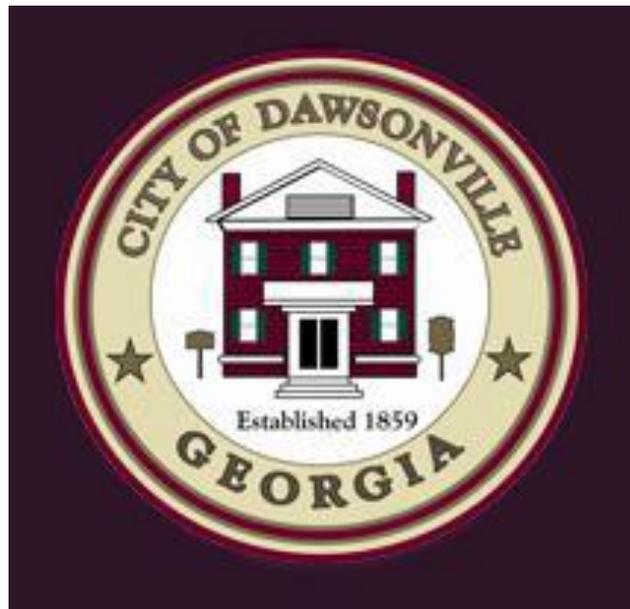


STANDARD SPECIFICATIONS
for
WATER DISTRIBUTION SYSTEMS
and
SANITARY SEWERAGE SYSTEMS



CITY OF DAWSONVILLE, GEORGIA

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for
WATER DISTRIBUTION SYSTEMS
and
SANITARY SEWERAGE SYSTEMS

CITY OF DAWSONVILLE, GEORGIA
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DETAILS**SECTION 1: POLICIES AND PROCEDURES****1.01 Scope and Intent**

- A. Purpose: The purpose of this document is to set forth the uniform policies, procedures, design requirements, material requirements and construction standards of the City of Dawsonville as to comply with all applicable state and federal laws for the installation of water distribution systems and sanitary sewerage systems.
- B. Use: The Developer shall design and install all water and sewerage systems to comply with this document. The City will use this document to check plans for new water and sewerage systems and improvements to existing water and sewerage systems.
- C. Variance: Under special conditions beyond the control of parties involved, the City of Dawsonville may vary from the specifications herein. The Superintendent or designee of the City shall authorize any variance in writing. The State of Georgia, Department of Natural Resources, Environmental Protection Division, shall be notified of any variance in writing.
- D. Amendments to the Specifications:
 - 1. The City shall amend the *Standard Specifications for Water Distribution Systems and Sanitary Sewerage Systems*, as determined necessary to improve the systems' performance and integrity. The Superintendent or designee of the City shall approve system performance and integrity amendments in writing.
 - 2. The City shall amend the *Standard Specifications for Water Distribution Systems and Sanitary Sewerage Systems*, as required due to changes in applicable regulations. The State of Georgia, Department of Natural Resources, Environmental Protection Division, shall approve regulatory amendments in writing.

SECTION 2: DEFINITIONS

The listed words or acronyms shall mean the following:

- **ACI:** American Concrete Institute.
- **ANSI:** American National Standards Institute.
- **ASTM:** American Society for Testing and Materials.
- **AWWA:** American Water Works Association.
- **CRSI:** Concrete Reinforcing Steel Institute.
- **Design Engineer:** The engineer or surveyor under whose direction the development plans submitted for review were prepared. Design Engineer shall be a Georgia Licensed Professional Engineer.
- **Developer:** Any person, firm, corporation, association or partnership or any agent thereof who undertakes or proposes to undertake the development of land so as to constitute a residential subdivision, apartment complex, condominium or commercial/industrial/ institutional establishment.
- **DFT:** Dry Film Thickness
- **Diameter:** Nominal inside diameter of pipe excluding bituminous or epoxy bonded coating thickness
- **DIP:** Ductile iron pipe
- **DOC:** United States of America Department of Commerce
- **Easement:** Non-profitable interest in land owned by another that entitles its holder to a specific limited use
- **EPD:** Environmental Protection Division
- **Force Main:** Piping, valves and other components of a single pressurized line used to convey raw water, potable water or sewage. A force main conveying potable water may have a limited number of service connections.
- **FMR:** Factory Mutual Research
- **GEFA:** Georgia Environmental Finance Authority
- **Georgia EPD:** State of Georgia, Department of Natural Resources, Environmental Protection Division.
- **GFI:** Ground fault interrupt
- **gpm:** Gallons per minute
- **Gravity Sewer:** Piping and other components used to convey sanitary sewage in a non-pressurized system
- **Lateral:** Pipe extending from a sewer main to a street right-of-way or easement for the purpose of servicing a property (lot). The lateral shall be six (6") inches in diameter, shall not contain a manhole and shall be less than 250 feet in length.
- **NEC:** National Electrical Code, latest edition
- **NEMA:** National Electrical Manufacturers' Association

