

Chapter D. Engineering

D.1. INTRODUCTORY PROVISIONS

D.1.1 INTRODUCTION

- A. Continued development of the Sumter area and expansion of the utility, drainage, and road systems owned, operated, and maintained by the City of Sumter has resulted in the need for a quality standard for those systems being deeded to or constructed for the City of Sumter. The benefits of standardization for the City include:
1. Reduction in overall cost of operations and maintenance
 2. Reduction in total inventory of spare or replacement components
 3. Familiarity with systems resulting in reduced down time during emergencies
 4. Common standard of design, materials and construction requirements
 5. Reduced design time, review time, and overall process time from project submittal to approval
 6. Reduced installation time, inspection time, and overall process time to reach project construction approval, complete project closeout, and obtain final commissioning
- B. These standards have been adopted by City Council and incorporated into a single document titled *Minimum Standards for the Design & Construction of Utility, Drainage, and Road Systems(a.k.a. Minimum Standards)*

D.1.2 ROLES AND RESPONSIBILITIES

- A. The following covers roles and responsibilities of the parties involved in the overall submittal and approval process for new utility, drainage, and road systems and is applicable to all developments requiring water and/or wastewater service from the City. This includes those projects that have main extensions, improvements to existing water and wastewater systems, and water and sewer service only requests.
- B. City of Sumter
1. City of Sumter Engineering Staff will:
 - (1) Determine water and/or wastewater service availability

- (2) Perform a hydrostatic flow test at the request of the Developer or the Developer's Engineer
 - (3) Determine all applicable fees
 - (4) Review project plans and permit applications for conformance with the requirements of these standards
 - (5) Ensure proposed plans are consistent with the City's long-term plans
 - (6) Sign Developer Engineer's prepared SCDOT encroachment permit applications
 - (7) Identify and communicate to the Developer and the Developer's Engineer any required changes when plans are not in conformance with the requirements of these standards
 - (8) Upon receipt of a SC DES Permit to Construct, distribute plans stamped "Approved for Installation"
2. City of Sumter Engineering Inspection Staff will:
 - (1) Observe and document construction related activities to ensure compliance with the requirements of these standards and City approved plans
 - (2) Require work determined not in compliance with these standards and/or approved plans to be promptly corrected to the satisfaction of the City
 - (3) Review and approve project Record Drawings
 - (4) Perform a final inspection for acceptance of the constructed water, sewer, drainage, and road systems. A final inspection will not be performed without an approved completed set of as-built plans
 3. City of Sumter Engineering Staff will:
 - (1) Review and approve required project closeout documents to be submitted to City Council for acceptance
 - (2) Provide final Operation and Maintenance (O&M) letter(s) to SC DES once City Council has accepted the ownership of the water and sewer system
 - (3) Submit a Service Acceptance notification to City Public Works and Planning Department
- C. Developer
1. The Developer shall be considered the person or entity initiating the development of a new residential or commercial property or improvement to an existing residential or commercial property and

is requesting water and/or wastewater service. This can be, but is not required to be, the Owner of the property. This person or entity shall have legal authority to execute necessary permits, applications, and legal documents which require the Owner's signature. This same person or entity will execute all documents throughout the project unless the project is sold and/or this authority is transferred to the new Owner or owners agent

2. The Developer will:
 - (1) Provide accurate information as to the person or entity responsible for the development and their contact information
 - (2) Be responsible for payment of all fees required in accordance with these standards
 - (3) Be responsible for the execution of all documents required for project closeout
 - (4) Be financially responsible for future requests for repairs, if any arise, during the maintenance agreement period after takeover of the constructed system(s) by the City

D. Developer's Engineer

1. The Developer's Engineer is the Engineer hired by the Developer or Property Owner to prepare and design plans for the project
2. The Developer's Engineer will:
 - (1) Request determination of water and/or wastewater service availability
 - (2) Request a hydrostatic flow test for all water projects
 - (3) Prepare and submit plans to the City of Sumter in accordance with the requirements of these standards and will be the engineer of record for the project
 - (4) Provide a survey of existing conditions
 - (5) Revise the plans in accordance with the City of Sumter's requirements
 - (6) Submit to the City of Sumter the SC DES permit application package
 - (7) Submit to the City of Sumter Engineering Department all encroachment permit applications for execution. Developer's Engineer is responsible for submission of encroachment permit to appropriate permitting agencies, and ensure all encroachment permits are closed prior to Commissioning

- (8) Schedule and attend scheduled Preconstruction Meeting with the assigned City of Sumter Engineering and Public Works Department staff prior to beginning construction
- (9) Monitor all phases of the work in progress during construction to ensure all utility, drainage, and road installations are in conformance with the approved plans and these standards. The City of Sumter accepts no responsibility or liability for work rejected due to non-conformance
- (10) Conduct required testing of systems in the presence of the City of Sumter Engineering and/or Public Works Staff
- (11) Promptly notify the City of Sumter Engineering and Public Works Staff concerning any changes which may be necessary during the progress of the work. No changes to the approved plans shall be performed without prior written approval from the City of Sumter Engineering Staff
- (12) Certify in writing that the utility, drainage, and road work was performed in accordance with the approved plans and these standards
- (13) Coordinate, compile, and submit accurate Record Drawings to the City of Sumter in accordance with these standards. Record drawings shall be stamped and signed by the engineer of record
- (14) Schedule a Final Inspection and/or Commissioning with the assigned City of Sumter Engineering Staff to determine conformance with the approved plans
- (15) Provide all information and submittals as required for project closeout and acceptance for ownership by the City of Sumter as defined in **Chapter D.10 (Inspections and Closeout)** of these standards

Chapter D. Engineering

D.2. DEVELOPMENT FEES

D.2.1. DEVELOPMENT FEES

A. General Information

1. The Developer shall be responsible for payment of all applicable development fees
2. The City of Sumter's development fees are subject to review by City Council and may be amended from time to time. Projects will be subject to the most current fees in effect at the time full payment is received
3. When designing water and/or wastewater systems, the Developer and the Developer's Engineer shall adhere to all policies included in the *City of Sumter Minimum Standard for Design & Construction of Utility, Drainage, and Road Systems*.

B. Tap and Impact Fees

1. Water
 - (1) Tap Fees- At the time of application for water service, a water Tap Fee shall be assessed to the customer for each meter based on its size, the purpose of which is to recover costs to the City of inspection and installing the meter and associated appurtenances
 - (2) No Tap Fee will be charges for dedicated, unmetered fire services
2. Wastewater
 - (1) Tap Fees – At the time of application for wastewater service, a Tap Fee shall be assessed to the customer for each tap based on its size, the purpose of which is to recover costs to the City for inspecting the tie-in of the customer's service line to the City's System service lateral at the property line or easement line

C. Engineering Services Fee

1. The City of Sumter will charge an Engineering Services Fee of \$500 as a component of each water and wastewater Tap Fee assessed. The Engineering Services Fee will serve to fund the cost of reviewing plans, specifications, design documents, sketches, calculations, and providing other

- associated administrative services and construction inspection services associated with new development and the installation of new utilities and roadways
2. The Engineering Services Fee will be charged on service only projects that are inclusive of a new manhole, hydrant, or main modification to cover the cost of inspection
- D. Maintenance Agreement Bond
1. The Maintenance Agreement includes a 15% guarantee based on the installed value of the water, sewer, drainage system and roadways documented in the Asset Inventory Worksheet submitted by the Developer's Engineer at project closeout. The guarantee - an Irrevocable Standby Letter of Credit from a financial institution or other instrument readily convertible to cash. The guarantee will be held for a period of 2 years from the date of Commissioning and will be refunded upon completion of the Maintenance Agreement Final Inspection, provided no deficiencies are found
 2. If deficiencies are found and the Developer does not correct these deficiencies, the bond will be used to cover the City's costs to make corrections. In which case, the entire bond amount will then be forfeited
 3. Payment of the Maintenance Agreement Bond must be received prior to issuance of the Service Acceptance Letter
 4. In some instances, service only projects will be required to provide a Maintenance Agreement Guarantee
- E. Maintenance Agreement Final Inspection Fee
1. Prior to releasing the Maintenance Agreement Guarantee, the City of Sumter will perform a final inspection of the installed water and/or wastewater system assets. For the purpose of making said inspections, a Maintenance Agreement Final Inspection Fee is charged. The Maintenance Agreement Final Inspection Fee will be based on the installed linear footage of water and/or wastewater mains as documented in the Asset Inventory Worksheet submitted by the Developer's Engineer at project closeout. Payment of the Maintenance Agreement Final Inspection Fee must be received prior to issuance of the Service Acceptance Letter
- F. Origination Fee

1. The Origination Fee is a fee charged to offset administrative and customer service costs required to establish a new account and to render a final bill when the account is closed

G. Other Fees

1. The City of Sumter's Water Distribution and Wastewater Collection Departments may charge additional fees.

DRAFT

Chapter D. Engineering

D.3.SUMBITTALS AND APPROVALS

D.3.1.SUBMITTALS AND APPROVALS

A. General

1. The City will consider for operation and maintenance only those utility, drainage, and road systems which are within the boundaries of the City's service area
2. Design and construction of utility, drainage, and road systems shall be in accordance with these standards
3. All connections to the City's existing water and wastewater systems, whether a system extension or new service only connection, must be approved in writing by the City
4. No utility, drainage, or road system components shall be put into service prior to the receipt of all approved project closeout documents, applicable fees, and the Permit to Operate as issued by the South Carolina Department of Environmental Services (SC DES) and accepted for ownership by City Council
5. The City has specific requirements and specifications for the selection and installation of backflow prevention assemblies. Information regarding The City's backflow prevention requirements is available on the Public Works Department website
6. The City has specific requirements for grease traps. For all services that may require a grease trap (typically all food/beverage serving and/or preparation establishments), a **Grease Trap Application (see application)** must be submitted to the City for review. Additional submittals including drawings/schematics for the proposed grease trap and plumbing connections may be required after initial application review. Grease Trap Applications must be approved by the City in writing prior to installation, and a complete inspection of the installed grease trap and connected kitchen fixtures must be performed by the City prior to service acceptance.

7. Those individuals associated with implementing projects are strongly encouraged to meet with the City's Engineering & Public Works Department staff to review plans and coordinate proposed projects with City of Sumter's long-term master plans
 8. A full description of the City of Sumter's fees can be found in **Chapter D.2 (Development Fees)** of these standards. The City's fees are subject to review by Council and may be amended from time to time
- B. Water and Wastewater Service Availability
1. The initial step for any new water or wastewater system being considered by the City is submission of a Request for Service Availability to determine service availability for the proposed development
 2. The information provided in the Request for the Service Availability will be utilized by the City Engineer to perform a preliminary hydraulic analysis of the proposed water and/or wastewater system
 3. Based on the results and conclusion determined by the preliminary hydraulic analysis, a Service Availability Letter will be issued by the City's Engineer stating whether service is available or is not available for the proposed development and directives for water and wastewater connection points
 4. A Service Availability Letter will be valid for 12 months from the date of issuance
 5. Any subsequent changes to the proposed development deemed significant
 6. by the City Engineering may require submission of a revised Request for Service Availability and issuance of a revised Service Availability Letter
 7. No Preliminary Fee Determination or Plan Review will be conducted without a valid Service Availability Letter stating the City's willingness and ability to provide water and/or wastewater service
- C. Preliminary Fee Determination
1. Upon receipt of a Service Availability Letter, a Preliminary Fee Determination package shall be submitted to the City's Engineering Department. The package shall include the following items (in digital format):
 - (1) Completed Preliminary Fee Determination Worksheet
 - (2) Valid Water and/or Wastewater Service Availability Letter
 - (3) Copy of water and/or wastewater system plans
 - (4) Copy of demolition plans, if applicable

- (5) Copy of existing conditions survey showing all existing utilities
 - (6) Water and/or wastewater calculations
 - (7) Copy of City Public Works Department hydrostatic flow test results
 - (8) Completed Asset Inventory Worksheet (submitted in Excel format) showing Developer Engineer's line-item cost estimate for the water and/or wastewater assets to be turned over to the City at the end of the project. Cost estimates should reflect, in general, all expenses associated with bringing the assets into service
 - (9) Additional information may be requested to complete a fee determination
2. The City will provide a Preliminary Fee Determination for the following:
 - (1) Engineering Services Fee
 - (2) Tap Fees
 - (3) Description of Project Closeout Fees
 - (4) For a full description of fees refer to **Chapter D.2 Development Fees** of these standards

D. Plan Review

1. Submittal Requirements and Plan Review Process
 - (1) Upon receipt of the Preliminary Fee Determination, the Developer or the Developer's Engineer shall submit a plan review package to the City Engineering Department. The package shall include the following items, or Plan Review will not proceed:
 - i. Engineering Services Fee Deposit
 - ii. Plan Review Application
 - iii. Water and/or wastewater system plans and drainage and road plans to include all details, drawn to a horizontal scale no smaller than 1-inch equals 50 feet and a vertical scale no smaller than 1 inch equals 5 feet. Plans should also be submitted electronically to engineering@sumtersc.gov. Plans shall be signed, sealed and dated by an Engineer licensed in the state of South Carolina and shall include the following:
 - a. Complete system design
 - (a) Include the following plan sheets: cover, general development, site plan, building layout, drainage, landscape, demolition,

existing conditions survey, water and wastewater system plans, and applicable City details

- (b) Landscape plans shall include any proposed hardscapes (i.e., signage, architectural columns, retaining walls or other types of above ground and underground structures)
- (c) Demolition plans shall include all existing water and wastewater services, with those proposed for abandonment clearly identified
- (d) Existing conditions survey shall include all existing utilities.

Requests for investigation to identify and mark existing services by the City's Public Works may be coordinated based upon the City's Public Works availability

- b. Plan and profile view for all water, wastewater, drainage, and road projects
- c. All fittings and appurtenances shall be clearly labeled with description and stationing. Use of Key notes should be limited
- d. All vertical and horizontal bends shall be shown and labeled on both the plan and profile view
- e. Profile for wastewater gravity sewer mains
- f. Profile for all water mains
- g. Profiles shall show and label (size, type, material, depth) for all utility crossings
- h. Profile for all water and wastewater mains installed by Jack and Bore or Horizontal Directional Drill or where steel casing is used
- i. For commercial developments, provide location and size of all proposed water and wastewater services along with addressing plan
- j. County Tax Map Reference Number of Property
- k. All public and private rights-of-way. Plans should indicate ownership of existing roadways (City, County, or State), road width and right-of-way width. Indicate the agency to operate and maintain proposed roadways
- l. Location, type, ownership, and width of all existing and proposed easements to include the City utility easements. In the event a proposed City utility easement encroaches upon or crosses an existing easement owned by another entity, an encroachment

permit shall be obtained from the existing easement holder. No plan approval will be issued without an executed copy of the encroachment permit being provided to the City. Please see **Chapter D.4 Easements** of these standards for additional details and requirements

- iv. 1 set of water and/or wastewater calculations signed, sealed and dated by an Engineer licensed in the state of South Carolina. Calculations shall be in accordance with the requirements set forth in the applicable sections of these standards
 - a. Water Mains – Chapter **D.7.1** Water Distribution System Design Standards. For commercial developments requesting water for temporary fire protection, provide additional fire flow calculations based on the size of the proposed backflow prevention assembly and fire service meter
 - b. Wastewater Gravity Sewer Mains – Chapter **D.8.1**, Wastewater Collection System Gravity Sewer Design Standards
 - c. Wastewater Force Mains - Chapter **D.8.4**, Wastewater Collection System Force Main Design Standards
 - d. Wastewater Pump Stations – Chapter **D.8.7**, Wastewater Collection System Pump Station Design Standards

- (2) Upon review of the submitted Plan Review items, the City will return to the Developer's Engineer:
 - i. Written design change requirements in the form of the official comment log and/or 1 set of plans indicating necessary corrections
 - ii. Request for any other required information pertinent to the proposed project
 - iii. Backflow review comments, if applicable

E. Plan Approval

- 1. Upon receiving the required design change requirements, the Developer's Engineer shall submit to the City Engineering Department 1 hard copy set of revised system plans along with the Developer's Engineer responses to the official comment log. Once an acceptable set of plans are approved, the City will notify the Developer's Engineer in writing or email
- 2. Upon notification of plan approval, the Developer's Engineer shall submit to the City the following:
 - (1) 1 complete sets of approved plans

- (2) Completed SC DES Construction Permit Application package
- (3) All information necessary to obtain required encroachment permit(s) in PDF format. Approved Contractor or Developer's Engineer is responsible for submission of encroachment permit

F. Construction Activity

1. The SCDES Permit to Construct and all applicable encroachment permits must be received by the City prior to beginning construction
2. Plans stamped "Approved for Installation" for main extension projects or "Approved for Construction" for service only projects will be distributed to the Developer and the Developer's Engineer for use by the Contractor. No construction activity shall proceed prior to receipt of stamped approved plans. These stamped approved plans shall remain with the Contractor on site at all times
3. Prior to construction activities, a Preconstruction Meeting shall be conducted. The Developer's Engineer shall schedule and attend the Preconstruction Meeting with the assigned City Construction Inspector. The Developer (or representative), Developer's Engineer (or representative), Contractor (to include any sub- contractors working on the utility, drainage, and road systems, and the City's Construction Inspector shall attend at a minimum
 - (1) The Preconstruction Meeting shall be held no more than 60 calendar days prior to the start of actual construction
 - (2) If construction does not begin within 60 calendar days of the Preconstruction Meeting, another Preconstruction Meeting shall be held
 - (3) If the selected Contractor chooses to use a sub-contractor to perform work on the project, the Contractor shall provide a written plan as to how they will manage and provide project oversight. The Contractor is responsible for the construction of all utility, drainage, and road installations
4. All required encroachment permits must be received by the City prior to performing construction activities in any existing public rights-of-way and/or easements
5. The Developer's Engineer is responsible for monitoring the project as required to ensure construction of the utility, drainage, and road systems meets all design requirements and the City's Minimum Standards. The Developer's Engineer shall provide its project inspection reports to the assigned City Construction Inspector upon request

6. If installation per the City approved plans cannot be achieved due to conflicts with other utilities (or sub-grade obstructions), the Contractor shall immediately notify the Developer's Engineer and the City Construction Inspector. No deviation from the City approved plans will be allowed without prior written approval from the City
7. If any requirements for carrying out project construction are not met, the City reserves the right to have the Developer or Developer's Engineer issue a STOP WORK ORDER

DRAFT

Chapter D. Engineering

D.4.EASEMENTS

D.4.1. EASEMENTS

A. General Information

1. Easements for all water, wastewater, and storm drain utility and associated appurtenances to be conveyed to the City, shall require the developer or the developer's engineer to submit easement form and drawing illustrating the easement to the city's engineering department for approval prior to constructing the utility
2. Easements shall be platted to provide equal distance on each side of the installed water, wastewater or storm drainage utility within the easement. The plat shall state the easement is for the City and the type of utility installed in the easement
3. Easements shall be clear of trees and debris and grassed unless other treatment is specified and approved by the City
4. Obstructions within, above, or below any easement such as buildings, building footers, building overhangs, canopy-type trees, overhead structures or other objects or structures which may limit access to or use of the entire easement by the City are not permitted
5. Standard asphalt or concrete pavement is acceptable within easements. Any standard asphalt or concrete pavement that is damaged by subsequent construction or maintenance by the City will be repaired or replaced with standard, readily available asphalt or concrete materials only. Decorative pavers, pervious pavement or other atypical asphalt or concrete materials utilized over the surface of the City's easement shall be the responsibility of the property owner for repair and/or replacement. Decorative pavers, pervious pavement or other atypical asphalt or concrete materials utilized over the surface of the City's easement will not be allowed
6. When applicable, the City utility easements shall be extended to the nearest property line that is shared with the adjoining property owner in a manner that does not conflict with current or future use of the property

7. In the event a proposed City utility easement encroaches upon or crosses an existing easement owned by another entity, an encroachment permit shall be obtained from the existing easement holder. Such encroachment permit shall be obtained by the Developer or the Developer's Engineer and shall be in the name of the City. The City shall have the right to review and accept or reject any terms of the proposed encroachment permit prior to its final approval and acceptance by the City of Sumter

B. Easement Width

1. All utility easements to be conveyed to the City shall have a width of 30 feet. The easement will be centered on the centerline of the utility line installed. The edge of easement shall not be less than 10 feet from any structural footer or permanent structure wall

C. Easement Plat

1. Prepare Final Plat shall state the easement is for the City, the type of utility installed in the easement, and the easement width
2. If a utility easement exists for the use of HOA or other entities the final plat should state, the easement owner and type of utility located in the easement
3. For additional information regarding easement plat requirements, refer to the Easement Checklist

D. Easement Agreement

1. As an instrument of conveyance, an easement form completed and signed by developer shall be recorded with the final subdivision plat. A copy of the recorded easement form shall be sent to the engineering department

Chapter D. Engineering

D.5. ROADWAY

D.5.1. ROADWAY DESIGN REQUIREMENTS

A. Roadway Design Requirements

1. All new roads and drainage shall be constructed by the developer at no cost to the City of Sumter. The developer shall be responsible for obtaining all permits. Required improvements under this section shall not be installed or constructed until required site plans have been approved by the City and an order to proceed has been issued

B. Road Classification

1. Local Street
 - a. Provides direct access to lots. Access streets shall be designed so no road section conveys an ADT greater than 250
2. Collector (Minor)
 - a. Provides direct access to lots and carries traffic from local streets. Designed to carry higher traffic than local streets. Sub-collectors shall be designed so that no road section conveys an ADT greater than 1,000 within residential areas. If proposed ADT exceeds this threshold, then an increase in pavement traffic classification is required.
3. Collector (Major)
 - a. Conducts and distributes traffic between access/sub-collector and arterial streets. Function is to promote free traffic flow; therefore parking and direct access to homes from this level of street shall be prohibited. Collectors shall be designed so that no road section conveys an ADT greater than 2,000. If proposed ADT exceeds this threshold, then an increase in pavement traffic classification is required
4. Arterial
 - a. Principal traffic artery that carries relatively high traffic volumes and convey traffic from access and collector streets. Its function is to promote the flow of traffic. Minor arterial shall be designed and constructed according to most SCDOT standards

C. Road Right-of-Way Widths

The following sections are descriptions, either textual or graphical, of typical required road right-of-way widths for select categories of road types

Local Street and Collector (Minor)

Width	
A. Right-of-Way Width	50'
B. Back-of-curb to back-of-curb	27'
Streetscape	
C. Sidewalk (min)	5' (both sides)
Travelway	
D. Travel lane	12' (pavement edge to pavement edge)
E. Grass verge	5' (both sides)
F. Sidewalk	5' (both sides)
G. Curb & Gutter	1.5' (both sides)
Engineering Specifications	
H. Design speed (mph)	25 mph
I. Design vehicle	Passenger vehicle
J. Driveway spacing	As needed
K. Curb radii	25'
L. Lighting	Required on all public streets for new development

Collector (Major) & (Minor)

Width	
A. Right-of-Way Width	66'
B. Back-of-curb to back-of-curb *	39'
Streetscape	
C. Sidewalk (min)	5' (both sides)
D. Grass verge	5' (both sides)
Travelway	
E. Travel lane **	12' (pavement edge to pavement edge)
Engineering Specifications	
F. Design speed (mph)	35 mph
G. Design vehicle	All vehicles
H. Signalized intersection density	As warranted

I. Driveway spacing	As needed
J. Median opening distance	N/A
K. Partial Medians / Island	No
L. Curb Radii	5 -10'
M. Lighting	Required on all public streets for new development, pedestrian scale optional and responsibility of developer
N. Permitted furniture	Bicycle racks, benches, parking meters

*Number of travel lanes will be determined by the traffic count

D. Pavement Width and Curb

1. Residential, collector, and arterial roads shall measure pavement width from pavement edge to pavement edge
2. Curb and gutters shall be installed on all paved roads. The curb shall consist of rolled curbed shown as **Figure A**

E. Road Geometric Design

1. Unless specifically addressed in these regulations, all geometric elements of roadway design for streets and roads in the City of Sumter Road System will be in accordance with the AASHTO Policy on Geometric Design of Highways and Streets and the SCDOT Roadway Design Manual
2. Horizontal Curves
 - a. Horizontal curves are to be introduced at all changes of direction on collector, local, and arterial streets. Refer to the SCDOT Roadway Design Manual for further information. The minimum radii of curvature are to be in accordance with Table 1. Refer to the SCDOT Roadway Design Manual for further information

Table 1: Street Classification Requirements

Street Classification	Stopping Site Distance (ft)	Min. Curve Radius (ft)	Max. Grade (%)
Minor Residential	160	150	12
Local Residential	160	150	12
Collector	275	350	12
Arterial	*	*	*

*Dependent on design speed selected

3. Vertical Curves
 - a. Crest vertical curves are to be of sufficient length to provide the minimum stopping sight distance at the design speed. Refer to the SCDOT Roadway Design Manual for further information
4. Intersections
 - a. The centerlines of no more than two (2) streets shall intersect at any one point. The centerlines of intersecting streets are to be perpendicular. All angles and distances are measured relative to the intersection of a street centerline
5. Curb Radius
 - a. The minimum acceptable curb radius at intersections is 25 feet. Larger radii must be provided in accordance with the AASHTO Policy on Geometric Design of Highways and Streets when significant tractor-trailer, or other large vehicle, traffic is expected
6. Dead End Streets
 - a. Cul-de-sacs shall not exceed 500 feet in length unless necessitated by topography or property accessibility and are approved by the City. Measurement shall be from the point where the centerline of the dead-end road intersects with the centerline of a general circulation road to the center of the turnaround of the cul-de-sac. Where one cul-de-sac extends from another cul-de-sac, the end of each cul-de-sac shall be no more than 1,200 feet from a general circulation road as measured by the centerline of the roads. Cul-de-sacs shall terminate in a circular turnaround having a minimum right-of-way of at least 100 feet in diameter and a paved turnaround with a minimum outside diameter of 80 feet

F. Sidewalks

1. Sidewalks in residential developments shall be constructed on both sides of the road to meet the following standards:
 - a. The minimum width of all sidewalks shall be five feet
 - b. Sidewalks shall match the grade or elevation of adjacent sidewalk at the property lines; if there is no adjacent sidewalk, the sidewalk shall be six inches above the adjacent edge of the pavement grade at the property line
 - c. Sidewalk shall have a maximum cross slope of 2%
 - d. Sidewalks shall be constructed to meet the minimum requirements of the Americans with Disabilities Act (ADA)
2. All sidewalks must be installed at the time of road acceptance by the City

G. Temporary Dead-End Roads and Half Roads

1. Temporary dead-end roads shall be provided with a temporary turnaround having a roadway surface diameter of 80 feet
 - a. This is only allowed for one (1) year and must be permitted with the City

H. Lateral Clearance

1. A minimum lateral clearance as shown below shall be from the back of curb
 - a. Rolled curb and gutter: 6.0 ft
 - b. Barrier type curb 4.0 ft
2. No entrance gates or other obstructions, with the exception of traffic control, street name signs, and mailboxes, are to be placed within these distances from the edge of the street
3. Trees are allowed at the right-of-way line only and must utilize a root barrier on the sidewalk and/or roadway side
4. It should be noted that the above setbacks are minimums based on the obstruction being located on a tangent. When an obstruction is located within a horizontal curve, the setback must be calculated using the equation:

$$R = \frac{s^2}{8M}$$

Where:

R = Radius of curvature at the centerline of the lane closest to the obstruction (feet)

M = Distance from the centerline of the lane to the obstruction (feet)

S = Stopping sight distance (feet)

Provided the above setbacks and sight distances requirements are met, trees may be retained or planted within the right-of-way for aesthetic or environmental purposes

I. Road Subgrade and Pavement Structure Requirements

1. A geotechnical report shall be submitted for the design of the roadway section based on subgrade soils, traffic design loads, and other factors that will affect the structural integrity of the roads. The traffic loads should include all house construction traffic as well as daily traffic of the proposed development. The roads shall have a 20 year design life. All roads to be dedicated to the City shall have a 1.5 inch surface type "C" course placed once 80% of all houses are constructed. A minimum road section of 3 inches of asphalt surface with 6 inches of macadam base course shall be used with 12 inches of sub compacted subbase soils. The surface course shall be place in two (2) 1.5

- inch lifts. The surface course shall be type "C" asphalt as defined in the SCDOT Standard Specification. The surface course, base course, and sub base shall all be constructed in accordance with SCDOT Standard Specification. The geotechnical report shall include all testing methods and requirements of the road section materials and testing of the installed materials
2. The geotechnical engineer shall provide a letter to the City stating the roads are constructed in general accordance with the project report. Any deviations from the report shall be noted in this letter. The City will not accept any roads for ownership without the geotechnical engineer's letter

DRAFT

D.5.2 ROADWAY CONSTRUCTION AND TESTING

A. Clearing and Grubbing

1. All work associated with clearing and grubbing of all debris, vegetative matter, trees, stumps, and obstructions within the limits of disturbance such as roadway, right-of-way, easement areas, ditches, etc., unless otherwise stated to remain in accordance with the approved set of plans. All clearing and grubbing work shall be authorized under a City of Sumter land disturbance permit. The contractor shall confirm all organic, vegetative matter (roots, stumps, logs, etc.) have been removed from the roadway area and document any unsuitable soil conditions with the right-of-way. The report shall be submitted to the City Engineer's office for review and approval

B. Road Embankment

1. All stumps and large roots must be removed from the roadbed prior to placement of fill for embankments regardless of fill height. All roadway sub base and embankment fill must be approved and signed off on by the geotechnical engineer. Roadway embankment fill is to be placed and compacted in lifts not exceeding eight (8) inches. The contractor is responsible for providing geotechnical testing and documentation that the sub base and fill material has been compacted to 95 percent of maximum dry density, as determined by ASTM 1557. Density testing of embankment fill is to be performed every 16 inches of fill or the fill limit, whichever is less. Spacing of density testing is to be every 250 feet of road, alternating lanes. Density testing shall be performed in accordance with the geotechnical report, however a minimum of two (2) tests per road per 16 inches of fill (or the fill limit, whichever is less). No proof-roll of the sub grade will be scheduled until the compaction has been documented and submitted to the City Engineering Department
2. Any roadway embankment modifications (extra stone, soil cement, lime treatment, geo grid, etc.) must be approved by the geotechnical engineer and the City Engineering Department

C. Materials and Equipment

1. Materials and equipment used for all roadway courses shall be in accordance with the latest edition of the SCDOT Standard Specifications and in working condition necessary for the construction, application, placement, and maintenance

2. Any geotechnical firm that is to conduct work in the City of Sumter shall hold at least one lab certification from the following agencies, and is responsible for providing their credentials when the initial proof roll is requested:
 - a. SCDOT
 - b. AASHTO
 - c. CMEC
 - d. USACE

D. Road Construction Requirements

1. The typical flexible pavement structure consists of subgrade (subbase) course, base course, and surface course and shall be in conformance with lines, grades, dimensions, and cross-sections shown on approved construction plans
2. Subgrade Course
The following subgrade course types are acceptable to the City of Sumter
 - a. Native Soils Subgrade can be used as a subgrade and must be properly prepared for construction and pavement structure
 - b. Cement Modified Subgrade can be used in the modification of an existing subgrade by adding Portland cement, pulverizing the in-place soil, mixing, shaping, compacting, curing, and finishing the mixed material to form a subbase for a pavement structure. This subgrade material shall be prepared in accordance with SCDOT Standard Specifications
3. Base Course
 - a. The following base course types shall consist of Macadam Base Course and type "B" Asphalt Base Course
4. Maintenance of Base Courses
 - a. Base courses shall be maintained in good condition until all work is complete and accepted. Any defects that may occur must be repaired immediately. Any repairs made shall be to the full depth of the subbase
5. Binder or Intermediate Course
 - a. The following Binder or Intermediate Course types are acceptable to the City of Sumter
 - i. Asphalt Concrete Intermediate Course, Type "C"
6. Intermediate Course
 - a. Intermediate Course shall be maintained in good condition until all work is complete and accepted. Any defects that may occur must be repaired

- immediately. Any repairs made shall be to the full depth of the intermediate course
- b. If intermediate course is in place for nine (9) months without surface course, the binder course is subject to an inspection. A proof roll inspection and geotechnical engineering evaluation will be required to assess the condition of the course. If the proof roll fails, then a geotechnical recommendation must be submitted for review within 10 days of the proof roll. Repairs, according to the approved geotechnical evaluation, must be completed within 30 days of the approval by the City of Sumter
7. Surface Course
 - a. The following Surface Course types are acceptable to the City of Sumter
 - i. Asphalt Surface Course Type C
 - ii. All roads will require 1.5 inches of surface course once 80% of the homes are constructed. The road section design shall be designed to support all construction traffic without the 1.5 inches of surface course
 8. Construction of Surface Course
 - a. Compacting, rolling, finishing, and opening to traffic shall be in accordance with the latest edition of the SCDOT Standard Specifications
 9. Maintenance of Surface Course
 - a. Asphalt Surface Course shall be maintained in good condition until all work is complete and accepted. Any defects that may occur must be repaired immediately. Any repairs made shall be to the full depth of the surface course
 10. Weather Restrictions
 - a. Asphalt Surface Course Type C cannot be applied on a wet surface or when the ambient temperature is below 45°F
 11. Asphalt Mixture Placement Quality Control Verifications
 - a. During all asphalt mixture placement and compaction operations, a density gauge shall be in use. Asphalt roadway quality control verifications shall be documented by a certified Asphalt Roadway Technician. The rolling and compacting roadway verification shall include the following:
 - i. Proper number and type of rolling and compacting equipment
 - ii. Identify asphalt type, depth thickness, mixture placement, and compaction during production

- iii. Document ambient air temperature
- b. If the City Engineer determines that the asphalt course has areas of non-uniformity between coarse and fine aggregate particles within the compacted surface course pavement, the contractor and developer are responsible for correcting all segregated areas. These areas are to be removed and replaced for the full depth of the surface course within 10 feet on either side of the segregated areas for the full width of the paving lane

E. Proof Rolling

1. A proof roll inspection involves the following components: the specifications for equipment, construction and requirements of testing the roadway embankment and subgrade for compaction uniformity and stability through a proof roll inspection
2. Equipment
 - a. The contractor shall ensure that the equipment used is in acceptable working condition necessary for the construction and testing in areas subject to proof roll inspections. A fully loaded tri-axle dump truck with a minimum 18,000 lbs is accepted for proof rolling. The approved equipment shall only have air-filled pneumatic tires with a pressure between 70 and 90 psi while proof rolling
3. Proof Rolling Method
 - a. Prior to scheduling any proof roll inspections, all density testing data must be submitted to and approved by the City
 - b. All proof rolls are to be performed in the presence of the City Engineer's representative, geotechnical engineer, and contractor
4. Proof Roll Types
 - a. The following proof roll types are described in the sub-sections that follow:
 - i. Concrete curb and gutter
 - ii. Cement Stabilized Earth (soil cement)
 - iii. Subgrade
 - iv. Embankment
 - v. Base course
5. Concrete Curb and Gutter Proof Roll and Soil Cement
 - a. Proof rolls may be performed for concrete curb and gutter and soil cement at the request of the contractor. No proof roll inspection can be conducted

without prior City approval of the submitted density and subgrade condition reports. Proof roll inspection shall use a fully loaded tri-axle dump truck

- b. The contractor shall schedule this inspection with the Engineering Department. The geotechnical engineer, City Engineer's Office, and contractor shall be represented and in attendance for the proof roll inspection. The City Engineer's Office reserves the right to conduct or require additional testing at any time
6. Embankment, Subgrade, and Base Course Proof Rolls
- a. Proof rolls may be performed for the embankment, subgrade, and base course at the request of the contractor. No proof roll inspection can be conducted without prior City approval of the submitted density and subgrade condition reports. Proof roll inspection shall use a loaded tandem axle dump truck only. The contractor shall schedule this inspection with the Engineering Department. The geotechnical engineer, City of Sumter Engineering Office, and contractor shall be represented and in attendance for the proof roll inspection. The Engineering Office reserves the right to conduct or require additional testing at any time. A proof roll geotechnical engineer's inspection/observation report shall be submitted to the City of Sumter Engineering Department

