lines and associated facilities.

Acreage fee - An amount calculated by dividing the total cost of a wastewater project by the number of acres of property which the project has the potential to serve. The number of acres includes all property upstream of the facility and/or which is planned to be pumped to a location where it will be tributary to the project. Acreage fees are only calculated for projects which are completed under a reimbursable program.

Activation - Placing into service a new water or sewer main or other facility. Activation may precede final acceptance.

Backflow - The flow of any substance from a customer's property back into the water distribution system. Backflow can result from improper connection of pressurized equipment to the plumbing system or from accidental pressure drops in the public water system which can be caused by pipe breaks or other equipment failure. Backflow of contaminated water into the public system can create a hazardous situation to other customers.

Capital Improvements Program - A budget plan for provision of infrastructure and other capital needs for the community. This plan is compiled annually and adopted by Charlotte City Council.

CIP - Acronym for Capital Improvements Program.

Utilities forces - Employees of the Charlotte-Mecklenburg Utility Department.

Common force main - In a low pressure sewer system, a pressurized sewer pipe provided for individual customers to connect the discharge lines from their privately owned grinder pumps.

Developer - An individual, firm, or corporation which is improving property or is causing property to be improved by the provision of streets, buildings, or other infrastructure or by the assembly or subdivision of property.

Domestic service - Provision of potable water for the purposes of consumption and hygiene for an individual or family and the collection of wastewater generated from these uses.

Drainage pattern - A ditch, creek, berm, depression or other feature along which water, if present, would accumulate and flow naturally downhill.

Eligible costs - In the context of the reimbursable program for extensions, this is the total actual cost of the portions of the project which qualify for reimbursement.

Encroachment - Agreement with the NC DOT or railroad to place water or sewer facilities within their right of way.

Extension - A new or proposed water or sewer main.

Final acceptance - Documented agreement between Utilities and the contractor or developer of a project that the work is satisfactorily completed and that there are no outstanding claims or deficiencies. Completion of the project may also involve submittal of maps, affidavits, tax statements, or other documents that are required by contractual agreement.

Fire line - A water service requested and installed for the purpose of providing enhanced fire protection to an individual property.

Fire Protection - Provision of adequately sized water mains, water volumes, and fire hydrants at suitable intervals to allow use by fire departments in fighting fires. The level of protection varies with land use and development type.

Gravity sewer system - The normal type of wastewater collection system that relies on the natural, downhill flow of wastewater through pipes constructed along drainage patterns and creeks to a wastewater treatment facility.

Industrial waste - Non-domestic liquid wastes, including but not limited to, process or operational wastewater, groundwater remediation discharges, contaminated storm water or surface water remediation discharges, and any other non-domestic liquid waste from industrial or commercial establishments.

Interceptor - A larger sewer pipe usually constructed along a major creek which collects wastewater flow discharged from trunk mains. Interceptors are sometimes also referred to as "outfalls".

Irrigation service - A water service requested and installed for the purpose of irrigating lawns or property. Water provided through such a service does not return to the wastewater collection system.

Lake Area Sewer Study (1990) - A study completed by an Engineering consultant under contract with Utilities which establishes a plan for provision of wastewater collection from property which naturally drains toward one of the major lakes in the Utilities service area. This study was completed in 1990.

Licensed utility contractor - An individual, firm, or corporation which is licensed by the North Carolina Licensing Board for General Contractors to perform public utility and/or unclassified construction projects which have a contract value not exceeding their license limitation.

Low pressure sewer system - A type of wastewater collection system which utilizes individual pumping by each property owner into a common force main. This type of system is utilized along waterfront property where natural drainage patterns have been disrupted by the creation of a large lake.

Needs Assessment - A planning document formally prepared by each City department every two years which identifies infrastructure and capital needs of the community which are projected for the upcoming 10 year period.

New construction or development - The establishment or substantial improvement of streets, buildings, useable property, or infrastructure where such facilities did not exist or were not suitable for the newly intended purposes.

Permits - Documentation of permission by Federal, State, and/or local agencies which have regulatory jurisdiction over the construction and operation of water and/or wastewater utilities to expand or modify the public water and/or sewer system.

Public water and/or sewer system - The water and/or sewer pipes, storage facilities, pumping stations, lift stations, treatment facilities and appurtenances that are owned by the City of Charlotte and operated and maintained by Utilities.

Residential dwelling - A room or combination of rooms designed for year-round habitation, containing a bathroom and kitchen facilities, and designed for or used as a permanent residence by at least one family.

Right of Way - A non-possessory interest in the land of another for the purpose of constructing, reconstructing, operating and maintaining water and/or sewer facilities.

Street main - A water or sewer pipe installed along a street, road, or highway primarily for the purpose of providing water or sewer service to the property along that street

Subdivision - All divisions of a tract or parcel of land into two or more lots, building sites, or other divisions for the purpose, whether immediate or future, of sale, or building development of any type.

Temporary construction easement – A temporary right in a specific tract of land for which Utilities has entered into an agreement with the owner that grants Utilities the right to use the land for a limited period of time in order to provide space needed to construct water and sewer facilities.

Total cost of project - The total cost of completing a project including planning, design, surveying, drafting, inspection, administration, acquisition of rights of ways, legal services, environmental studies, permits, construction and all other costs necessarily incurred between project initiation and final acceptance.

Transmission main - A water pipe constructed primarily for the movement of water from one area to another. Transmission mains are usually, but not always, 12" or greater in diameter. Transmission mains usually supply water to smaller street mains.

Treatment facility - A plant designed and constructed for the purpose of removing pollutants and/or other impurities from wastewater or from raw water.

Tributary - A stream or pipe which flows by gravity or is pumped into another stream or pipe.

Trunk main - A sewer pipe constructed along a drainage pattern or minor creek to collect flows discharged from sewer street mains.

User fee - Charges which are collected for normal provision of water and/or sewer service. User fees do not include onetime charges such as connection or capacity charges, nor late fees, turn on/off fees or other similar charges.

Utilities – Charlotte-Mecklenburg Utilities. Where action is required or contemplated by Utilities in this Policy, *Utilities* shall refer to the Director or his designee.