- **No. 57 Stone:** Class I embedment or backfill material consisting of manufactured aggregates (crushed stone) in accordance with ASTM D 2321-89 (Reapproved 1995) and ASTM D 2487-00. Percent passing sieve sizes are as follows: 100% passes 1-1/2", < or 10% passes No. 4 and < 5% passes No. 200.
- **Pavement:** Any asphalt, concrete, gravel or dirt surface including curbs and sidewalks used by vehicles and/or pedestrians
- **pcf:** Pounds per cubic foot
- **psi:** Pounds per square inch
- **Pump Station:** All pumps, valves, wetwells, controls and other components used to pump sanitary sewage into a force main
- **PVC:** Polyvinyl chloride
- **Rock:** Solid material being greater than one (1) cubic yard in size which by actual demonstration cannot, in the opinion of the City Engineer, be reasonably excavated with a minimum 135 horsepower backhoe, in good condition and equipped with manufacturer's standard boom and rock points or similar approved equipment; and which must be systematically drilled and blasted or broken by power-operated hammer, hydraulic rock breaker or expansive compounds.
- **Rock Excavation:** Removal of solid material, as the above specifies, and does not necessarily correspond to "rock" as implied by the names of geologic formations.
- **Sanitary Sewerage System:** Multiple pipes, manholes and other components that convey sewage and to which storm water, surface water and ground water are not intentionally admitted.
- **SCADA:** Supervisory Control and Data Acquisition system
- **Service Connection:** Fitting(s) connecting a service line or lateral from a property (lot) to a water main or sewer main
- **Service Line:** Pressurized pipe extending from a water main to a water meter or pressurized pipe extending from a water main to a fire hydrant.
- **Sewage:** The combination of water-carried wastes from residential housing, institutional facilities, and commercial and industrial complexes together with such groundwater, surface water, and storm water as may inadvertently be present.
- **Sewer:** A pipe or conduit that conveys sewage
- **Sewer Main:** Sewer to which one or more laterals are connected
- **Sewer Outfall:** Sewer to which one or more sewer mains are connected
- **Sewer Trunk:** Sewer to which one or more sewer mains or sewer outfalls are connected and discharges into a wastewater facility.
- **Suitable Soil:** Soil that conforms to and as recommended by ASTM D 2321-89 (Reapproved 1995) and ASTM D 2487-00 and that is free of organic and/or deleterious material, expansive clay and rock fragments larger than three (3") inches.
- **Superintendent:** Superintendent of Water
- **UL:** Underwriters Laboratory

- **Utility Contractor:** Georgia Licensed Utility Contractor in accordance with the Official Code of Georgia, Chapter 43
- **USEPA:** United States Environmental Protection Agency
- **Water Distribution System:** Pressurized pipes, valves and other components that convey potable water
- **Water Main:** Pressurized pipe used to convey potable water from a force main to a service line
- **WPCP:** Water Pollution Control Plant
- **WTP:** Water Treatment Plant
- **WWTP:** Wastewater Treatment Plant

SECTION 3: DESIGN APPROVAL**3.01 General**

- A. The design of water distribution systems and sanitary sewerage systems shall conform to the specifications herein.
- B. Concurrent with plan submittal, the Design Engineer shall provide a completed *City of Dawsonville Water Distribution/Sanitary Sewer Addition Submittal* form to the City. The *City of Dawsonville Water Distribution/Sanitary Sewer Addition Submittal* form is enclosed as Appendix A.
- C. After receiving approval of the plans from the City, the Developer will be required to submit any applicable forms and documentation to the Georgia Environmental Protection Division. Applicable forms may include but are not limited to, the EPD's *Drinking Water Project Submittal Form* and the EPD's *Sanitary Sewer Extension Submittal Form*, which can be found on the Georgia Environmental Protection Division's website. After receiving approval from the Georgia Environmental Protection Division the Developer shall submit three (3) printed sets of plans and one (1) electronic set of plans to the City with a letter detailing any changes required by the Georgia Environmental Protection Division.

3.02 Technical Review

- A. Proposed water distribution system and sanitary sewerage system plans shall be reviewed by the City under the supervision of a Georgia Licensed Professional Engineer for technical adequacy and conformance to applicable requirements.
- B. Upon receipt of a proposed development, the City shall perform a feasibility study to verify the project complies with the Service Delivery Strategy for Dawson County and determine whether the existing City water distribution system and/or sanitary sewerage system has sufficient capacity. The City will bill the Developer for all costs associated with review of the proposed development. The following review shall be completed.
 1. Water Distribution System
 - a. The latest 12 months of reported production from the system shall be examined to determine an average monthly production rate. A proposed development, whose supply requirement would cause the system to exceed the Georgia Environmental Protection Division permitted rate, shall not be connected to the City system.
 - b. Pressure and flow from the contributing water distribution system shall be examined to determine whether the additional supply requirement will adversely affect the surrounding system. A proposed development, whose supply requirement would adversely

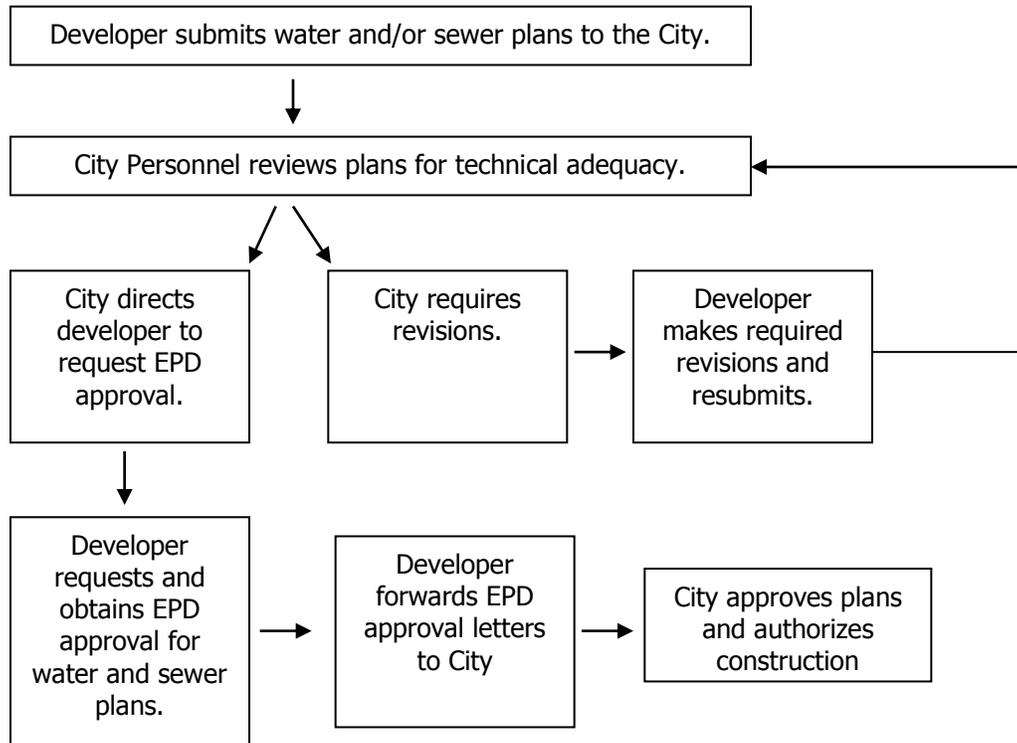
affect the surrounding system, shall not be connected to the City system.