F. Roadway Signs/Traffic Control Devices

1. Road signs, in conformance with the requirements of the Federal Highway Administration's Manual on Uniform Traffic Control Devices latest edition
2. Roadway Signs
 - a. Shall be installed by the Developer in accordance with an approved sign plan developed by the Design Engineer

D.5.3 PAVEMENT SUBMITTAL REQUIREMENTS

A. Pavement Submittal Requirements

1. Plan and profile sheets for each road. Include all horizontal & vertical curve information. Include station numbers
2. Plan and profile should be at no smaller scale than 1 inch = 50 feet horizontal scale and 1 inch = 5 feet vertical scale
3. Show water, sewer, and storm drain utility's horizontal and vertical locations to include depths below road surface course. All utilities should be 12 inches below the base course. If utilities cannot be located 12 inches below the base course, a geotechnical engineer can design a road section allowing for the reduced sub base section
4. Provide typical roadway cross sections indicating thickness and material of each road way course (subgrade, base and surface course)
5. The surface course shall consist of lanes that are 12 feet wide from edge of asphalt to centerline of road or to the beginning of the next lane on roads with more than two lanes. The road shall have a 1 inch in 48 feet of slope from the center line of the road to the edge of pavement
6. The centerline slop of the road should not exceed 8 percent and should be a minimum of 0.5 percent. All roads designed with centerline slopes between 0.5 percent and 1 percent will require as built surveys of the roads verifying the roads are constructed with the minimum slope. The engineer of record will need to stamp and sign the as built road survey
7. All roads shall have curbs and gutters at the edge of pavement. The curbing shall consist of roll curbing as illustrated on Figure 1 or barrier curb illustrated as Figure 2
8. The road shoulder should be graded to a maximum slope of 2 percent from the back of curb to the road right of way line and should provide for positive drainage. The shoulder should be seeded with grass

Chapter D. Engineering

D.6. DRAINAGE

D.6.1. DRAINAGE PIPE AND BASIN STANDARD

A. Drainage Pipe and Basin Standard

1. The minimum size storm drainage pipe allowable shall be 18 inches in diameter. All storm drainage to be “xx” by City shall be reinforced concrete pipe (RCP)
2. The minimum allowable slope for storm drainage pipe shall be one-half of 1% (0.005 ft/ft) or a minimum flow velocity of 3 feet per second at all flow levels. Maximum allowable slope for storm drainage pipe is twenty (20) percent (0.20 ft/ft)
3. At pipe outfalls, the use of a rip-rap apron, placed on filter fabric, for a minimum distance equal to or greater than 6 pipe diameters. Use type A riprap as defined by *SCDOT Standard Specification Section 804*. Fabric shall be from SCDOT Qualified Product List
4. Type and class of storm drainage pipe, as well as the construction of pipe culverts, shall be in accordance with SCDOT’s *Supplemental Technical Specifications, Sections 714*. The proposed use of any type of storm drainage pipes other than RCP shall be considered on a case by case basis
5. A minimum of 1 foot of cover shall be provided for RCP storm drainage pipe. Storm drainage pipe shall be placed to minimize the length running under pavement. Where it is necessary for a pipe to cross the roadway, the preferred placement shall be at a 90 degree angle. All cross lines in the roadway shall be compacted in 8” lifts to 95% Standard Proctor maximum density and to 100% on the last 8” inches
6. Any “open” storm drainage cross line pipe shall extend out of the toe of the roadway embankment; in no case will the end of the pipe be within 5 feet of the roadway shoulder
7. Storm drainage pipe discharging into a drainage channel shall intersect the channel in a manner such that the interior angle measured from its centerline of flow, is at least 90 degrees. Rip-rap, or other suitable protection, is required

- from the outlet point to the bottom of the channel and on the opposite channel bank to prevent scour and erosion
8. Storm drainage pipes discharging into a wet pond below the permanent pool shall be analyzed to ensure that the tailwater conditions do not adversely impact storm drainage capacity or increase the potential for flooding. Where storm drainage pipes discharge above the permanent pool, rip-rap or other energy dissipation structures shall be designed and installed to ensure non-erosive velocities and discourage resuspension of solids in the pond
 9. An access point to allow maintenance shall be available within every 300 feet for 18" diameter pipe, every 400 feet for 24" pipe, and every 500 feet for larger storm drainage pipes
 10. The 100-year, 24-hour storm event shall be used to check all drainage designs for local flooding and, most notably, potential flood hazards to adjacent structures and/or property
 11. Hydraulic grade line and head loss calculations for determining water surface elevations shall be performed for connections to existing systems
 12. Calculations should be performed for the appropriate design storm event
 13. For storm drainage systems with less than 10 connections, Manning's Equation shall be acceptable for sizing the capacity of drain pipes for non-submerged conditions where the free water surface elevation is below the crown of the pipes
 14. Storm drain profile plots should be included in the set of construction plans
 15. Storm drainage systems shall be designed to convey stormwater runoff by gravity flow

B. Culverts

1. Proper consideration of inlet and outlet control shall be given in the design of culverts and outlets
2. The pipe, appurtenant entrance, and outlet structure should properly account for water, bed-load, and floating debris at all stages of flow
3. The outlet should be designed to resist undermining and wash-out. Rip-rap aprons, flared end sections, wing walls, or other means shall be sized and specified, as necessary
4. Culvert section techniques can range from solving empirical formulas, to using nomographs and charts, to comprehensive mathematical analysis for specific hydraulic conditions. Other widely accepted models may be used, but

must be approved by the City Engineering Department. Designs shall be based upon SCDOT requirements where applicable

5. Additional hydraulic capacity shall be required as necessary to prevent backwater effects that may adversely impact upstream property or structures

C. Headwalls and Outlets

1. All exposed ends of pipes shall be protected by a flared end section or one of the following type headwalls:
 - (1) A concrete or brick headwall plastered with grout is preferred
 - (2) A rip-rap headwall is acceptable for pipes 24" or less in a number of situations. If used, it should conform to the standard details provided in [Appendix D](#). Note that this technique requires the use of both filter fabric and grout. For pipes greater than 24", a concrete headwall with wings is required
 - (3) Where feasible, outfalls that convey newly-concentrated runoff from new development and discharge to an area without an existing channel must discharge through a natural buffer area a minimum of 50 feet in width from the property line. The discharge shall enter an energy dissipater to slow the velocity of water and convert the discharge back to sheet flow, or one that is below an erosive velocity for the site conditions before entering the buffer area. Where the concentrated runoff from the new development discharges into a channel, a stabilized outlet must be provided such that the discharge does not cause erosion of the receiving channel
 - (4) Outlets will not be allowed to discharge on fill slopes

D. Energy Dissipation

1. All concentrated discharge points shall be sufficiently stabilized, or have energy dissipating devices added, to mitigate the potential for long-term erosion of the areas receiving the stormwater flows. Calculations shall be provided justifying the design and material used. The use of energy dissipating devices shall be considered in all applications, and an explanation shall be provided for all instances where they are excluded from the design (e.g. flows enter directly into a stable, natural swale/channel)
2. Where concentrated runoff does not discharge to a channel, level spreaders, rip-rap aprons, plunge pools, etc. shall be properly designed and installed to ensure that concentrated flows are converted into sheet flow. The use of level spreaders shall be considered in all applications, and an explanation shall be

provided for all instances where they are excluded from the design (e.g. flows enter directly into a natural swale/channel)

E. Catch Basins, Yard Inlets, Manholes, and Junction Boxes

1. Materials and construction shall be prefabricated concrete box
2. Materials and construction shall be as specified in Section 719 of the SCDOT Standard Drawings
3. Side inlet catch basins or junction boxes with concrete covers shall have a metal ring and manhole lid cast within the top for easy access (e.g. pull holes in lid)
4. When the depth of a catch basin or junction box exceeds 4 feet, rungs/steps shall be provided for ascent and descent (Steps are to be ASTM-C-478, or equivalent)
5. The box top shall be a minimum of 3 feet by 3 feet. Sides shall be plastered with grout
6. All pipes entering or leaving shall not protrude more than 4 inches into the box
7. All roadway catch basins be Modified Florida Type Catch Basins
8. Yard inlets shall be designed to accommodate a given flow such that ponded water is removed within 72 hours, and does not cause flooding to adjacent buildings or other interests. As long as these criterion are met, the depth of ponded water is allowed to exceed the top of the manhole lid by no more than six (6) inches for the appropriate design storm
9. It is desirable to locate catch basins outside curve radii. If this is not reasonably possible, the catch basin shall be set back an extra foot and the face of the catch basin shall be parallel to a chord joining the two points on the curve radius located by projecting lines from the sides of the catch basin box
10. Catch basins shall contain a minimum drop of 0.2 feet from invert in to invert out
11. Floors are to be concrete with raised corners
12. Within a catch basin, the elevation at the crown of any inlet pipe shall be equal to or greater than the crown of the outlet pipe
13. Catch basins shall be field staked to ensure proper catch basin inlet alignment with the street gutter line

14. Are around all catch basins shall be backfilled in 12" lifts, compacted to 95% Standard Proctor maximum density
15. Inlet protection shall be provided at all inlets into the stormwater system during construction and until project closure procedures have been completed or notification from the City's Engineering Department has been given stating that an acceptable level of stabilization has been achieved. Guidance on design, installation and maintenance of inlet protection can be found in the *SCDES Storm Water Management BMP Field Manual (2005)*. The City does not allow inlet protection devices that are installed inside an inlet or pipe. All inlet protection devices must be located at the surface/entrance of the inlet
16. Maximum depth in which the water may pond above or around an inlet must not threaten surrounding permanent structures or facilities and ponded water shall not extend into travel lanes
17. Catch basins, yard inlets, and junction boxes shall be constructed large enough to accept the pipes entering and exiting the box. Also, when necessary, an offset lid or other means shall be provided for safe access into the box for maintenance purposes. A detail shall be provided that clearly depicts these requirements

F. Detention/Retention Structures:

1. A 50 foot minimum undisturbed buffer is required between the property line and drainage outfall. Where the pond discharges into a new or existing channel, the 50 foot setback applies, and the channel must be stabilized against erosion
2. All ponds shall have an emergency spillway designed to safely pass the 100-year storm event. Earthen emergency spillways shall be designed so as not to overtop during the 25-year storm event. Larger ponds that fall under the purview of the Dams and Reservoirs Safety Act must comply with those regulations
3. Corrugated metal pipe (CMP) is not allowed through pond dams; only RCP shall be allowed
4. Any development that uses a parking area or other feature for detention storage capacity shall clearly identify the limits and depths of the expected detention pool. Travel lanes cannot be used as detention storage
5. Basin configurations which create stagnant water conditions shall be avoided

G. Open Channel Hydraulics

1. Open Channels shall include all permanent storm drainage channels including swales and diversions. These storm drainage systems shall be designed based upon the following criteria
 - (1) Each swale design configuration (i.e. width, depth, side-slopes, and longitudinal slopes) used for a site must be provided- no “typical details” shall be allowed for sites that have multiple swale design configurations
 - (2) All open channels are to be uniform and shall be stabilized to prevent erosion. A number of acceptable techniques are shown in the current version of the *SCDES Storm Water Management BMP Field Manual (2025)*
 - (3) The design of open channels shall be based on Manning’s Formula where backwater effects from obstructions and/or tailwater are not present. Flow velocities must be non-erosive to soils present or the channel surfaces must be adequately lined (e.g. rolled erosion control product, rip-rap, concrete). All channels in clayey soils shall be limited to a maximum flow velocity of 5 feet per second. All channels in sandy soils shall be limited to a maximum flow velocity of 2.5 feet per second
 - (4) The minimum channel grade shall be 0.005 ft/ft, there will be no pools or standing water areas formed in the channels at smaller slopes
 - (5) Design conditions can be assumed to be steady, uniform flow
 - (6) Except for roadside ditches, the side slopes of grassed lined channels without rolled erosion control products or turf reinforcement matting shall be no steeper than 3H:1V
 - (7) Channels may be designed with multiple stage levels with a low flow section to carry the 2-year storm event and a high flow section to carry storms of larger frequencies

Chapter D. Engineering

D.7.WATER

D.7.1. WATER DISTRIBUTION SYSTEM DESIGN STANDARDS

A. General

1. The following water system design standards are based on Federal, State, and local health requirements and the requirements of the City.
2. These design standards are applicable to all development requiring water service from the City
3. As a general rule, the City does not allow aerial water main crossings. Examples of aerial crossings include, but are not limited to, water mains constructed on piers or pilings, and water mains attached to structures such as roadways, bridges or piers
4. Where it is necessary for water mains to cross surface water or wetlands, the preferred method of installation is by Horizontal Directional Drill or Jack and Bore. In either case, the Developer's Engineer is encouraged to meet with the City to discuss method of installation prior to submitting development plans for plan review

B. Design Criteria

1. Design water mains in accordance with the requirements of the South Carolina Department of Environmental Services (SCDES) *State Primary Drinking Water Regulation R.61-58* and the requirements of these standards
2. Plan and Profile
 - (1) Provide plan view for all water mains drawn to a horizontal scale no smaller than 1-inch equals 50-feet
 - (2) When required, provide water main profile drawn to a vertical scale no smaller than 1-inch equals 5-feet
 - (3) Provide plan and profile for all water mains
 - (4) Provide plan and profile at each location where water main crosses over or under a storm drainage pipe or structure, or sewer lines
 - (5) Provide plan and profile for all water mains installed by jack and bore or horizontal directional drill

3. Water mains shall not be closer than 25-feet horizontally from any portion of a wastewater tile field or spray field. If this separation is not possible, the water mains shall be protected by an acceptable method approved by SCDES and the City
4. Water mains shall be located outside of contaminated areas. Where it is necessary for water mains to cross contaminated areas, the Developer's Engineer shall submit proposed method of construction to the City for review and approval prior to submitting development plans for plan review
5. There shall be no connection between the water distribution system and any pipes, pumps, hydrants, or tanks whereby unsafe water or other contaminated materials may be discharged or drawn into the system
6. Locate water mains, valves and meters outside of paved roadway, if possible. Do not locate water mains, valves, meters or hydrants under or behind parking spaces or in any other areas that could inhibit access for operations and maintenance
7. Minimize dead ends by looping of all water mains. Arrange water mains so they are looped and interconnected at intersections without using crosses
8. Where dead-ends occur, provide a fire hydrant on water mains 6-inch and larger and a yard hydrant on water mains less than 6-inch. Size flushing devices to provide flows with a velocity of at least 2.5 fps in the water main being flushed
9. All water mains installed by direct bury or jack and bore shall be ductile iron pipe or C900 DR14 PVC
10. All water mains installed by horizontal directional drill shall be High Density Polyethylene (HDPE)
11. Provide restrained joint pipe and fittings on all piping at each fitting, valve, and fire hydrant connection. The location and length of restrained joint pipe will be clearly marked on the plans
12. Provide minimum 36-inch to maximum 48-inch cover at finished grade. Justification and any deviation must be acceptable to the City
13. Water Main Size
 - (1) Minimum water main size shall be 6-inch. 4-inch mains may be allowed on dead-end lines provided the main cannot be extended and the main does not provide fire protection

- (2) Maximum water main size shall be no larger than the water main from which it is being extended from or, in the case of a looped water main, no larger than the water main to which it is being extended to, whichever being the larger
- (3) The City reserves the right to stipulate the maximum water main size for any water main extension

C. Capacity Design

- 1. Size mains based on either 1/5 the maximum instantaneous demand plus fire flow or maximum instantaneous demand, whichever is greater. The minimum pressure under conditions of maximum instantaneous demand shall be 25 psi at every service tap. 20 psi will be acceptable at any service tap when fire flows or flushing flows are provided in excess of maximum peak hourly flow
- 2. Minimum design fire flow shall be 500 GPM
- 3. Hydraulic calculations shall be based on the available static and residual pressure in the main to be extended. These pressures will be from a fire hydrant flow test performed by the City
- 4. Use Hazen and Williams design coefficient, C=120
- 5. The maximum instantaneous demand is to be calculated using the tables provided below, as published in the *Community Water System Source Book* by Joseph S. Ameen

Table D.7.1-1 – Maximum Instantaneous Flows for Residential Areas

Number of Residences Served	Flow per Residence in GPM
1 (First)	15.0
2 – 10*	5.0
11 – 20**	4.0
21 – 30	3.8
31 – 40	3.4
41 – 50	3.2
51 – 60	2.7
61 – 70	2.5
71 – 80	2.2
81 – 90	2.1
91 – 100	2.0

101 – 125	1.8
126 – 150	1.6
151 – 175	1.4
176 – 200	1.3
201 – 300	1.2
301 – 400	1.0
401 – 500	0.8
501 – 750	0.7
751 – 1,000	0.5

* Second, third, etc. through tenth residence served

** Eleventh, twelfth, etc., through twentieth residence served

Table D.7.1-2 – Maximum Instantaneous Flows for Commercial Areas

Type of Business	GPM on Basis Shown
Barber Shop	3.0 gpm per chair
Beauty Shop	3.0 gpm per chair
Dentist Office	4.0 gpm per chair
Department Store*	1.0 – 2.0 – 3.0 gpm per employee
Drug Store	5.0 gpm
with fountain service	add 6.0 gpm per fountain area
serving meals	add 2.0 gpm per seat
Industrial Plants**	4.0 gpm plus 1.0 gpm per employee
Laundry	30.0 gpm per 1,000 pounds of clothes
Launderette	8.0 gpm per unit
Meat Market, Super Market	6.0 gpm per 2,500 sq ft floor area
Motel, Hotel	4.0 gpm per unit
Office Building	0.5 gpm per 100 sq ft floor area or 2.0 gpm per employee
Physician's Office	3.0 gpm per examining room
Restaurant	2.0 gpm per seat
single service	6.0 to 20.0 gpm total
drive-in	2.0 to 7.0 gpm total
Service Station	10.0 gpm per wash rack
Theater	0.2 gpm per seat

drive-in	0.2 gpm per car space
Other Establishments***	Estimate at 4.0 gpm each

* Including customer service

** Not including process water

*** Non-water using establishments

Table D.7.1.-3 – Maximum Instantaneous Flows for Institutions

Type of Institution	Basis of Flow, GPM
Boarding Schools, Colleges	2.0 gpm per student
Churches	0.4 gpm per member
Clubs: Country, Civic	0.6 gpm per member
Hospitals	4.0 gpm per bed
Nursing Homes	2.0 gpm per bed
Prisons	3.0 gpm per inmate
Rooming House	Same as Residential*
Schools: Day, Elementary, Junior High, Senior High	
Number of Students	GPM Per Student
0 – 50	2.00
100	1.90
200	1.88
300	1.80
400	1.72
500	1.64
600	1.56
700	1.44
800	1.38
900	1.32
1,000	1.20
1,200	1.04
1,400	0.86
1,600	0.70
1,800	0.54
2,000	0.40

* Each unit of an apartment building should be considered as an individual residence.

D. Relation to Sewer Mains

1. There shall be no physical connection between a public potable water supply system and a sewer, or appurtenance thereto which may permit the passage of any sewage or polluted water into the potable supply. No potable water pipe shall pass through or come into contact with any part of a gravity sewer manhole
2. Horizontal and Vertical Separation:
 - (1) Water mains shall be laid at least 10-feet horizontally from any existing or proposed sewer main. The distance shall be measured edge to edge. For water mains where it is not practical to maintain 10-foot separation, deviation may be allowed provided that the water main is in a separate trench or on an undisturbed earth shelf located on one side of the sewer main and at an elevation so the bottom of the water main is at least 18-inches above the top of the sewer main
3. Crossings
 - (1) Water mains crossing sewer mains shall be laid to provide a minimum vertical distance of 18-inches between the outside of the water main and the outside of the sewer main. This shall be the case whether the water main is either above or below the sewer main. Whenever possible, the water main shall be located above the sewer main. The crossing shall be arranged so that the water main joints will be equidistant and as far as possible from the sewer main joints. Where a water main crosses under a gravity sewer main, adequate structural support shall be provided for the gravity sewer main to maintain line and grade
 - (2) Where it is not practical to obtain proper horizontal and vertical separation as stipulated above, both the water main or the gravity sewer main shall be installed in a watertight steel casing that extends 10-feet either side of the crossing, measured perpendicular to the outside of the water main.

E. Relation to Storm Drains

1. General
 - (1) No water main shall pass through or come into contact with any part of a storm drain pipe or structure
2. Horizontal Separation

(1) Water mains shall be laid at least 5-feet horizontally from any existing or proposed storm drain pipe or structure. The distance shall be measured edge to edge

3. Crossings Above

(1) Water mains crossing above storm drains shall be laid to provide a minimum vertical separation of 12-inches between the outside of the storm drain and the outside of the water main

4. Crossings Below

(1) Single Barrel, 18-inch Diameter or Less

- i. Water mains crossing below a single barrel storm drain pipe 18-inch diameter or less shall be laid to provide a minimum vertical separation of 18-inches between the outside of the storm drain and the outside of the water main
- ii. Where vertical separation is between 18-inches and 42- inches, one full length of ductile iron water main shall be centered under the storm drain crossing. The crossing shall be arranged so that the water main joints will be equidistant and as far away as possible from the storm drain crossing

(2) Single Barrel, 30-inch Diameter or Greater

- i. Water mains crossing below a single barrel storm drain pipe 30-inch diameter or greater shall be laid to provide a minimum vertical separation of 18-inches between the outside of the storm drain and the outside of the water main and shall be installed in a steel casing, regardless of the depth of vertical separation, that extends 5-feet on both sides of the crossing, measured perpendicular to the outside of the storm drain. A longer length may be required, as determined by the City, based on the depth and location of the crossing. The crossing shall be arranged so that the water main joints will be equidistant and as far as possible from the storm drain crossing

(3) Multiple Barrel

- i. Water mains crossing below 2 or more adjacent storm drain pipes, regardless of diameter, shall be laid to provide a minimum vertical separation of 18-inches between the outside of the storm drain and the outside of the water main and shall be installed in a steel casing, regardless of the depth of vertical separation, that extends 5-feet on

both sides of the crossing, measured perpendicular to the outside of the storm drain. A longer length may be required, as determined by the City, based on the depth and location of the crossing. The crossing shall be arranged so that the water main joints will be equidistant and as far as possible from the storm drain crossing

(4) Box Culverts

- i. Water mains crossing below box culverts shall be laid to provide a minimum vertical separation of 18-inches between the outside of the box culvert and the outside of the water main and shall be installed in a steel casing, regardless of the depth of vertical separation, that extends 5-feet on both sides of the crossing, measured perpendicular to the outside of the box culvert. A longer length may be required, as determined by the City, based on the depth or location of the crossing. The crossing shall be arranged so that the water main joints will be equidistant and as far as possible from the storm drain crossing

F. Services

1. Location

- (1) All meter boxes and meter vaults to be installed within road right-of-way, outside of the paved roadway, or in a City easement dedicated for the water system
- (2) Install all service lines, meter boxes and meter vaults perpendicular to the road right-of-way
- (3) Locate $\frac{3}{4}$ -inch and 1-inch services and meter box for residential properties so services and meters are not located in concrete
- (4) Locate meter box or meter vault either completely inside or completely outside of paved sidewalks. No portion of a meter box or meter vault shall be inside an ADA sidewalk ramp
- (5) Do not locate meter box or meter vault in driveways, under or behind parking spaces, or in any other areas that could inhibit access for operations and maintenance
- (6) Maximum length of service line, from the water main to the meter, shall not exceed 150-feet
- (7) All water service lines shall have tracer wire attached

2. Tap Size

(1) General

- i. The service line, including any branch lines, from the tap to the customer's point of connection, may be the same size as the tap, but may not be any larger
- ii. The City reserves the right to stipulate the minimum or maximum size service tap available off of any water main regardless of the water main size

(2) Services, 2-inch and smaller

- i. Tap size shall be, at a minimum, one size smaller than the water main being tapped

G. Joint Restraint

1. General

- (1) Design restrained joints in accordance with the Ductile Iron Pipe Research Association (DIPRA) standards for all fittings, valves, hydrants and pipe joints as required to resist forces during testing and normal operating pressures within the distribution system
- (2) Retainer glands shall be used on all mechanical joint fittings. All tees, plugs, caps, and bends equal to or exceeding 11-1/4 degrees, and at other locations where unbalanced forces exist, must have acceptable thrust restraint

H. Valves

1. Gate Valves

- (1) Water mains 4-inch through 12-inch: Use resilient wedge gate valves.
- (2) Provide valves at maximum 500-foot intervals. Requests for spacing greater than 500-foot will be reviewed on a case-by-case basis
- (3) Provide three (3) valves for a tee intersection and four (4) valves for two-offset tee intersections. The use of crosses is not acceptable
- (4) Valves should be placed to minimize the number of City customers out of service due to a water main break and/or any maintenance operation
- (5) The City reserves the right to require additional valves if it is deemed in the best interest of current and future customers

I. Fire Hydrants

1. General

- (1) Minimum main size for water mains serving fire hydrants shall be 6- inch.
- (2) Minimum size for hydrant lead shall be 6-inch
- (3) Provide hydrant control valve on all hydrant leads

2. Location

- (1) Fire hydrants will be generally spaced at intervals of 1,000-feet in rural areas and at intervals of 500-feet in urban areas
- (2) The City reserves the right to require the installation of additional fire hydrants, solely at its discretion
- (3) When practical, locate fire hydrants at road intersections or at property corners
- (4) Do not locate fire hydrants in driveways, ditches, wetlands or in areas not easily accessible for operation and maintenance
- (5) No portion of a fire hydrant shall be inside an ADA sidewalk or ramp

J. Yard Hydrants

1. General

- (1) All 4-inch dead-end water mains shall be designed to include a Post Hydrant
- (2) Blow-off hydrants or other such appurtenances shall not be connected directly to any storm drain or sewer

- (3) Fire hydrants shall be required as blow-offs on water mains 6-inch and larger to achieve a 2.5 foot per second scouring velocity

DRAFT

D.7.2.WATER DISTRIBUTION SYSTEM MATERIALS FOR CONSTRUCTION

A. General

1. This section includes pipe and fitting material specifications, joint materials, valves and encasement requirements.
2. All materials used in the construction of water distribution systems shall be new and unused when delivered on-site and shall be suitable for installation and operation under the conditions for which they are to be used.
3. All chemicals/ products added to public water supply must be third party certified as meeting the specifications of ANSI/NSF Standard 60.
4. All brass components in contact with potable water must be made from either CDA/UNS Brass Alloys C89520 or C89833 with a maximum lead content of .25% by weight. Brass alloys not listed in ANSI/AWWA C800 Paragraph 4.1.2 are not approved. All fittings shall be stamped or embossed with a mark or name indicating that the product is manufactured from the low-lead alloy.
5. All materials/products that contact potable water must be third party certified as meeting the specifications of ANSI/NSF Standard 61.
6. The pressure rating of pipe must be capable of handling 1.5 times the normal working pressure.
7. All pipe fittings, packing, jointing materials and valves must conform to Section C of the AWWA Standards.

B. Bedding Material

1. Clean, well graded Class II and/or Class III soils
2. Class II soils shall be used in the pipe zone
3. Use Class II or Class III above the pipe zone
4. Backfill material must be tamped in layers around the pipe and to a sufficient height above the pipe to adequately support and protect the pipe
5. Stones must not come in contact with the pipe and must be within 6-inches of the pipe

C. Ductile Iron Pipe

1. Provide for all water mains. All sizes of pipe shall be laying length of 18- feet to 20-feet
2. All buried pipe shall be pressure class as follows:

Pipe Sizes (inch)	Pressure Class (psi)
------------------------------	---------------------------------

4 – 12	350
14 – 20	250

3. Pipe wall thickness shall be in accordance to bury depth as shown on drawing: ANSI/AWWA A21.50/C115
 4. Flange pipe or Victaulic grooved pipe shall be class 53
 5. Use cement mortar lining: ANSI/AWWA C104/A21.4, standard thickness
 6. Use rubber gaskets and lubricant: ANSI/AWWA C111/A21.11
 7. No metric sized pipe shall be permitted
 8. All pipe to be shipped with gaskets, glands, and bolts unless specified otherwise
 9. All pipe lengths must be tested to 500 psi working pressure prior to shipping
 10. Accepted products: American Cast Iron Pipe Company, Griffin Pipe Company, U.S. Pipe Company, and McWane Cast Iron Pipe Company
- D. Ductile Iron Pipe Joints
1. General
 - (1) Ductile iron pipe and fittings shall be furnished with push-on joints, push-on restrained joints, mechanical joints, flanged joints, and grooved joints as required
 - (2) Pipe ends (spigot end, bell and socket) for all pipe shall be gauged with suitable gauges at sufficiently frequent intervals to ensure compliance to the standard dimensions of ANSI/AWWA C151/A21.5
 - (3) Provide rubber gaskets and lubricants complying with ANSI/AWWA C111/A21.11 for mechanical or push-on joints
 - i. Natural rubber gaskets are not acceptable
 - ii. Lubricants, which will support microbiological growth, shall not be used for slip-on joints
 - iii. Vegetable shortening shall not be used to lubricate joints
 2. Push-on Joints
 - (1) Provide push-on joints complying with ANSI/AWWA 21.11/C11 as modified by ANSI/AWWA C151/A21.51
 - (2) Accepted products: Fastite, Tyton, and Bell-tite
 3. Mechanical Joints

- (1) Provide mechanical joints complying with ANSI/AWWA 21.11/C11 as modified by ANSI/AWWA C151/A21.51
4. Flanged Joints
 - (1) Provide flanged joints complying with ANSI/AWWA C115/A21.15
 - i. Provide ASTM D1330, Grade I rubber, full face type gaskets
 - ii. Thickness
 - a. Up to 10-inch pipe diameter: 1/16-inch
 - b. Larger than 10-inch pipe diameter: 1/8-inch
 - iii. Certified as suitable for chlorinated and chloraminated potable water
5. Restrained Joints
 - (1) Provide restrained joint pipe and fittings on all piping at each fitting, valve, fire hydrant connection and on pipe joints as shown on the plans
 - (2) Conform to ANSI/AWWA A21.11/C111 as modified by ANSI/AWWA C151/A21.51
 - (3) Accepted Products:
 - i. American Cast Iron Pipe: Fast Grip, Flex-Ring, Field Flex- Ring or Lock-Ring
 - ii. US Pipe: TR Flex or Field Lok 350 Gaskets
 - iii. Griffin Pipe: Snap-Lok Restrained Joint, or Talon RJ Gasket
 - iv. EBAA: Series 1100 Megalug Restraint Gland
 - v. Ford: Series 1400 Restraint Gland
 - vi. Sigma: One-Lok Series SLD Restraint Gland
 - vii. McWane: Sure Stop 350 Restraint Gasket
 - viii. For connections to PVC pipe:
 - a. EBAA: Megalug series 2000PV
 - b. Ford: Series 1500 Restraint Gland
6. Bolts, Nuts, and All-Threaded Rod
 - (1) Tee bolts and nuts shall be made of high strength low alloy steel (ASTM A307), Cor-Ten (ASTM A242), 304 stainless steel, or 316 stainless steel
 - (2) Nuts and bolts used for flanged connections shall be grade 316 stainless steel
 - (3) All fasteners shall have minimum yield strength of 45,000 psi. Material type shall be marked on the fasteners
 - (4) All-thread rod shall be grade 316 stainless steel

- (5) Stainless steel materials shall contain sufficient chromium to resist corrosion, oxidation, and rust
- (6) Materials shall be sound, clean, and coated with a rust resistant lubricant, approved for use with potable water
- (7) Threads shall be in accordance with ANSI B1.1, Unified Inch Screw Threads, and with B1.2, Screw Threads, Gages, and Gaging, conforming to the coarse thread series (UNC) Unified Coarse, with threads Class 2A internal and Class 2B external
- (8) Bolts 3/4" and smaller shall be furnished with heavy hex heads conforming to ANSI B18.2.1
- (9) Bolts larger than 3/4" may have either standard or heavy hex heads conforming to ANSI B18.2.1

E. Ductile Iron Pipe Fittings

1. General

- (1) Use cement mortar lining: ANSI/AWWA C104/A21.4, Standard thickness or epoxy lining
- (2) Compact fittings for piping 3-inch through 48-inch may be provided in accordance with ANSI/AWWA C153/A21.53.88
- (3) No metric sized fittings shall be permitted
- (4) All fittings are to be shipped with gaskets, glands, nuts, and bolts unless specified otherwise
- (5) Provide joint restraint at each fitting, valve and fire hydrant connection unless specified otherwise herein or indicated on the drawings.