2. Sanitary Sewerage system

- a. The wastewater treatment facility must be in compliance with its *NPDES* permit. If the facility is not in compliance with the *NPDES* permit then the sewerage system connection will not be approved.
 - b. The latest 12 months of reported discharge from the receiving WPCP shall be examined to determine an average monthly flow rate. A proposed development, whose discharge would cause the receiving WPCP to exceed the Georgia EPD permitted flow rate, shall not be connected to the City system.
 - c. A capacity study shall be performed to determine whether the discharge from the development would exceed the capacity of the existing receiving sewers. A proposed development, whose discharge would exceed the capacity of the receiving sewers, shall not be connected to the City system.
- C. City review comments shall be marked on Technical Review Checklists and noted on development plans in the color red (Red Line Comments). Technical Review Checklists used during the City review are included in Appendix B.

3.03 Plan Processing

- A. Water distribution system and/or sanitary sewerage system plans shall be submitted to the City. If the development will be constructed in phases, the Developer shall submit an overall development plan and detailed plans for each phase. Three (3) printed sets and one (1) electronic set of water distribution system and/or sanitary sewerage system plans are required for each submittal during the City review process. A letter addressing previous comments will be required with all resubmittals.
- B. The Design Engineer shall address City review comments. Plans containing the original Red Line Comments shall accompany each re-submittal to the City.
- C. Soil Erosion and Sedimentation Control Plans pertaining to the overall Development shall be reviewed and approved by the local issuing authority. Construction of any kind shall not begin on a project prior to the issuance of a Land Disturbance Activity permit.
- D. The City of Dawsonville's plan processing sequence is shown on the following chart.



3.04 Approval by Regulatory Agencies

- A. The Developer’s Engineer shall address all deficiencies and resubmit plans in accordance with Division I, Sections 3.02 and 3.03. Plans shall not be approved until all deficiencies have been addressed to the satisfaction of the City Engineer.
- B. Note that plan approval by the City Engineer shall not be construed, in any manner, to relieve the Developer of his responsibility for strict compliance with the specifications herein and any applicable laws and regulations.
- C. Installation of water distribution systems and/or sanitary sewerage systems shall not commence on any development until the City has granted final approval of water distribution system and/or sanitary sewer plans and the local issuing authority has issued a Land Disturbance Activity permit, and the Georgia Environmental Protection Division has written an approval letter.
- D. Note that other agencies may have regulatory authority and the Developer is responsible for obtaining other agency approval. Other agencies could be, but are not limited to, State of Georgia Department of Natural Resources, State of Georgia Department of Transportation, United States Army Corps of Engineers, United States Environmental Protection Agency, electrical, phone, cable, and natural gas providers.

3.05 Period of Plan Approval

Approved water distribution system and/or sanitary sewerage system plans shall be valid for six (6) months. Approved plans that are not initiated or are inactive for a six (6) month period shall become invalid. Should an approved plan be invalidated, the City Engineer shall determine whether the plan must be resubmitted for approval.

SECTION 4: EASEMENTS AND DEEDED PROPERTY**4.01 General**

- A. Components of water distribution systems and sanitary sewerage systems, to be owned by the City, should be situated within streets' rights-of-way.
- B. The following water distribution system and sanitary sewerage system components, to be owned by the City, shall be situated within an easement that is granted to the City, when a street right-of-way is not available.
 - 1. Force main
 - 2. Water main
 - 3. Water meter/check valve assembly
 - 4. Fire hydrant
 - 5. Sewer main
 - 6. Sewer outfall
 - 7. Manhole
 - 8. Other components required by the City
- C. An easement shall not encroach into a structure's foundation and shall be clear of all obstructions not associated with the water and/or sanitary sewerage system including but not limited to construction debris, fencing and trees.
- D. Property developed and occupied by a pump station and/or an access road, to be owned by the City, shall be platted and deeded to the City.
- E. All property and easements shall meet requirements for final plats detailed in the City's *Land Development Regulations*.

4.02 On-Site Easement

- A. "On-site" easements are those easements falling within the boundaries of the current phase of the development. "On-site" easements shall be shown on the plat and recorded through the process of recording the final plat.
- B. Developer shall grant to the City, the exclusive right to construct, reconstruct, operate, maintain, repair, replace, improve, alter, remove, relocate and inspect water distribution systems and/or sanitary sewerage systems that are situated over, across and under the land wherein the water distribution systems and/or sanitary sewerage systems lie on the Developer's property.

4.03 Off-Site Easement

- A. "Off-site" easements are those easements falling outside the boundaries of the current phase of the development. Easements through property owned by the

developer, including water and sewer lines that will be included in later phases of the same project, must be treated as off-site easements.

- B. Off-site easements shall be negotiated and acquired by the Developer with the property owner.
- C. Construction of the off-site water distribution systems and/or sanitary sewerage systems shall not begin until all off-site easements for system completion have been acquired by the Developer and recorded by the City.

4.04 Easement Size

- A. The minimum width of a permanent on-site/off-site easement associated with water distribution system and sanitary sewerage system components shall be 20 feet.
- B. The minimum size of an easement associated with a water meter/check valve assembly shall be 20' by 30'.
- C. Easement width or size may be increased or decreased at the discretion of the City Engineer.

4.05 Deeded Property

- A. The minimum size of deeded property associated with a pump station shall be 60' by 60'.
- B. The minimum width of deeded property associated with an access road shall be 30'.
- C. The size or width of deeded property may be increased or decreased at the discretion of the City Engineer.

SECTION 5: INSTALLATION**General**

- A. The installation of water distribution systems and sanitary sewerage systems shall be in accordance with the approved plans and specifications herein.
- B. A set of plans stamped approved by the City shall be present on the job site whenever work is being performed on the water distribution system and/or sanitary sewerage system.
- C. A representative of the Developer, the installation contractor, the County Fire Marshall and the City shall attend a pre-construction conference at the City at least ten (10) working days prior to the start of any construction. The Developer is responsible for scheduling the conference when all representatives can attend. The purpose of this conference will be to define roles and responsibilities for the correct execution of the proposed water and/or sewer line installations.

Utility Contractor

- A. A licensed Utility Contractor shall install water distribution systems and sanitary sewerage systems.
- B. Prior to commencing construction activities on a proposed water distribution system and/or sanitary sewerage system, the City Engineer shall receive a copy of the Utility Contractor's License.

City Installation

- A. The City shall perform the following system components installation at a cost to the Developer/Owner:
 - 1. Supply materials and labor to install water meter and check valve assemblies from 5/8-inch in diameter through 2-inches in diameter;
 - 2. Supply labor to tap water main;
 - 3. Supply materials and labor to install a sewer main tap for a private individual.
- B. The installation of residential water service lines will be performed by the Developer's Utility Contractor with approval by the City.

Insurance Requirements

- A. Utility Contractors performing work on City funded or partially funded projects shall comply with current City insurance and bonding requirements.
- B. Companies such as railroads, electric power suppliers, natural gas suppliers, etc. may require Utility Contractors to furnish insurance, in addition to City

requirements when crossing their respective easements. The Utility Contractor shall provide such insurance as required.

5.05 Inspection

- A. A City Inspector, under the supervision of a Georgia Licensed Professional Engineer, shall inspect water distribution systems and sanitary sewerage systems during all phases of construction to ensure the systems are being constructed in accordance with the plans approved by the City and specifications herein.
- B. The Developer shall provide the City Engineer a 48-hour notice prior to commencing construction on a water distribution system and/or sanitary sewerage system.
- C. The Developer/Utility Contractor shall, at all times, permit and facilitate inspection of work by the City. The presence of a City Inspector or City Engineer on the site of work shall not be construed to, in any manner, relieve the Developer/Utility Contractor of their responsibility for strict compliance with the approved plans and specifications herein.
- D. The City Inspector shall not change or modify the approved water distribution and/or sanitary sewerage system plans or specifications herein without written approval from the City Engineer.
- E. The City Inspector shall inform the Developer/Utility Contractor when construction is deficient from the approved plans and specifications herein. Deficiencies shall be addressed in a timely manner as determined by the City Inspector. Construction activities and other pertinent information shall be recorded on an Inspection Report included in Appendix C.
- F. The City or County Building Department shall perform inspections relating to electric power supply.
- G. Deficiencies not addressed in a timely manner shall be justification for the City to stop work on a project. The City Engineer shall issue a Stop Work Order to the Developer/Utility Contractor in writing. Continued work on a project after being issued a Stop Work Order shall be justification for necessary enforcement actions.

5.06 Testing

- A. Details on testing procedures are included in Division IV. Testing shall be performed at the expense of the contractor.
- B. Water distribution systems shall be subjected to bacteriological and hydrostatic tests.
- C. Sanitary sewerage systems shall be subjected to pressure testing, televising and mandrel testing.

- D. The City shall be given a 48-hour notice prior to any testing. A City Inspector shall witness all testing.
- E. Testing for the compressive strength of concrete and density of compacted soil shall be performed at the expense of the Developer by City approved geotechnical and material testing companies. Materials not meeting required specification shall be removed, replaced and retested for compliance at the expense of the Developer.
- F. Results of tests performed by testing companies shall be provided to the City Engineer. Testing forms used by the City are included in Appendices D and E.

SECTION 6: CONNECTING TO CITY SYSTEMS**6.01 General**

- A. Provided the Developer has complied with the terms of these Policies and Procedures and the installed water distribution system and/or sanitary sewerage system is in accordance with the approved plans and specifications herein, the City shall allow the Developer/Owner to connect the new system(s) into the City system(s). Copies of the City letters approving construction of the Developer's water distribution system and/or sanitary sewerage system are included in Appendices I and J.
- B. City cannot authorize a wastewater conveyance plan which involves hauling of wastewater.
- C. The conveyance of wastewater onto the ground or into a receiving stream is prohibited.

6.02 Connection to Existing Systems

- A. The City Inspector shall be notified at least 48-hours in advance of connecting to the City systems.
- B. A City Inspector shall be present during connection of the Developer's systems to the City systems. Prior to installation, a City Inspector shall approve all materials supplied by the Developer to be used in making the connection.
- C. Upon completing a water distribution and/or sanitary sewer connection, the Developer's systems shall be valved-off and/or immediately plugged, respectively, until Final Acceptance.
- D. Should an unauthorized connection or connection without the presence of the City Inspector be made to the City systems, the Developer shall be subject to a fine and/or refusal of service. Under any circumstance, the Developer shall expose and thoroughly clean all piping and components of the connection for inspection by the City. Noncompliant connections and/or damage to the City system shall be repaired or replaced in conformance with the approved plans and specifications herein at the expense of the Developer.

SECTION 7: SYSTEM ACCEPTANCE**7.01 General**

Acceptance of the Developer's water distribution system and/or sanitary sewerage system shall be considered by the City at such time as the Developer has met all terms and conditions of the specifications herein.

7.02 Final Inspection

Prior to final acceptance, a City Inspector shall perform a final inspection of the water distribution system and/or sanitary sewerage system after all pavement is installed. The final inspection shall determine the proper installation of valve and meter boxes, the integrity of manholes, and the absence of debris in sewers and presence of proper curb markings. Results of the inspection shall be recorded on a Final Inspection Report and is included in Appendices G and H. Deficiencies encountered shall be immediately addressed and an additional final inspection shall be required.