2. Mechanical joint fittings shall conform to ANSI/AWWA A21.53/C153 or ANSI/AWWA A21.10/C110

3. Flanged Fittings

- (1) Conform to ANSI/AWWA A21.10/C110
- (2) Fitting flanges shall have facing and drilling which match AWWA/ANSI C115/B16.1 except where class 250 flanges are specifically noted

4. Sleeves, 4-inch and Larger

- (1) Provide full-length mechanical joint ductile iron solid sleeve, 12-inch minimum length, where needed to make piping connections
- (2) Provide cut-in sleeve, ductile iron, with mechanical restraint joint where installing fittings in an existing line

5. Accepted products: Tyler Union, Star Pipe Products, and Sigma Corporation

F. Tapping Sleeves

1. Tapping sleeve sizes 4-inch through 36-inch shall conform to the following criteria:

(1) Provide stainless steel tapping split-type sleeve with flanged outlet

(2) Provide bolts, follower rings and gaskets on each end of the sleeve

(3) Provide for minimum working pressure of 150 psi

(4) Provide square or hexagonal head bolts with hexagonal nuts. All square and hexagonal head bolts and hexagonal nuts shall be Cor-Ten steel, 304 stainless steel, or 316 stainless steel

(5) Provide ¾-inch NPT test plug on top of the outlet

(6) Accepted Products:

i. 4-inch through 16-inch: Mueller H-615

G. Valves

1. General

(1) All valves shall be in conformance with the latest revision of all reference standards of AWWA or ANSI

(2) 4-inch through 12-inch: Use resilient wedge gate valves

(3) All valves shall "Open Left"

(4) Provide a 2-inch ductile iron wrench nut with direction of valve operation clearly visible when looking down on the nut. Hold-down nut or bolt will be Type 316 stainless steel

(5) Provide stem extensions on all valves where the top of the operator nut is located greater than 36-inches below the top of the valve box

(6) All valves shall be equipped with a non-rising stem

2. Gate Valves

(1) All valves will meet or exceed all requirements of AWWA C509 or AWWA C515

(2) Outer valve body will have raised lettering cast in, providing manufacturers name, valve size, year of manufacture, pressure rating, location of casting and each part is to be clearly marked indicating ductile or cast iron

(3) All valves will be electrostatically, fusion-bonded epoxy coated, minimum 8-mil thickness inside and out, conforming to ANSI/AWWA C550 Standards

- (4) Resilient wedge to be ductile or cast iron fully encapsulated with EPDM elastomer, including guide path and will be US Food and Drug Administration approved for potable water and have an EPDM visible marking
 - (5) All valves will have a minimum 250 psi working pressure and a 500-psi static pressure
 - (6) Valve stem material will be bronze, brass, or Type 304 stainless steel
 - (7) Valves will have two upper O-ring seals on the stem above the thrust collar and at least one O-ring seal below the collar so designed to allow for replacement of the upper O-rings with the valve under full operating pressure
 - (8) Valves will have thrust washers located above and below the thrust collar to insure smooth frictionless operation
 - (9) All exterior bonnet and thrust collar bolting, whether recessed or exposed, are to be Type 316 stainless steel and marked by type
 - (10) Waterway seat area will be smooth without ridges or cavities and valves will have full size bore throughout the flow-way
 - (11) All valves will be hydrostatically pressure tested prior to shipment in compliance with AWWA C509 or AWWA C515 Standards and be covered by the Manufacturer's Ten-Year Limited Warranty from the date of purchase by the end user
 - (12) Accepted products: Mueller and Clow
3. Tapping Valves, 16-inch and Smaller
 - (1) Conform to the requirements for gate valves as specified in Item 2 above, Gate Valves
 - (2) Accepted products: Mueller and Clow

H. Fire Hydrants

1. Compression type, opening against pressure and closing with pressure, comply with ANSI/AWWA C502 dry-barrel fire hydrants, existing nation standards and ANSI B26
2. Hydrants shall have a 6-inch mechanical joint connection with a 4 ½-inch main valve. EPDM rubber will be specified on all hydrants and hydrant replacement parts to protect against chloramine deterioration

3. 6-inch bell connection, two (2) 2 ½-inch hose connections, one (1) 4 ½-inch pumper nozzle with mechanical removal feature, set screw, lock ring, etc., and shall conform to ANSI B26
4. Hydrants shall have a 1 ½-inch pentagon shaped operating stem nut and shall “Open Right” (clockwise). Arrow shall be cast in top of hydrant indicating direction of opening
5. National Standard screw threads on outlet nozzles
6. Two- part breakable safety flange shall be integral parts of barrel casting at least 2-inch above bury line
7. Barrel lengths shall generally be for 3 ½-foot bury
8. Interior shall be two-part thermosetting or fusion bonded, coated holiday free to a minimum thickness of 4 mils conforming to AWWA C550: Standard for Protective Interior Coatings for Valves and Hydrants
9. Exterior coating shall be as follows:
 - (1) Hydrant barrel will be painted Sherwin Williams Chrome Yellow, product number B54T1104
 - (2) Weather cap (bonnet), operating nut, and nozzle caps will be painted Sherwin Williams Orange, product number B54E39 for 6” diameter waterlines. 8” waterlines will be painted Sherwin Williams Safety Green, product number B54T1104
 - (3) Exterior hydrant parts below ground will be asphaltic or epoxy coated
10. All bronze or brass internal working parts in contact with service water are to be maximum 16% in zinc content and 79% minimum in copper
11. Retaining bolts from shoe to lower barrel shall be 316 stainless steel
12. Upper assembly shall be provided with a grease or oil reservoir that automatically lubricates all operating stem threads and bearing surfaces each time of operation. The system shall be completely sealed from waterway and external contaminants. The reservoir is to have an external filler point that does not require dismantling any portion of the hydrant during regular maintenance and all hydrants are to be completely lubricated with food grade product prior to leaving the factory
13. Exterior casting shall indicate type, design, date, and location of manufacturer
14. Upper and lower main stem rods shall be steel, stainless steel, or bronze in accordance with AWWA C502
15. Accepted Products: Mueller Company: Super Centurion A-423

16. Fire hydrants shall be equipped with Storz connector with cap

I. Services

1. Taps

(1) DIP water mains

- i. Services 1-inch or less: Tapping Saddle Double Strap
- ii. Services 1 ½-inch to 2-inch: Tapping saddle
- iii. Services greater than 2-inch: Tapping sleeve

(2) Existing PVC water mains

- i. Services 1-inch to 2-inch: Tapping saddle
- ii. Services larger than 2-inch: Tapping sleeve with full body valve

2. Tapping Saddles

(1) Provide all of the following materials:

- i. Body - Ductile Iron ASTM-A536
- ii. Bales and Strips – Type 304 or 316 stainless steel
- iii. Studs - Type 304 or 316 stainless steel
- iv. Hardware - Type 304 or 316 stainless steel
- v. Iron pipe thread

(2) Provide double strap for all sizes

(3) Finish – Provide fusion bonded nylon to an average thickness of 12 mils

(4) Accepted products:

- i. Smith Blair: 317
- ii. Ford: FCD 202
- iii. Mueller: DR2S
- iv. JCM: 406
- v. Romac: 202N

3. Service Line Piping

(1) Minimum size, 1-inch

(2) Services 1-inch to 2-inch, provide CTS Poly, 0.065” minimum thickness, suitable for underground water services and supplied in conformance with ASTM B88

(3) Services greater than 2-inch, provide PVC or Poly pipe

4. Corporation Valves

(1) Corporation Valves will have NPT thread inlets. The outlet connection will be CTS /OD, conductive compression (grip nut) type outlets

- (2) Accepted products:
 - i. Mueller: 300 Corp, Model # B-25028N
 - ii. Ford: Ball Corp, Model # FB1100-X-Q-NL
 - iii. A.Y. McDonald: Ball Corp, Model # 74704-BG
- 5. Meter Setter
 - (1) Meter setters for 2-inch flanged meters are constructed of brass and copper tubing, ball valve inlet with padlock wing, check valve outlet, brace pipe eyelet on FIP 90° Ells on inlet and outlet sides of set-up
 - (2) Accepted products:
 - i. Ford: # VBH 77-15-44-77-Q-NL for 2-inch
 - ii. Mueller: 2" with 15" riser and 110 compression connection
 - iii. A.Y. McDonald: 721- 715WDGG 770 for 2-inch
- 6. Curb Stops
 - (1) Provide curb stops for 1 ½-inch and 2-inch services
 - (2) Accepted products:
 - i. Mueller: Model # B-25209N
 - ii. A.Y. McDonald: Model # 76100-WG
 - iii. Ford: Model # B44-XXX-Q-NL
- 7. Couplings
 - (1) Provide couplings for service line connections
 - (2) Accepted products:
 - i. Straight Couplings, 1-inch x ¾-inch
 - a. Mueller: Model # H-15403N
 - b. Ford: Model # C44-34-Q-NL
 - c. A.Y. McDonald: Model # 74758G
 - ii. Y Branch, 1-inch x ¾-inch x ¾-inch
 - a. Mueller: Model # H-15343N
 - b. Ford: Model # Y44-243-Q-NL
 - c. A.Y. McDonald, Model # 708YSG
 - iii. 90 Degree Bends, 1 ½-inch and 2-inch
 - a. Mueller: Model # H-15526N
 - b. Ford: Model # L44-XX-Q-N
 - c. A.Y. McDonald: Model # 74761G

D.7.3. WATER DISTRIBUTION SYSTEM CONSTRUCTION PROCEDURES

A. General

1. Construction of water and wastewater systems to be turned over to the City must be performed by a City approved Contractor
2. Prior to construction activities taking place, the Developer's Engineer shall coordinate in advance a Pre-Construction Meeting with the assigned City Construction Inspector. The Developer, Developer's Engineer, Contractor(s), and City's Construction Inspector shall be in attendance at a minimum
3. If any requirements for carrying out project construction are not met, the City reserves the right to have the Developer's Engineer issue a STOP WORK ORDER

B. Operation of the City of Sumter Valves and Hydrants

1. Only City of Sumter personnel shall operate City of Sumter valves or hydrants unless otherwise directed or approved by the City
2. All hydrant and blow-off operations shall be done in a manner so that private property is not impacted and there shall be no flooding of streets or roadways or any other traffic problems created

C. Handling of Materials

1. Store rubber gaskets and polyethylene film under cover and out of direct sunlight. Do not store nuts, bolts, glands, and other accessories directly on the ground. Keep all materials free of dirt and debris. Store per manufacturer's recommendations
2. Keep valves off the ground and keep interior free of dirt and debris. Do not expose valve interior to direct sunlight. Store and maintain, if necessary, per manufacturer's recommendations
3. Keep inside of pipe free of dirt and debris
4. Handle pipe and fittings per manufacturer's recommendations so as to ensure delivery to the trench in sound, undamaged condition
5. Use pinch bars, slings or tongs for aligning or turning pipe
6. Use care not to damage pipe linings

D. Trench Excavation

This section is provided to outline most types of laying conditions but is not intended to cover all special laying conditions or the Engineer's special requirements.

1. Trench excavation shall be made via open cut and true to the lines and grades shown on the plans, unless boring is necessary or required. Banks of

- the trenches shall be cut in vertical, parallel planes equidistant from the pipe centerline. The horizontal distance between such planes, or the overall width of trench, shall vary with the size of the pipe to be installed
2. Bell holes for bell-and-spigot pipe shall be excavated at proper intervals so that the barrel of the pipe will rest for its entire length upon the bottom of the trench. Bell holes shall be large enough to permit proper installation of joints in the pipe
 3. When muck, quicksand, soft clay, swampy or other material unsuitable for foundations or sub-grade is encountered such material shall be removed and replaced with crushed stone (slag is not acceptable)
 4. After excavation, the area between the final pipe grade and the trench soil bottom shall be filled with crushed stone materials as required, compacted to proper grade, and made ready for pipe laying (slag is not acceptable)
 5. Debris encountered in trench excavation for water mains and other pipelines shall be removed for the overall width of trench which shall be as shown on the plans. It shall be removed to a depth of 6-inches below the bottom of the pipe for pipes smaller than 24-inch; 8-inches below the bottom of the pipe for pipes 24-inch to 36-inch; and 12-inches below the bottom of the pipe for pipes larger than 36-inch, if debris extends to such depth
 6. In all cases, materials deposited shall be placed so that in the event of rain, no damage will result to the work
 7. The sides of all excavations shall be sufficiently sheeted, shored and braced whenever necessary to prevent slides, cave-ins, settlements or movement of the banks and to maintain the excavation clear of obstructions. Maintain the walls of the excavation properly in place and protect all persons and property from injury or damage. Sheeting, shoring or bracing materials shall not be left in place unless as shown by the plans or permitted by the City. All sheeting and bracing shall be left in place until the trench has been backfilled 1-foot above the top of the pipe

E. Trench Backfill

1. The backfilling of pipeline trenches shall be started immediately after the pipe work has been inspected
2. The initial backfill material, placed to a height of 1-foot above the top of the pipe, shall consist of approved backfill material free from organic matter and deleterious substances, containing no rocks or lumps over 2-inch in any dimension. It shall be carefully placed and compacted throughout the entire area to be backfilled

3. Backfill shall be deposited in 6-inch layers (before compaction) and thoroughly compacted with power tools to 95% of theoretical maximum density, modified Proctor ASTM-D-1557
4. Where pipe trenches are cut across or along pavement, the trenches shall be backfilled in accordance with applicable permits
5. Backfilling around structures shall be done in the manner specified above for pipe trenches by power tamping for the full depth of cut from the bottom of the finished grade
6. Metallic Detection Tape
 - a. Provide 2-inch-wide metallic detection tape for all direct buried water mains
 - b. Locate 12-inches below ground surface above pipe
7. All backfilling shall be done in such a manner as will not disturb or injure the pipe or structure over or against which it is being placed. Any pipe or structure injured, damaged or moved from its proper line or grade during backfilling operations shall be uncovered, repaired, and then re-backfilled as herein specified
8. All excavations suspected of not meeting compaction requirements shall be tested for conformance by a City approved testing lab. Tests shall be performed at the locations and depths directed by the City. Tests shall be at the expense of the installing contractor

F. Pipe and Appurtenances

1. General
 - a. Inspect pipe for damage. Remove damaged and unacceptable pipe. Keep interior and joint surfaces clean and free of foreign materials. Install a mechanical joint or push-on type ductile iron plug or cap whenever work stops for a period of one (1) day or greater
 - b. Replace pipe where any part of coating or lining is damaged
 - c. Lower pipe and accessories into trench by means of derrick, ropes, belt slings, or other equipment approved by the pipe manufacturer
 - d. Do not dump or drop any of the materials into the trench
 - e. Except where necessary in making connections to other lines, lay pipe with the bells facing in the direction of laying
 - f. Rest the full length of each section of pipe solidly on the pipe bed, with recesses excavated to accommodate bells, couplings, and joints

- g. Bell pipe using manufacturer's approved leverage bar. Do not use machinery to bell pipe. Home line is to be clearly visible when pipe is joined
 - h. Do not lay pipe in water or when trench conditions are unsuitable for the work. Keep water out of the trench until jointing is completed
 - i. Re-lay pipe that has the grade or joint disturbed after laying
2. Alignment and Grade
- a. Install pipe to the alignment and profile shown on the approved drawings
 - b. Fittings, valves, and other appurtenances shall be located where shown on the approved plans, with the pipe being cut if necessary to ensure accurate placement
 - c. Cutting Pipe
 - i. Cut pipe neatly and without damage to the pipe or lining
 - ii. Unless otherwise recommended by the pipe manufacturer, cut pipe with milling type cutter, rolling pipe cutter, or abrasive saw cutter. Do not flame cut. Use wheel cutters when practical
 - iii. Cuts must be even and perpendicular with length of pipe
 - iv. Dress cut ends of pipe in accordance with manufacturer's directives for the type of joint to be made
 - v. Cut ends and rough edges should be ground smooth and, for push-on type connection, the cut end must be beveled slightly
 - d. Pipe lines intended to be straight shall be so laid
 - e. Where vertical or horizontal alignment requires deflection from straight lines or grade, do not exceed 75% of maximum deflection recommended by the pipe manufacturer or AWWA Standard 600
 - f. If alignment requires deflection exceeding recommended limits, furnish bends to provide angular deflections within the allowable limits
3. Jointing Pipe and Appurtenances
- a. Mechanical, Push-On, and Restrained Joint
 - i. Join pipe with mechanical or push-on type joints in accordance with the manufacturer's recommendations. Provide all special tools and devices, such as special jacks, chokers, and similar items required for proper installation. Lubricants for the pipe gaskets shall be used and shall be manufacturer's standard. All mechanical joints used on hydrants, hydrant leads, taps and valves shall have restraining glands
 - b. Flanged

- i. Prior to connecting flanged pipe, the faces of the flanges shall be thoroughly cleaned of all oil, grease, and foreign material. The rubber gaskets shall be checked for proper fit and thoroughly cleaned. Care shall be taken to ensure proper seating of the flange gasket. Bolts shall be tightened so that the pressure on the gasket is uniform. Torque-limiting wrenches shall be used to ensure uniform bearing insofar as possible. If joints leak when the hydrostatic test is applied, the gaskets shall be removed and reset and bolts re-tightened
4. Installation of Restraining Glands
 - a. Adjoining surfaces shall be clean, lubricated and meet the requirements of ANSI/AWWA C111/A21.11
 - b. Install using assembly recommendations established in ANSI/AWWA C111/A21.11 as well as installation instructions provided by the manufacturer
 - c. If twist-off nuts are provided, tighten screws until nuts break loose

G. Tie-in to Existing Mains

1. General
 - a. Tie-ins to existing mains shall be done by use of wet taps using tapping sleeve and tapping valve or by installation of a tee and valve. Existing waterline shall not be tapped on the opposite side of the existing pipe from where the new waterline intersects the existing waterline, also known as “back tapping” a waterline
 - b. Developer’s Engineer or Contractor shall coordinate with the assigned City Construction Inspector to schedule wet tap or tee installation. A minimum of 3 working days shall be allowed for scheduling
2. Wet Taps
 - a. Tapping sleeve shall be installed on the water main with the tapping flange and valve at the 3 o’clock or 9 o’clock position
 - b. Provide thrust blocking behind tapping sleeve
 - c. Pressure test the tapping sleeve and valve at 150 psi. Pressure shall hold steady for 15 minutes
 - d. Tap main thru the tapping valve
 - e. When tap is complete, remove pipe coupon from shell cutter and provide to the City Construction Inspector
 - f. Encase tapping sleeve, pipe and valve in polywrap
 - g. Backfill and set valve box
3. Tee and Valve

- a. Cut out section of main to allow the installation of the tee with a solid sleeve
- b. Install tee and solid sleeve
- c. Add valve to the branch side of tee
- d. Shut new valve on branch side of tee, restore water to main and check for leaks
- e. Encase new tee, sleeve, pipe and valve in polywrap
- f. Backfill and set valve box

H. Setting Valves and Valve Boxes

1. Valves shall be carefully handled, cleaned and checked for operation prior to backfilling. Care shall be taken to ensure that no dirt, rock, or other obstacles that would interfere with the operation are left in the valve
2. Center valve box on the valve, setting plumb. Valve box shall not rest on any part of the valve
3. Tamp earth fill around each valve box to a distance of 4-feet on all sides, or to the undisturbed trench face if less than 4-feet
4. Install shaft extensions plumb without any binding
5. Valves shall be installed in a position such that the plane of operation or rotation for the operating nut is parallel to the ground surface
6. Fully open and close each valve to manufacturer's specifications to assure that all parts are in working condition. All valves shall be left in the fully open position unless directed otherwise by the City
7. Place valve box protection ring around top of valve box. Top of the ring is to be level with top of valve box and or no more than 1-inch above finish grade

I. Fire Hydrants

1. Installation
 - a. Inspect hydrant carefully, ensuring that all foreign material is removed from the barrel. Inspect materials upon receipt for damaged or missing items. Store rubber gaskets under cover, out of direct sunlight. Do not store nuts, bolts, glands, and other appurtenances directly on the ground. Keep interiors free of dirt and debris
 - b. Hydrants shall be carefully handled, cleaned and checked for operation prior to backfilling. Care shall be taken to ensure that no dirt, rock and other obstacles that would interfere with the operation are left in the hydrant
 - c. Provide proper anchorage to fire hydrant installations by means of retainer glands

- d. Rotate fire hydrant offset fitting so hydrant is plumb and at the elevation detailed or install extension kit as necessary to position the bury line at finished grade
 - e. Install stone drainage bed. Fire hydrants must be provided with a gravel pocket or dry well. Hydrant drains must not be connected to or be located within 10 feet of a wastewater sewer
 - f. Provide polyethylene wrap around boot. Ensure weep holes just above the boot are not obstructed
 - g. Fully open and close each hydrant to manufacturer's specification to assure that all parts are in working condition
2. Acceptance
 - a. Prior to acceptance by the City, if paint is damaged or otherwise not acceptable, hydrants shall be repainted in accordance with these Standards
 - b. Under the direction of the City Inspector, the Developer's Engineer or the Developer Engineer's Representative shall perform a flow test on all newly installed fire hydrants. Flow test results shall be furnished to the City as part of the project acceptance paperwork
 - c. All hydrants shall be bagged until South Carolina Department of Environmental Services (SC DES) permit to operate has been received and the City has commissioned

J. Services

1. General
 - a. All residential water services shall be located as shown on the approved plans. Provide straight alignment perpendicular to the road centerline from the meter to the main
 - b. Saddle taps are required on all PVC mains and when making 2-inch taps on ductile iron mains. Taps will be made with through-the-saddle style tapping machines, using coupon-type tapping bits under system pressure. The tapered iron drill bit shall be used where saddles are required on ductile iron. All saddle taps are to be located at the 2 o'clock or 10 o'clock position on the main
2. Service Line Installation
 - a. All service lines will be installed with a minimum of 24-inches to a maximum of 36-inches of cover on all street crossings, and a minimum of 24-inches under all open ditches

- b. PVC sleeves are optional on service lines crossing streets, driveways or parking areas. The Contractor may install a capped 4- inch Schedule 40 PVC water service carrier pipe to provide the flexibility of installing the water service line at a later date during the construction period. The carrier pipe will be used to install copper water service lines. The carrier pipe shall be installed a minimum of 36-inches and a maximum of 60-inches below the surface of the road and made easily accessible. The carrier pipe shall be flagged with direct burial electronically detectable tape.
3. Meter Box and Meter Vault Installation
 - a. Install meter box or meter vault within road right-of-way, outside of the paved roadway or in a City easement
 - b. Provide straight alignment perpendicular to the road centerline from the meter box to the main
 - c. Locate meter box or meter vault either completely inside or completely outside of paved sidewalks. No portion of a meter box shall be inside an ADA sidewalk ramp
 - d. Do not locate meter box or meter vault in driveways, under or behind parking spaces, or in any other areas that could inhibit access for operation and maintenance
 - e. Meter boxes for $\frac{3}{4}$ -inch and 1-inch services shall be placed on a 6- inch bed of gravel
 - f. Meter boxes for $1\frac{1}{2}$ -inch and 2-inch services shall be supported with 4- inch x 8-inch x 16-inch concrete blocks
 - g. Meter setters for $1\frac{1}{2}$ -inch and 2-inch services shall utilize a spacer between the flanges to stabilize the setup during installation and backfill procedures.
 - h. Set top of meter boxes or meter vault at final finished grade
 4. City Meter Installation
 - a. The following requirements shall be met prior to the City installing a meter:
 - i. Meter box or meter vault shall be flush and level to final finished grade
 - ii. Water shall be on at the meter box or meter vault
 - iii. Meter box or meter vault shall be tied to house, unit, condo, apartment, etc.
 - b. Contractor shall provide assistance when meters are being installed where it is not readily evident as to which customer the meter is serving

K. Hydrostatic Testing

1. General

- a. Conduct a hydrostatic pressure test on all newly installed water mains, including connected service lines, in accordance with AWWA C600
 - b. Conduct test on each main or on sections of main between valves
 - c. Clean and flush mains of dirt and foreign material prior to conducting test
 - d. If concrete thrust blocking is installed, do not perform hydrostatic test until at least 5 days after placement of blocking
 - e. Test pressure shall be a minimum of 150 psi based on the elevation of the lowest point of the section of main being tested and corrected to the elevation of the test gauge
 - f. Slowly fill main in order to expel all air through air release valves or other installed appurtenances and to avoid excessive surge pressures at air vent opening(s)
 - g. Test shall be conducted in the presence of the Developer's Engineer or his representative and witnessed by a City representative. Schedule with a City Inspector a a minimum 72 hours prior to scheduled test
 - h. Main installation will not be accepted if the quantity of makeup water required for the test is greater than the calculated testing allowance
2. Hydrostatic Pressure Test
- a. After filling water main and before applying test pressure, the main shall be maintained at the working pressure for a sufficient period of time for it to stabilize with respect to line movement, water absorption by the lining, etc. This may require several cycles of pressurizing and bleeding of trapped air
 - b. A suitable test pump, furnished by the Contractor, shall be connected to the main by means of a tap, or other suitable method, and the proper test pressure slowly applied to the main. Test pressure shall not vary by more than +/- 5 psi for the duration of the test and shall at no time during the test drop below 150 psi. The test shall be conducted for a minimum of 2 hours
 - c. Test pressure shall be maintained within the tolerance by adding makeup water through the pressure test pump into the main. The amount of makeup water added to the main (i.e. leakage) shall be accurately measured (in gallons per hour) by suitable methods and shall not exceed the applicable testing allowance
 - d. Testing allowance is defined as the maximum quantity of makeup water that is added into the main undergoing hydrostatic pressure testing, or any valved section thereof, in order to maintain pressure within +/- 5 psi of the

specified test pressure. No water main installation will be accepted if the quantity of makeup water is greater than that determined by the following formula:

$$L = \frac{SD\sqrt{P}}{148,000}$$

Where:

L = testing allowance (makeup water), in gallons per hour

S = length of pipe tested, in feet

D = nominal diameter of pipe, in inches

P = average test pressure during the hydrostatic test, in pounds per square inch (gauge)

- e. Acceptance of any main shall be determined on the basis of the testing allowance only. If any test discloses that the quantity of makeup water (i.e. leakage) is greater than the testing allowance as determined above, repairs or replacements shall be made to the main and the main retested. Any visible leaks shall be immediately repaired regardless of the allowance used for testing
- f. During the pressure test, any exposed pipe, fittings, valves, hydrants, and joints shall be carefully examined. Any damage or defects discovered during or following the pressure test shall be repaired or replaced with new material and the test repeated until satisfactory results are obtained
- g. Certified test results shall be provided by the Developer's Engineer to the assigned City Engineering Department with the project acceptance paperwork

L. Disinfection

1. Conduct disinfection in accordance with AWWA C651 before being placed in service
 - a. Upon completion of testing, disinfect all water mains in accordance with SCDES requirements
 - b. Newly laid valves or other appurtenances shall be operated several times while line is filled with chlorinating agent
 - c. If bacteriological test results fail, to meet results specified, repeat procedures until satisfactory results are obtained
2. Procedure

- a. Flush line to extent possible with available pressure and outlets, prior to disinfection
 - b. Apply chlorine as liquid chlorine and chlorine compound such as calcium hypochlorite with known chlorine content. Water from the existing distribution system or other source of supply should be controlled so as to flow slowly into the newly laid pipeline during the application of chlorine
 - c. Apply through corporation cock in top of main, at beginning of section being sterilized
 - d. Use proper feeder and flow regulator to introduce chlorinating agent
 - e. Application rate shall not be less than 50 ppm
 - f. Retain chlorinated water in main not less than 24 hours
 - g. At end of retention period, at least 10 ppm of chlorine shall remain in the water at the extreme end of section
 - h. Flush the system with potable water and the sampling program begins
 - i. Dechlorinate chlorinated water used for disinfecting in accordance with the requirements of SCDES
3. Acceptance
- a. Provide 2 separate samples for each sample location, taken at 24 hour intervals, free of coliform bacteria. The Developer's Engineer or contractor shall pull samples in accordance with SCDES specifications. Provide a copy of sample results to the City
 - b. Sample locations shall be as required by SCDES and, at a minimum, at the following locations:
 - i. The tie-in location of new and existing water mains
 - ii. The end of all dead-end mains
 - iii. At intervals of no more than 1,200-feet
 - c. All sample locations are to be given an identifying label

Chapter D. Engineering

D.8.WASTEWATER

D.8.1.WASTEWATER COLLECTION SYSTEM GRAVITY SEWER DESIGN STANDARDS

A. General

1. The following wastewater collection system gravity sewer design standards are based on Federal, State, and the requirements of the City
2. These design standards are applicable to all developments requiring wastewater service from the City
3. For property to be served with sewer outside the city limits, the land developer or property owner must receive approval in writing from the City Manager
4. Where it is necessary for gravity sewer mains to cross surface water or wetlands, the preferred method is directional boring. The engineer shall submit a proposed method of construction to the City for review and approval prior to submitting plans for review

B. Design Criteria

1. Design gravity sewer mains in accordance with the requirements of the *South Carolina Department of Environmental Services (SCDES) Standards for Wastewater Facility Construction: R.61-67* and the requirements of these standards
2. Plan and Profile
 - a. Provide plan and profile for all gravity sewer mains drawn to a horizontal scale no smaller than 1 inch equals 50 feet and a vertical scale no smaller than 1 inch equals 5 feet
3. Gravity sewer mains shall be polyvinyl chloride (PVC), SDR 35 or DIP Class 150
4. Minimum depth of cover 3 feet at finished grade and maximum depth of 16 feet inside subdivisions
5. Minimum gravity sewer main diameter shall be 8 inches. Maximum diameter shall not exceed the diameter of the downstream main from the point of connection

6. Gravity sewer line shall be designed to have a velocity at 2 feet per second
7. Sewer manholes shall be placed a maximum of 400 feet apart, at change of direction of the sewer line and at the end of the sewer line
8. Where a smaller gravity sewer main joins a larger one, match the crowns of each
9. Manholes should have a minimum of 0.1 feet between invert in and invert out of the manhole
10. Provide straight alignment with uniform slope between manholes and depth adequate to receive wastewater from the lowest service
11. Minimum downstream angle between gravity sewer mains intersecting at manhole: 90 degrees
12. Locate gravity sewer mains and manholes outside of paved roadway, if possible
13. Manholes shall be either fully inside or fully outside of paved roadways and sidewalks. No portion of a manhole shall be inside of an ADA sidewalk ramp
14. Do not locate manholes under or behind parking spaces or in any other areas that could inhibit access for operations and maintenance
15. All manholes shall have paved access for cleaning. Such paved access shall be suitable to accommodate the largest sewer cleaning vehicle in City of Sumter's inventory
16. Services with cleanouts shall be installed to all lots so as to properly serve each existing house and each vacant lot facing or abutting on the street or alley in which the gravity sewer main is being laid, and at such other locations as may be designated by the City
17. Locate cleanout at the property line or edge of easement to provide access for maintenance.

C. Capacity Design

1. Size gravity sewer mains based on peak hourly flow projections 2.5 times the average daily flow projection
2. Average daily flow projections for all domestic wastewater facilities shall be based on the type of facility to be served and shall comply with the unit contributory loading criteria, *Appendix A of the South Carolina Department of Environmental Services (SCDES) Standards for Wastewater Facility Construction: R.61-67*
3. Design for minimum velocity of 2 feet per second with pipe flowing full. Use Manning coefficient of roughness $n = 0.013$

4. Minimum Slope

Nominal Sewer Size	Minimum Slope in Feet Per 100 Feet
8 inch	0.40
10 inch	0.28
12 inch	0.22
15 inch	0.15
18 inch	0.12
21 inch	0.10
24 inch	0.08
27 inch	0.067

D. Relation to Water Mains

1. There shall be no physical connection between a public or private potable water supply system and a sewer, or appurtenance thereto which may permit the passage of any sewage or polluted water into the potable supply. No potable water pipe shall pass through or come into contact with any part of a gravity sewer manhole
2. Horizontal and Vertical Separation
 - a. Gravity sewer mains shall be laid at least 10 feet horizontally from any existing or proposed water main. The distance shall be measured edge to edge. For gravity sewers where it is not practical to maintain 10 foot separation, deviation may be allowed provided that the water main is in a separate trench or on an undisturbed earth shelf located on one side of the gravity sewer main and at an elevation so the bottom of the water main is at least 18 inches above the top of the gravity sewer main. Justification and any deviation must be acceptable to the City
3. Crossings
 - a. Gravity sewer mains crossing water mains shall be laid to provide a minimum vertical distance of 18 inches between the outside of the water main and the outside of the gravity sewer main. This shall be the case whether the water main is either above or below the gravity sewer main. Whenever possible, the water main shall be located above the gravity sewer main. The crossing shall be arranged so that the gravity sewer joints will be equidistant and as far as possible from the water main joints.

Where a water main crosses under a gravity sewer main, adequate structural support shall be provided for the gravity sewer main to maintain line and grade

- b. Where it is not practical to obtain proper horizontal and vertical separation as stipulated above, either the water main or the gravity sewer main shall be installed in a watertight steel casing that extends 10-feet on both sides of the crossing, measured perpendicular to the outside of the water main

E. Relation to Storm Drains

1. General

- a. No gravity sewer main shall pass through or come into contact with any part of a storm drainage pipe or structure

2. Horizontal Separation

- a. Gravity sewer mains shall be laid at least 5-feet horizontally from any existing or proposed storm drainpipe or structure. The distance shall be measured edge to edge

3. Crossings Above

- a. Gravity sewer mains crossing above storm drains shall be laid to provide a minimum vertical distance of 12 inches between the outside of the storm drain and the outside of the gravity sewer main

4. Crossings Below

a. Single Barrel, 24 inch Diameter or Less

- i. Gravity sewer mains crossing below a single barrel storm drain pipe 24 inch diameter or less shall be laid to provide a minimum vertical distance of 18 inches between the outside of the storm drain and the outside of the gravity sewer main
- ii. Where vertical separation is between 18 inches and 42 inches, one full length of Ductile Iron Pipe shall be centered under the storm drain crossing. The crossing shall be arranged so that the gravity sewer joints will be equidistant and as far as possible from the storm drain crossing

b. 30 inch Diameter or Greater, Multiple Drain Lines or Box Culvert

- i. Gravity sewer mains crossing below a single barrel storm drain pipe 30 inch diameter or greater shall be laid to provide a minimum vertical separation of 18 inches between the outside of the storm drain and the outside of the gravity sewer main and shall be installed in a steel casing, regardless the depth of vertical separation, that extends 5- feet

on both sides of the crossing, measured perpendicular to the outside of the storm drain. A longer length may be required, as determined by the City, based on the depth and location of the crossing. The crossing shall be arranged so that the gravity sewer joints will be equidistant and as far as possible from the storm drain crossing

F. Services

1. Locate at property line in grass on landscape area. Service should not be located under concrete. Provide straight alignment perpendicular to the road centerline from the cleanout to the point of connection at the main
2. Size:
 - a. Minimum service size is 4 inch diameter for residential construction and shall conform to ASTM D 1785 Schedule 40.
 - b. Commercial services will be specified by the design professional
3. Service Connections
 - a. Service connections shall be watertight and shall not protrude into the gravity sewer main. All materials used to make service connections shall be compatible with each other and with the pipe materials to be joined and shall be corrosion proof
 - b. 6 inch services – connect at manhole or gravity sewer main
 - c. 8 inch services – connect at manhole
 - d. When connection is to the gravity sewer main, use wye branches. Wyes shall be installed at an angle of 30 to 45 degrees to the horizontal to avoid deposition and buildup of solids at the connection.
 - e. When connection is at the manhole, install so the crown of the gravity sewer main and the service is the same. The service shall protrude at least 1 inch and no more than 2 inches from the inside manhole wall and be properly grouted

G. Manholes

1. Location
 - a. Manholes shall be installed at the end of each line; at all changes in grade, size, or alignment; at all intersections; and at distances not greater than 400 feet
 - b. Locate manholes either fully inside or fully outside of paved roadways and sidewalks. No portion of a manhole shall be inside of an ADA sidewalk ramp

- c. Do not locate manholes under or behind parking spaces or in any other areas that could inhibit access for operations and maintenance
2. Drop Type
- a. An inside drop pipe shall be provided for gravity sewer mains entering a manhole at an invert elevation of 24 inches or more above the manhole invert. Where the difference in elevation between the incoming gravity sewer main and the manhole invert is less than 24 inches, the invert shall be filleted to prevent solids deposition
 - b. Drop manholes shall have a minimum inside diameter of 5 feet
 - c. No more than 6 inch drops or one 8 inch drop shall be allowed in a single manhole
3. Diameter
- a. Drop manholes and manholes over 8 feet deep shall be a minimum of 5 feet in diameter

Nominal Sewer Main Size	Manhole Diameter
8 inch to 12 inch	4 foot
15 inch to 18 inch	5 foot
21 inch to 30 inch	6 foot

4. Flow Channel
- a. The flow channel straight through a manhole shall be made to conform as closely as possible in shape and slope to that of the connecting gravity sewer mains. The channel walls should be formed or shaped to the full height of the crown of the outlet gravity sewer in such a manner as to not obstruct maintenance, inspection, or flow in the gravity sewer. The connecting gravity sewer mains, inflow and outflow, shall protrude at least 1 inch and no more than 2 inches from the inside manhole wall and be properly grouted
5. Bench
- a. A bench shall be provided on each side of any manhole channel when the pipe diameter(s) are less than the manhole diameter. The bench should be sloped no less than ½ inch per foot. No lateral sewer, service connection, or drop manhole pipe shall discharge onto the surface of the bench
6. Access

- a. All manholes shall have paved access for cleaning. Such access shall be smooth concrete or asphalt pavement designed to meet the following minimum requirements:
 - i. Gross vehicle weight capacity: 66,000 pounds
 - ii. Pavement width: 12 feet
 - iii. Left turn radius: 40.8 feet
 - iv. Right turn radius: 36.1 feet
 - v. Turnaround diameter: 87.1 feet

DRAFT

**D.8.2.WASTEWATER COLLECTION SYSTEM GRAVITY SEWER MATERIALS
FOR CONSTRUCTION**

A. General

1. This section includes pipe and fitting material specifications, and joint material and encasement requirements
2. All materials used in the construction of gravity sewers shall be new and unused when delivered on-site and shall be suitable for installation and operation under the conditions for which they are to be used

B. Pipe and Fittings

1. Polyvinyl Chloride (PVC) Pipe and Fittings
 - a. 4" – 15" SDR 35 and 18" - 36" PS – 115:
 - i. Pipe and fittings shall meet the requirements of ASTM D3034 for 4" through 15" SDR 35 and F679 for 18" through 36" PS -115 sewer pipe
 - ii. The pipe shall be colored green for in-ground identification as sewer pipe
 - iii. Pipe shall be made from quality PVC resin equal to or exceeding cell class 12454 or 12365 as defined in ASTM D1784
 - iv. Provisions must be made for expansion and contraction at each joint with an elastomeric gasket
 - v. The bell shall consist of an integral wall section with a solid cross section elastomeric gasket which meets the requirements of ASTM F477
 - vi. Gaskets shall be factory assembled and securely locked in place to prevent displacement during assembly
 - vii. Standard laying lengths shall be 14' or 20'
 - viii. Fittings and accessories shall be as manufactured and furnished by the pipe supplier or approved equal and have bell and/or spigot configurations compatible with that of the pipe
 - ix. For transitions between PVC and Ductile Iron Pipe use ductile iron adapter with Protecto 401 lining by Romac Industries, Inc., Model 501 Transition Coupling or approved equal
 - b. C900/C905:

- i. Pipe and fittings 4" through 12" shall meet the requirements of AWWA C900. Pipe and fittings 14" through 24" shall meet the requirements of AWWA C905
 - ii. The bell shall consist of an integral thickened wall section with an elastomeric seal. The wall thickness in the bell section shall conform to the requirements of Section 6.2 of ASTM D3139
 - iii. The pipe shall be manufactured to cast iron outside diameter in accordance with AWWA C900/C905
 - iv. The seal shall meet the requirements of ASTM F477
 - v. Standard laying lengths shall be 20'
 - vi. The pipe shall be colored green for in-ground identification as sewer pipe
2. Ductile Iron Pipe (DIP) and Fittings
- a. Pipe and fittings shall be lined with Protecto 401, 40 mils nominal thickness
 - b. For transitions between PVC and Ductile Iron Pipe use ductile iron adapter with Protecto 401 lining by Romac Industries, Inc., Model 501 Transition Coupling or approved equal
 - c. Pipe shall be in accordance with ANSI A21.50/AWWA C150 and conform to the requirements of A21.51/AWWA C151. Push-on and restrained joint pipe shall have a minimum rated working pressure of 150 psi
 - d. Pipe and fittings shall be furnished with push-on joints, push-on restrained joints, mechanical joints, and flanged joints as required. Pipe ends (spigot end, bell, and socket) for all pipes shall comply with the standard dimensions of ANSI/AWWA C151/A1.5
 - e. Push-on joints shall conform to ANSI A21.11/AWWA C111
 - f. Mechanical joints and bolts shall conform to AWWA C111. Bolts shall be high strength low alloy steel
 - g. Polyethylene encasement shall NOT be used on gravity sewers
 - h. Acceptable products: American Cast Iron Pipe Company, Griffin Pipe Company, U.S. Pipe Company, and McWane Cast Iron Pipe Company

C. Metallic Detection Tape

1. Provide 2" wide metallic detection tape on all buried piping
 - a. Provide 5.0 mil overall thickness with no less than a 50 gauge solid aluminum foil core

- b. Foil to be visible from both sides
 - c. No inks or printing extended to the edges of the tape
 - d. Encase printing to avoid ink rub-off
 - e. Tensile strength – 28 lbs/inch
 - f. Use heat set Mylar inks
2. Locate 12” below ground surface in pipe trench
 3. Color to be green
 4. Wording on tape to indicate “CAUTION SEWER LINE BURIED BELOW” at no greater than 24” on center

D. Manholes

1. Precast manholes shall be in accordance with ASTM C478
2. Use precast manholes without steps. Factory installed steps shall be removed and penetrations grouted
3. Manhole diameter:

Standard Manholes Schedule of Governing Dimensions	
Pipe Size	Manhole Diameter
8” to 12”	*4’ – 0”
14” to 18”	5’ – 0”
21” to 30”	6’ – 0”
36” or Larger	7’ – 0”

*Drop manholes and manholes over 8’ deep shall be a minimum of 5’ in diameter

4. Manhole riser sections, minimum wall thickness shall be:

Minimum Wall Thickness	
4’ Diameter Manhole	5”
5’ Diameter Manhole	5”
6’ Diameter Manhole	6”

Cone sections shall have a minimum wall thickness of 8” at their top

5. Provide monolithic base slab with walls. Bottoms cast with invert and bench are acceptable. Minimum base slab thickness shall be:

Minimum Base Slab Thickness	
4’ Diameter Manhole	6”

5' Diameter Manhole	8"
6' Diameter Manhole	8"

6. Suitable openings for inlet and outlet sewer pipe shall be cast or cored into the base sections and into riser sections for drop connections. These openings shall be circular, accurately made, and located as required for each manhole. Base riser sections shall be set on compacted pipe embedment material, 12" in thickness
7. Flexible manhole sleeves or flexible manhole entrance joints shall be installed on all pipe entering and leaving manholes. The flange shall be secured to the wall of the manhole base to form a tight water-stop. Sleeve material shall comply with the requirements of ASTM C-923. Sleeves shall be secured to the sewer pipe to make a watertight union with stainless steel strap clamps, draw bolts, and nuts
8. The manhole sections shall be jointed with "Ram-Nek" joint sealer or equal. "Ram-Nek" shall be placed as recommended by the manufacturer. Outside of joint shall be wrapped with WrapidSeal Manhole Encapsulation System or approved equal. Material shall be 12" in width, centered on the joint. Install in accordance with manufacturer's recommendations
9. Manhole inverts shall be constructed of cement grout and shall have the same cross section as the invert of the sewers, which they connect. The manhole invert shall be carefully formed to the required size and grade by gradual and even changes in sections. All channels shall be troweled smooth. Changes in direction to flow through the manhole shall be made to a true curve with as large a radius as the size of the manhole will permit. Concrete brick will be used to form only the invert channel walls. All other annular space shall be filled with non-shrink concrete grout. No fillers such as broken block, gravel, sand, or excavated material, are allowed in the construction of fillets (benches). Inverts shall be "U" design with top of "U" even with the crown of the pipe. Invert piping shall not extend inside manhole any farther than 2". The slope of the invert benches shall be a minimum of 2" higher than the crown of the pipe. When dissimilar pipe size occurs, the elevation of the crown of the pipes must be the same

10. Manhole sections shall be free from large honeycombs, cracks, spalds, large chips, exposed reinforcing, and broken bells or spigots. Allowable deviation in form joints shall be 1". Edges of bells and spigots shall be even and straight
11. Size lift holes and inserts for a precision fit with the lift devices. Do not penetrate through the manhole wall. Comply with OSHA Standard
12. Provide flat slab tops where manhole depth is less than 4'-0". Use flat slab top section: HS-20 traffic loading
13. Frames and covers:
 - a. General:
 - i. This Works, Inc. or U.S. Foundry shall manufacture all castings. Frames and covers shall be East Jordan Iron Works model 2029 or U.S. Foundry model 480 frame and RA-SSG cover
 - b. Materials:
 - i. Grey iron castings for heavy-duty applications shall be manufactured from iron conforming to ASTM A48 Class 35B, as noted in AASHTO M306-04
 - c. Manufacture:
 - i. The covers will be water tight with no holes or perforations. Two stainless steel pick bars will be included on cover. Castings shall be of uniform quality, free from sand holes, gas holes, shrinkage, cracks and other surface defects. Surfaces of the castings shall be free from burned-on sand and shall be reasonably smooth. Runners, risers, fins and other cast-on pieces shall be removed from the castings and such areas shall be ground smooth. Bearing surfaces between manhole rings and covers shall be cast or machined with such precision that uniform bearing shall be provided throughout the perimeter area of contact. As-cast dimensions may vary within accepted industry tolerances
 - d. Proof Load Testing:
 - i. Traffic service castings shall have a first article proof load test conducted and the results of that proof load test shall be made available to the City upon request. The proof load test shall be conducted in accordance with the methods and procedures outlined in AASHTO M306-04, Section 5, Proof Load Testing
 - e. Marking:

- i. Each casting shall be identifiable and show, at a minimum, the following: name of the producing foundry, country of manufacture (such as "Made in USA"), ASTM material designation, recycle symbol, individual part number. Cast into the center of the cover will be the letters CPW, 2" – 3" in height. Also cast into the cover will be the words SANITARY SEWER, 1 ½" – 2" in height. Producing foundry name will be cast with a height of 1"

14. Manhole Frame to Cone Connection (Exterior)

- a. Wrap outside of frame to cone connection using WrapidSeal Manhole Encapsulation System. Install per manufacturer's instructions

15. Drop Manhole

- a. Where the difference in the invert elevation between an intersecting sewer and a manhole is 24" or greater, an inside drop manhole shall be constructed. It shall be similar in construction to the standard manhole except that a drop connection of pipe and fittings of the proper size and material shall be constructed inside the manhole and supported by stainless steel clamps and bolts

16. Coatings:

- a. Coat force main receiving manholes and the next manhole downstream
- b. Coat pump station receiving manhole
- c. Coating shall be Raven 405 Epoxy System and shall be applied by a Raven Certified Applicator
- d. Coating shall be tested for pinholes using approved spark test method. Applicator shall be responsible for correcting any defects found during testing

E. Pipe and Manhole Foundation and Backfill Materials

1. Pipe and manhole bedding material shall be No. 57 stone
2. Backfill Materials
 - a. Reuse of existing excavated materials will be allowed provided the materials are compactable, dried or dampened to their optimum moisture content, are free from roots and large clods of clay, and are granular and non-cohesive in nature
 - b. Select fill shall be sand-clay, fine sand or sand gravel mixes

**D.8.3.WASTEWATER COLLECTION SYSTEM GRAVITY SEWER
CONSTRUCTION PROCEDURES**

A. General

1. Construction of the wastewater system to be conveyed to the City shall be performed in accordance with the approved engineering drawings, specifications and applicable permits. Any deviations from the engineering plans, specifications and permits may prevent the City from accepting the wastewater system for ownership
2. Prior to construction activities taking place, the Developer's Engineer shall coordinate in advance a Pre-Construction Meeting with representatives from the City and the contractor
3. The contractor shall bring up any issues that may require deviating from the approved engineering plans, specifications, and permits. The plans or specifications will need to be altered by the developers engineer and approved by the engineer/public works department in writing prior to beginning construction
4. The contractor is responsible for work site safety. Although the city will visit the construction site to observe construction, the City shall not be held liable for work site safety
5. If any requirements for carrying out project construction are not met, the City reserves the right to issue a STOP WORK ORDER

B. Handling of Materials

1. All construction material shall be shipped and handled to prevent any damage to the material and stored in units received from the manufacturer prior to use
2. All material that can be damaged from direct sunlight shall be covered with opaque material prior to use
3. Any material that becomes damaged from delivery, handling or storage of construction material shall be removed from the construction site
4. All construction material to be used in the wastewater system shall be new from material supplier. The city will not accept material that has been used previously or has been scrapped or discarded
5. All construction materials shall be placed on site in a location that can be inspected by the city's representative to ensure the material is in conformance with the approved plans and specifications

C. Pipe Cutting

1. Unless otherwise recommended by the pipe manufacturer, cut pipe with milling type cutter, rolling pipe cutter, or abrasive saw cutter. Do not flame cut. Use wheel cutters when practical. Cuts must be even and perpendicular with length of pipe. Dress cut ends of pipe in accordance with manufacturer's directives for the type of joint to be made. Cut ends and rough edges should be ground smooth and, for push-on type connection, the cut end must be beveled slightly

D. Trench Excavation

This section of the Minimum Standards is provided to outline most types of laying conditions, but is not intended to cover all special laying conditions or the Engineer's special requirements

1. Trench excavation shall be made in open cut and true to the lines and grades shown on the plans, unless boring is necessary or required. Banks of the trenches shall be cut in vertical, parallel planes, equidistant from the pipe centerline. The horizontal distance between such planes, or the overall width of trench, shall vary with the size of the pipe to be installed. The overall width of trench shall be as recommended by the manufacturer
2. Bell holes for bell-and-spigot pipe shall be excavated at proper intervals so that the barrel of the pipe will rest for its entire length upon the bottom of the trench. Bell holes shall be large enough to permit proper installation of joints in the pipe
3. When muck, quicksand, soft clay, swampy or other material unsuitable for foundations or sub-grade is encountered, such material shall be removed and replaced with No. 57 stone
4. After excavation, the area between the final pipe grade and the trench soil bottom shall be filled with No. 57 stone as required, compacted to proper grade, and made ready for pipe laying
5. Debris encountered in trench excavation for sewer mains and other pipelines shall be removed for the overall width of trench to be 12 inches below the bottom of the pipe
6. The sides of all excavations shall be sufficiently sheeted, shored and braced whenever necessary to prevent slides, cave-ins, settlements or movement of the banks and to maintain the excavation clear of obstructions. Maintain the walls of the excavation properly in place and protect all persons and property

from injury or damage. All sheeting and bracing shall be left in place until the trench has been backfilled

E. Trench Backfill

1. The backfilling of pipeline trenches shall be started immediately after the pipe work has been inspected. The initial backfill material, placed to a height of 1' above the top of the pipe, shall consist of approved backfill material free from organic matter and deleterious substances, containing no rocks or lumps over 2" in any dimension. It shall be carefully placed and compacted throughout entire area backfilled
2. Backfill the trench above the pipe zone with approved backfill material in lifts not exceeding 6" loose depth and compact each lift to a minimum of 95 percent of maximum dry density, as determined by ASTM D 1557, with mechanical vibrating or impact tampers
3. Where pipe trenches are cut across or along pavement, the trenches shall be backfilled in accordance with the approved plans and permits
4. Backfilling around structures shall be done in the manner specified above for pipe trenches by power tamping for the full depth of cut to the top of the finished grade
5. All backfilling shall be done in such a manner as will not disturb or damage the pipe or structure over or against which it is being placed. Any pipe or structure damaged or moved from its proper line or grade during backfilling operations shall be uncovered, repaired, and then re-backfilled as herein specified
6. All excavations suspected of not meeting compaction requirements shall be tested for conformance by the contractors or developer testing lab. Tests shall be performed at the locations and depths directed by the City

F. Pipe Installation

1. General
 - a. Inspect pipe for damage. Remove damaged and unacceptable pipe. Keep interior and joint surfaces clean and free of foreign materials. Install a mechanical joint or push-on type ductile iron plug whenever work stops for a period of a day or greater
 - b. Replace pipe where any part of coating or lining is damaged
 - c. Lower pipe and accessories into trench by means of derrick, ropes, belt slings, or other equipment approved by the manufacturer

- d. Pipe or other construction supplies should not be dumped or dopped in the trench
 - e. Except where necessary in making connections to other lines, lay pipe with the bells facing in the direction of laying
 - f. Rest the full length of each section of pipe solidly on the pipe bed, with recesses excavated to accommodate bells, couplings, and joints
 - g. Bell pipe using manufacture's approved leverage bar. Do not use machinery to bell pipe. Home line is to be clearly visible when pipe is joined
 - h. Do not lay pipe in water or when trench conditions are unsuitable for the work. Keep water out of the trench until jointing is completed
 - i. Re-lay pipe that has the grade or joint disturbed after laying
2. Alignment and Grade:
- a. Gravity sewer pipe installation must comply with ANSI/ASTM D2321 as the minimum acceptable standard as well as any additional requirements as stated herein
 - b. Before sewer pipe is placed in position in the trench the bottom and sides to the trench shall be carefully prepared as per manufacturer's specifications. Each pipe shall be accurately placed to the exact line and grade called for on the approved drawings. Laser equipment shall be used in setting pipe
 - c. PVC and Ductile Iron Pipe shall be laid in a full bed of No. 57 stone. Pipe laying shall proceed upgrade, starting at the lower end of the grade and with the bells upgrade. Pipe shall be straight when placed in the trench. Trench bottoms found to be at incorrect grade after pipe laying operations having begun shall be corrected and brought to exact line and grade
 - d. After each line of pipe has been laid, it shall be carefully inspected and all earth, trash, rags, and other foreign matter removed from the interior
 - e. Each joint shall be laid so that it will form a close concentric joint with adjoining pipe and so as to avoid sudden deflections
 - f. All jointing of pipe and fittings shall be in accordance with the pipe manufacturer's recommendations
 - g. Any leaks or defects discovered after completion of the work shall be repaired immediately. All pipes in place shall be carefully protected from damage until the backfilling operations have been completed
 - h. Water shall not be allowed to run through the pipe or stand in the trench

G. Connections to Existing Mains

1. Connection of gravity sewer main to an existing system shall be made at an existing manhole or by constructing a cut-in Manhole
 - a. Existing manhole:
 - i. Connection to an existing manhole shall be made in the presence of the City inspector
 - ii. New holes in manholes shall be core drilled
 - iii. When connecting to an existing manhole, temporarily block and/or divert sewage flows. Use high early strength cement to form proper channels with minimum interruption of service
 - iv. Seal around new pipe as specified
 - b. Cut-in manhole:
 - i. Temporarily block and/or divert sewage flows. Cut out length of existing pipe to accept new pipe in manhole
 - ii. If benches are pre-formed, insert short section of PVC pipe in the existing holes and seal. Lower bottom section of manhole into hole and sleeve to existing piping
 - iii. If benches are not pre-formed, cut the PVC pipe to form the channel and insert the required length of pipe through the holes in the bottom section of the manhole, set to match existing slope, and seal. Lower the assembly into the hole, sleeve to existing piping, and unblock sewage flows. Using high early strength cement, form benches as in typical manholes

H. Manholes

1. Use proper bedding as specified
2. Set base level so that the walls will be plumb
3. Clean inverts, spigots, and pipe ends
4. Apply joint sealer and set firmly in place to assure watertight joints
5. Connect pipe boot to piping with dual stainless steel straps
6. Grout lift holes from the outside using non-shrink grout
7. Install exterior joint collar
8. Form the invert channels directly in the concrete of the manhole base with mortar and concrete brick. Smooth the floor of the manhole outside the channels and slope toward the channels at not less than 1" per foot, nor more than 2" per foot

- a. Shape the invert channels to be smooth and semi-circular, conforming to the inside of the adjacent sewer section. Channel top shall be to crown of pipe
 - b. Make changes in direction of flow with a smooth curve of as large a radius as the size of the manhole will permit
 - c. Make changes in size and grade of channels smoothly and evenly
 - d. Slope invert uniformly from invert of inlet to invert of outlet
9. Match manhole top to finish grade utilizing concrete adjustment rings
- a. Manhole tops shall be watertight and at finished grade elevation. If located in pavement, elevation shall be set to match finished grade
 - b. Leveling and final grading of manhole frames and covers shall be accomplished by using concrete brick or concrete grade rings. When using grade rings, a maximum of two (2) 4" grade rings or one (1) 6" grade ring shall be used. The total number of grade rings shall not exceed 8" in thickness. Grade rings shall be laid in a full bed of non- shrink grout and covered after laying with a smooth coating of non- shrink grout or hydraulic cement a minimum of 2" thick
 - c. After the manhole has been set in its final position, the cast iron frame for the cover shall be carefully set at finished grade and properly bonded using a full bed of non-shrink grout. Where manholes are constructed in paved areas, sidewalks, etc., the top surface of the frame and cover shall be tilted so as to conform to the exact slope, crown, and grade of the existing pavement
10. Coatings
- a. Coat force main receiving manhole and the next manhole downstream
 - b. Coat Pump Station receiving manhole
 - c. Coating shall be Raven 405 Epoxy System and shall be applied and tested by a Raven Certified Applicator

I. Services

1. Services with cleanouts shall be installed to all lots so as to properly serve each existing house and each vacant lot facing or abutting on the street in which the gravity sewer main is being laid, and at such other locations as may be designated by the engineering or public works departments
2. Locate services as shown on approved plans. The letter "X", minimum 3" in height, shall be stamped into concrete curb to identify location of service

3. In landscaped areas, cleanout caps shall be SMARTPlug as manufactured by GPK Products, Inc. Cleanouts shall terminate 3" to 6" below finish grade
4. In paved areas, a PVC cleanout plug shall be installed 3" below finish grade and covered by a Neenah R-1976 frame and lid
5. Do not stack service lines vertically over the gravity sewer main
6. Elder Valve Assembly
 - a. Install upstream of the cleanout at all residential and individual commercial services where the City will not own and operate the water distribution system
 - b. Provide tee handles and plunger assemblies, for the exact number of services as shown on the final approved Record Drawings, to the City inspector prior to Project Commissioning

J. Testing

The Developer's Engineer is responsible for coordinating the testing of the wastewater system with the engineering department. The City will observe all testing of the wastewater system. The Developer's Engineer and contractor will be responsible for implementing all testing and the Developer's Engineer is responsible for determining the test results. The Developer's Engineer will submit successful test results to the engineering department

1. Mandrel
 - a. After backfilling trenches, Contractor shall test PVC sewer pipe for initial diametric deflections by the use of a 5% mandrel which is acceptable to the City. Mandrel shall be proof tested in the presence of the Engineer or his representative. The initial diametric deflection shall not exceed 5%. The mandrel pull shall be as described in the Ten State Standards . The Contractor shall not use any mechanical device in the mandrel pull
2. Air Testing
 - a. The Contractor shall conduct low-pressure air tests on all completed sections of gravity sewer. The air test results will be used to evaluate materials and construction methods on the sewer line sections. The Contractor shall furnish an air compressor which will provide at least 300 cubic feet of air per minute at 100 psi, pressure gauges, air hoses, air hose connections and other equipment necessary to conduct the air test. Plugs in sewers 18" in size and larger shall be connected by cable for

thrust reaction. The following provisions will be adhered to when conducting low- pressure air tests:

- i. Equipment:
 - a. Plug Design
 - (a) Either mechanical or pneumatic plugs may be used. All plugs shall be designed to resist internal testing pressures without the aid of external bracing or blocking. However, the Contractor should internally restrain or externally brace the plugs to the manhole wall as an added safety precaution throughout the test
 - b. Singular Control
 - (a) To facilitate test verification, all air used shall pass through a single, above ground control panel
 - c. Air Control
 - (a) The above ground air control equipment shall include a shut- off valve, pressure regulating valve, input pressure gauge, and a continuous monitoring, calibrated pressure gauge having a pressure range from 0 to at least 10 psi. Gauge shall display a NIST traceable calibration sticker with calibration date. The continuous monitoring gauge shall be no less than 4" in diameter with minimum divisions of 0.10 psi and an accuracy of plus or minus 0.04 psi
 - (b) Acceptable Air Test Control Units:
 - i. SEALCO Model 5012-100 Portable Low Pressure Air Test Control Unit
 - ii. Cherne Air-Loc Low Pressure Air-Testing System
 - iii. Approved equal
 - d. Separate Hoses
 - (a) Two separate hoses shall be used to: (1) connect the control panel to the sealed line for introducing low-pressure air, and (2) a separate hose connection for constant monitoring of air pressure build-up in the line
 - e. Pneumatic Plugs
 - (a) If pneumatic plugs are utilized, a separate hose shall also be required to inflate the pneumatic plugs from the above ground control panel
- ii. Test Procedure:

- a. Plug Installation and Testing
 - (a) After a manhole-to-manhole reach of pipe has been backfilled to final grade, prepared for testing, and the specified waiting period has elapsed, the plugs shall be placed in the line at each manhole and secured
- b. Line Pressurization
 - (a) Low pressure air shall be slowly introduced into the sealed line until the internal air pressure reaches 4.0 psi greater than the average back pressure of any groundwater above the pipe, but not greater than 9.0 psi. Immediately before testing, if groundwater is present, the groundwater elevation must be determined by appropriate means
- c. Pressure Stabilization
 - (a) After achieving the required internal pressure, the air supply shall be throttled to maintain the pressure for at least 2 minutes. This time permits the temperature of the entering air to equalize with the temperature of the pipe walls
- d. Timing Pressure Loss:
 - (a) When temperatures have been equalized and the pressure stabilized, the air hose from the control panel to the air supply shall be shut off or disconnected. The continuous monitoring pressure gauge shall then be observed while the pressure is decreased to no less than 5.0 psi. At a reading of 4.0 psi, or any convenient observed pressure reading between 4.0 psi and 4.5 psi, timing shall commence with a stopwatch or other timing device that is at least 99.8% accurate
 - (b) A predetermined required time for a specified pressure drop shall be used to determine the lines acceptability. Traditionally, a pressure drop of 1.0 psi has been specified. However, other pressure drop values may be specified, provided the required holding times are adjusted accordingly
 - (c) If the specified pressure drop is 0.5 psi rather than the more traditional 1.0 psi, then the required test times for a 1.0 psi pressure must be halved. Specifying a 0.5 psi pressure drop is desirable in that it can reduce the time needed to accomplish the air test without sacrificing test integrity. Therefore, the

following subsections contain provisions for both the traditional 1.0 psi pressure drop and the more efficient 0.5 psi pressure drop. All requirements for a specified 0.5 psi drop are given in parentheses

- e. Determination of Line Failure
 - (a) If the time shown in Table I (or Table II), for the designated pipe size and length, elapses before the air pressure drops 1.0 psi (or 0.5 psi); the section undergoing test shall have passed and shall be presumed to be free of defects. The test may be discontinued once the prescribed time has elapsed even though the 1.0 psi (or 0.5 psi) drop has not occurred
- f. Determination of Line Failure
 - (a) If the pressure drops 1.0 psi (or 0.5 psi) before the appropriate time shown in Table I (or Table II) has elapsed, the air loss rate shall be considered excessive and the section of pipe has failed the test
- g. Line Repair or Replacement
 - (a) If the section fails to meet these requirements, the Contractor shall determine at his own expense the source, or sources of leakage, and he shall repair or replace all defective materials and/or workmanship to the satisfaction of the City. The extent and type of repair, which may be allowed, shall be subject to approval by the City. The completed pipe installation shall then be retested and required to meet the requirements of the test
- h. Pressure Test Table
 - (a) The following table is provided to assist in determining required test pressure where groundwater is present. Table is based on average groundwater depth above the pipe invert for the section of pipe to be tested. It is the responsibility of the Engineer to calculate proposed test pressure and submit to the City inspector for approval. In the absence of groundwater, minimum test pressure shall be 4.0 psi. Under no circumstances shall maximum test pressure exceed 9.0 psi

Groundwater Above Pipe Invert (ft)	Pressure (psi)
1	4.5
2	5.0
3	5.5
4	6.0
5	6.5
6	7.0
7	7.0
8	7.5
9	8.0
10	8.5
11	9.0

i. Specified Time Tables

(a) To facilitate the proper use of this recommended practice for air testing, the following tables are provided. Table I contains the specified minimum times required for a 1.0 psi pressure drop from a starting pressure of at least 4.0 psi greater than the average back pressure of any groundwater above the pipe's invert. Table II contains specified minimum times required for a 0.5 psi pressure drop from a starting pressure of at least 4.0 psi greater than the average back pressure of any groundwater above the pipe's invert. Both Tables also include easy to use formulas for calculating required test times for various pipe sizes and odd lengths

Table D.8.3-1
Specification time required for a 1.0 psig pressure drop for size and length of pipe indicated for Q=0.0015

1 Pipe Diameter (in)	2 Min Time (min:sec)	3 Length for Min Time (ft)	4 Time for Longer Length (sec)	Specification Time for Length (L) shown (min:sec)								
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft	
4	4:00	597	0.380L	4:00	4:00	4:00	4:00	4:00	4:00	4:00	4:00	4:00
6	5:40	398	0.854L	5:40	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24	

10	9:26	239	2.374L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	199	3.418L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.342L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470L	19:50	26:10	34:54	43:37	52:21	61:00	59:48	78:31
24	22:40	99	13.674L	22:47	34:11	45:34	56:58	68:32	79:46	91:10	102:33
27	25:30	88	17.306L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	28:20	80	21.366L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15
33	31:10	72	25.852L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53
36	34:00	66	30.768L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46

Table D.8.3-2

Specification time required for a 0.5 psig pressure drop for size and length of pipe indicated for Q=0.0015

1 Pipe Diameter (in)	2 Min Time (min:sec)	3 Length for Min Time (ft)	4 Time for Longer Length (sec)	Specification Time for Length (L) shown (min:sec)							
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	4:00	597	0.190L	4:00	4:00	4:00	4:00	4:00	4:00	4:00	4:00
6	4:00	398	0.427L	4:00	4:00	4:00	4:00	4:00	4:00	4:00	4:00
8	4:00	298	0.760L	4:00	4:00	4:00	4:00	4:00		5:04	5:42
10	4:43	239	1.187L	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54
12	5:40	199	1.709L	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50
15	7:05	159	2.671L	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02
18	8:30	133	3.846L	8:30	9:37	12:49	16:01	19:14	22:26	25:38	28:51
21	9:55	114	5.235L	9:55	13:05	17:27	21:49	26:11		34:54	39:16
24	11:20	99	6.837L	11:24	17:57	22:48	28:30	34:11	39:53	45:35	51:17
27	12:45	88	8.653L	14:25	21:38	28:51	36:04	43:16		57:43	46:54
30	14:10	80	10.683L	17:48	26:43	35:37	44:31	53:25		71:13	80:07
33	15:35	72	12.926L	21:33	32:19	43:56	53:52	64:38	75:24	86:10	96:57
36	17:00	66	15.384L	25:39	38:28	51:17	64:06	76:55	89:44	102:34	115:23

iii. Manhole Vacuum Test

- a. When directed by the City, manholes shall be tested via vacuum testing per ASTM C1244 except that the minimum test times shall be as defined in the Manhole Vacuum Test Table (test times modified from those in ASTM C-1244). Vacuum testing shall not be performed until the manhole is completely finished, including applying any protective coating where specified. Manholes shall be thoroughly cleaned of all silt, debris and foreign matter of any kind prior to the vacuum testing and then again prior to final inspection as required

- b. Vacuum tests shall be performed by placing the testing unit at the top of the manhole in accordance with the manufacturer's recommendations. A vacuum of 10 inches of mercury shall be drawn on the manhole, the valve on the vacuum line of the test unit closed, and the vacuum pump shut off. The time shall be measured for the vacuum to drop to 9 inches of mercury. The manhole shall pass if the time for the vacuum reading to drop from 10 inches of mercury to 9 inches of mercury meets or exceeds the test times indicated in Table 1 below. The test times in Table 1 are modified from those in ASTM C-1244. Table 1 shall be included on the Contractor's test reports. Refer to ASTM C-1244 for further requirements
- c. Any leaks found during the vacuum testing shall be repaired by the Contractor in a manner approved by the City. The manhole shall be vacuum tested again after such repairs are made until the manhole passes the vacuum test at no additional cost to the Owner

**Table D.8.3-4
Manhole Vacuum Test Table**

Minimum Vacuum Test Times for Various Manhole Diameters									
Manhole Depth (feet)	Manhole Diameter (inches)								
	36	42	48	54	60	66	72	84	96
	Test Time (seconds)								
8	60	60	60	60	60	60	66	72	78
10	60	60	60	60	66	72	82	98	114
12	60	60	60	70	78	86	98	118	138
14	60	60	70	82	92	102	114	136	158
16	60	68	80	92	104	116	134	160	188
18	64	76	90	104	118	130	146	178	208
20	70	84	100	116	130	144	162	194	226
22	78	92	110	128	144	158	178	212	246
24	84	102	118	140	156	174	194	232	270
26	92	110	128	150	170	188	210	250	290
28	98	118	138	162	182	202	226	270	314
30	106	126	148	174	196	216	242	288	334

- d. There shall be no groundwater infiltration or other leakage (active or evidence of being previously active) through the manhole walls, benches, inverts or pipe connections at the manholes. If leakage is

found, it shall be eliminated with an appropriate grout or non-shrink cement mortar approved by the City. Injection grouting (Avanti AV-202 Multigrout or approved equal) may be required to stop leaks around the pipe connections or in the invert channel or benches. The City's decision on how defective manholes are repaired shall be final. If any defective manholes are discovered after they have been installed or during the warranty period, they shall be repaired or replaced in a satisfactory manner at no additional cost to the City. Repaired manholes, including those repaired during the warranty period, shall be vacuum tested again at no additional cost to the City

iv. Manhole Coating Test

- a. Coating shall be tested for pinholes using approved spark test method. Applicator shall be responsible for correcting any defects found during testing

K. Closed Circuit Television (CCTV) Inspection

1. Intent

- a. It is the intent of this specification to provide inspection criteria for all sanitary sewer pipelines installed as part of any new development project. This specification requires that the pipelines be inspected utilizing the Pipeline Assessment Certification Program (PACP) inspection standards and closed-circuit television techniques. This process has been developed to identify and locate any sewer line defects, determine corrective action and perform/document post-correction inspection. It is the responsibility of the Developer's Engineer to ensure that these CCTV inspection procedures are performed. All costs associated with CCTV inspection are the responsibility of the Developer/Contractor

2. Scope of Work:

- a. The CCTV Contractor shall video inspect all mainline sections from manhole to manhole, and all service laterals from the right-of-way boundary to the mainline connection or manhole connection. Video inspection shall be performed immediately following construction and prior to the low-air pressure and deflection testing. It is in the best interest of the Developer/Utility Contractor to complete this task in a timely manner
- b. Prior to performing CCTV inspection activities, all sewer lines and service laterals designated to be televised shall be thoroughly cleaned. After

cleaning, all equipment will be removed from the sewer line(s). Just prior to performing the video inspection procedure, water must be introduced into the nearest upstream manhole, and all cleanouts for laterals, until observed at the nearest downstream manhole

3. CCTV and associated equipment:
 - a. Television inspection equipment shall have an accurate footage counter that will display on the monitor and record the camera distance from the centerline of the starting manhole. Distance measurements within the sewer line are to be accurate within 0.5% of the above ground measurement. Line segment inspections shall be made manhole to manhole. Prior to the beginning of each CCTV inspection, manhole identification numbers, as indicated on project drawing or as supplied by the Developer's Engineer, will be displayed in the title and shall become a part of the video record. These manhole identification numbers shall correspond to the numbers shown on the project plans
 - b. The camera shall be of the remotely operated pan and tilt type. The rotating camera and light head configuration shall have the capability of 360 degree rotating view angle and a minimum 270 degree pan angle with the capability to pan and tilt simultaneously while the transporter moves to view defects and voids around the entire diameter of the pipe wall, ensuring complete inspection of the mainline pipe, service laterals and any deficiencies
 - c. The camera, television monitor, and other components shall be color. Geometrical distortion of the image shall not exceed one percent. To ensure peak picture quality throughout all conditions encountered, the color camera shall be equipped with the necessary circuitry to allow for the remote adjustment of the optical focus iris from the power control unit at the viewing station. A variable intensity control of the camera lights shall also be located at the viewing station
 - d. All fog shall be evacuated from the pipeline and the pipeline kept clear of any fog during the CCTV inspection process
 - e. Lighting and camera quality shall be suitable to allow a clear, in-focus picture for the entire inside periphery of pipelines extending at least 10 feet in front of the camera. In High Density Polyethylene (HDPE) or ductile iron poly-lined pipe, lighting should be sufficient enough to provide a clear view at least 2 feet in front of the camera. The replay of the recorded video

information shall be free of electrical interference and shall provide a clear stable image

4. Execution:
 - a. It is the responsibility of the Developer's Engineer to provide the CCTV Contractor with a set of City stamped "APPROVED FOR INSTALLATION" Construction Plans prior to CCTV inspection activities. Line segment inspections shall be made manhole to manhole
 - b. Internal inspection of pipelines shall be performed by PACP certified personnel, trained in the identification of pipe deficiencies and condition assessment utilizing closed-circuit television inspection equipment. A full 360 degree view of the pipe is required during inspection. The pipe must be clear and free of any dirt and/or debris. The CCTV Inspection Technician shall have full control of the movement of the television camera unit at all times. The travel speed of the camera shall be variable but uniform and shall not exceed 20 feet per minute (fpm). Any means of propelling the camera through the sewer line which would produce non-uniform or jerky movement of the camera, will not be acceptable. The television system shall be capable of performing line segment inspection in increments of 400 feet with one setup
 - c. Service laterals shall be inspected utilizing a CCTV inspection push system, capable of inspecting up to 100 feet of pipe. All sanitary service lateral segments must be CCTV inspected from the top of the riser located at the property line, to the sewer mainline, noting type of cleanout installed, on the same disk for a continuous run. Continuous footage readings for identifying the location of defects must be accurate to within 3% tolerance. Deficiency identifications are to be called out and recorded to the nearest full foot. Any inaccuracy in the continuous footage meter, identified deficiencies, or lateral location descriptions which cause doubt as to the accuracy of the locations or total length shall render the line segment recording as unacceptable
 - d. As directed by the City, the Developer's Engineer or his representative, the camera shall be stopped to view and analyze conditions that appear unusual or uncommon. The CCTV Inspection Technician shall, at all times, be able to move the camera through the lines in either direction without the loss of quality in the video presentation

- e. The interior of the pipe shall be carefully inspected to determine the location and extent of all deficiencies. Pipe conditions that result in a question of proper installation procedures shall be noted so that these conditions can be reviewed and, if necessary, corrected before actual acceptance of the sewer system
- f. CCTV inspections will take place immediately after construction and prior to, or concurrent with, the low pressure air and mandrel testing. This will allow the correction of deficiencies found during the CCTV inspection process
- g. Access for CCTV inspection purposes shall be made via existing line segment manholes and lateral cleanouts. Should access to a particular sewer segment be difficult, and where adjacent segments require television inspection, the CCTV Contractor may be allowed to complete the inspection of multiple sewer line segments with one setup. When multiple sewer line segments are inspected utilizing one setup, the CCTV Contractor shall zero the footage counter at each subsequent sewer manhole to establish a uniform starting point, Station 0+00, for each line segment televised
- h. At all defects and service connections, the camera shall be stopped and the pan and tilt features shall be used to obtain a clear picture. At each service lateral, the camera shall be panned to view up each lateral or point of connection. Make note of any deficiencies through the use of Data Collection Software
- i. CCTV Contractor shall record inspections in a PACP format and the video shall be recorded in a high quality CD/DVD format. The title block shall include the following information:
 - i. Date and time of day
 - ii. PACP certified television operator's identification (Name, ID number, etc.)
 - iii. Sewer segment number. Segment numbers shall be designated by the ENGINEER
 - iv. Upstream manhole number
 - v. Downstream manhole number
 - vi. Size of sewer pipe
 - vii. Pipe material

- viii. Closest cross street or address where the line segment is located
 - ix. Direction of movement of camera and direction of normal flow
 - x. Location of service connections indicated by clock position and with counter distance in feet from beginning manhole's centerline
 - xi. Location (start and end counter distances in feet from the beginning manhole's centerline) and description of obstructions, structural defects, longitudinal and/or circumferential cracking, joints including open and/or offset joints, ovality, leakage or evidence thereof, break in connections, protruding connections, mineral deposits, roots, previous repairs, deposits on pipe walls, sags, and other abnormalities with respect to the sewer's condition with counter distance in feet from the beginning manhole's centerline
 - xii. CCTV Contractor's log shall contain the same information
- j. CD/DVD shall visually display, at a minimum, the CCTV Contractor's name, Project name, City Job Number and Extension, date of inspection, pipe segment number, manhole numbers or lateral lot numbers. The distance between manholes shall be verified by measuring tape. If the counter distance and the taping distance differ by more than 3 feet per 100 feet, the run shall be re-televised by CCTV Contractor
 - k. CD/DVD shall be maintained and delivered in a hard case, which shall display the project name, City Job Number, date of inspection, manhole segment number(s) inspected, and camera operator's identification. No segment shall be split between two disks. A disk may have multiple segments, so long as an entire section is on one disk. Original disks of all sections will be provided to the City Construction Inspector along with the respective television inspection field logs to be reviewed for completeness and soundness of construction prior to the Commissioning. Upon review and approval, copies will be provided to the Utility Contractor and Developer's Engineer. Originals will remain the property of the City
 - l. If during video operations the television camera will not pass safely through the entire sewer line segment being inspected, CCTV Contractor shall set up equipment in the reverse, so that the inspection can be performed from the opposite manhole; from downstream to upstream. Where an obstruction is encountered and a reverse set up is required, the distance shall be entered into the log and noted on the video format from

which manhole the measurements are being made. If under the reverse setup the camera again fails to pass through the entire sewer line segment, the inspection shall be stopped. All obstructions in the sewer segment that prohibit passage of the television camera shall be immediately reported to the Engineer by the CCTV Contractor, referencing location and nature of the obstruction. No correction work shall proceed until Utility Contractor receives direction from the Developer's Engineer or the City Construction Inspector regarding removal or repair of deficiency

- m. Should CCTV Contractor's televising equipment become lodged in any sewer line, it shall be removed by CCTV Contractor at his expense. This shall include, if necessary, excavation and repair of the sewer main and/or lateral, underground utility repairs, backfilling and surface restoration. Upon removal of CCTV equipment and repair, CCTV Contractor shall re-televiser the line segment to Developer's Engineer or his representative that the line segment has been placed back into operational condition with no further deficiencies
5. Acceptance:
- a. CCTV Contractor shall present inspection video and inspection logs on CD/DVD disk(s). A continuous image in complete conformance with these specifications and with a full view of the internal pipe surface is required. CCTV Contractor shall re-clean and televise any segment for which the video does not present a clear image of 100% of the internal pipe surface at all times, and/or is accompanied by an incomplete inspection log
 - b. Any of the following observations shall be considered defects:
 - i. Any bellies in a joint of pipe will be cause for rejection of the pipe segment
 - ii. Joint separations
 - iii. Offset joints
 - iv. Chips in pipe ends
 - v. Cracked or damaged pipe or evidence of the presence of an external object bearing upon the pipe (rocks, roots, etc.)
 - vi. Infiltration
 - vii. Roots
 - viii. Debris or other foreign objects inside of pipe

- ix. Other obvious deficiencies when compared to Approved Plans, Permits, and/or Minimum Standards
- c. The Utility Contractor shall be notified in writing of any deficiencies revealed by the CCTV inspection that will require repair. After repairs have been made, the line segment(s) shall be re-inspected at the Developer's/Contractor's expense. The CCTV inspection video shall be submitted to the City for review upon completion of discrepancies. Correction of any and all deficiencies must be corrected prior to acceptance of the project by the City

DRAFT

D.8.4.WASTEWATER COLLECTION SYSTEM FORCE MAIN DESIGN STANDARDS

A. General

1. The following force main design standards are based on Federal, State and local health requirements and the requirements of the City
2. These design standards are applicable to all developments requiring wastewater service from the City
3. Where it is necessary for wastewater force mains to cross surface water or wetlands, the engineer shall submit a proposed method of construction to the City's Engineering Department for review and approval prior to submitting plans for permitting
4. The preferred method of installation for force mains crossing surface water or wetlands is by Horizontal Directional Drill

B. Design Criteria

1. Design force mains in accordance with the requirements of the *South Carolina Department of Environmental Services (SCDES) for Wastewater Facility Construction: R.61-67*, and the requirements of these Standards
2. Size force mains to provide minimum velocity of 2 feet per second at design flow and maximum velocity of 8 feet per second for PVC force mains. Maximum velocity determination should be based with two pumps operating
3. Use Hazen and Williams design coefficient: PVC: C=150, DIP: C=140, HDPE: C=155
4. Minimum force mains diameter shall be 4"
5. PVC force main shall be AWWA C900 for force mains between 4 through 12 inches in diameter and AWWA C905 for force mains 14 and 48 inches in diameter
6. Ductile Iron Pipe force mains shall be pressure class 250 for all pipe diameters

C. Separation of Water Mains and Force Mains

1. Where possible, locate force mains at least 10' feet horizontally away from water mains
2. Should 10' feet separation not be practical, then the force main may be located closer provided:
 - a. It is laid in a separate trench

- b. It is laid in the same trench with the water main located at one side on a bench of undisturbed earth
- c. In either of the above cases, crown elevation of the force main shall be at least 18" below bottom of water main
3. Where force mains and water mains cross, the force main shall go under the water main and be at least 18" below the bottom of water main

D. Cover

1. Provide suitable cover over all mains. Minimum cover depth as follows:
 - a. 12" diameter and smaller: 36"
 - b. 14" diameter and larger: 48"
 - c. All piping located within a public right-of-way shall be constructed in accordance with applicable permits and these Standards

E. Connection to an Existing Gravity System

1. Connection to an existing gravity system shall be made at an existing manhole or by constructing a cut-in manhole
2. Coat force main receiving manhole and the next manhole downstream

F. Valves

1. Air Release Valves:
 - a. Design force main to minimize the number of air release valves
 - b. Provide at high points in the force main
 - c. Provide at maximum 3000' intervals
 - d. Maintain minimum 36" cover at location of air release valve
 - e. Provide valve vault
2. Plug Valves:
 - a. Force Mains greater than 5,000' in length, provide a plug valve at the halfway point
 - b. Where no other force main isolation valve exists, provide plug valve within 250' of an air release valve
 - c. Provide valve box and valve box protection ring

D.8.5.WASTEWATER COLLECTION SYSTEM FORCE MAIN MATERIALS FOR CONSTRUCTION

A. General

1. This section includes pipe and fitting material specifications, and joint material and encasement requirements
2. All materials used in the construction of force mains shall be new and unused when delivered on-site and shall be suitable for installation and operation under the conditions for which they are to be used

B. Pipe and Fittings

1. Polyvinyl Chloride (PVC) Pipe and Fittings:
 - a. 2" diameter: Pressure rated SDR21, ASTM D-2241
 - b. 4" diameter and above: ANSI/AWWA C900/AWWA C905, Table 2, Pressure Class 150, and ASTM D-2241
 - c. Use integral bell or coupling type with elastomeric gaskets
 - d. Factory-installed gaskets integral with the pipe
 - e. Use ductile iron fittings with pressure rating of 150 psi: ANSI/AWWA C110/A21.10, lined with Protecto 401, 40 mils nominal thickness
 - f. Provide adaptor glands, gaskets, etc. as required to accommodate any differences in pipe and fitting dimensions
2. Fusible Polyvinyl Chloride (FPVC) Pressure Pipe:
 - a. Fusible Polyvinyl Chloride pipe shall conform to AWWA C900 or AWWA C905, and/or ASTM D2241 or ASTM D1785 for IPS standard dimensionality, if applicable. Testing shall be in accordance with AWWA standards for all pipe types
 - b. Fusible Polyvinyl Chloride pipe shall be extruded with plain ends. The ends shall be square to the pipe and free of any bevel or chamfer. There shall be no bell or gasket of any kind incorporated into the pipe
 - c. Fusible Polyvinyl Chloride pipe shall be manufactured in a standard 20', 30' or 40' nominal length
 - d. Fusible Polyvinyl Chloride Pipe shall be green in color for wastewater use
 - e. Pipe generally shall be marked per AWWA C900 or AWWA C905, and shall include as a minimum:
 - i. Nominal pipe size
 - ii. PVC

- iii. Dimension Ratio, Standard Dimension Ratio, or Schedule
 - iv. AWWA pressure class or standard pressure rating for non- AWWA pipe
 - v. AWWA Standard designation number or pipe type for non- AWWA pipe
 - vi. Extrusion production-record code
 - vii. Trademark or trade name
 - viii. Cell Classification 12454 and/or PVC material code 1120 may also be included
 - f. Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, or other visible deleterious faults
 - g. Use ductile iron fittings with pressure rating of 150 psi: ANSI/AWWA C110/A21.10, lined with Protecto 401, 40 mils nominal thickness
3. High Density Polyethylene (HDPE) Pipe and Fittings:
- a. Pipe shall be manufactured from a PE 3408 resin listed with the Plastic Pipe Institute (PPI) as TR-4. The resin material shall meet the specifications of ASTM D3350-02 with a minimum cell classification of PE345464C. Pipe O.D. sizes shall be ductile iron pipe sizes (DIPS). Pipe shall have a manufacturing standard of ASTM D3035 and be manufactured by an ISO 9001 certified manufacturer. The pipe shall contain no recycled compounds except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. The pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, voids, or other injurious defects
 - b. Fittings:
 - i. Butt fusion fittings shall be in accordance with ASTM D3261 and shall be manufactured by injection molding, a combination of extrusion and machining, or fabricated from HDPE pipe conforming to this specification. All fittings shall be pressure rated to provide a working pressure rating no less than that of the pipe. Fabricated fittings shall be manufactured using a McElroy Datalogger to record fusion pressure and temperature. A graphic representation of the temperature and pressure data for all fusion joints made producing fittings shall be maintained as part of the quality control. The fitting shall be

- homogeneous throughout and free of visible cracks, holes, foreign inclusions, voids, or other injurious defects
- ii. Electrofusion fittings shall be PE3408 HDPE, Cell Classification of 345464C as determined by ASTM D3350-02 and be the same base resin as the pipe. Electrofusion Fittings shall have a manufacturing standard of ASTM F1055
 - iii. Flanged and Mechanical Joint Adapters shall be PE 3408 HDPE, Cell Classification of 345464C as determined by ASTM D3350-02 and be the same base resin as the pipe. Flanged and mechanical joint adapters shall have a manufacturing standard of ASTM D3216. All adapters shall be pressure rated to provide a working pressure rating no less than that of the pipe
 - iv. Mechanical restraint for HDPE may be provided by mechanical means separate from the mechanical joint gasket sealing gland. The restrainer shall provide wide, supportive contact around the full circumference of the pipe and be equal to the listed widths. Means of restraint shall be machined serrations on the inside surface of the restrainer equal to or greater than the listed serrations per inch and width. Loading of the restrainer shall be by a ductile iron follower that provides even circumferential loading over the entire restrainer. Design shall be such that restraint shall be increased with increases in line pressure. Serrated restrainer shall be ductile iron ASTM A536-80 with a ductile iron follower; bolts and nuts shall be corrosive resistant, high strength alloy steel. The restrainer shall have a pressure rating of, or equal to that of the pipe on which it is used or 150 PSI whichever is lesser. Restrainers shall be JCM Industries, Sur-Grip or approved equal.

Nominal Size (Inch)	Restraint Width (Inch)	Serrations Per Inch
4 – 6	1 ½	8
8, 10, & 12	1 ¾	8

Pipe stiffeners shall be used in conjunction with restrainers. The pipe stiffeners shall be designed to support the interior wall of the HDPE. The stiffeners shall support the pipe's end and control the "necking down" reaction to the pressure applied during normal installation. The pipe stiffeners shall be formed of 304 or 316 stainless steel to the

HDPE manufacturers published average inside diameter of the specific size and DR of the HDPE. Stiffeners shall be by JCM Industries or approved equal.

4. Ductile Iron Pipe (DIP) and Fittings:
- a. All Ductile Iron Pipe and fittings shall be lined with Protecto 401, 40 mils nominal thickness
 - b. Ductile Iron Pipe shall be in accordance with ANSI A21.50/AWWA C150 and conform to the requirements of A21.51/AWWA C151. Push-on and restrained joint pipe shall have a minimum rated working pressure of 150 psi. All buried pipe shall be pressure class as follows:

Pipe Sizes (Inch)	Pressure Class (psi)
4 – 12	350
14 – 20	250
24	200
30 – 64	150

- c. Ductile Iron Pipe and fittings shall be furnished with push-on joints, push-on restrained joints, mechanical joints, and flanged joints as required. Pipe ends (spigot end, bell, and socket) for all pipes shall be gauged with suitable gauges at sufficiently frequent intervals to ensure compliance to the standard dimensions of ANSI/AWWA C151/A1.5
 - d. Push-on joints shall conform to ANSI A21.11/AWWA C111
 - e. Mechanical joints shall conform to AWWA C111. Bolts shall be high strength low alloy steel per AWWA C111
 - f. All buried ductile iron force main pipes shall be polyethylene wrapped. Thickness: 8 mils; Color: green (AWWA C105)
 - g. Acceptable products: American Cast Iron Pipe Company, Griffin Pipe Company, U.S. Pipe Company, and McWane Cast Iron Pipe Company
5. Restrained Joint Fittings:
- a. Provide at each fitting and valve. Restrained joints shall be in accordance with DIPRA, “Thrust Restraint Designed for Ductile Iron Pipe”
 - b. Restrained joint pipe will be indicated clearly on plans. The location and length of restrained joint pipe will be clearly marked on the drawings at all points where the direction or cross-sectional area of the pipe changes as

well as at all bends, reducers, offsets, tees, wyes, dead ends, valves and transitions from PVC, FPVC or HDPE to Ductile Iron Pipe

- c. Acceptable products:
 - i. American Cast Iron Pipe – Fast Grip, Flex-Ring, Field Flex- Ring or Lock-Ring
 - ii. US Pipe – TR Flex or Field Lok 350 Gaskets
 - iii. Griffin Pipe – Snap-Lok Restrained Joint
 - iv. EBBA – Megalug Restraint Gland
 - v. Ford – Series 1500 Restraint Gland
 - vi. Sigma – One-Lok Series SLD Restraint Gland
 - vii. McWane – Sure Stop 350 Restraint Gasket
 - viii. Cape Fear Industries – EZ Restraint Gland for Ductile Iron

C. Metallic Detection Tape

1. Provide 2” wide metallic detection tape on all buried piping
 - a. Provide 5.0 mil overall thickness with no less than a 50 gauge solid aluminum foil core
 - b. Foil to be visible from both sides
 - c. No inks or printing extended to the edges of the tape
 - d. Encase printing to avoid ink rub-off
 - e. Tensile strength – 28 lbs/inch
 - f. Use heat set Mylar inks
2. Locate 12” below ground surface in pipe trench
3. Color to be green
4. Wording on tape to indicate “CAUTION SEWER LINE BURIED BELOW” at no greater than 24” on center

D. Tracer Wire

1. All force main installations shall include the installation of a locator wire. The locator wire shall be taped to the top of the pipe with polyethylene tape during the pipe laying operation. For force mains, which are installed by the open-trench method, the locator wire shall be stranded 12-gauge copper with insulation rated UF or USE by Underwriter’s Laboratories. For force mains, which are installed by a trenchless method, horizontal directional drilling or other, the locator wire shall be stranded 10-gauge stainless steel with insulation rated UF or USE by Underwriter’s Laboratories. Underground splice connections shall be minimized and shall be rated for direct burial service.

The tracer wire shall be looped into “dummy” cast-iron water valve boxes with caps labeled “SEWER”, painted green, and at grade level, one being installed adjacent to the valve vault at the source pump station. Additional valve boxes shall be installed at intervals of no greater than every 1000’ along the length of the force main, unless the main was installed by a trenchless method. A final valve box shall be installed at the discharge point of the force main, whether that is at a manhole or at a “tee” into another force main. The looped termination shall allow for the connection of an electronic locator transmitter

E. Air Release Valves

1. Provide combination air valve
2. Maintain minimum 36” cover over force main at location of air valve
3. The combination air valve shall be suitable for use at pressures up to 150 PSI
4. The valve shall have Type 316 stainless steel body, cover and cover bolts with a NPT inlet and outlet connection. Valves shall have a Type 316 stainless steel float and a replaceable seat of Buna-N or other suitable material. Venting orifice and internal linkage mechanism shall be Type 316 stainless steel
5. Valve size shall be 1” or 2” size as shown on the plans, both sizes to be supplied with 2” NPT pipeline connection. The distance from 2” pipeline connection to the top of the combination air valve shall not exceed 10”
6. Valve shall be supplied with flushing attachments consisting of 2” stainless steel inlet isolating ball valve, 1” stainless steel blow off ball valve and ½” stainless steel flushing ball valve and stainless steel pipe nipples and a 5’ rubber hose with quick connect couplings
7. Valves shall be GA Industries Figure 959SS-ESF
8. Provide valve vault:
 - a. Air release valves shall be enclosed in a 4’ diameter precast manhole with a flat slab top as a minimum standard
 - b. Provide manhole frame and vented cover. Frame and cover shall be East Jordan Iron Works model 2029 or U.S. Foundry model 480 frame and RA-SSG cover. Cast into the center of the cover will be the letters CPW, 2” - 3” in height. Also cast into the cover will be the words SANITARY SEWER, 1.5” - 2” in height
 - c. Base shall be formed using solid concrete blocks set on a 12” deep bed of compacted No. 57 stone

- d. Coatings:
 - i. Coat interior surfaces of air release valve vault
 - ii. Coating shall be Raven 405 Epoxy System, 120 mil nominal thickness, and shall be applied by a Raven Certified Applicator
 - iii. Coating shall be tested for pinholes using approved spark test method. Applicator shall be responsible for correcting any defects found during testing

F. Cushioned Swing Check Valves

1. Provide cast iron body with bronze seating ring and stainless steel shaft for attachment of weight and lever with non-corrosive adjustable air cushioned shock chamber
2. Mount the cushioned chamber to the side of the valve body with piston operating in the chamber, which will prevent valve closing without any hammering action
3. Shock absorption by air: Adjustable closing speed
4. Approved manufacturer: G. A. Industries, Inc. Figure 250-D
5. Provide valve vault:
 - a. Check valves shall be enclosed in a 4' diameter precast manhole with a flat slab top as a minimum standard
 - b. Provide manhole frame and vented cover. Frame and cover shall be East Jordan Iron Works model 2029 or U.S. Foundry model 480 frame and RA-SSG cover. Cast into the center of the cover will be the letters CPW, 2" - 3" in height. Also cast into the cover will be the words SANITARY SEWER, 1.5" - 2" in height
 - c. Base shall be formed using solid concrete blocks set on a 12" deep bed of compacted No. 57 stone

G. Plug Valves

1. Provide cast iron body in accordance with ASTM A126
2. Flanged end, ANSI 125 lbs. Standard, or mechanical joint
3. Use drip tight shutoff plug mounted in stainless steel bearings
4. Provide 1/8" thick hand welded in overlay, no less than 90% nickel content on all surfaces contacting the plug face. Seat to be raised from the valve body and machined to a smooth finish
5. Provide bolted bonnet design. Stem seals shall be provided in accordance with AWWA C517

6. Furnish lever actuator
7. Approved manufacturer: DeZurik or Pratt/Milliken
8. Provide valve box:
 - a. Valve box shall be full cast or ductile iron with iron covers suitable for heavy traffic use and conform to ASTM A-48, Class 20 Specifications
 - b. Valve boxes shall be screw type and have a 5.25" inside shaft diameter
 - c. Have the word "SEWER" cast into the cover
 - d. Coat box and cover with 2 shop coats of bitumastic paint
 - e. No part of the valve box is to rest on the buried valve
 - f. Acceptable product: Products of Tyler Union #6850 Series, Bingham & Taylor #4905 Series of U.S. manufacture only, AFC Box with external stem and locking lid, and East Jordan Ironworks #8550 Series
 - g. Provide at each valve box in unpaved areas a precast concrete protection ring

D.8.6.WASTEWATER COLLECTION SYSTEM FORCE MAIN CONSTRUCTION PROCEDURES

A. General

1. Construction of water and wastewater systems to be turned over to the City must be performed by a City approved Contractor
2. Prior to construction activities taking place, the Developer's Engineer shall coordinate in advance a Pre-Construction Meeting with the assigned City Construction Inspector. The Developer, Developer's Engineer, Contractor(s), and the City's Construction Inspector shall be in attendance at a minimum
3. If any requirements for carrying out project construction are not met, the City reserves the right to have the Developer's Engineer issue a STOP WORK ORDER

B. Operation of City Water System Valves

1. Only City personnel shall operate City valves or hydrants unless otherwise directed or approved by the City
2. All hydrant and blow-off operations shall be done in a manner so that private property is not impacted and there shall be no flooding of streets or roadways or any other traffic problems created

C. Handling of Materials

1. General
 - a. Store rubber gaskets and polyethylene film under cover and out of direct sunlight. Do not store nuts, bolts, glands, and other accessories directly on the ground. Keep inside of pipe and fittings free of dirt and debris
 - b. Keep valves off the ground and keep interior free of dirt and debris. Do not expose valve interior to direct sunlight
 - c. Handle pipe so as to ensure delivery to the trench in sound, undamaged condition
 - d. Carry pipe into position
 - e. Use pinch bars, slings or tongs for aligning or turning the pipe
 - f. Use care not to damage Ductile Iron Pipe linings
2. Polyvinyl Chloride (PVC) pipe:
 - a. Store in unit packages as received from manufacturer until just prior to use
 - b. Stack units to prevent deformation to pipe barrels and bells
 - c. Protect from direct sunlight by covering with opaque material

3. Fusible Polyvinyl Chloride (FPVC) pipe:
 - a. Pipe lengths should be stored and placed on level ground. Pipe should be stored at the job site in the unit packaging provided by the manufacturer. Caution should be exercised to avoid compression, damage, or deformation to the ends of the pipe. The interior of the pipe, as well as all end surfaces, should be kept free from dirt and foreign matter
 - b. Pipe shall be handled and supported with the use of woven fiber pipe slings or approved equal. Care shall be exercised when handling the pipe to not cut, gouge, scratch or otherwise abrade the piping in any way
 - c. If pipe is to be stored for periods of 1 year or longer, the pipe should be shaded or otherwise shielded from direct sunlight. Covering of the pipe, which allows for temperature build-up, is strictly prohibited. Pipe should be covered with an opaque material while permitting adequate air circulation above and around the pipe as required to prevent excess heat accumulation
 - d. Pipe shall be stored and stacked per the pipe manufacturer's guidelines
4. High Density Polyethylene (HDPE) pipe:
 - a. Pipe shall be delivered without, nicks, gouges, or other physical damage
 - b. Pipe shall be stored on clean, level ground to prevent undue scratching or gouging. If the pipe must be stacked for storage, such stacking shall be done in accordance with the pipe manufacturer's recommendations. The pipe shall be handled in such a manner that it is not pulled over sharp objects or cut by chokers or lifting equipment
 - c. Sections of pipe having been discovered with cuts or gouges in excess of 10% of the pipe wall thickness shall be cut out and removed. The undamaged portions of the pipe shall be rejoined using the heat fusion joining method
 - d. Fused segments of the pipe shall be handled so as to avoid damage to the pipe. Chains or cable type chokers must be avoided when lifting fused sections of pipe. Nylon slings are preferred. Spreader bars are recommended when lifting long fused sections

D. Trench Excavation

This section of the Standards is provided to outline most types of laying conditions, but is not intended to cover all special laying conditions or the Engineer's special requirements

1. Trench excavation shall be made in open cut and true to the lines and grades shown on the plans, unless boring is necessary or required. Banks of the trenches shall be cut in vertical, parallel planes, equidistant from the pipe centerline. The horizontal distance between such planes, or the overall width of trench, shall vary with the size of the pipe to be installed. The overall width of trench shall be as recommended by the manufacturer
2. Bell holes for bell-and-spigot pipe shall be excavated at proper intervals so that the barrel of the pipe will rest for its entire length upon the bottom of the trench. Bell holes shall be large enough to permit proper installation of joints in the pipe
3. When muck, quicksand, soft clay, swampy or other material unsuitable for foundations or sub-grade is encountered, such material shall be removed and replaced with No. 57 stone
4. After excavation, the area between the final pipe grade and the trench soil bottom shall be filled with No. 57 stone as required, compacted to proper grade, and made ready for pipe laying
5. Debris encountered in trench excavation shall be removed for the overall width of trench which shall be as shown on the plans. It shall be removed to a depth of 6" below the bottom of the pipe for pipes smaller than 24" in size; 8" below the bottom of the pipe for pipes 24" to 36" in size; and 12" below the bottom of the pipe for pipes larger than 36" in size, if debris extends to such depth
6. In all cases, materials deposited shall be placed so that in the event of rain, no damage will result to the work
7. The sides of all excavations shall be sufficiently sheeted, shored and braced whenever necessary to prevent slides, cave-ins, settlements or movement of the banks and to maintain the excavation clear of obstructions. Maintain the walls of the excavation properly in place and protect all persons and property from injury or damage. Sheeting, shoring or bracing materials shall not be left in place unless as shown by the plans or permitted by the City. All sheeting and bracing shall be left in place until the trench has been backfilled 1' above the top of the pipe

E. Trench Backfill

1. The backfilling of pipeline trenches shall be started immediately after the pipe work has been inspected. The initial backfill material, placed to a height of 1'

- above the top of the pipe, shall consist of approved backfill material free from organic matter and deleterious substances, containing no rocks or lumps over 2" in any dimension. It shall be carefully placed and compacted throughout entire area backfilled. Backfill the trench above the pipe zone with approved backfill material in lifts not exceeding 6" loose depth and compact each lift to a minimum of 95% of maximum density, as determined by ASTM D 1557, with mechanical vibrating or impact tampers
2. Where pipe trenches are cut across or along pavement, the trenches shall be backfilled in accordance with applicable permits
 3. Backfilling around structures shall be done in the manner specified above for pipe trenches by power tamping for the full depth of cut to the top of the finished grade
 4. All backfilling shall be done in such a manner as will not disturb or damage the pipe or structure over or against which it is being placed. Any pipe or structure damaged or moved from its proper line or grade during backfilling operations shall be uncovered, repaired, and then re-backfilled as herein specified
 5. All excavations suspected of not meeting compaction requirements shall be tested for conformance by a City approved testing lab. Tests shall be performed at the locations and depths directed by the City

F. Pipe, Valve, and Appurtenance Installation

1. General:
 - a. Inspect pipe for damage. Remove damaged and unacceptable pipe. Keep interior and joint surfaces clean and free of foreign materials. Securely close open ends of pipe, fittings, and valves when work is not in progress
 - b. Replace pipe where any part of coating or lining is damaged
 - c. Lower pipe and accessories into trench by means of derrick, ropes, belt slings, or other equipment approved by the manufacturer
 - d. Do not dump or drop any of the materials into the trench
 - e. Except where necessary in making connections to other lines, lay pipe with the bells facing in the direction of laying
 - f. Rest the full length of each section of pipe solidly on the pipe bed, with recesses excavated to accommodate bells, couplings, and joints

- g. Bell pipe using manufacturer's approved leverage bar. Do not use machinery to bell pipe. Home line is to be clearly visible when pipe is joined
 - h. Do not lay pipe in water or when trench conditions are unsuitable for the work. Keep water out of the trench until jointing is completed
 - i. Re-lay pipe that has the joint disturbed after laying
 - j. Valves shall be carefully handled, cleaned and checked for operation prior to backfilling. Care shall be taken to ensure that no dirt, rock, or other obstacles that would interfere with the operation are left in the valve. Valves shall be installed in a position such that the plane of operation or rotation for the operating nut is parallel to the ground surface
2. Alignment and Grade
- a. Fittings, valves, and other appurtenances shall be located where shown on the approved plans, with the pipe being cut if necessary to assure accurate placement. Install the pipe, valves, and appurtenances to the alignment and profile shown on the approved drawings
 - b. Pipe lines intended to be straight shall be so laid
 - c. Where vertical or horizontal alignment requires deflection from straight lines or grade, do not exceed 75% of maximum deflection recommended by the pipe manufacturer or AWWA Standard 600
 - d. If alignment requires deflection exceeding recommended limits, furnish bends to provide angular deflections within the allowable limits
3. Jointing Pipe, Valves, and Appurtenances:
- a. Mechanical, Push-On, and Restrained Joint
 - i. Join pipe with mechanical or push-on type joints in accordance with the manufacturer's recommendations. Provide all special tools and devices, such as special jacks, chokers, and similar items required for proper installation. Lubricants for the pipe gaskets shall be used and shall be manufacturer's standard. All mechanical joints used on taps and valves shall have restraining glands
 - ii. Flanged
 - a. Prior to connecting flanged pipe, the faces of the flanges shall be thoroughly cleaned of all oil, grease, and foreign material. The rubber gaskets shall be checked for proper fit and thoroughly cleaned. Care shall be taken to ensure proper seating of the flange gasket. Bolts shall be tightened so that the pressure on the gasket

is uniform. Torque-limiting wrenches shall be used to ensure uniform bearing insofar as possible. If joints leak when the hydrostatic test is applied, the gaskets shall be removed and reset and bolts re- tightened

4. Installation of Restraining Glands:
 - a. Adjoining surfaces shall be clean, lubricated and meet the requirements of ANSI/AWWA C111/A21.11
 - b. Install using assembly recommendations established in ANSI/AWWA C111/A21.11 as well as installation instructions provided by the manufacturer
 - c. If twist-off nuts are provided, tighten screws until nuts breaks loose
5. Cutting pipe:
 - a. Cut pipe neatly without damage to the pipe
 - b. Unless otherwise recommended by the pipe manufacturer, cut pipe with milling type cutter, rolling pipe cutter, or abrasive saw cutter. Do not flame cut. Use wheel cutters when practical. Cuts must be even and perpendicular with length of pipe. Dress cut ends of pipe in accordance with manufacturer's directives for the type of joint to be made. Cut ends and rough edges should be ground smooth
 - c. DIP and PVC pipe with push-on type connection, the cut end must be slightly beveled
6. Polyethylene Encasement
 - a. All valves, ductile iron force mains, fittings, and appurtenances are to be wrapped in a linear low-density polyethylene film, 8 mil, color green, in accordance with ANSI Standard A21.5 (AWWA C105). Close all open ends and damaged areas securely with poly-tape. If damaged polyethylene film cannot be repaired, replace with new film

G. Connection to an Existing Gravity System

1. Connection of new force main to an existing gravity system shall be made at an existing manhole or by constructing a cut-in manhole
 - a. Existing manhole:
 - i. Connection to an existing manhole shall be made in the presence of the City inspector
 - ii. Connection shall be made at existing flow line
 - iii. New holes in manholes shall be core drilled

- iv. When connecting to an existing manhole, temporarily block and/or divert sewage flows. Use high early strength cement to form proper channels with minimum interruption of service
- v. Seal around new pipe
- b. Cut-in manhole:
 - i. Temporarily block and/or divert sewage flows. Cut out length of existing pipe to accept new pipe in manhole
 - ii. If benches are pre-formed, insert short section of PVC pipe in the existing holes and seal. Lower bottom section of manhole into hole and sleeve to existing piping
 - iii. If benches are not pre-formed, cut the PVC pipe to form the channel and insert the required length of pipe through the holes in the bottom section of the manhole, set to match existing slope, and seal. Lower the assembly into the hole, sleeve to existing piping, and unblock sewage flows. Using high early strength cement, form benches as in typical manholes
- c. Coatings:
 - i. Coat force main receiving manhole and the next manhole downstream
 - ii. Coating shall be Raven 405 Epoxy System, 120 mil nominal thickness, and shall be applied by a Raven Certified Applicator
 - iii. Coating shall be tested for pinholes using approved spark test method. Applicator shall be responsible for correcting any defects found during testing

H. Connection to an Existing Force Main

1. Connection to an existing force main shall be made by installation of a tee or wye. NOTE: Under conditions that arise from time to time, the City will review submittals for direct taps. When approved by the City, force mains less than 6" in diameter; use 316 stainless steel tapping saddles. Force mains 6" in diameter and larger; use 316 stainless steel tapping sleeves
2. Provide cushioned swing check valve with isolating plug valve on each side of check valve

I. Installation of Air Release Valves

1. Maintain minimum 36" cover over force main at location of air release valve
2. Force mains less than 6" in diameter; install air release valve using 316 stainless steel tapping saddle

3. Force mains 6" in diameter and larger; install air release valve using 316 stainless steel tapping sleeve
4. Provide 316 stainless steel isolation ball valve
5. Set plumb valve
6. Provide valve vault:
 - a. Air release valves shall be enclosed in a 4' diameter precast manhole with a flat top slab as a minimum. Base shall be formed using solid concrete blocks set on a 12" deep bed of compacted No. 57 stone
 - b. Provide manhole frame and vented cover
 - c. Coatings:
 - i. Coat interior surfaces of air release valve vault
 - ii. Coating shall be Raven 405 Epoxy System, 120 mil nominal thickness, and shall be applied by a Raven Certified Applicator
 - iii. Coating shall be tested for pinholes using approved spark test method. Applicator shall be responsible for correcting any defects found during testing

J. Installation of Cushioned Swing Check Valves

1. Maintain minimum 36" cover over force main at location of check valve
2. Set valve level
3. Mount the cushioned chamber to the side of the valve body with piston operating in the chamber, which will prevent valve closing without any hammering action
4. Provide valve vault:
 - a. Check valves shall be enclosed in a 4' diameter precast manhole with a flat top slab as a minimum. Base shall be formed using solid concrete blocks set on a 12" deep bed of compacted No. 57 stone
 - b. Provide manhole frame and vented cover

K. Installation of Plug Valves

1. Maintain minimum 36" cover over force main at location of plug valve
2. Provide valve box. No part of the valve box is to rest on the buried valve
3. Provide at each valve box in unpaved areas a precast concrete protection ring

L. Metallic Detection Tape Installation

1. Provide 2" wide metallic detection tape on all direct buried force mains
2. Locate 12" below ground surface in pipe trench

M. Tracer Wire Installation

1. All force main installations shall include the installation of a locator wire. The locator wire shall be taped to the top of the pipe with polyethylene tape during the pipe laying operation. For force mains, which are installed by the open-trench method, the locator wire shall be stranded 12-gauge copper with insulation rated UF or USE by Underwriter's Laboratories. For force mains, which are installed by a trenchless method, horizontal directional drilling or other, the locator wire shall be stranded 10-gauge stainless steel with insulation rated UF or USE by Underwriter's Laboratories. Underground splice connections shall be minimized and shall be rated for direct burial service. The tracer wire shall be looped into "dummy" cast-iron water valve boxes with caps labeled "SEWER", painted green, and installed at grade level, one being installed adjacent to the valve vault at the source pump station. Additional valve boxes shall be installed at intervals of no greater than every 1000' along the length of the force main, unless the main was installed by a trenchless method. A final valve box shall be installed at the discharge point of the force main, whether that is at a manhole or at a "tee" into another force main. The looped termination shall allow for the connection of an electronic locator transmitter
2. Prior to acceptance of the wastewater force main by the City, the Contractor shall demonstrate that the locator wire functions properly. The Contractor shall use one of several commercially available utility locating instruments to energize and trace the locator wire. When the wastewater force main is installed in the road shoulder, green-marking flags (pin flags) shall be installed along the length of the wastewater main at intervals of no greater than 20' feet. Where the force main is installed under concrete or asphalt, green marking paint shall be used. Testing of the locator wire and installation of the marking flags shall be done prior to scheduling a final inspection of the wastewater system