All GEFA, SRF, ARRA, USEPA, DOC and Georgia Board of Regent funded projects will require State inspection of the construction.

7.03 Warranty

The Developer shall warrant the development's water distribution system and/or sanitary sewerage system and hold the City harmless against all costs, expenses and losses, including, without limitation, incidental and consequential damages, resulting from any defects in the Developer's water distribution system and/or sanitary sewerage system, including without limitation, defects in material and workmanship, which are discovered or arise within a minimum period of one (1) year beginning on the date of final acceptance by the City. A longer warranty period may be required on certain material requirements and/or construction standards as indicated in the specifications.

7.04 Final Acceptance

- A. Final acceptance of the Developer's water distribution system and/or sanitary sewerage system by the City shall be when written, signed and dated by the City Engineer. A copy of the City Final Acceptance Letter is included in Appendix L.
- B. Upon issuance of Final Acceptance Letter, the Developer's new system(s) may be opened to the City system(s).

SECTION 1: DESIGN REQUIREMENTS**1.01 General**

The design and plan preparation of water distribution systems and sanitary sewerage systems shall conform to the specifications herein.

1.02 Licensed Professionals

- A. Water distribution system and/or gravity flow sanitary sewerage system design and plan preparation for a residential subdivision or parts thereof on a Developer's property shall be performed by a Georgia Licensed Professional Engineer who has sufficient knowledge to properly perform the design.
- B. Water distribution system and/or gravity flow sanitary sewerage system design and plan preparation for property off-site of a Developer's property shall be performed by a Georgia Licensed Professional Engineer who has sufficient knowledge to properly perform the design.
- C. Water distribution system and/or gravity flow sanitary sewerage system design and plan preparation for commercial/industrial property shall be performed by a Georgia Licensed Professional Engineer who has sufficient knowledge to properly perform the design.
- D. Force main and sanitary sewer pump station design and plan preparation shall be performed by a Georgia Licensed Professional Engineer who has sufficient knowledge to properly perform the design.
- E. The professional performing the design and preparing the plans shall seal each plan sheet with their stamp and sign their name across the stamp.

1.03 Reference Documents and Standards

General methods of design and construction shall conform to the specifications herein and the following. When standards conflict with one another, the City Engineer shall determine the applicable standard.

- A. Georgia Environmental Protection Division, Minimum Standards for Public Water Systems, May 2000.
- B. Georgia Environmental Protection Division, Rules and Regulations for Water Quality Control, Chapter 391-3-6, latest effective date.
- C. Water Environment Federation, Regulation of Sewer Use, WEF Manual of Practice No. 3, latest edition.
- D. Mississippi River Board of State Public Health and Environmental Managers, generally referred to as the "Ten (10) States Standards for Sewage Works".

- E. Gravity Sanitary Sewer Design and Construction, American Society of Civil Engineers Manuals and Reports on Engineering Practice No. 60, Water Environment Federal Manual of Practice No. FD-5, revised April 1982
- F. Georgia Department of Transportation specifications and regulations, latest editions.
- G. Utility Accommodations Policy and Standards, Georgia Department of Transportation, Office of Utilities, latest edition.
- H. Manual on Uniform Traffic Control Devices (MUTCD)- FHWA
- I. American Water Works Association Standards, latest editions
- J. Soil Surveys of Dawson County, Georgia, by the United States Department of Agriculture, Natural Resource Conservation Service
- K. American National Standards Institute Standards, latest editions
- L. American Society for Testing and Materials Standards, latest editions.
- M. Occupational Safety and Health Administration regulations, latest editions
- N. American Society of Mechanical Engineers standards, latest editions
- O. National Electrical Manufacturer's Association standards, latest editions
- P. American Concrete Institute standards, latest editions
- Q. City of Dawsonville, Standards
- R. Dawson County, Standards

1.04 Plan Requirements

- A. Water distribution system and/or sanitary sewerage system plans shall be comprised of the following sheets as required. Each sheet should be 24" by 36" in size. The detail sheets shall contain City of Dawsonville Standard Details.
 - 1. Cover Sheet
 - 2. Site Plan Sheet
 - 3. Grading Plan
 - 4. Overall Utilities Plan Sheet
 - 5. Storm Water System Plan Sheet
 - 6. Water Distribution System Plan Sheet
 - 7. Water Distribution System Details and Construction Notes Sheet
 - 8. Gravity Sewerage System Plan Sheet
 - 9. Gravity Sewerage System Profile Sheet

10. Gravity Sewerage System Details and Construction Notes Sheet
 11. Sanitary Sewer Pump Station Site Plan and Cross-Section Sheet
 12. Sanitary Sewer Pump Station Electrical Plan Sheet
 13. Sanitary Sewer Pump Station Details and Construction Notes Sheet
 14. Force Main Plan Sheet
 15. Force Main Profile Sheet
 16. Force Main Details and Construction Notes Sheet
 17. Soil Erosion, Sedimentation and Pollution Control Plan Sheet
 18. Soil Erosion, Sedimentation and Pollution Control Details and Construction Notes Sheet
- B. The drawings shall bear the following notes:
1. The City of Dawsonville shall be notified 48 hours prior to any water or sewer line construction or repair. Call City Hall at (706) 265 – 3256.
 2. All water and sanitary sewer materials and workmanship shall be in accordance with the *City of Dawsonville Standard Specifications for Water and Sewerage Systems*.
 3. The Contractor shall be responsible for maintaining a marked-up set of design drawings showing “as-built” conditions. These “as-built” drawings shall be updated daily and made available to the City Engineer and/or the City Inspector upon request. The mark-ups shall be at the site at all times and shall be used to develop final record drawings.
- C. Water distribution and/or sanitary sewerage system plan sheets shall be prepared and include as a minimum the information detailed on the Technical Review Checklist included in Appendix B.
- D. Concurrent with the initial submittal of water distribution system and/or sanitary sewerage system plans to the City, a completed City of Dawsonville *Water Distribution/Sanitary Sewer Addition Submittal* form shall be submitted. The City plan review process shall not commence until the City of Dawsonville *Water Distribution/Sanitary Sewer Addition Submittal* form is received. The City of Dawsonville *Water Distribution/Sanitary Sewer Addition Submittal* form is included in Appendix A.