N. Jack and Bore

1. General
 - a. Description
 - i. This section covers the work necessary to furnish and install steel casings and carrier pipes under surface structures, where indicated, as specified herein, and as needed for a complete and proper installation
 - b. Safety

- i. Perform all excavation and backfilling activities in accordance with the *Occupational Safety and Health Act*

2. Materials

- a. Carrier pipe shall be restrained joint ductile iron
- b. Steel Pipe Casing shall be manufactured from steel conforming to ASTM A 139 for Grade B, with minimum yield strength of 35,000 psi before cold forming
 - i. Pipe shall be straight seam welded. A protective coating will not be required
 - ii. Minimum diameter and wall thickness of the steel piping shall be as listed in the following table

Restrained Joint DIP Carrier Pipe Size (inches)	Minimum Casing Size (inches)	Minimum Casing Thickness (inches)
4	14	0.250
6	16	0.281
8	18	0.312
10	20	0.375
12	24	0.375
14	26	0.438
16	30	0.469
18	32	0.500
20	36	0.532
24	42	0.625
30	48	0.688
36	54	0.781
42	56	0.812
48	62	0.875
54	72	1.000

- iii. The thicknesses of the casing shown in 2.b.2 are minimum thicknesses. Actual thicknesses shall be determined by the casing installer based on an evaluation of the required jacking forces

- c. Casing Spacers

- i. Casing spacers shall be flanged, bolt-on style with a two-section stainless steel shell lined with a PVC liner, minimum 0.09" thick, also having a hardness of 85-90 durometer. Runners shall be attached to stainless steel risers which shall be properly welded to the shell. The height of the runners and risers shall be manufactured such that the pipe does not float in the casing. Casing spacers shall be as manufactured by Cascade Waterworks Manufacturing Company, Contractors Manufacturing, Inc., or approved equal
3. Execution
 - a. Installation of Steel Pipe Casing
 - i. Installation of steel pipe casing shall be by the dry bore method at locations as shown on the Contract Drawings and approved by the applicable permits. Installation of steel pipe casing shall be in accordance with applicable regulations, the Contract Drawings, these specifications, and any permits required with respect to the particular boring
 - a. Boring Pit and Receiving Pit
 - (a) The boring pit shall be solid sheeted, braced, and shored as necessary to provide a safe operation. The Contractor shall take all precautions, and comply with all local, state and federal requirements as may be necessary to protect private property, public property and/or existing utilities. Maintain in dry condition by use of pumps, drains or other approved method.
 - (b) The receiving pit shall be constructed in accordance with the Contract drawings and applicable permits
 - b. Line and Grade
 - (a) The Contractor shall set the boring rig so that after the casing is complete, and the carrier pipe is installed, the invert of the pipe shall conform to grade and alignment as shown on the Contract Drawings. As the casing is installed, Contractor shall check the horizontal and vertical alignment frequently. Contractor shall install the boring at a 90-degree angle to the crossing unless permitting authority approves a different specific angle of crossing. The depth shall be a minimum depth as prescribed by the governing authority unless a deeper depth is dictated by design

c. Boring

(a) In all cases, jacking and boring of the casing pipe shall be accomplished by the dry jack and bore method without jetting, sluicing, or wet boring. For casing pipes 48" in diameter and larger, a closed face shield bore head shall be utilized in front of the casing. For casing pipes less than 48" in diameter, the casing may be installed via open face method whereby the hole shall be bored and cased through the soil by a cutting head on a continuous auger mounted inside the casing pipe. The distance between the leading end of the first auger section and the leading end of the casing shall be as necessary to maintain a solid plug of spoil material inside the forward portion of the casing. At no time during the operation shall the auger head be allowed to extend out in front of the casing being installed. The boring of the hole and jacking of the casing pipe shall be done simultaneously, with continuous installation, until the casing pipe is in final position

d. Dewatering

(a) Contractor shall fully investigate the location of all jack and bores for the project and determine required dewatering methodologies for each location in order to provide for and conduct a dry jack and bore. Contractor shall submit plans and specifications for dewatering to the Engineer for approval prior to beginning the process (for railways, railway authority must also approve). Pumps of sufficient capacity to handle the flow shall be maintained at the site, provided the Contractor has received approval from the engineer to operate them. Pumps in operation shall be constantly attended on a 24-hour basis until, in the sole judgment of the DOT or railway authority ; the operation can be safely halted. When dewatering, a process for monitoring any settlement of tracks, roads, or structures must be in place. Prior to commencing boring, the Contractor shall verify, with acceptance by the Engineer, the absence of groundwater to below the lowest elevation of the casing at each entry/exit pit and as necessary along the casing route

e. Diameter of hole

- (a) Bored installations shall have a bored hole no more than 1" greater than outside diameter of the casing pipe to be installed. In the event that voids are detected, the voids shall be grouted
- f. Casing Pipe Length
 - (a) Lengths of casing pipe shall be as long as practical for site conditions. Joints between lengths shall be completely welded in accordance with American Welding Society recommended procedures. Prior to welding joints, the Contractor shall ensure that both ends of the casing sections being welded are square. The length of the casing shall be such that each end of the casing shall extend a minimum of 6' beyond the edge of pavement/back of curb of a paved roadway, or if railway installation, in accordance with requirements of the railway authority
- g. Lubricant
 - (a) The Contractor shall plan to use a casing lubricant, such as bentonite, in the event excessive frictional forces jeopardize the successful completion of the casing installation
- h. Jacking
 - (a) Once the jacking procedure has begun, it shall be continued without stopping until the boring and jacking operation is complete
- i. Installation of the Carrier Pipe
 - (a) Inspect carefully, ensuring that all foreign material is removed from the casing and the casing meets alignment criteria for the type of carrier pipe being used
 - (b) The casing shall be installed as closely to grade as possible with no more deviation than can be adjusted with spacers to achieve the carrier pipe design grade
 - (c) Install casing spacers on the carrier pipe per the manufacturer's instructions
 - (d) Provide a minimum of one spacer per ten linear feet of pipe
 - (e) Install the carrier pipe in the casing ensuring each joint is pushed "home" before the joint is installed into the casing
 - (f) Provide centered and restrained configuration
- j. End Seals

- (a) Grout each end of the casing with concrete brick and Type II concrete in such a manner to prevent the infiltration of foreign materials into the casing pipe, but allowing leakage to pass in the event of a carrier pipe break
- ii. Rights-of-Way, Easements, and Permits
 - a. Prior to the beginning of the Work, consult with the Engineer to determine that all rights-of-way, easements, permits, or other legalities are in order and become familiar with the requirements thereof. Confine the Work as required to comply with such requirements. Any encroachment beyond such limits shall be the Contractor's responsibility
- iii. Conflict of Specifications
 - a. Where laws or orders of public authority prescribes a higher degree of protection than specified herein, then the higher degree so prescribed shall be deemed a part of this specification and govern the specific installation

O. Hydrostatic Testing

1. Conduct hydrostatic testing in accordance with AWWA C600
 - a. Conduct tests on each line or valved section of line
 - b. Clean and flush line of dirt and foreign material
 - c. Slowly fill main in order to expel air from the main through the air release valves or other appurtenance
 - d. Tests are to be conducted in the presence of the Developer's Engineer or his representative and witnessed by a City representative
2. Pressure Tests
 - a. Pressure leakage test shall be conducted in accordance with AWWA C600. Each section of the pipeline shall be subjected to and successfully meet a pressure test of 150% of its working pressure, but not less than 100 psi. The line shall be slowly filled with water and all air expelled through the air valves or other means
 - b. A suitable test pump, furnished by the Contractor, shall be connected to the line by means of a tap in the line, or other suitable method, and the proper test pressure slowly applied to the line. The test pressure, +/- 5 psi, shall be maintained for at least 2 hours. Leaks, if found, shall be immediately

repaired. The Developer's Engineer or his representative shall be present on site and confirm the test results

- c. Replace defective pipe, joints, fittings and valves with new material and repeat the test until results are satisfactory

3. Leakage Test

- a. Conduct leakage test in conjunction with pressure test
- b. Testing allowance shall be defined as the maximum quantity of makeup water that is added into a pipeline undergoing hydrostatic pressure testing, or any valved section thereof, in order to maintain pressure within +/- 5 psi of the specified test pressure (after the pipeline has been filled with water and the air has been expelled). No pipe installation will be accepted if the quantity of makeup water is greater than that determined by the following formula:

$$L = \frac{SD\sqrt{P}}{148,000}$$

Where:

L = Allowable Leakage, in gallons per hour

S = Length of Pipe tested, in feet

D = Nominal Diameter, in inches

P = Average test pressure, in psig

- c. Should test disclose leakage greater than that specified above, repair, or if necessary, remove and replace the defective joint or valve until the leakage is within the specified allowance

D.8.7. WASTEWATER COLLECTION SYSTEM PUMP STATION DESIGN STANDARDS

A. General

1. The following wastewater pump station design standards are based on Federal, State and local health requirements and the requirements of the City
2. These design standards are applicable to all developments requiring wastewater service from the City
3. Design pump station in accordance with the requirements of the South Carolina Department of Environmental Service (SCDES) Standards for Wastewater Facility Construction: R.61-67, and the requirements of these Standards

B. Capacity Design

1. Average daily flow projections for all domestic wastewater facilities shall be based on the type of facility to be served
2. All flows shall comply with the unit contributory loading criteria, Appendix A of the South Carolina Department of Environmental Service Standards for Wastewater Facility Construction: R.61-67
3. Size pump stations based on peak hourly flow projection two and one half (2.5) times the average daily flow projection
4. When designing pumps, consideration is to be given to the ultimate capacity of the pump station, in accordance with the City 's Master Plans

C. Pump Station Design

1. Pumps:
 - a. Provide at least two (2) pumps of equal capacity, each capable of handling the design peak flow
 - b. Pumps shall be designed to operate in a lead-lag sequence and be on an alternating cycle
 - c. Pumps shall have an operating point at or near peak efficiency
 - d. Pumps shall be non-overloading for all duty points
 - e. Pump suction and discharge piping shall be at least 4" in diameter
 - f. Provide a swing check valve, gate valve, and pressure gauge connection on each pump discharge line
2. Wetwell:

- a. Normal operating volume shall prevent any one pump from starting more than six (6) times per hour
- b. Minimum allowable wetwell diameter shall be 8'-0"
- c. Maximum allowable depth shall be 26' below finished grade
- d. Size the wetwell based on the following formula:

$$V = \left(\frac{T}{Q} + \frac{S}{Q} \right)$$

Where:

V = Effective volume of wetwell, in gallons

T = Time for one pump cycle, in minutes

Q = Pumping rate, in gallons per minute

S = Peak flow into wetwell, in gallons per minute

- e. Wetwell level settings:
 - i. Distance between pump "OFF" and lead pump "ON": minimum as specified by the pump manufacturer, or as calculated for cycle time; whichever is greater
 - ii. Distance between lead pump "ON" and lag pump "ON": 6" minimum
 - iii. Distance between lag pump "ON" and alarm "ON": 6" minimum
 - iv. Distance between alarm elevation and inlet pipe: 12" minimum
 - f. Top of wetwell slab shall be set to provide positive drainage away from the station and minimize flooding. At a minimum, top of slab shall be 6" above centerline elevation of public access road
3. Pump Station Site:
- a. Minimum property size: 50' x 50'
 - b. Site shall be asphalt paved. Provide 6" stone aggregate base with geofabric underlayment and 2" asphalt cover
 - c. Design pump station site layout to allow access of service trucks to the pump station wetwell
 - d. Provide receiving manhole on influent line within pump station fence
 - e. Provide by-pass connection

- f. Provide a transfer switch for a portable generator
 - g. No overhead power line will be allowed to cross the site
 - h. The station shall have a 1" copper water service terminated in a City water meter box
 - i. Provide a freeze proof yard hydrant
 - j. Fencing:
 - i. Site shall be secured by a 6' high chain link fence. NOTE: Brick fences will be reviewed on a case-by-case basis and are subject to the approval of the City. Wooden fences shall not be allowed
 - ii. Provide vehicle access gate and personnel access gate. Design vehicle access gate to allow entrance of service trucks without blocking the main roadway
 - k. Access road:
 - i. Site shall be serviced by an asphalt road with top of road above the 25-year flood elevation. Road and site drainage shall be included in the design and approved by appropriate permitting agency
 - ii. Minimum road width: 16'
 - iii. Asphalt, in accordance with the requirements of SCDOT
4. Electrical:
- a. General:
 - i. Electrical design of pump station shall conform to the latest editions of NFPA 70 (National Electrical Code) and NFPA 820 (Standard for Fire Protection in Wastewater Treatment and Collection Facilities)
 - ii. All electrical work shall be performed by licensed personnel
 - iii. Design electrical service to handle the ultimate capacity of the pump station. Coordinate electrical service with local utility , 3phase 480 volt is preferred
 - iv. Three (3) phase power shall be required on all motors greater than 5 Hp. No "add-a-phase" systems shall be allowed. No phase converters will be allowed. Single-phase power is not allowed
 - v. Provide flood light through utility company
 - b. Electrical Equipment Rack:
 - i. Electrical equipment rack shall be large enough to house all control equipment to include SCADA

- ii. Electrical equipment rack shall be made entirely of structural aluminum and be adequately grounded
 - iii. Power shall be located underground and shall be located on the rack in such a manner so the electric meter can be easily read from outside the fenced area
 - iv. Concrete pad shall be provided for the electrical equipment rack and extend a minimum of 4' outside of wetwell to face of the control panel
 - v. The control panel shall be located a minimum radius of 5'-0" outside the hatch opening and shall be protected by a conduit seal or other appropriate measures meeting the requirements of the National Electrical Code, to prevent the atmosphere of the wetwell from gaining access to the control panel. The seal shall be located so that the motor may be removed and electrically disconnected without disturbing the seal
 - vi. All electrical cables from the motor and wetwell level sensors shall be terminated in a weather tight box located directly below the control panel. If size of pump cables allows use of boxes, install minimum 8"x10" with 316 stainless steel terminal strip and backing plate
 - vii. Electrical supply, control, and alarm circuits shall be designed to provide strain relief and to allow disconnection from outside the wetwell. Terminals and connectors shall be protected from corrosion by location outside the wetwell or through use of watertight seals. If located outside, weatherproof equipment shall be used
 - viii. Soft starts are not allowed on any motors unless approved by the City. If soft starts are required by the electric utility provider, the system must be designed to clear their own faults due to power outages and prior approval from the City is still required. The City prefers VFDs in these situations over soft starts
 - ix. Provide transient voltage surge suppresser on load side of transfer switch
 - x. Provide GFI Duplex receptacles
5. **ADD SECTION ABOUT FOG LOG DEVICE FOR PUMP STATION**
6. Cellular SCADA System
- a. Submit cellular based SCADA system to the City for approval

D.8.8. WASTEWATER COLLECTION SYSTEM PUMP STATION MATERIALS FOR CONSTRUCTION

A. General

1. This section includes material specifications for pump stations and associated appurtenances
2. All materials used in the construction of pump stations shall be new and unused when delivered on-site and shall be suitable for installation and operation under the conditions for which they are to be used

B. Wetwells

1. Use manhole sections complying with Section 12 of these Standards
2. Wetwell vent cap:
 - a. Size: 6"
 - b. Approved product: Josam Vandal-Proof Vent Cap, Model 26706
3. Wetwell access door:
 - a. Fabricate from welded aluminum sections
 - b. Provide dual hinged door of ¼" aluminum tread plate for each pump
 - c. Upper surface shall be flush, with no protrusions
 - d. Fit door with recessed latch requiring a special square tool for access
 - e. Provide all hardware of Type 316 stainless steel
 - f. Provide Type 316 stainless steel support bracing with a self-locking hinge mechanism to lock into open position
 - g. Provide a recessed padlock hasp
 - h. Access doors shall include Protective Grating Panel option by Halliday Products, Inc., or Safe Grate System by ITT Flygt

C. Primary Level Control System

1. Ultrasonic level control system:
 - a. Provide Milltronics Hydroranger Plus with transducer
 - b. House Milltronics Hydroranger in a NEMA 4X non-metallic enclosure
 - c. House NEMA 4X enclosure in NEMA 12 Type 316 stainless steel enclosure. Provide drip shield with 3-point latch and lockable handle
 - d. Mount NEMA 12 enclosure on electrical equipment rack, separate from pump control panel
 - e. Utilize contact output signals from the ultrasonic controller for pump control high and low level alarms

2. Transducer:
 - a. Install in wetwell using Type 316 stainless steel angle and hardware
 - b. No less than 40' of cable
 - c. Provide necessary cord grips and cable support

D. Backup Level Control System

1. Use 2 float switches
 - a. Single action design, integrally weighted floats
 - b. Capable of withstanding water penetration under 25' of water
 - c. Micro-switch type
 - d. Seal in a polypropylene housing
 - e. No less than 40' of cable with polypropylene cord grips and mounting hardware
 - f. 3 to 1 safety factor, minimum
2. Provide for both pumps "On" and both pumps "Off" operation:
 - a. Utilize the upper and lower float to control both pumps in the event that the ultrasonic level control system fails
 - i. Upper float for pumps start and high-high level alarm
 - ii. Lower float for pumps stop and low-low level alarm
 - b. Design the float control circuitry so that the operation of the pumps under backup control is not contingent upon the operation of the ultrasonic level controller
3. Float cable holder:
 - a. Use six (6) hook, Type 316 stainless steel
 - b. Mount with Type 316 stainless steel anchors
 - c. Approved products: Halliday Product Series J4A Cable Holder, Type 316 Stainless Steel

E. Pipe and Fittings

1. All piping shall be Pressure Class 250 Ductile Iron Pipe and all fittings shall be Pressure Class 150 Ductile Iron Pipe
2. Provide flanged pipe ends complying with pertinent provision of ANSI/AWWA C110/A21.10
3. Fittings: Use flanged ductile iron fittings complying with ANSI/AWWA C110/A21.10
4. Couplings:

- a. Provide cast iron flanged coupling adapters to connect discharge and suction piping to field piping
- b. Provide restraining glands
5. All pipe and fittings shall be lined for sewers with Protecto 401 and conform to ANSI/ASTM D1248
6. Exterior of all piping and fittings shall be coated with Tnemec paint in accordance with the following specifications:
 - a. Exterior exposed steel:
 - i. Surface Preparation - SSPC-SP6/NACE 3 Commercial Blast Cleaning. The surface shall be free of all foreign matter and dry prior to painting
 - ii. 1st Coat – Series 1 Omnithane applied at 2.5-3.5 dry mils
 - iii. 2nd Coat – Series N-69 (Color: 110GN Clover) Hi-Build Epoxoline II applied at 4.0-6.0 dry mils
 - iv. 3rd Coat – Series 73-U (Color: 112GN Foliage) Endura Shield applied at 3.0-5.0 dry mils
 - b. Steel (Immersion):
 - i. Surface Preparation – SSPC-SP10/NACE 2 Near White Blast Cleaning. The surface shall be free of all foreign matter and dry prior to painting
 - ii. 1st Coat – Series 1 Omnithane applied at 2.5-3.5 dry mils
 - iii. 2nd Coat – Series N-69 (Color: 110GN Clover) Hi-Build Epoxoline II applied at 4.0-6.0 dry mils
 - iv. 3rd Coat – Series 104 (Color: 112GN Foliage) H.S. Epoxy applied at 3.0-5.0 dry mils
 - c. All field applications shall be inspected and approved by a Tnemec authorized factory representative and City of Sumter approved representative
 - d. Approval shall be in the form of a written acceptance letter to be supplied by the Tnemec representative stating that all areas of application have been cleaned, primed and coated in accordance with the factory's approval for warranty acceptance

F. Valves

1. Gate Valves:
 - a. Provide cast iron body in accordance with ASTM A126
 - b. Flanged end, ANSI 125 lbs

- c. Use drip-tight shutoff plug mounted in stainless steel bearings
 - d. Provide 1/8" thick hand welded in overlay, no less than 90% nickel content on all surfaces contacting the plug face. Seat to be raised from the valve body and machined to a smooth finish
 - e. Provide bolted bonnet design. Stem seals shall be provided in accordance with AWWA C517
 - f. Valve Actuator:
 - i. 6" and smaller exposed valves shall be provided with wrench actuators
 - ii. 8" and larger exposed valves shall be provided with worm gear type manual actuators
 - iii. Valves shall open left
 - g. Approved manufacturer: DeZurik or Pratt/Milliken
2. Ball Check Valves:
- a. Valve housing shall be constructed of a high quality nodular cast iron type GGG40/ASTM 65-45-12/SAE D4512
 - b. Valve shall be suitable for pressures up to 145 psi
 - c. Valve assembly shall be easily serviced
 - d. Approved manufacturer: ITT Flygt, Type 5087, or approved equal
3. Cushioned Awing Check Valves:
- a. Provide cast iron body with bronze seating ring and stainless steel shaft for attachment of weight and lever with non-corrosive adjustable air cushioned shock chamber
 - b. Mount the cushioned chamber to the side of the valve body with piston operating in the chamber, which will prevent valve closing without any hammering action
 - c. Shock absorption by air: Adjustable closing speed
 - d. Approved manufacturer: G. A. Industries, Inc., Figure 250-D
4. Air Release Valves:
- a. Provide combination air valve
 - b. The combination air valve shall be suitable for use at pressures up to 150 PSI
 - c. The valve shall have Type 316 stainless steel body, cover and cover bolts with a NPT inlet and outlet connection. Valves shall have a Type 316 stainless steel float and a replaceable seat of Buna-N or other suitable

material. Venting orifice and internal linkage mechanism shall be Type 316 stainless steel

- d. Valve size shall be 1" or 2" size as shown on the plans, both sizes to be supplied with 2" NPT pipeline connection. The distance from 2" pipeline connection to the top of the combination air valve shall not exceed 10"
 - e. Valve shall be supplied with flushing attachments consisting of 2" stainless steel inlet isolating ball valve, 1" stainless steel blow off ball valve and ½" stainless steel flushing ball valve and stainless steel pipe nipples and a 5' rubber hose with quick connect couplings
 - f. Valves shall be GA Industries Figure 942SS-F
5. Coatings:
- a. Coat exterior of plug valves, ball check valves and cushioned swing check valves with TNE MEC paint. Do not paint air release valves
 - b. The following coatings shall be applied in accordance with manufacturer's recommendations:
 - i. Surface Preparation - SSPC-SP6/NACE 3 Commercial Blast Cleaning. The surface shall be free of all foreign matter and dry prior to painting
 - ii. 1st Coat – Series 1 Omnithane applied at 2.5-3.5 dry mils
 - iii. 2nd Coat – Series N-69 (Color: 110GN Clover) Hi-Build Epoxoline II applied at 4.0-6.0 dry mils
 - iv. 3rd Coat – Series 73-U (Color: 112GN Foliage) Endura Shield applied at 3.0-5.0 dry mils
 - c. All field applications shall be inspected and approved by a Tnemec authorized factory representative and City of Sumter approved representative
 - d. Approval shall be in the form of a written acceptance letter to be supplied by the Tnemec representative stating that all areas of application have been cleaned, primed and coated in accordance with the factory's approval for warranty acceptance

G. Fencing

1. Provide chain link fence
2. All materials shall be galvanized including fabric, posts, rails and associated appurtenances
 - a. Chain link shall be 6' high, ends twisted and barbed, and commercial grade 9-gauge 2" mesh with PVC coating (black or green)

- b. End, corner and pull posts shall be 2.875" O.D
 - c. Line posts shall be 2.375" O.D
 - d. Top rail shall be 1.66" O.D
 - e. Bottom tension wire shall be 7-gauge spring coil wire
 - f. Gate posts shall be 3" O.D. for gates up to 6' wide
 - g. Gate posts shall be 4" O.D. for gates 7' to 13' wide
3. Vehicle Access Gate:
 - a. Vehicle access gate shall be a pair of 7' long by 6' high sections constructed of 2" O.D. pipe. Frame members shall not exceed 6" in length
 - b. Gate shall be equipped with a prop post center latch and hasp assembly. A ground anchor cast in concrete shall be provided
 - c. Gates shall be factory fabricated and equipped with gate hold backs. Panel shall have a horizontal brace at center of fabric height
 4. Personnel Access Gate:
 - a. Personnel access gate shall be a 3' long by 6' high section constructed of 2" O.D. pipe
 - b. Gate shall be equipped with a latch and hasp assembly
 - c. Gate shall be factory fabricated and equipped with gate hold backs
 - d. Panel shall have a horizontal brace at center of fabric height

H. Station Security Light

1. Provide an enclosed and gasketed 150 watt High Pressure Sodium light fixture with photo-electric cell
2. Light circuit to be protected by dedicated, 20A, 1P, GFCI circuit breaker in control panel and controlled by a manual on/off switch mounted in the control panel

I. Submersible Pump Station

1. Pumps:
 - a. General:
 - i. ANSI 125 lb standard cast iron flange fitting or cast with volute
 - ii. Pump components: cast iron, ASTM A48, Class 30
 - iii. All exposed fasteners and washers: Type 316L stainless steel
 - iv. Pump lift handle: Type 316 stainless steel
 - v. Coating:
 - a. All components coming into contact with sewage
 - b. Pump exterior: PVC epoxy primer and a chlorine rubber paint finish

- b. Impeller:
 - i. Double shrouded non-clog type
 - ii. Gray cast iron, Class 30, balanced dynamically to 0.5"
 - iii. Paint with one coat of alkyd resin primer
 - iv. Provide wear ring consisting of a replaceable stationary ring made of brass, drive fitted to the volute inlet
 - v. Sliding fit between the impeller and the shaft with one key
- c. Volute
 - i. Single piece, non-concentric design
- d. Shaft:
 - i. ANSI Type 420 stainless steel
- e. Bearings:
 - i. 2 permanently lubricated bearings
 - ii. B-10 bearing life of 50,000 hours
 - iii. Upper bearing: single deep groove ball bearing
 - iv. Lower bearing: two row angular contact ball bearings
- f. Watertight seals:
 - i. Nitrile rubber O-rings
 - ii. Fittings: Accomplish sealing by metal-to-metal contact between machined surfaces
 - iii. Gaskets, elliptical O-rings, grease or other devices are not acceptable
- g. Mechanical seals:
 - i. Tandem mechanical shaft seal system
 - ii. Operate the upper of the tandem set of seals in an oil chamber
 - iii. Upper seal set: one stationary tungsten carbide ring soldered to a holder of stainless steel and one positively driven rotating carbon ring to function as an independent secondary barrier between the pumped liquid and the stator bearings
 - iv. Lower seal set: a stationary ring soldered to a holder of stainless steel and a positively driven rotating ring, both of tungsten carbide. Hold each interface in contact by its own spring system
 - v. Require neither maintenance nor adjustment, easily inspected and replaced
 - vi. Provide all seal hardware of stainless steel
- h. Warranty:

- i. The pump manufacturer shall warrant the units being supplied against defects in workmanship and material for a period of five (5) years or 10,000 hours under the Municipal Wastewater Permanent Installation Warranty Policy under normal use, operating and service. The warranty shall be in printed form and apply to all similar units
- i. Approved Pump Manufacturer:
 - i. Barnes Pumps
 - ii. Ebara Pump
 - iii. Flygt
2. Pump Motor:
 - a. General:
 - i. Submersible type, designed for continuous duty, suitable for Class I, Div. I area and capable of sustaining a minimum of twelve (12) starts per hour
 - ii. Integral motor and pump
 - iii. Air filled, squirrel cage induction, shell type design, Class F insulation system. Class F materials rated for continuous duty in 40 degree C (104 degree F) liquids
 - iv. Cast iron motor frame and end shields
 - v. Stainless steel hardware and shaft
 - vi. Service factor: 1.15
 - vii. Minimum efficiency rating of 90%
 - viii. Minimum power factor rating of 85%
 - ix. Stator:
 - a. Heat-shrink fitted to shaft
 - b. Dip and bake in Class F varnish
 - c. Do not use bolts, pins or other fastening devices requiring penetration of the stator housing
 - d. Aluminum rotor bars and short-circuit rings
 - b. Cable entry water seal system:
 - i. Single cylindrical elastomer grommet, flanked by stainless steel washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the entry body containing a strain relief function, separate from the function of sealing the cable

- ii. Bear assembly against a shoulder in the pump top
 - iii. Separate the cable entry junction chamber and motor by a stator lead sealing gland or terminal board to isolate the motor interior from foreign material gaining access through the pump top. Do not use epoxies, silicones, or other secondary sealing systems
 - c. Provide pre-lubricated bearings: Minimum B-10 life of 50,000 hours
 - d. Thermal protection:
 - i. Motor rated thermally to NEMA MG1-12.42
 - ii. 3 thermostatic switches (one in each phase) in the stator windings
 - e. Junction chamber:
 - i. Seal from the motor by elastomer compression seal (o-ring)
 - ii. Connect between the cable conductors and stator leads with threaded compressed type binding, post permanently affixed to a terminal board
 - f. Seal protection:
 - i. Provide moisture detection device
3. Discharge connection:
- a. Permanently installed discharge connection system
 - b. Pump(s) automatically connected to the discharge connection elbow when lowered into place. Easily removed for inspection or service
 - c. Accomplish sealing of the pump unit to the discharge connection elbow by a simple linear downward motion of the pump
 - d. Stainless steel sliding guide bracket to be an integral part of the pump unit
 - e. Guide the entire weight of the pumping unit by no less than two guide bars and press tightly against the discharge connection elbow with metal-to-metal contact
 - f. A diaphragm, O-ring or other devices to interface sealing of the discharge are not acceptable
 - g. No portion of the pump to bear directly on the floor of the sump
4. Discharge elbow:
- a. Grey cast iron: ASTM A48, Class 30
 - b. Vertical leg: ANSI Class 125 lb. flange
 - c. Provide integral cast iron base
 - d. If necessary, size elbow with a reducer to reduce the maximum velocities and to match discharge piping
5. Pressure gauges:

- a. Provide on the discharge side of each pump
 - b. Range - nearest available upper range above pump shut off head
 - c. Provide rounded type, stainless steel case, 4 ½" nominal diameter with phosphor-bronze bourdon tubes, glycerin filled, 3" NPT bottom male threaded connections, stainless steel rack and pinion movement, black micro-adjusted corners and black figures with white plastic dials, and a threaded ring
 - d. Gauge accuracy: Within 1% of the total scale range
 - e. Provide diaphragm isolators on all gauges. Provide diaphragm material resistant to chemicals in the process line being measured
 - f. Gauge connections to consist of the following:
 - i. ¼" Type 316 stainless steel shutoff valve with Viton seals as manufactured by Whitey ball valve
 - ii. ¼" stainless steel piping connections
6. Guide rails (per pump):
- a. Provide two lengths of Schedule 40, Type 316 stainless steel pipe, with diameter as specified by manufacturer
 - b. Type 316 stainless steel bottom and top pilots
 - c. Acceptable manufacturer: Halliday Metals
7. Pump guides:
- a. Attach to pump volute with stainless steel hex head cap screws
8. Lift chain:
- a. Provide each pump and motor with Type 316 stainless steel lifting chain sized per manufacturer's recommendations. Minimum ¼" welded stainless steel link chain
 - b. Length to reach top of station plus an additional 3'
 - c. Attach upper end of chain to wetwell access frame with Type 316 stainless steel clip and stainless steel eye nut
 - d. Connect chain to pump using Type 316 stainless steel screw pin and shackle
9. Pump control panel:
- a. Enclosure:
 - i. Code gauge, Type 316 stainless steel: NEMA 12, gasketed with drip shield. Provide for support frame mounting with exterior flanges
 - ii. Single 3-point locking latch w/ pad locking provisions. Attach with stainless steel screws

- iii. Removable aluminum inner swing panel
 - a. Minimum thickness of 0.125"
 - b. Continuous stainless steel piano type hinge
 - c. Minimum horizontal swing of 90 degrees
- iv. Use removable aluminum back panel
 - a. 0.125" minimum thickness
 - b. Attach to enclosure on collar studs
 - c. Do not use self-tapping screws
- v. Engraved nameplates on door mounted hardware. Attach with stainless steel screws
- b. Control panel components:
 - i. Provide the following components with the panel:
 - a. Pump is on
 - b. Pump is off
 - ii. Motor starting components:
 - a. For motors less than 20 hp provide NEMA rated, magnetic motor starters
 - (a) Use motor starter contacts easily replaceable without removing the motor's starter from its mounted position. Acceptable products: Square D (Class 8536) or General Electric
 - (b) Provide phase failure, under voltage release and overload protection on all three phases. Acceptable product: Allen Bradley 813S or Diversified SLA-230-ASA
 - b. For motors 20 hp and larger provide soft-start solid- state starters.
 - c. . Acceptable products: Square D or Eaton
 - d. Circuit breaker and operating mechanism:
 - (a) Provide thermal magnetic circuit breaker having a minimum symmetrical RMS interrupting rating based on available fault current calculations
 - (b) Provide padlock-able operating mechanism on each motor circuit breaker
 - (c) Locate mechanism operator handles on exterior of the inner swing panel with interlocks which permit the panel to be opened only when circuit breakers are in the OFF position
 - (d) Provide Square D or Eaton
 - e. Pump alternator relay:

- (a) Provide electrical/mechanical industrial design, Class 47
 - i. Push button with test relay and toggle between automatic and lead pump 1 or 2
 - ii. Acceptable product: MPE, Inc., Model # 008- 120-13SP
- (b) Provide pump sequence selector switch
 - i. Provide manual selection of either Pump No. 1 or No. 2 as the "LEAD" pump
 - ii. Acceptable products: Allen Bradley Series 800H or Square D Class 9001SK
- f. High temperature shutdown:
 - (a) Provide high temperature shutdown for each motor utilizing the temperature switches embedded in the motor windings
 - i. Under high temperature conditions the switch shall open, de-energize the motor starter and stop the pump motor
 - ii. Automatic reset type
- g. Moisture detector control (seal failure):
 - (a) Provide for each pump a float switch sensor to detect moisture in the stator chamber
 - (b) Detection of moisture by the sensor shall disrupt the motor starting circuit of the pump
 - (c) Motor shall remain inoperative until problem is corrected and the control circuit is manually reset
- h. Provide overload reset device, operable without opening the inner swing panel
- i. Provide the following components mounted on the back plate:
 - (a) 120V control circuit transformer (open core and coil type) with primary circuit breaker and secondary circuit breakers for:
 - i. Control
 - ii. Duplex receptacle
 - iii. Condensation heater
 - iv. Area light
 - (b) Automatic shut-off timer for alarm horn
 - i. Set to operate one (1) minute each hour until acknowledged
 - ii. Provide timer bypass switch
 - (c) Provide flasher for alarm light. Light to flash until acknowledged
 - (d) Transient Voltage Surge Suppressor (TVSS)

- (e) Provide power terminals and control terminals
- j. Design control sequence so that panel is functioning automatically again after a power failure and manual reset is not necessary. Provide a time delay relay to prevent both pumps from starting simultaneously after power failure
- k. Provide a terminal board for connection of line, pump leads and level sensors and controls
- l. Provide elapsed time meter for each motor
 - (a) Six digits, non-re-settable
 - (b) Indicate total run time in hours and tenths
 - (c) Approved manufacturer: Grasslin Controls Corporation
- m. Provide high water alarm signal from ultrasonic controller and from float switch
 - (a) Front panel mounted silence switch
 - (b) 120V AC
 - (c) Utilize standard 60-watt incandescent bulb, vapor tight, alarm light with red globe, guard and mounting hardware
 - i. Mount above panel on support on a 1" diameter stainless steel rod 12" to 18" above the panel
 - ii. Provide threaded type globe
 - (d) 120V AC Alarm horn:
 - i. Weatherproof housing
 - ii. Mounting lugs
 - iii. Conduit tap
 - iv. Mount on side of the panel
 - v. Horn and light: Operate simultaneously on high level
- n. Provide a motor ammeter:
 - (a) Panel mounted
 - i. Scale range greater than pump rating
 - ii. Provide an "Off-L1-L2-L3" selector switch
 - iii. Provide a "Pump 1 - Pump 2" selector switch
 - iv. Acceptable manufacturer: General Electric
- o. Control relays:
 - (a) General purpose plug-in tube base type
 - (b) Din rail mounted relay sockets
 - (c) Acceptable products: Allen Bradley or Square D

- p. Wiring:
 - (a) Factory wired completely, except for power supply, motor, temperature switches and moisture sensor, connections, and mercury float switches. Ultrasonics to be used as primary level control. Provide power terminal strips for emergency float switches
 - i. Comply with applicable standards of National Electric Code
 - ii. Color code and number as indicated on factory wiring diagram
 - iii. Control wire: MTW 90 degree C #14 AWG
 - (b) Electrically ground all components to a common ground screw mounted on the removable back panel
 - (c) Group all wiring in plastic wire troughs except wiring from the 14-gauge backplate to the door shall be done in separate bundled harnesses for control circuits
 - (d) Provide sufficient motor lead wiring and level control wiring to make connections in the junction box
- q. Float switch and motor power cable: Provide cable of adequate length to terminate in control panel junction box without splicing
- r. Lights and alarms:
 - (a) Utilize signal contacts from ultrasonic level system and float switches
 - (b) Provide individual remote alarm contacts

J. Grinder Pump Station

1. Under conditions that arise from time to time, where normal installations cannot be implemented, The City of Sumter will review submittals for grinder pump installation. When it has been approved, the following criteria shall be used:
 - a. Duplex station only - with guide rails
 - b. No motors larger than 2 Hp
 - c. Approved Manufacturer: ABS Piranha E-2
 - d. Minimum 5' diameter precast concrete wetwell with separate valve box (locking type)
 - i. Coat wetwell and valve box with Raven 405 Epoxy System
 - ii. Coating shall be applied by a Raven Certified Applicator

- iii. Coating shall be tested for pinholes using approved spark test method. Applicator shall be responsible for correcting any defects found during testing
- e. Control panel shall be as follows:
 - i. The electrical controls for single-phase pumps shall be mounted in NEMA 12, Type 316 stainless steel enclosure with drip shield and 3-point locking latch with padlocking provisions. All conduits to and from the pump shall be sealed and protected against wear penetration
 - ii. A separate hinged inner door shall be provided for mounting the padlockable door interlocking handle of the main disconnect switch, green running lights, H-O-A switches, red seal alarm lights, 6 digit totalizers and 120 VAC GFI receptacle
 - iii. A 20 amp two-pole main disconnect switch shall be provided to de-energize the control panel. From the load side of this switch a two-pole 20A circuit breaker for each motor short-circuit protection
 - iv. The 120V control circuits shall be protected by a maximum 6-amp single-pole circuit breaker connected to the load side of the main disconnect switch. There shall be a separate maximum 6 amp single-pole circuit breaker for each high level alarm circuit only and be connected parallel to the control circuit breaker to ensure high level alarm function after tripping of control breaker and motor branch circuit breaker
 - v. Each motor will be protected by an adjustable, 2-pole bimetallic overload relay, meeting NEMA Class 10 tripping characteristics and shall be temperature compensated. The UL listed overload relay must be approved to be used in control panels. The control auxiliary contact of the overload relay must be connected in series with the motor contactor coil to switch off the contactor in the event of overload
 - vi. The UL listed NEMA sized motor contactor must have a guaranteed component life span without maintenance or contact replacement of
 - vii. 1 million operations. (Definite purpose contactors will not be allowed.)
 - viii. The inherent motor over temperature contacts shall be connected in series with the motor contactor

- ix. There will be an electronic seal alarm monitoring relay installed with voltage at the sensor and shall not exceed 24V with a signal current not to exceed 0.5mA
- x. All pilot devices mounted at the inner door shall have phenolic or metallic engraved name plates. The control panel shall be fitted with an integral red (min 40 watt) bulb flashing, tamper proof alarm light.
- xi. All starting capacitors, run capacitors and voltage sensing start relays shall be of heavy duty quality
- xii. The pumps shall be controlled by ultrasonic level device. See sections on "LEVEL CONTROL"
- xiii. There will also be installed in the control panel a device for automatic electrical alternation of pumps
- xiv. Provided to the City of Sumter 1 additional pump for inventory
- xv. All electrical work shall be performed by licensed personnel
- xvi. All installations shall be in accordance with National Electrical Code
- xvii. All wires shall have a wire-around wire identification number as shown in the wiring diagram at both ends. All components shall be identified with the same number as shown in the wiring diagram
- xviii. 5 year warranty on pump

**D.8.9 WASTEWATER COLLECTION SYSTEM PUMP STATION
CONSTRUCTION PROCEDURES**

A. General

1. The Construction of water and wastewater systems to be turned over to the City must be performed by a City approved Contractor
2. Prior to construction activities taking place, the Developer's Engineer shall coordinate in advance a Pre-Construction Meeting with the assigned City Construction Inspector. The Developer, Developer's Engineer, Contractor(s), and City's Construction Inspector shall be in attendance at a minimum
3. If any requirements for carrying out project construction are not met, the City reserves the right to have the Developer's Engineer issue a STOP WORK ORDER

B. Operation of City Valves

1. No City valve shall be operated without prior approval of the City

C. Handling of Materials

1. General:
 - a. Store rubber gaskets under cover and out of direct sunlight. Do not store nuts, bolts, glands, and other accessories directly on the ground. Keep inside of pipe and fittings free of dirt and debris
 - b. Keep valves off the ground and keep interior free of dirt and debris. Do not expose valve interior to direct sunlight
 - c. Handle pipe so as to ensure delivery in sound, undamaged condition
 - d. Carry pipe into position. Use pinch bars, slings or tongs for aligning or turning the pipe
 - e. Use care not to damage Ductile Iron Pipe linings
2. Submersible Pumps:
 - a. Store pump in shipping container until ready for use. The pump should be covered to protect it from dust, dirt and water. The ends of the cable must be protected against moisture
 - b. Do not allow the pump to freeze. If the pump must be stored in a sub-freezing environment, consult the factory for specific recommendations
 - c. Prior to installation, the pump motor should be rotated by hand to ensure the mechanical seals are free-spinning
3. Self-Priming Pumps:

- a. Carefully transport, store, handle and set each unit in place to prevent distortion, misalignment or other damage
- b. Off-load equipment at installation site using equipment of sufficient size and design to prevent injury or damage
- c. Immediately after off-loading, inspect complete pump station and appurtenances for shipping damage or missing parts
- d. Validate all station serial numbers and parts list with shipping documentation

D. Wetwell

1. Install wetwell in accordance with pertinent provisions for manhole installation in Section 13 of these Standards
2. The bottom slab of the wetwell shall be set on a minimum of 18" of No. 57 stone
3. Set base level so that walls will be plumb
4. Form constant height slope on walls of wetwell bottom using Portland cement grout
5. Steps shall not be used in wetwell
6. All interior hardware shall be Type 316 stainless steel including, but not limited to, the following:
 - a. Lifting chains
 - b. Anchor bolts
 - c. Bolts, nuts, and washers
 - d. Guide rails and supports
 - e. Rail guides
 - f. Power cable holder
 - g. Cable strain support
 - h. Float cable holder
7. Coatings:
 - a. Coat all interior concrete surfaces of wetwell to include walls and bottom surface of the top slab
 - i. Coating shall be Raven 405 Epoxy System and shall be applied by a Raven Certified Applicator
 - ii. Care shall be taken to protect all pumps, valves, piping and internal hardware from overspray during application

- iii. Coating shall be installed at 120 mils nominal thickness. Applicator shall verify thickness during installation by the use of a wet film thickness gauge
- iv. Coating shall be tested for pinholes using approved spark test method. Applicator shall be responsible for correcting any defects found during testing

E. Level Controls

1. Primary level control by Milltronics Hydroranger Plus with transducer. Backup level control by two (2) floats, one at high-high level, one at low-low level
2. Locate ultrasonic transducer per manufacturer's recommendations
3. Locate backup floats where flow from the inlet pipe will not interfere with the floats
4. Provide a separate hanger for the float cables

F. Piping and Fittings

1. Join pipe in accordance with the manufacturer's recommendations. Provide all special tools and devices, such as special jacks, chokers, and similar items required for proper installation. Lubricants for the pipe gaskets shall be used and shall be the manufacturer's standards
2. Flanged pipe:
 - a. Prior to connecting flanged pipe, the faces of the flanges shall be thoroughly cleaned of all oil, grease, and foreign material
 - b. Rubber gaskets shall be checked for proper fit and thoroughly cleaned
 - c. Care shall be taken to ensure proper seating of the flange gasket
 - d. Bolts shall be tightened so that the pressure on the gasket is uniform. Torque-limiting wrenches shall be used to ensure uniform bearing insofar as possible
 - e. If joints leak when the hydrostatic test is applied, the gaskets shall be removed and reset and bolts re-tightened
3. Restraining Glands:
 - a. Adjoining surfaces shall be clean, lubricated and meet the requirements of ANSI/AWWA C111/A21.11
 - b. Install using assembly recommendations established in ANSI/AWWA C111/A21.11 as well as installation instructions provided by the manufacturer

G. Valves

1. General:
 - a. Install all valves in accordance with manufacturer's recommendations
 - b. Valves shall be installed plumb and level
 - c. After installation, valves shall be fully operated in the presence of the City inspector
2. Cushioned swing check valves:
 - a. Provide one cushioned swing check valves on each discharge pipe
 - b. Mount the cushioned chamber to the side of the valve body with piston operating in chamber, which will prevent valve closing without any hammering action
 - c. Shock absorption by air: Adjustable closing speed
 - d. Approved manufacturer: G.A. Industries, Inc., Figure 250-D
3. Gate valves:
 - a. Provide three gear operated hand wheel actuated gate valves, one on each discharge piping to permit either or both pumps to be isolated from the header, and one on the bypass pumping connection
 - b. Furnish valve with a drip tight shutoff plug mounted in stainless steel bearings
 - c. Furnish gate valves, with "open-left" operation
 - d. Approved manufacturer: DeZurik or Pratt
4. Air release valve:
 - a. Equip above ground discharge piping with automatic air release valve designed to permit the escape of air to the atmosphere
 - b. Valve shall have Type 316 stainless steel body, cover and cover bolts with an NPT inlet and outlet connection
 - c. Provide a Type 316 stainless steel ball valve and union connection on the inlet piping
 - d. Valve shall be GA Industries Figure 942SS-F

H. SCADA radio antenna and antenna pole

1. General:
 - a. This section describes general requirements for radio antenna poles up to 60' in height
 - b. Requirements for radio antenna towers and poles greater than 60' in height will be reviewed on a case-by-case basis

2. All antenna poles shall be installed as close as physically possible to Motor Control Center (MCC) or building housing the Remote Telemetry Unit (RTU)
3. Site Conditions:
 - a. Verify all underground utility locations before digging for installation of antenna poles or underground conduit
 - b. Contractor shall determine to his own satisfaction the location and nature of all surface and subsurface obstacles and soil conditions which will be encountered during the construction
4. A licensed surveyor shall be employed to ensure antenna pole is installed level and plumb
5. Antenna shall be installed in strict accordance with the manufacturer's recommended procedures and requirements
6. Final installation shall be inspected and certified by a licensed party, individual, or regulatory agency as required by local codes. All costs for permitting, inspections and certifications are the responsibility of the Developer
7. Wood pole and antenna mast:
 - a. Conform to all applicable local codes and regulations for erection of utility poles. Place backfill in layers not more than 8" in loose depth. Compact each layer to not less than 95% proctor density, ASTM D- 1557. Use hand compaction adjacent to buildings and other structures
 - b. Use concrete backfill when solid rock is encountered or where existing soil conditions upon compaction do not provide a stable foundation for the pole
 - c. Where solid rock is encountered near grade, pole depth below grade shall be a minimum of 4'. Notify the Engineer when solid rock is encountered. Alternative locations will be allowed with the City approval if the communication path is not obstructed and transmission losses are not substantially increased
 - d. Coordinate cad welding of antenna mast and lightning rods and installation of cables prior to installation
 - e. Wooden poles using direct burial or concrete caisson foundations:
 - i. Provide and install two (2) each ¾" diameter, 10' long copper clad grounding rods. One ground rod shall be installed on each side of concrete caisson or direct burial pole 180 degrees apart

- ii. Provide and install one (1) ground wire the entire length of the pole
 - iii. Cad weld grounding wire from lightning rod and antenna mast to top of pole
 - iv. Cad weld ground wire and pole bottom with two (2) ground wires and cad welded to copper clad grounding rods
 - v. Wooden poles with one Yagi directional antenna system, the antenna system may serve as the lightning rod. Top front of directional antenna shall be installed low enough on antenna mast to provide a minimum 45 degree angle from the top of mast to front top of antenna
 - vi. One antenna system using Omni: Provide one (1) 2" galvanized 10' antenna mast and one (1) 3/4" copper ground rod bonded to antenna mast and pole. The lightning rod tip shall be above the highest antenna tip and shall have a minimum 45 degree angle
 - vii. Weatherproof all exterior antenna connections
 - viii. Antenna mast shall be wire cad bonded to ground wire
 - ix. Install the antenna mast vertically on top of wooden pole by drilling mast and wooden pole in two (2) locations with a minimum hole spacing 12" apart. Using carriage nuts and bolts and lock washers, bolt through antenna mast and wooden pole to tightly secure mast to pole
 - x. Provide coaxial mounting clips every 24" for entire length of coaxial cable. Provide and install two (2) coaxial grounding kits, one on top of mast and one at bottom of coaxial cable. Bond to ground wire
 - xi. Point/aim antenna per City provided coordinates
8. Steel pole and antenna mast:
- a. Install pole in accordance with manufacturer's recommendations
 - b. Inspect antenna pole assembly upon delivery and verify the integrity of the equipment delivered
 - c. Mount all required antenna/coax standoff equipment. Provide coaxial mounting clips every 24" for entire length of coaxial cable
 - d. Install four (4) each 3/4" diameter, 10' copper clad grounding rods. Install one (1) on each side of concrete pole base
 - e. Cad weld two (2) ground wires at base of pole, 180 degrees apart. Cad weld ground wire to each grounding rod
 - f. Cad weld two (2) grounding wires, one from lightning rod and one from antenna mast, to top of the pole

- g. One antenna system: Provide one (1) 2" galvanized 10' antenna mast and one (1) 3/4" copper ground rod bonded to antenna mast and pole. The lightning rod tip shall be above the highest antenna tip and shall have a minimum 45 degree angle
 - h. Two antenna system mounting one Yagi and one Omni: Provide two (2) 2" galvanized antenna mast, one 10' and one 5'. Omni antenna shall be mounted on 10' mast
 - i. Weatherproof all exterior antenna connections
 - j. Provide and install two (2) coaxial grounding kits, one on top of mast and one at bottom of coaxial cable. Bond to ground wire
 - k. Point/aim antenna per City System provided coordinates
9. Fiberglass poles and antenna masts:
- a. Install pole in accordance with manufacturer's recommendations
 - b. Inspect antenna pole assembly upon delivery and verify the integrity of the equipment delivered
 - c. Mount all required antenna/coax standoff equipment
 - d. Attach a number four copper ground wire to the entire length of the fiberglass pole on the opposite side of the pole from the transmission cable. At the base, cad weld connect two (2) 3/4" diameter, 10' long copper ground rounds. At the top, connect ground wire to extension mast
 - e. Connect lightning rod to the ground wire and mount to the top of the pole
 - f. Place backfill in layers no more than 6" in loose depth and compact to not less than 95% proctor density, ASTM D-1557. Compact each layer to required density. Use hand compaction adjacent to buildings and other structures
 - g. Install a mower ring around base of pole to prevent damage by lawn equipment
 - h. Install two (4) each 3/4" diameter, 10' copper clad grounding rods. Install one (1) on each side of concrete pole base
 - i. Fiberglass poles using direct burial or concrete caisson foundations:
 - i. Provide and install two (2) each 3/4" diameter, 10' long copper clad grounding rods. One ground rod shall be installed on each side of concrete caisson or direct burial pole 180 degrees apart
 - ii. Provide and install one (1) ground wire the entire length of the pole
 - iii. Cad weld grounding wire from lightning rod and antenna mast to top of pole

- iv. Cad weld ground wire and pole bottom with two (2) ground wires and cad welded to copper clad grounding rods
- v. Mount coax cable and antenna(s) in accordance with approved manufacturer's installation and antenna mounting practices for fiberglass poles
- vi. Weatherproof all exterior antenna connections
- vii. Provide and install two (2) coaxial grounding kits, one on top of mast and one at bottom of coaxial cable. Bond to ground wire
- viii. Point/aim antenna per City provided coordinates

I. Fencing

1. Fencing installation shall not begin before the proposed fence line has been inspected for low areas and incidental grading and compacting have been completed
2. Excavation for post footings shall be drilled holes in virgin or compacted soil
3. Depth of each post shall be set as specified by the manufacturer, but not less than 24" below finished grade when in firm, undisturbed soil. Posts shall be set deeper, as required, in soft and problem soils and for heavy lateral loads
4. Setting posts:
 - a. Loose and foreign material shall be removed from holes and the soil moistened prior to placing concrete
 - b. Top of footings shall be trowel-finished and sloped or domed to carry water away from posts
5. All posts to be plumb
6. All posts should be able to pass a pull test when a force of 48 pounds is applied perpendicular to the fence at the top of the post. The post should not deflect more than 1" at the locations where the force is applied
7. Concrete:
 - a. Concrete shall conform to ASTM C 94/C94M. Mix shall be designed to obtain concrete with a minimum 28-day compressive strength of 2,500 psi
 - b. Concrete shall have attained at 75 percent of its minimum 28-day compressive strength, but in no case sooner than 7 calendar days after placement, before rails or fabric are installed. Fabric and wires shall not be stretched or gates hung until the concrete has attained its full strength

J. Asphalt

1. Provide asphaltic concrete pavement across entire pump station site, extending a minimum of 6" past fence line
2. Provide asphaltic concrete paved entrance road, minimum 16' wide
3. Asphaltic concrete pavement shall comply with the following requirements:
 - a. Underlayment - Provide geofabric underlayment
 - b. Stabilized Aggregate Base Course (SABC) – Provide SABC In accordance with SCDOT Standard Specifications, Section 306, Type 1, placed at a depth of 6", compacted to 95% of maximum dry density in accordance with ASTM D 1557, Method D
 - c. Prime Coat – Applied uniformly at a rate of 0.5 gallons per square yard over compacted and cleaned sub-base surface in accordance with SCDOT Standard Specifications
 - d. Surface Course - Provide hot laid asphaltic concrete surface course in accordance with SCDOT Standard Specifications, Section 403, Type 2 Asphaltic Concrete, placed at a minimum depth of 2"

K. Submersible Pump Station

1. Use base plate as a template for drilling individual hole patterns. Mount base plates using Type 316 stainless steel expansion anchors
2. Form constant height slope on walls of wetwell bottom using Portland cement grout
3. Assemble guide rails to access frame and plumb the assembly
4. Install cable holder to precast top: Use Type 316 stainless steel anchors
5. Install pumps and piping, plumbing the assembly for proper alignment and fit
6. Seal around inlet and discharge piping with non-shrink grout
7. Install power cables using cable strain relief and cord grips (stainless steel)
8. Field wiring:
 - a. Extend grounding wire from control panel main ground screw to external ground as shown in details. Comply with NEC and local electrical codes
 - b. Make motor lead, level control, temperature sensor, moisture sensor, and power supply connections
 - c. Seal all conduits between junction box and control panel as shown in details. Comply with all pertinent National Electric Code requirements
 - d. Seal conduit terminations in control panel with duct seal
9. Electrical schematic:

- a. Provide three (3) laminated electrical schematic diagrams of the pump controls including terminal board connections
 - i. Permanently mount one (1) schematic diagram on the inside of the enclosure door
 - ii. Include one (1) schematic diagram in inside panel door document pouch
 - iii. Provide one (1) schematic diagram to CPW's Pump Station Senior Supervisor
10. Startup and Testing:
- a. startup and performance testing. Factory representative shall remain on site until startup and performance testing has been accepted by the City
 - b. The Developer's Engineer shall conduct testing of pump station pumps and controls to verify operating parameters are met per design criteria. The Developer's Engineer shall be responsible for coordinating the pump manufacturers, the City representative, and the contractor for draw down testing
 - c. In the presence of the Developer's Engineer and the City:
 - i. Remove pump from structure
 - ii. Replace, demonstrating proper alignment and operation of mating parts
 - iii. Operate pumps utilizing manual and automatic modes
 - iv. Demonstrate proper operational sequences, including alarm conditions
 - v. Measure amperage, voltage, pumping rate and discharge pressure for:
 - a. Each pump operating separately
 - b. Both pumps operating simultaneously
 - d. The Developer's Engineer shall submit six (6) copies of final test report to the City
11. Provide six (6) copies of the Operations and Maintenance Manuals
12. Spare parts:
- a. Provide the following minimum spare parts:
 - i. One of each seal assemblies
 - ii. One complete set of bearings
 - iii. One set of wear rings
 - iv. One of each type relay
 - v. One pump alternator

- vi. One float switch with cable
- vii. One of each type pilot light
- viii. One box of each type lamp
- ix. One set of fuses complete
- b. Package in one container all spare parts and clearly identify on the outside what the unit is for. Seal tightly and properly protect for long term storage

DRAFT

Chapter D. Engineering

D.9. PUMP STATION

D.9.1 GENERAL

A. Related Documents

1. Requirements of the General and Supplemental Conditions apply to all Work in this Section. Provide all labor, materials, equipment, and services indicated on the Drawings, or specified herein, or reasonably necessary for or incidental to a complete job

B. Description of Work

1. This section consists of furnishing all labor, material, equipment, and appurtenances required for a complete and acceptable sewage pumping station installation in accordance with drawing details and specified requirements herein

C. Related Work Specified Elsewhere

- | | |
|--------------------------------------|---------------|
| 1. Excavation and Backfill | Section 02220 |
| 2. Precast Concrete Structures | Section 02566 |
| 3. Cast In Place Concrete | Section 03300 |
| 4. Motor Controllers and Disconnects | Section 16479 |

D. Submittals

1. Submit the following:
 - a. Manufacturer's Catalog Data
 - b. Design Data
 - c. Performance Curve
 - d. Break Away Fitting Data
 - e. Access Cover Data
 - f. Control Data Panel
 - g. Manufacturer's Installation Instructions
 - h. Field Test Reports
 - i. Manufacturer's Certificates

D.9.2. PRODUCTS**A. Manufacturer's Qualifications**

1. Company specializing in manufacturing the products specified in this section with minimum 5 years experience
2. Pumps provided herein shall be either Barmessa or Barnes Submersible Solids Handling Sewage Pumps

B. Equipment Requirements:

1. Equipment for the Pumping Station shall conform to the following requirements:
 - a. Totally submersible centrifugal pumps capable of handling raw, unscreened sewage, including up to 3" diameter spherical solids, shall be provided and installed. The design shall be such that the pump unit will be automatically and firmly connected to the discharge piping when lowered into place on its mating discharge connection, permanently installed in the wetwell. The pump shall be easily removable for inspection or service, requiring no bolts, nuts, or other fastenings to be disconnected. For this purpose there shall be no need for personnel to enter the wetwell
 - b. The pumps shall be capable of handling liquids with temperatures to 104°F continuous, 160°F intermittent
 - c. Bearings shall be oil-lubricated and designed for 50,000 hours operating at minimum flow
 - d. Pumps shall be furnished with oil filled Inverter Duty Motors per NEMA MG-1, Part 31 with stator winding of the open type with Class H spike resistant magnet wire and a minimum 1.2 service factor
 - e. The volute, seal plate, adapter, motor housing, and motor housing cap shall be constructed of high quality, ASTM A-48 Class 30 cast iron. Impeller shall be furnished in ASTM A-536 ductile iron with a keyed, tapered shaft bore. Pumps shall be coated with two coats of DuPont Corlar® amido amine modified polymer satin gloss epoxy with a total 10 mil minimum thickness in the manufacturer's standard color or equal coating. All exposed hardware shall be 300 series stainless steel including the lifting bail
 - f. The pump construction shall contain no points of critical clearance, nor require periodic adjustment or replacement to maintain operating efficiency

- g. Discharge connection shall be a standard 125 pound 4-inch flange, slotted to accommodate 4" ANSI or 100mm ISO flanges
- h. Pump shaft shall be 416 stainless steel with a tapered impeller fit to reduce rotor imbalance and minimize stress risers associated with stepped shafts. All gaskets shall be of the angular gland compression O-ring type eliminating critical slip fits and the possibility of damage during service associated with sliding O-ring sealing arrangements
- i. The impeller shall be of a single or multi-vane design with pump out vanes on the back side. The impeller shall be dynamically balanced to ISO G6.3 specifications, The matching volute shall be provided with a replaceable bronze wear ring at the inlet
- j. Tandem mechanical shaft seals shall be of the single spring design operating in an intermediate oil-filled seat cavity. Pump out vanes in the back of the impeller shroud shall be large enough to efficiently expel solids away from the seal area. The materials of construction shall be silicon carbide vs. silicon carbide for the pump-end seal and carbon vs. ceramic for the motor-end seal, lapped and polished to a tolerance of one light band, 300 series stainless steel hardware, and Buna-N elastomeric parts. The pump end seal shall be pinned in place to prevent rotation of the stationary seat and shall seal to the pump housing via an O-ring to maximize heat transfer. The seal shall be commercially available and not a pump manufacturer's proprietary design. A moisture sensor detection system consisting of two probes shall be integrated within the oil-filled seal chamber which is isolated from the motor chamber. The leads for the moisture detector shall be contained within the power cable
- k. Pump motor shall be sized to be non-overloading throughout the entire pump curve. The rotor and stator assembly shall be of the standard frame design and the stator pressed into the motor housing for mechanical stability. The motor shall be constructed with windings operated in a sealed environment containing dielectric oil
- l. Motors shall be dielectric oil filled for optimal thermal management and maximum bearing life. The motor windings shall be of Class H, spike resistant insulation. The motor shall meet the NEMA Design B standard and be Inverter Duty Rated per NEMA MGD1, part 31. Motor shall be explosion proof for use in Class 1, Division 1 locations

- m. Pump shaft shall be 416 stainless steel, keyed and tapered for the matching impeller. The lower bearing shall be of the double row ball type, locked in position to accept radial and axial thrust loads, and the upper bearing of the single ball type for radial loads. Bearings shall operate in an oil bath environment
- n. Three thermal sensors (one per phase) shall be embedded in the end coil of the stator windings, wired in series, and used to monitor stator temperatures. This shall be used in conjunction with an external motor overload protection device and wired to the control panel through the single power cable
- o. Pump motor cable shall be equipped with a suitable length of Type SOW submersible power cord constructed to run continuously from the pump motor to the pump control panel splice box mounted at the location shown on the drawings without splicing. The cable shall include the moisture and temperature sensor leads. The cord shall enter the pump in a cast iron terminal box assembly bolted to the motor housing sealed with Buna-N O-rings and filled with epoxy to seal the outer cable jacket and individual strands to prevent water from entering the motor housing. Additional sealing and strain relief shall utilize a secondary pressure grommet at point of cable entry
- p. Pump shall have a maximum driven speed of 1750 RPM. In addition, each pump shall have characteristics as shown below:
- | | | |
|----------------------|--|-----------|
| i. Pump Curve: | Flow (gpm) | Head (ft) |
| | 0 | 62 |
| | 50 | 58 |
| | 100 | 54 |
| | 150 | 50 |
| | 200 | 48 |
| | 250 | 44 |
| | 300 | 41 |
| ii. Horsepower: | 15 max | |
| iii. Min Efficiency: | 50% at operating point of 236 gpm at 46' TDH | |
| iv. Discharge Size: | 4" | |
| v. Base Elbow: | 4" x 4" | |
| vi. Voltage: | 460 V, 3 ϕ , 60 Hz | |

- q. Accessories shall be provided for the pumping station as specified below:
- i. The discharge elbow shall have a foot for anchoring to the wetwell floor and a means for firmly supporting the guide rails. The design and mass of the discharge elbow shall be sufficient for rigidly supporting the eccentric load of the pump unit and discharge piping. The discharge elbow shall connect to the discharge-piping riser. The elbow shall have ANSI, 125 pound flange dimensions and drilling
 - ii. Each pump unit shall be equipped with one or two standard weight stainless steel pipes, sized to fit the discharge elbow and pump guide bracket. The pipe shall extend from the pump up to the access frame at the top of the wet well
 - iii. A pump retrieval system for each pump consisting of stainless steel chain and hardware attached to each pump lifting bail for use with a “grip eye” type lifting system and stainless steel lift cable, all which adequately sized by the pump manufacturer for installing and removing the pump units, shall be furnished with the pumps. A minimum of one “grip eye” mechanism shall be furnished
 - iv. The size and location of wetwell and valve vault access hatches shall be coordinated with pump manufacturer and precast manufacturer. Hatches shall be constructed of minimum $\frac{1}{4}$ ” checkered aluminum plate with suitable framing and reinforcing to allow a 300 psf live load on the closed hatch. Hatches shall be operable from inside and outside the wetwell or vault, shall have torsion bars to ease opening, and shall lock in the open position. Doors shall be equipped with a hasp and staple lock or a removable key wrench mechanism to prevent entry by unauthorized persons. Wetwell access hatches shall be provided with a fall protection system such as Retro-grate by Halliday to mitigate falls into wetwells from open hatches
 - v. A spare pump impeller shall be provided to the Owner upon completion of the installation
 - vi. An influent trash basket device shall be provided and mounted to the influent pipe of the pump station. The device shall be “Station Guard” as manufactured by Raynor Environmental Enterprises, (or approved equal), and shall be furnished with all necessary appurtenances to allow easy retrieval and cleaning

- vii. A stainless steel portable hoist, 1000 pound capacity, with stainless steel winch, hook and cable shall be furnished. Furnish and install a lined, stainless steel socket for embedment into the precast wetwell top. Coordinate with wetwell supplier. Furnish a stainless steel cap to keep the socket free from debris. Hoist shall be Halliday Model D2B36D, or approved equal
- r. Control Panel:
 - i. A pump control panel shall be furnished and installed as indicated. The control panel shall be capable of being mounted at the location shown on drawings. Panel shall be wired in accordance with the National Electric Code in NEMA 4X stainless steel weatherproof enclosure. All components shall be identified by ¼-inch letters on permanent plastic nametags. All control wiring shall be labeled at both ends. Panel shall receive 120/240V AC, 3-phase, 4-wire, 60 Hz, delta-connected power with a grounded neutral connection at the middle of one delta phase. The control panel shall be equipped with the following in accordance with specification Division 16 and the NEC: individual motor disconnects, WEG brand motor soft-starters, pump run meters or clocks, pilot lights, GFCI receptacle, overload protection, control relays, lead/lag motor alternator, adjustable time delay pump starting to prevent simultaneous starting of pumps, automatic transfer to non-operating pump in event of overload in operating pump, overload reset, phase monitor, H-O-A selector switch for each pump, RUN indicator light for each pump, STOP indicator light for each pump, FAULT indicator light for each pump. OVERLOAD RESET pushbutton for each pump, voltage monitor relay, control circuit transformers, circuit breaker for cabinet heater, alarm circuit to activate an alarm light and horn and terminal board for external connections. See electrical drawings for One Line Power Riser Diagram and Stand-by Power Connection. Panel shall be capable of being mounted as shown in the plans and UL labeled after construction. Provide alarm light and horn integral to the control panel and mounted on the top (light) and rear (horn). Provide an LED light strip within the pump control panel to illuminate upon opening. The switch for the light strip shall be integral to the panel. The pump control panel shall be provided with adequate ventilation fans to prevent damage to the sensitive electronics from

excessive heat gain. All general purpose type relays used in the manufacture of the control panel shall be 8 pin octal style (Granger #1A193) with matching base (Granger #5X852). Control panel shall provide power distribution as indicated on electrical drawings

- s. Level Controls:
 - i. Water level sensing devices with cable and cable supports shall be provided at the wet well as shown on the project drawings. Each level sensor shall be a pear-shaped, hermetically sealed enclosure, housing a mercury switch. The sensor shall be suspended by a three-conductor cable, heavily sheathed for resistance to immersion, corrosion, and abrasion. The mercury switch shall be opened and closed by the change in orientation of the sensor caused by the rising and falling water level in the wet well. The sensor shall remain vertically suspended in the wetwell whether totally, partially, or non-submerged by means of a metal weight mounted externally for float-type sensors or contained within the body of the sensor in the case of semi-floating type sensors. Each sensor shall be supplied with sufficient length of cable for an unspliced run to the junction panel located as shown on the drawings. Level control sensors shall be provided to control pump off function, lead pump on, lag pump on, and high level alarm activation
- t. Warranty
 - i. The pump Manufacturer shall warrant the units being supplied to the Owner against defects in workmanship and materials for a period of five (5) years under normal use, operation, and service. The warranty shall be in printed form and apply to all similar units. This warranty shall be in addition to the normal one (1) year warranty required

D.9.3 EXECUTION

A. Execution

1. Each pump station and all appurtenances shall be constructed to conform to all applicable portions of the other sections of these specifications, to drawing requirements and to the following:
 - a. Cleanup of the site shall be made upon completion of the work and the entire site left in a condition acceptable to the Engineer
 - b. Pumps, Equipment, and Piping

- i. The contractor shall install the pump stations and other equipment in strict accordance with the manufacturer's instructions. After installation pump alignments will be checked and corrected if necessary. Excessive vibration or noise shall not be allowed within the speed range of the pumps
 - ii. The completed installations shall be properly lubricated, checked and the operating characteristics determined by the manufacturer's representative in the presence of the Engineer. Additionally, the amperage draw shall be checked at the design conditions for each pump unit
 - iii. Electrical work will be done as specified and shown on the drawings
- c. Items of Piping, Wiring, or Equipment which are necessary for a complete and functional system, but which are not shown on the drawings or specifically called for in the specifications shall be furnished and installed without additional cost to the Owner

D.9.4 EQUIPMENT SERVICE

A. Equipment Service

1. Manufacturers of equipment utilized in the work shall provide all instructions and assistance necessary for the proper erection and installation of their equipment. After erection, the manufacturer shall furnish the services of a qualified representative to inspect the equipment installation, the equipment in service and instruct the Owner's operator in its operation and maintenance
2. The Services of a Qualified Representative to place equipment in operation and give instruction in its use shall be provided for whatever time necessary to ensure proper installation, operation, and instruction. Service shall consist of not less than two (2) days on site. The Engineer shall be notified as to the time for all trips, sufficiently in advance to be present if desired. Copies of reports for startup services provided shall be provided to the Owner and Engineer
3. Operation and Maintenance Manuals (4 copies) shall be furnished by equipment manufacturers for their equipment. The manual shall contain complete parts list showing factory parts numbers. It shall also contain complete operating and service instructions and shall be tabbed and indexed

for each use. Manuals shall be submitted to the Engineer for approval within 30 days after approval of shop drawings

DRAFT

Chapter D. Engineering

D.10. INSPECTIONS AND CLOSEOUT

D.10.1. ROAD AND DRAINAGE

A. Roadway Testing and Inspections

1. Roadway Construction shall follow City of Sumter and SCDOT requirements as outlined in Section D5.2.

Table D.10-1: Roadway Course Testing Requirements

Roadway Courses	Mix Design Required?	Thickness and Density Frequency	Prime Coat Required?
Subgrade Course			
Cement Modified	Yes	500 ft per 2 lane roadway	No
Soil Aggregate	No	250 ft per 2 lane roadway	Yes
Base Course			
Cement Stabilized Earth (Soil Cement)	Yes	250 ft per 2 lane roadway	Yes (curing coat)
Macadam	No	250 ft per 2 lane roadway	Yes
Intermediate Course			
Asphalt Binder or Immediate Course	No	500 ft per 2 lane roadway	Yes (tack coat)
Surface Course			
Asphalt Surface Course Type C or Type D	Yes	500 ft per 2 lane roadway	Yes (tack coat)

B. Stormwater Inspections

1. Public Works Stormwater Division (PW/SWD) Staff is authorized by the City of Sumter Stormwater Management Ordinance to inspect construction sites and enforce the requirements of this Manual. The staff shall be:
 - a. Authorized to enter and inspect all properties for regular inspections, periodic investigations, monitoring, observation, measurement, enforcement, sampling, and any other duties necessary to carry out the provisions of the Stormwater Management Ordinance