1.05 Modifications to Plans

Water Distribution system and/or sanitary sewerage system plans approved by the City of Dawsonville shall not be modified or deviated from during construction unless the City’s Superintendent approves modifications or deviations in writing.

1.06 As-Built Drawings

- A. As-Built Drawings of the installed water distribution system and/or sanitary sewerage system shall be prepared and sealed in accordance with Division II, Section 1.02.
- B. As-Built Drawings shall be completed upon connecting the development's water distribution system and/or sanitary sewerage system to the City system.
- C. As-Built Drawings shall show all street names, right-of-way widths, related easements, lot number, location, size and material of all water distribution system and/or sanitary sewerage system components.
- D. As-Built Drawings shall be prepared using a survey that ties the development's water distribution system and/or sanitary sewerage systems horizontally and vertically to the local USGS benchmarks or temporary benchmarks established by the City Engineer.
- E. The following certification shall be included on the As-Built Drawings and signed by the Design Engineer:

"I certify that the water distribution system and/or sanitary sewerage system depicted by this As-Built Drawing was constructed in accordance with the plans approved by the City. The information submitted on this As-Built Drawing is to the best of my knowledge and belief, true, accurate and complete."
- F. The Developer's water distribution system and/or sanitary sewerage system shall not be considered complete until the As-Built Drawings have been reviewed and approved by the City Engineer. Note that three (3) reproducible sets of the approved As-Built Drawings shall be submitted to the City Engineer.

- C. Indicate on plans whether structures require fire suppression systems. If so, then indicate the required fire suppression system usage rate (gallons per minute).
- D. The designed system shall provide for the following fire flow demands in the development.
 - Residential Area 750 gallons per minute
 - Commercial/Industrial Area 1,000 gallons per minute
- E. The following range of supply pressures shall be assumed when sizing system components:
 - Pressure 20 psi to 150 psi

2.03 Water Line Material and Size

- A. Water mains and associated fittings shall be ductile iron, in accordance with Division III of these specification, with a minimum diameter of eight (8") inches.
- B. Water main pipe assembly shall be push-on joint unless indicated otherwise.
- C. Water main pipe assembly in a bore casing shall be restrained joint unless indicated otherwise.
- D. Service line supplying a single fire hydrant within the right-of way shall be ductile iron with a minimum diameter of six (6") inches.
- E. Service line serving one (1) residential lot shall be CTSPE-340:SDR 9; pressure class 200 polyethylene with a minimum diameter of ¾-inch.
- F. Service line serving two (2) residential lots shall be CTSPE-340:SDR 9; pressure class 200 polyethylene with a minimum diameter of one (1") inch. The service line shall be fitted with a tee. The tee and service lines, coming from the tee, shall have a minimum diameter of ¾-inch.
- G. Service line serving commercial/industrial buildings shall be polyethylene with a minimum diameter of ¾-inch and a maximum diameter of three (3") inches or ductile iron sized as necessary for the demand.
- H. All service lines crossing streets shall be installed inside Class 160 PVC casing. Casing shall extend to a minimum of 5 feet on each side of the curb/pavement.

2.04 Water Line Location

- A. Situate water mains outside of pavement, within street right-of-way when possible, at five (5') feet beyond the back of curb or edge of pavement or at location approved by the City Engineer.
- B. Situate water mains on the north and east sides of streets when possible.

- C. Water mains shall have a minimum ten (10') foot horizontal separation from any sewer.
- D. When water mains cross sewer lines, they shall cross perpendicular with the water line at least eighteen (18") inches above the sewer line. The pipes used in the crossing shall be laid so that the joints on the water line pipe are equidistant from the sewer line and the joints on the sewer line pipe are equidistance from the water line.
- E. Water mains constructed parallel to streams shall be located such that the nearest area of disturbed soil is greater than fifty (50') feet from the stream bank.
- F. Water mains crossing streams of widths greater than fifteen (15") feet shall have restrained joint piping.
- G. A service line supplying a single lot shall be located as near a respective property boundary as practical.
- H. A service line serving two (2) lots, from the water main to the meter, shall be located in-line with the lots' common property boundary.
- I. No water main or service line shall be constructed on solid waste landfills.
- J. No water main or service line shall be constructed to serve a structure that is constructed on or to be constructed on a solid waste landfill.
- K. Each water main and service line shall be locatable.
- L. A ¾-inch service tap and corporation stop for chlorination shall be shown on the plans and installed on the proposed water main within 3 to 5 feet of each connection to the City's water main.
- M. Use Detail Nos. 1.1, 3.1, 5.1 and 10.1 when applicable.

2.05 Fire Hydrant Location and Spacing

- A. Hydrants shall be situated within the street's right-of-way adjacent to the right-of-way boundary.
- B. A hydrant shall be situated at the end of each cul-de-sac or dead-end street.
- C. Fire hydrants servicing residential areas shall be spaced a maximum of 500 feet as measured along the edge of pavement. No lot shall be greater than 250 feet from a fire hydrant.
- D. Fire hydrants servicing commercial and industrial areas shall be spaced a maximum of 300 feet as measured along the edge of pavement.
- E. Fire hydrants on County ROW shall be a maximum of 1,000 feet spaced as measured along the edge of pavement.
- F. Each fire hydrant shall have a 6-inch gate valve bolted directly to a hydrant tee.