- b. Authorized to conduct inspections and file reports for periodic inspections as necessary during land disturbing activities to assure compliance with the approved Stormwater Pollution Prevention Plan (SWPPP), Land Disturbance Permit (LDP), construction plans, and/or City of Sumter Stormwater Management Ordinance
 - c. Authorized to furnish the permit holder or other authorized agent the results of inspection in a timely manner after the completion of each inspection
 - d. Authorized to issue a Notice of Violations (NOV) to the permit holder or other authorized agent when any portion of the site work does not comply with the approved SWPPP, LDP, construction plans and/or City of Sumter Stormwater Management Ordinance
 - e. Authorized to issue a Stop Work Order (SWO) as the result of unsafe conditions, working without a permit, unsatisfactory work or other non-compliance without any prior notice. A SWO may be issued when previous requests by PW/SWD to remedy any non-compliance(s) (NOVs, holding building permits /inspections/finals, citations, etc.) that have not been followed with appropriate and prompt corrective action
 - f. Authorized to hold building permits, inspections, and finals in order to gain compliance with approved plans. These actions may be in conjunction with NOVs, SWOs, etc. These actions shall only be asserted to the entity or his subcontractors that have initiated the noncompliance
 - g. Authorized to issue a civil citation(s) as a result of failure to comply with all previous enforcement measures
 - h. Authorized to perform a final inspection upon the completion of the stormwater system to determine if the completed work is constructed in accordance with the approved SWPPP, LDP, construction plans, and/or City of Sumter Stormwater Management Ordinance
 - i. Authorized to conduct post-construction inspections and file reports for inspections as necessary to assure all permanent post-construction stormwater management facilities are operating according to the SWPPP, LDP, construction plans, and/or City of Sumter Stormwater Management Ordinance
- 2. Stormwater Management Staff Responsibility**
- a. PW/SWD staff shall conduct site inspections on all land disturbing activities and sites that have permanent post-construction stormwater management facilities. The permit holder or other authorized agent shall notify the PW/SWD staff at least 48 hours before the initiation of construction. Failure to notify the PW/SWD before a project begins may

result in the issuance of a SWO. The permit holder must also notify the PW/SWD staff upon project completion when a final inspection shall be conducted to ensure compliance with the approved LDP, SWPPP, construction plans, and/or City of Sumter Stormwater Management Ordinance. PW/SWD staff shall be responsible for:

- b. Inspecting the project site at a minimum of once a month
- c. Verifying that the approved SWPPP, LDP and construction plans are on the project site or are available through other approved means
- d. Verifying that active construction sites are inspected for compliance with the approved SWPPP, LDP, construction plans, and/or City of Sumter Stormwater Management Ordinance
- e. Verifying that maintenance is being performed in accordance with the maintenance schedules as approved with the LDP
- f. Providing the permit holder or other authorized agent an inspection report when a deficiency is noted. The following items will be noted in the inspection report:
 - i. Inspector name, project name, date, and location of the site inspection
 - ii. Whether the approved SWPPP, LDP, and construction plans are on site and have been properly implemented and maintained
 - iii. If the deficiency is in relation to the approved SWPPP, LDP, construction plans, and/or City of Sumter Stormwater Management Ordinance
 - iv. Corrective action to be taken and corresponding date for the action to be completed
- g. Conducting a post-construction inspection of permanent stormwater management facilities. All maintenance inspections shall be conducted at reasonable times. If the owner cannot be contacted, the inspection shall be performed and a report shall be sent to the owner
- h. Providing the owner or other authorized agent of a permanent stormwater management facility with a written permanent maintenance inspection report when a deficiency is noted. The following items will be noted in the inspection report:
 - i. Inspector name, project name, date, and location of the site inspection
 - ii. Whether the maintenance activities have been property implemented and completed
 - iii. Maintenance deficiencies
 - iv. Corrective action to be taken and corresponding date for the action to be completed

- i. Upon refusal by any property owner to allow City staff to enter or continue an inspection, the staff shall terminate the inspection. The PW/SWD Staff shall immediately report the refusal and grounds to the PW/SWD. The PW/SWD shall promptly seek the appropriate compulsory process
 - j. Upon completion of a land disturbance or post construction inspection the PW/SWD staff shall notify the person financially responsible for the land disturbing activities or for permanent maintenance in writing within three working days when a violation(s) is observed. NOVs will include the following information:
 - i. Nature of the violations
 - ii. Proposed penalty
 - iii. Required corrective actions
 - iv. The time period for adequately correcting the violations
 - k. In the case of an immediate threat to life and/or property or any other emergency as deemed necessary by City of Sumter Public Safety, the PW/SWD may employ the necessary labor and materials to perform the required work as expeditiously as possible. The owner shall reimburse all costs, including administrative costs, to City of Sumter to address the immediate threat
- 3. Inspections by Other Responsible Parties**
- a. In accordance with National Pollutant Discharge Elimination System (NPDES) General Permit for Stormwater Discharges from Large and Small Construction Activities, City of Sumter Stormwater Management Ordinance and this Manual, permittees are responsible for conducting inspections during and after construction. In addition, permanent stormwater control owners are required to conduct inspections on those controls. Specific requirements for these inspections are provided in the following sections:
 - b. Construction Inspection by Permittee
 - c. Inspections shall be conducted for each stormwater management best management practice (BMP) shown on the construction plans in accordance with the NPDES Construction General Permit, as it relates to frequency, qualifications of the staff, and documentation. Copies of inspection reports must be inserted in the Onsite SWPPP (OS-SWPPP) and be made available to PW/SWD staff upon request
 - d. Post-Construction Maintenance Inspection by Owner
 - e. The purpose of maintenance inspections is to ensure that stormwater management BMPs are working properly. All components of the stormwater system shall be maintained in accordance with the

maintenance covenant and schedule. BMP owners must perform an inspection of BMPs once every five years or when maintenance concerns have been identified, complete inspection documentation and submit to the City. Where maintenance needs are identified, the BMP owner is responsible for completing the maintenance

4. Working Without a Permit

- a. Any person that proceeds with land disturbing activities on a site that requires a SWPPP and/or LDP without first submitting a SWPPP and obtaining a permit shall automatically have a SWO placed on the development. If the SWO is issued for not obtaining a LDP, a penalty fee equal to two times the normal plan review fee will be charged. A Land Disturbance Permit (including payment of normal fees) must be approved prior to continuing work on site. Payment of fees and other penalties must be completed prior to lifting the SWO. The SWO shall require correction of violations. No other project activities other than correcting violations and deficiencies can resume until the SWO has been lifted by the PW/SWD

5. Verbal Warnings

- a. A Verbal Warning may be given for less severe violations or for first time offenders if it shall result in immediate compliance. Staff should document the verbal warning delivery in inspection reports, in an email, or in site notes

6. Corrective Order (Written Warning)

- a. A Corrective Order is a written warning intended for minor violations. The PW/SWD Staff may issue a Corrective Order to the responsible party and/or property owner where the violation has occurred. A Corrective Order shall be submitted in writing within three working days of the inspection

7. Notice of Violation

- a. The purpose of the Notice of Violation (NOV) is to formally notify the permit holder or other authorized agent of non-compliance noted during inspections. An NOV shall be submitted in writing within three working days of the inspection
- b. The PW/SWD may require the violator to submit, a written corrective action plan (CAP) by the deadline stated on the NOV. When required, the CAP must be submitted by the violator to the Director of Public Works. An inspection to ensure that corrective actions have been completed will be conducted by the PW/SWD staff. Submission of the CAP in no way relieves the violator of liability for any violations occurring before or after receipt of the NOV. See Section XX for further information about the CAP

8. Stop Work Order

- a. The purpose of a Stop Work Order (SWO) is to give the violator an opportunity to gain compliance with an NOV or other violation with the approved SWPPP, LDP, construction plans and/or City of Sumter Stormwater Management Ordinance. No further work other than correcting violations and deficiencies shall be allowed until the site is in compliance and the SWO is lifted
- b. The PW/SWD may require the violator to submit, a written corrective action plan (CAP) by the deadline stated on the SWO. When required, the CAP must be submitted by the violator to the Director of Public Works. An inspection to ensure that corrective actions have been completed will be conducted by the PW/SWD Staff. Submission of the CAP in no way relieves the violator of liability for any violations occurring before or after receipt of the SWO. See Section 13 for further information about the CAP

9. Building Permits, Inspections, and Finals

- a. The PW/SWD may place a hold on building permits, inspections, and final certificate of occupancy in order to give the violator an opportunity to gain compliance with the approved SWPPP, LDP, construction plans and/or City of Sumter Stormwater Management Ordinance. These actions may be in conjunction with NOVs, SWOs, etc

10. Civil Citations

- a. The issuance of Civil Citations by the staff may be made for the following situations:
- b. When a SWO has been issued, and work continues in defiance of the order
- c. On abandoned sites where no work has been taking place, and continued non-compliance with a NOV may result in the issuance of repeat citations
- d. When repeated, recurring violations take place at the same development site or when repeated recurring violations take place by the same responsible party
- e. Violations may subject the permit holder to Civil Penalties set forth by the magistrate for each violation. Each separate day that a violation remains uncorrected constitutes a new and separate violation
- f. Citations shall be hand delivered when possible. When it is not possible, the Citation shall be sent by Certified Mail. Permit Holders, owners, agents, permittees, lessees, builders, contractors, developers, firms, corporations, or partnerships listed on permit application or tax record may be cited under this provision

- g. Along with the Civil Citation, the PW/SWD may require the violator to submit, a written corrective action plan (CAP) by the deadline stated on the Civil Citation. When required, the CAP must be submitted by the violator to the Director of Public Works. An inspection to ensure that corrective actions have been completed will be conducted by the PW/SWD Staff. Submission of the CAP in no way relieves the violator of liability for any violations occurring before or after receipt of the Civil Citation. See Section 13 for further information about the CAP

11. Criminal Penalties

- a. In addition to any applicable civil penalties, any person who negligently, willfully or intentionally violates any provision of the Stormwater Management Ordinance shall be guilty of a misdemeanor and shall be punished within the jurisdictional limits of the magistrate's court. Each day of a violation shall constitute a new and separate offense

12. Issuing Violations

- a. The PW/SWD staff shall issue an NOV to a permit holder, and/or other authorized agent upon findings of non-compliance of the SWPPP, LDP, construction plans and/or City of Sumter Stormwater Management Ordinance. Subsequent non-compliance or failure to complete the items on the NOV may result in a SWO and/or citation. Repeat offenders may have accelerated compliance timelines
- b. For violations that do not involve the safety of life or an imminent threat of serious damage to the environment and public or private property, NOV's, SWOs, building holds, and/or citations may be issued for, but are not limited to, the following:
- c. Failure to notify the PW/SWD before beginning work on any phase of a development project or failure to have work inspected
 - i. Any work that has been placed without a required inspection approval shall be certified in writing by a registered design professional before the next phase of construction shall begin
 - ii. PW/SWD reserves the right to inspect all facilities that have not been viewed due to the permit holder's failure to notify the PW/SWD before work began. Any deficiencies that need to be corrected before work starts again shall be listed and given a compliance date. The permit holder shall be notified to call for future inspections
- d. Failure to have sediment and erosion controls in place, improper installation, and/or maintenance deficiencies
- e. Construction not in accordance with the approved plans
- f. Working without grading, building, or other applicable permits

- g. Encroachment upon buffer areas during construction
- h. Failure to properly maintain permanent post-construction stormwater management facilities, including water quality buffers
- i. Enforcement timelines are up to the discrepancy of the PW/SWD

13. Corrective Action Plan

- a. With any corrective action noted above, the PW/SWD has the authority to require a violator submit a written CAP. Some corrective actions needed at a site are straightforward, simple actions such as cleaning out sediment controls or vegetating an area. However, other actions may require more planning and thought. In those situations, the City may require a CAP. Depending on site conditions, the PW/SWD Staff may require that the CAP be prepared by a Qualified Person or prepared and certified by a Professional Engineer. A CAP must include:
 - b. Proposed corrective actions to resolve the violation, including immediate actions and final actions
 - c. Proposed schedule for the corrective actions
 - d. When requiring a CAP, the PW/SWD inspector will set a deadline for submittal of the CAP for review and acceptance. If immediate measures are needed to halt damages to the City's stormwater system, private property or a stream, those actions should be separately addressed in the enforcement action and required immediately as opposed to waiting for submittal of the CAP

C. Closeout and Dedication

1. Closeout (Project Completion)

- a. All Projects that have been submitted, approved, and received Land Disturbance Permits will require a Closeout Package to be submitted. This package needs to include at a minimum:
 - i. Surveyed as-built drawings
 - ii. As-built calculations
 - iii. PTOs for applicable utilities
 - iv. Notice of Termination
 - v. Engineer's Certification
 - vi. SCDOT Encroachment Permit (if applicable)
 - vii. Permanent Maintenance Responsibility Agreement

For Residential Projects, roadways, and associated storm drainage constructed according to the approved set of plans may be dedicated to City of Sumter for ownership and maintenance. This is accomplished through the

City's Closeout Process and the City reserves the right to deny acceptance of any project petitioned to be turned over to the City.

Once a Closeout Package has been submitted to the Department of Community Planning and Development for review, a Final Inspection can be scheduled. The package must include the above-mentioned items and items in Steps one (1) and two (2) can be submitted simultaneously. All information must be submitted to the City of Sumter Engineering Department, and the applicant should choose "Closeout Permit" when applying for the permit and should include the following:

- Record Drawings – The drawings must include "ALL" improvements and final road and storm drainage profiles.
- Record Drawings (CAD) – The digital submission should be a (.dwg) or (.dxf) file and must include all layers.

Also, as a condition for acceptance of infrastructure into the City system, City of Sumter requires a one-year or two-year warranty depending on the circumstances during construction as determined by the City Engineer, accompanied by a bond in the amount of 10 percent of the construction costs associated with the deeded infrastructure. The warranty will pertain to the design and construction of the streets and accompanying drainage system in accordance with the Road Design Standards and their satisfactory performance during the warranty period. The warranty period begins with the City's execution of the deed. All pavement failures and other structural defects that are detected during the warranty period are to be corrected by the grantor upon official notification by the Department of Public Works.

2. Dedication of Infrastructure

Upon receipt of the dedication package, the Department will review all information for accuracy. If all information is accounted for and accurate, a recommendation will be submitted to the City Engineer for acceptance of the project into the City inventory within three (3) days of receipt of a complete package. The dedication package must include the following:

- Certificate of Title
- Deeds (Road Right-of-Way)
- Deeds (Storm Drainage Easements)
- Affidavit (For Department of Revenue)
- Final Plat (Last Revised)
- Memorandum of Understanding

Templates for the Road Right-of-Way Deed, Storm Drainage Easement Deed, and Affidavit for Deeds Templates can provided by the City of Sumter Engineering Department.

3. Financial Surety

For purposes of these Standards, "Financial Surety" shall refer to a City approved instrument and arrangement undertaken by and at the expense of the developer, established to provide a financial guarantee in favor of the City. In the event of default or failure by the developer, the Financial Surety shall be seized upon so as to provide funds for the completion of all required infrastructure improvements. In lieu of the completion of a subdivision (infrastructure improvements), prior to final plat approval, the developer can provide financial surety in an amount with surety and conditions satisfactory to it, providing for and securing to the City the actual construction and installation of all improvements within a specified time period as expressed in the financial documents.

a. Types of Surety Bonds

The following types of bonds shall be acceptable to the City, subject to review and approval by the City of Sumter Legal Department and/or the City Engineer or his/her authorized representative.

b. Surety Bond

A surety bond issued by an insurance company licensed to do business in the State of South Carolina in an amount equal to 125 percent of the estimated cost of improvements. The City engineer or his/her authorized representative will validate the remaining scope of work presented and the estimated cost of improvements.

c. Escrow Funds

A Cashier's Check may be accepted in an amount equal to 125 percent of the estimated cost of improvements. The City engineer or his/her authorized representative must validate remaining scope of work presented along with the estimated cost of improvements. The contract may authorize a reduction of the escrow account upon completion of a portion of the improvements, but at no time shall the escrow account be less than 125 percent of the remaining improvements.

d. Letter of Credit

An Irrevocable Letter of Credit may be accepted by a lending institution/bank licensed to do business in the State of South Carolina in an amount equal to 125 percent of the estimated cost of improvements.

The City engineer or his/her authorized representative must validate remaining scope of work presented along with the estimated cost of improvements.

e. Financial Surety Submissions

The Financial Surety Package shall be submitted directly to the City of Sumter Engineering Department, 141 N Main St, Sumter, SC 29150, Attention: Community Planning and Development - New Development. A complete financial surety package shall include the following:

- i. Engineers Cost Estimate (Prepared by Engineer) Sealed and Signed. The cost estimate must include a breakdown of work to be completed to include unit cost and totals.
- ii. Statement of Conditions (SOC) (Prepared by Developer or Representative). The SOC is the formal agreement between the City and Developer. This document will specify the terms of the agreement and specify an expiration date of the agreement.
- iii. Bond, Letter-of-Credit or Cashier's Check (Prepared by Bank or Insurance Company)
- iv. Memorandum of Understanding (Prepared by City of Sumter). The memorandum of understanding is an agreement between the Bank/Insurance Company and the City which describes the terms of the surety agreement between the Developer and City.
- v. The Bonded Plat should be submitted directly to the City of Sumter Planning Department.

D.X.X. UTILITIES

A. Final Inspections

1. The purpose of the Final Inspection is to inspect all aspects of the constructed utility, drainage, and road systems to determine conformance with the plans stamped "Approved for Installation" or "Approved for Construction" by the City of Sumter
2. For Service Only Projects: Due to the smaller scope of service only projects, fewer inspection days are typically necessary. It is possible that the Preconstruction Meeting and Final Inspection could occur on the same day
(1) While it may not be practical to submit all required closeout items prior to Final Inspection, all required items must be submitted and approved by the City of Sumter prior to final approval and acceptance of the new service

- (2) Service only project closeout requirements outlined below will be communicated in writing to the Developer, Developer's Engineer and Contractor by the assigned City of Sumter Construction Inspector during the Preconstruction Meeting
 - (3) For service only projects, Record Drawings should be updated copies of the City of Sumter stamped "Approved for Construction" construction plans submitted by the Developer's Engineer and shall be updated to reflect actual installed infrastructure. All aspects of City Engineering Department shall be included in the Record Drawings
 - (4) For wastewater service only projects, an open trench inspection of infrastructure installed in the public right-of-way or City of Sumter easement is required. An additional inspection is required
3. For Main Extension Projects: Upon completion of construction and prior to scheduling the Final Inspection, the Developer's Engineer shall submit a Final Inspection package to the assigned City of Sumter Engineering Department. The Final Inspection package shall include the following items:
- (1) One (1) draft digital and hard copy of Record Drawings for review. Record Drawings shall be prepared in accordance with City requirements.
 - (2) One (1) draft digital and hard copy of all water main and wastewater force main Valve Cards for review. Valve Cards shall be prepared in accordance with the requirements City requirements
 - (3) One (1) draft digital and hard copy of Easement Plat for review. Easement Plat shall be prepared in accordance with the requirements of of this Section
 - (4) Pressure test results for all water mains and wastewater force mains. Test results shall be certified by the Developer's Engineer or the Developer Engineer's representative
 - (5) Low--pressure test results for wastewater gravity sewers. Test results shall be certified by the Developer's Engineer or the Developer Engineer's representative
 - (6) Two (2) USB drives containing Closed Circuit Television (CCTV) inspection video and CCTV Contractor's Log for wastewater gravity sewers. CCTV submittal shall be in accordance with the requirements of Section 11 of these standards. Developer's Engineer shall review the

- CCTV video and inspection report for any deficiencies prior to submitting to the City of Sumter
- (7) Mandrel test results, when directed by the City of Sumter, for wastewater gravity sewers. Test results shall be certified by the Developer's Engineer or the Developer Engineer's representative
 - (8) Manhole vacuum test results, when directed by the City of Sumter, for wastewater gravity sewers. Test results shall be certified by the Developer's Engineer or the Developer Engineer's representative
 - (9) Spark test results for epoxy coated manholes and wet wells
 - (10) Pump Stations - For projects involving wastewater pump stations, the following additional items shall be provided:
 - i. One (1) draft digital and hard copy of Pump Station Record Drawings and Valve Cards for review
 - ii. All electrical schematics, drawdown test results, and float level settings laminated and mounted inside the control panel door
 - iii. Complete list of supplied spare parts as specified in these standards
 - iv. Applicable SCADA information as determined by contacting City of Sumter's Mechanical Maintenance Manager at 803-774-4021.
 - (11) If any items are determined to be missing or if corrections are required, the City of Sumter will provide notification to the Developer's Engineer
 - (12) Upon the City of Sumter's approval of the Final Inspection package, the Engineering Department Employee will notify the Developer's Engineer to proceed with scheduling the Final Inspection. Please allow a minimum of seven (7) working days for review and approval of the Final Inspection package
 - (13) Upon notification of approval, the Developer's Engineer shall schedule a Final Inspection with the assigned City of Sumter Construction Inspector. A minimum of seven (7) working days shall be allowed for scheduling. The Developer's Engineer, the City of Sumter Contractor, the assigned City of Sumter Construction Inspector, and representatives from the City of Sumter's Water Distribution and/or Wastewater Collection Department(s) shall be in attendance, at a minimum
 - (14) Upon completion of the Final Inspection, the City of Sumter's Construction Inspector will prepare a punch list of items to be corrected by the Contractor and will issue the punch list to the Developer's Engineer

- (15) After the Final Inspection, the Developer's Engineer shall submit one (1) digital and hard copy of revised Record Drawings and Valve Cards for final approval to the assigned City of Sumter Engineering Department. Requirements for digital submittals for approved Record Drawings and Valve Cards are described in this Section.

B. Permit to Operate

1. Upon completion of the Final Inspection and final approval of Record Drawings and Valve Cards by the City of Sumter Construction Inspector, the Developer and the Developer's Engineer shall coordinate the submittal of a Project Closeout package. The Developer's Engineer or the Developer Engineer's representative shall review and certify that all items submitted as part of the Project Closeout package are complete and meet the requirements of these standards
2. For main extension projects, the Project Closeout package shall include all the items listed below and shall be submitted to the City of Sumter Engineering Department
3. For service only projects, the Project Closeout package may not include all of the items listed below. The required items will be communicated to the Developer and the Developer's Engineer by the City of Sumter Construction Inspector during the Preconstruction Meeting
4. Project Closeout Package Items:
5. A letter from the issuing permitting agency that all work for encroachment permits has been inspected and approved and the permit has been closed out
 - (1) A letter from the issuing permitting agency that all work for encroachment permits has been inspected and approved and the permit has been closed out
 - (2) Developer Engineer's Letter of Certification stating the project is complete and has been constructed in accordance with the stamped approved plans by the City of Sumter
 - (3) Bacteriological sample test results from an SC DES certified laboratory. Test Results must be less than 30 days old

- (4) Pressure test results for all water mains and wastewater force mains. Test results shall be certified by the Developer's Engineer or the Developer Engineer's representative
- (5) Flow test results for all installed fire hydrants. Flow tests shall be performed under the direction of the City of Sumter Inspector and the results certified by the Developer's Engineer or the Developer Engineer's representative
- (6) Low-pressure test results for wastewater gravity sewers. Test results shall be certified by the Developer's Engineer or the Developer Engineer's representative
- (7) Mandrel test results, when directed by the City of Sumter, for wastewater gravity sewers. Test results shall be certified by the Developer's Engineer or the Developer Engineer's representative
- (8) Manhole vacuum test results, when directed by the City of Sumter, for wastewater sewer manholes. Test results shall be certified by the Developer's Engineer or the Developer Engineer's representative
- (9) Spark test results for epoxy coated manholes and wetwells
- (10) Wastewater Collections Department approved copies of Closed Circuit Television (CCTV) inspection reports and CCTV Contractor's Log for wastewater gravity sewers
- (11) Pump station drawdown test results for all wastewater pump stations. Test results shall be certified by the Developer's Engineer or the Developer Engineer's representative
- (12) Record Drawings and Valve Cards
 - i. Submit two (2) hard copies of final approved Record Drawings and two (2) hard copies of final approved Valve Cards along with required digital submittals as described below. The Developer's Engineer or Surveyor shall deliver digital files in AutoCAD format (.dwg). The State Plane Coordinates shall be tied to the drawing in AutoCAD in order for the drawings to be placed in the correct position inside GIS. For more information, contact the GIS Coordinator at (803) 774-3987
 - a. Record Drawings in AutoCAD format
 - (a) Submit in accordance with the requirements of this Section (Record Drawings, Valve Cards, and Asset Inventory Worksheet)

- (b) Provide in NAD 83 (2011) South Carolina State Plane Coordinates, oriented Grid North and tied to the current realization of the South Carolina Geodetic Survey Virtual Reference Station (VRS) network. Vertical coordinates shall be related to the National Geodetic Vertical Datum NGVD 1929 (Z coordinate). The Benchmark and vertical datum shall be noted on each sheet of the Developer's plans. Example: THIS DRAWING REFERENCES NAD 83 (2011) HORIZONTAL STATE PLANE COORDINATE SYSTEM, ELEVATIONS ARE BASED ON NGVD 1929 VERTICAL DATUM
- (c) Show each drawing entity with coordinates tied to SC Grid, and show the grid tie at the point of connection to the existing system with bearing and distance to the Grid monument used and identified
- (d) Have water and wastewater lines in separate drawing layers
- (e) Have all water appurtenances (i.e., hydrants, valves, services, tees, etc.) and all wastewater appurtenances (i.e., manholes, valves, cleanouts, etc.) in separate drawing layers
- b. Coordinate Table
- (a) A Coordinate Table with coordinate values (Northing, Easting) and elevations related to NGVD 1929 for all installed water and/or wastewater appurtenances shall be delivered in a comma delimited ASCII file in the format Point Number, Northing, Easting, Elevation and Description. Elevations must be provided for water valves (captured from top of nut, not the lid) and wastewater manholes (captured rim elevation). If abbreviations are used as descriptors, a key to those abbreviations must be provided. Coordinate figures shall be based on the South Carolina State Plane Coordinate System, NAD 83 (2011) and ties to the current realization of the South Carolina Geodetic Survey Virtual Reference Station (VRS) network. The surveyor also has the option to provide this file as a .txt or .xls file with the same format as referenced above
- c. Valve Cards in AutoCAD format

- (a) Submit in accordance with the requirements of this Section (Record Drawings, Valve Cards, and Asset Inventory Worksheet)
- d. Record Drawings and Easement Plats (PDF)
 - (a) Record Drawing PDF should be of the final approved Record Drawings as submitted in accordance with the requirements of this Section; sealed, signed, dated by the Professional Land Surveyor and the Engineer of Record reflecting all as-constructed conditions
 - (b) Easement Plat PDF should be of the Easement Plat submitted in accordance with the requirements of this Section; sealed, signed, dated by the Professional Land Surveyor and the Engineer of Record reflecting all as-constructed conditions
 - (c) PDF shall be black and white with white background. Minimal color text or graphics pertinent to the submittal will be accepted
 - (d) Final PDF should be saved to open in proper orientation
 - (e) If drawing is multiple pages, a single multi-page PDF shall be submitted
- e. Legal (A fillable PDF of each legal document is available on our website)
 - (a) Affidavit of Title Water – Establishes the Developer (Grantor) as the possessor of the title of the water utility infrastructure assets to be transferred to the City of Sumter (Grantee)
 - (b) Affidavit of Title Wastewater – Establishes the Developer (Grantor) as the possessor of the title of the wastewater utility infrastructure assets to be transferred to the City of Sumter (Grantee)
 - (c) Bill of Sale Water – Conveys ownership of the water utility infrastructure to the City of Sumter
 - (d) Bill of Sale Wastewater - Conveys ownership of the wastewater utility infrastructure to the City of Sumter
 - (e) Maintenance Agreement Water – Establishes a two-year maintenance period for repair of any deficiencies in the water utility infrastructure at the expense of the Developer

- (f) Maintenance Agreement Wastewater – Establishes a two- year maintenance period for repair of any deficiencies in the wastewater utility infrastructure at the expense of the Developer
 - (g) Pump Stations – For projects involving wastewater pump stations, the following additional legal documents shall be provided:
 - i. Affidavit for Transfer of Real Property - Establishes the *Grantor* as the possessor of the title of the real property to be transferred to the City of Sumter (*Grantee*)
 - ii. Title to Real Estate – Conveys ownership of the real property from the *Grantor* to the City of Sumter (*Grantee*)
 - iii. Affidavit for Exempt Transfer – Establishes the deed as being exempt from the deed recording fee because it is a transfer to a political subdivision of the State
 - f. Easements
 - (a) Plats - Submit ten (10) hard copies; each must have original signature and seal. The prints shall be no larger than 22 inches x 34 inches and prepared in accordance with the requirements of the City of Sumter and the requirements of the Office of Register Mesne Conveyance / Register of Deeds for the City in which the plat is to be recorded. The Developer will record all easement plats. Copies of recorded easement plats will be emailed to the City of Sumter Engineering Department. For additional information regarding easement plat requirements, refer to the Easement checklist
 - (b) Easement Agreement - As an instrument of conveyance, prepare and submit a City of Sumter Easement Agreement
 - (c) Subdivision Plat - Submit one (1) hard copy of recorded Subdivision Plat
 - g. Pump Stations - For projects involving wastewater pump stations, the following additional items shall be provided:
 - (a) Provide one (1) hard copy and one (1) digital copy of all applicable Operation and Maintenance manuals
 - (b) Provide one (1) hardcopy and (1) digital copy of current electric bill to be used for account transfer upon Commissioning
6. Upon receipt of all requirements for Project Closeout, the assigned City of Sumter Project and Engineering Department staff shall issue the final quotes

for the Maintenance Agreement Bond and Maintenance Agreement Final Inspection Fee described below:

- (1) Maintenance Agreement Bond
 - i. As a part of the Maintenance Agreement, the Developer shall furnish a 10% bond based on the installed value of the system assets as documented in the Asset Inventory Worksheet submitted by the Developer's Engineer. The bond may be either cash or an Irrevocable Standby Letter of Credit from a financial institution. No bonding agencies will be accepted. Payment of the Maintenance Agreement Bond must be received prior to issuance of the Service Acceptance Letter. When payment is made using an Irrevocable Standby Letter of Credit, the Issuance Date for the letter of credit shall be between the date Final Inspection and the date of acceptance by City Council and shall cover a period of at least two (2) years from the Issuance Date. On a case-by-case basis, the City of Sumter may require an extended maintenance and warranty period.
 - ii. In the event the development is transferred to new ownership during the maintenance period, the bond and Maintenance Agreement must be updated to the new ownership
- (2) Maintenance Agreement Final Inspection Fee
 - i. The Maintenance Agreement Final Inspection Fee is charged at \$0.70 per linear foot of water main and wastewater force main installed, and \$3.00 per linear foot of wastewater gravity main installed. This is a non-refundable fee which covers expenses to perform the Maintenance Agreement final inspection. Payment of the Maintenance Agreement Final Inspection Fee must be received prior to issuance of the Service Acceptance Letter
- (3) Upon approval of the Final Closeout package the City of Sumter Project and Engineering Department Staff will issue an O&M letter to SC DES. This letter is in conjunction with any documentation from the Developer's Engineer required by SC DES for issuance of a Permit to Operate

C. Final Acceptance

1. The purpose of the Commissioning is to ensure all punch list items have been satisfactorily addressed by the Contractor and to conduct a final walk through of the constructed water and/or wastewater systems. Upon acceptance of the systems by all parties, the Engineering Department Staff shall have all responsible parties sign a Project Commissioning Form documenting final acceptance. Commissioning is not required for service only projects
2. Upon receipt of the SC DES permit to operate, the Developer's Engineer shall coordinate with the assigned Engineering Department Staff to schedule the onsite Project Commissioning. A minimum of five (5) working days shall be

- allowed for scheduling. The Developer's Engineer, City of Sumter Contractor, and the assigned Engineering Department Staff shall be in attendance
3. The items listed below shall be provided by the Developer's Engineer for use at the Commissioning. If any items are not provided, Commissioning will not proceed:
 - (1) Two (2) hard copies of final Record Drawings. These copies are in addition to those required in this Section
 - (2) Two (2) hard copies of all water main and wastewater force main Valve Cards. These copies are in addition to those required in this Section
 4. Pump Stations - For projects involving wastewater pump stations, the following additional items shall be provided:
 - (1) Two (2) hard copies of final Pump Station Record Drawings. These copies are in addition to those required in this Section
 - (2) Complete set of spare parts as specified in Section D.8.7.Wastewater Collection System Pump Station Design Standards
 - (3) Operation and Maintenance Manuals
 - i. Manuals shall be specific to the equipment supplied
 - a. Provide factory pump curves for installed pumps
 - b. Manuals applicable to many different configurations and which require the operator to selectively read portions of the instructions will not be accepted
 - c. The equipment model that the manual applies to shall be indicated by an arrow
 - ii. Table of contents specific to each manual
 - iii. At the beginning of each manual, provide a description of the equipment to include model numbers, purchase order numbers, serial numbers, motor information, and performance and design criteria
 - iv. Correlate manuals with approved shop drawings and include the following minimum information:
 - a. Parts list, including recommended spare parts
 - b. Guarantees/Warranties
 - c. Provide a maintenance and lubrication schedule to be a summary of all preventative maintenance and lubrication
 - d. Address and telephone numbers of the source for repairs, spare parts, and service

- e. Detailed descriptions of operating procedures for the item of equipment specifically written for this installation, including start-up and shut- down procedures
- f. Equipment performance specifications, including pump curves and drawdown test data
- g. Results of start-up and any further recommendations resulting from start-up
- v. Upon successful Commissioning, the assigned Project and Engineering Staff will transfer the pump station electrical service account to the City of Sumter

B. Application for New Services

1. Upon successful Project Commissioning and payment of all Project Closeout fees, a Service Acceptance Letter will be issued to City of Sumter Utility Billing Department. No request for services will be accepted prior to issuance of the Service Acceptance Letter
2. Applications for service shall be submitted through City of Sumter Utility Billing Department. Application may be made in person, on our website or by contacting the Customer Service Department at (803) 436-2541. Accurate account information is required to ensure correct billing and to expedite the installation of services. Tap fees are generally paid at this time
3. If the City of Sumter has determined that a backflow prevention assembly is required, a notification will be mailed to the Owner. Water service will not be turned on until the assembly has been installed by the Owner's Contractor and inspected by the City of Sumter's Public Works Department. It is the responsibility of the contractor installing the assembly to notify the Public Works Department and to schedule the inspection. Upon successful completion of the inspection, the assembly must be tested within seven (7) days after the date of inspection. Testing is the responsibility of the Owner and must be performed by a City of Sumter Approved Backflow Prevention Assembly Tester. Information regarding the City of Sumter's backflow prevention requirements is available on the Engineering page of our website or by contacting the Public Works Director at (803) 436-2558
4. Any wastewater service connection to a City of Sumter cleanout must be inspected by City of Sumter's Public Works Department prior to backfilling the

wastewater service at the point of connection to the cleanout. To schedule an inspection contact (contact name?) at (803) 436-2558

5. For wastewater services requiring a grease trap, a grease trap application must be submitted to the City of Sumter. Grease trap applications must be approved prior to installation and a complete inspection of the installed grease trap must be performed by the City of Sumter prior to service acceptance. Additional information regarding the City of Sumter's grease trap requirements is available by contacting the Wastewater Plant Staff at wastewaterplant@sumtersc.gov

C. Project Cancellation

1. Any project without "Activity" from the Owner, Developer, the Developer's Engineer or the Developer's Utility Contractor for a period of twelve (12) months, concerning intent to proceed with the project, shall be cancelled by the City of Sumter and any Service Availability Letter issued by the City of Sumter for utility service shall be considered withdrawn. Examples of "Activity" include such actions as plan submittals, payment of fees, meetings with City of Sumter Engineering or Public Works Staff, written correspondence concerning design, submittal of permit applications, and water and/or wastewater construction activities. Examples not considered "Activity" are submittals to other municipal planning departments or review boards, telephone calls, and correspondence with other permitting agencies
2. Engineering Services Fee refunds will be handled according to the status of the project at the time it is canceled. Please see Section 5 (Development Fees) of these standards for a complete description. If the Developer wishes to proceed with a project after the City of Sumter has closed its project file, a new project submittal will be required in conformance with the City of Sumter's current policies. Engineering Services Fees will be assessed at the rates current at the time the project is resubmitted. No credit will be given for Engineering Services Fees previously retained by the City of Sumter for projects that have been canceled and resubmitted