- G. Fire hydrants shall not be placed on water mains which are smaller than 8-inches in diameter unless the line is looped, and the Developer can show that the furthest hydrant can maintain a flow of 750 gpm at 20 psi.
- H. Acceptable Manufacturers:
 - a. Mueller
 - b. M&H Valve
 - c. American Darling
- I. Use Detail Nos. 4.1 and 5.1 when applicable.

2.06 Valve Size and Location

- A. Valves shall be of the same size as the pipe in which the valve is situated, unless noted otherwise.
- B. A corporation valve shall be situated at the tap location into a water main of a ¾-inch or 1-inch service line.
- C. A ball valve shall be situated downstream of tapping saddle or tapping sleeve when tapping into a water main or force main with a 1½-inch or 2-inch service line. The ball valve shall be situated within a meter vault.
- D. Gate valves shall be situated in-line with water mains as follows, unless noted otherwise. The placement of gate valves under pavement shall be allowed, unless noted otherwise. Valve location markers shall be installed for all valves (except hydrant lead valves). The markers shall be four feet high concrete posts with brass discs cast into one side. The marker shall extend 18 inches above finish grade.
 - 1. Attach tapping gate valve immediately downstream of tapping saddle or tapping sleeve when tapping into water main or force main with a smaller water main or service line.
 - 2. Situate gate valve immediately downstream of a tee when connecting into a water main.
 - 3. Situate gate valve on each immediate side of a three (3)-way connection or four (4)-way connection.
 - 4. Situate gate valve on the hydrant lead immediately upstream of a fire hydrant when hydrant is situated within street right-of-way.
 - 5. All tees shall have two (2) valves away from the source, and every cross shall have three valves away from the source.
 - 6. Tapping sleeves and tapping valves should not be used to connect a new line to an existing water line unless approved by the City Engineer. Instead, a tee with two valves shall be installed.

7. Situate gate valve on the hydrant lead within street right-of-way when fire service extends beyond right-of-way.
 8. A gate valve shall be installed on the water main at every other hydrant.
 9. Situate gate valve in water mains at a maximum spacing of 800 feet.
 10. Gate valve shall be situated outside of vault immediately upstream and downstream of three (3") inch and larger water meter/check valve assemblies.
 11. A slip type valve box shall be situated over a gate valve.
 12. All stub-out valves and dead-end valves shall have a mechanical joint cap.
- E. A curb stop shall be situated inside of meter box immediately upstream of $\frac{5}{8}$ -inch through two (2") inch water meter/check valve assemblies.
- F. Use Detail Nos. 6.1, 6.2 and 6.3 when applicable.

2.07 Water Line Depth

- A. Water mains and service lines to fire hydrants shall have a minimum suitable soil cover of four (4') feet. The depth of four (4') feet from finish grade to top of pipe shall be determined as follows.
1. As measured from edge of pavement (top back-of-curb) when the finish grade elevation of the pipe route is equal to or greater than adjacent pavement elevation.
 2. As measured from finish grade elevation of the pipe route when the pipe route elevation is less than the adjacent pavement elevation.
 3. Other depth approved by the City Engineer.
- B. Water mains crossing under a creek or ditch shall have a minimum suitable soil cover of two (2') feet.
- C. Water mains shall have a minimum 18-inch vertical separation from any sewer.
- D. Service lines under pavement shall have a minimum suitable soil cover of 2.5 feet as measured from top of curb or top of pavement.
- E. Service lines outside of pavement shall have a minimum suitable soil cover of 1.5 feet as measured from the meter.
- F. Water mains 18-inches in diameter and larger shall be checked for buoyancy when submerged in groundwater or situated within the 100-year flood zone.
- G. Use Detail Nos. 1.1, 2.1 and 3.1 when applicable.

2.08 Thrust Restraint

- A. Thrust restraint shall be installed at all fittings, hydrants, valves and other locations deemed necessary by the City Engineer.
- B. Thrust restraints at hydrants and valves shall be accomplished by installing a minimum of two (2) eyebolts on the hydrant or valve and tying to an adjacent fitting or concrete tie-back using three-quarter (3/4") inch stainless steel threaded rod.
- C. Thrust restraint at fittings shall be accomplished by using one of the following methods.
 - 1. Cast-in-place concrete blocking installed to dimensions as shown on thrust block detail.
 - 2. Restrained joint pipe and fittings installed upon approval by City Engineer.
- D. Use Detail Nos. 4.1, 7.1, 7.2 and 9.1 when applicable.

2.09 Water Meters and Backflow Prevention

- A. All water usage including fire and irrigation shall be metered and have backflow prevention devices.
- B. Fire sprinkler mains shall have double detector check valves. A double check backflow preventer and a detector check valve may be installed in lieu of the double detector check valve.
- C. Establishments determined by the City or City Engineer to have a high backflow hazard shall have reduced pressure zone (RPZ) backflow preventers. RPZ backflow prevents shall be installed in an insulated enclosure above ground.
- D. All water usage shall be metered using a single meter when possible.
- E. Meters shall be sized according to the anticipated demand and Division III, Section 7 of this document.
- F. Each meter shall have a backflow device consisting of double check valve assembly.
- G. Water meters and backflow devices shall be housed in boxes or vaults.
- H. Water meters and backflow devices shall be situated within the street right-of-way or in an easement area.
- I. Use Detail Nos. 11.1, 12.1, 13.1, 14.1, 15.1 and 16.1 when applicable.

- D. Recommended and absolute minimum pipe slopes for gravity sewer based on the size of pipe to be installed are summarized in the following table.

Slope Requirements

<u>Diameter</u>	<u>Absolute Minimum</u>	<u>Recommended Minimum</u>
8-inch	0.40%	0.70%
10-inch	0.29%	0.50%
12-inch	0.22%	0.40%
14-inch	0.22%	0.40%
15-inch	0.15%	0.30%
16-inch	0.15%	0.30%
18-inch	0.12%	0.24%
20-inch	0.12%	0.24%
21-inch	0.10%	0.20%
24-inch	0.08%	0.16%
27-inch	0.07%	0.14%
30-inch	0.06%	0.12%
36-inch	0.05%	0.10%

- E. Sewers with slopes less than the recommended minimum may be accepted on a site by site basis.
- F. The over sizing of pipe to meet minimum grade requirements shall be prohibited.
- G. Outlet pipes connected to a terminal manhole shall have a minimum slope of 1.00%.
- H. The maximum slope of a gravity sewer shall be 15.0%. When approved by the City Engineer, slopes between 15.0% and 20.0% may be used with the addition of concrete anchors (dead man). The Developer's Engineer shall determine the size and spacing of anchors. The City Engineer shall approve all anchor designs.
- I. When increasing the size of gravity sewer pipe, pipe crowns shall be matched at manholes.
- J. Angle formed by alignment of influent and effluent sewer pipe at manhole shall be greater than or equal (\geq) to 90° and less than or equal (\leq) to 270°.
- K. The surcharging of manholes shall be prohibited.

3.04 Sewer Material and Size

- A. Sewer outfall, sewer main and lateral pipe and associated fittings shall be ductile iron or PVC in accordance with Division III of these specifications.
- B. Sewer pipe assembly shall be push-on joint unless indicated otherwise.
- C. Transition coupling used to connect pipes of differing material shall be rigid and made of steel and/or ductile iron or other material approved by the City Engineer.
- D. Sewer outfalls and sewer mains shall have a minimum diameter of eight (8") inches.
- E. Laterals shall have a minimum diameter of six (6") inches.
- F. Sewers of PVC shall not exceed eighteen (18") inches in diameter.
- G. Sewers eighteen (18") inches in diameter and larger shall be checked for buoyancy when submerged in groundwater or situated within the 100-year flood zone.

3.05 Sewer Location

- A. Situate sewer outfalls and mains at the centerline of a right-of-way when possible or at the centerline of an easement.
- B. If the sewer main and outfall line cannot be situated in the right of way, a twenty (20') foot easement shall be provided. No permanent structures shall be built within the sewer easement. Easements shall have suitable soil compaction, bearing capacity, and slopes to allow a 25-ton sewer vacuum/jet truck to traverse the entire length.
- C. Sewer outfalls and mains shall have a minimum ten (10') foot horizontal and eighteen (18") inch minimum vertical separation from any water main.
- D. Lateral from the sewer main to the structure being served shall be located nearest the center of the property as practical. A separate lateral shall service each property.
- E. A 6" cleanout with brass cap shall be installed inside a turf box on each service at the property line.
- F. All laterals shall connect to sewer main rather than direct connection into a manhole.
- G. Sewer outfalls, mains and laterals constructed parallel to streams shall be located such that the nearest area of disturbed soil is greater than fifty (50') feet from the stream bank.
- H. Sewers shall not be installed under or over any lake, reservoir or detention pond.
- I. No sewerage system component shall be constructed on solid waste landfills.

- J. No sewerage system component shall be constructed to serve a structure that is constructed on or to be constructed on a solid waste landfill.
- K. Each sewer outfall, sewer main and lateral shall be locatable by means of mylar tape, wire or other method approved by the City Engineer.
- L. Use Detail No. 1.1, 2.2 and 2.3 when applicable.

3.06 Sewer Depth and Structural Integrity

- A. Sewer outfalls and mains shall have a minimum suitable soil cover of four (4') feet or other depth approved by the City Engineer.
- B. Sewer main shall be situated at a depth as to allow lateral to be constructed at a minimum two (2%) percent slope from sewer main to probable structure location on each lot to be served assuming lateral is three (3') feet in depth at probable structure location.
- C. Vertical connection of a lateral into a sewer main shall be prohibited.
- D. Top of pipe shall be two (2') feet below any stream or ditch when crossed or paralleled.
- E. DIP shall be used for the following conditions:
 - A. Where depth of soil cover is less than four (4') feet before or after sewer installation.
 - B. Where depth of soil cover is greater than fifteen (15') feet before or after sewer installation.
 - C. Where sewer crosses over or under a storm drain pipe.
 - D. Where sewer crosses over or under a water main.
 - E. Where sewer crosses over or under a stream or ditch.
 - F. Other locations deemed necessary by the City Engineer or Engineer.
 - G. When a sewer crosses under a stream, a minimum of two (2) cast-in-place concrete collars shall be installed on the pipe, down gradient from the stream.
 - H. Sewers shall have a minimum 18-inch vertical separation from any water main.
 - I. Use Detail Nos. 18.1, 18.2, 19.1 and 20.1 when applicable.

3.07 Manhole Location and Spacing

- A. Provide a manhole at each change in grade, pipe size, alignment, intersection and at terminal point of sewer.

- B. Space manholes a maximum of 400 feet of continuous run for pipes 15 inches in diameter and smaller.
- C. Space manholes a maximum of 500 feet of continuous run for pipes 18 inches in diameter and larger.
- D. Manholes situated within the 100-year flood elevation zone shall have top of cover elevations above the 100-year flood elevation or cover shall be with gasket and bolted down.
- E. Manholes situated within the 100-year flood elevation zone and/or the groundwater table shall be checked for buoyancy.
- F. Manhole inverts shall be constructed to provide a smooth transition between influent and effluent piping.
- G. Influent pipes with inverts greater than 2' above the outlet pipe invert shall be connected to the manhole by an outside drop.
- H. Manholes situated in pavement shall have top of covers level with finished grade.
- I. Manholes situated in non-paved areas shall have top of covers a minimum of twelve (12") inches above finished grade.
- J. Elevation drop between the inlet and outlet should be a minimum of 0.2 feet.
- K. Use Detail No. 21.1 when applicable.

SECTION 4: FORCE MAINS**4.01 General**

The following section shall be used as a guideline for the design of sanitary sewer force mains.

4.02 Hydraulics

- A. Force mains shall be sized to allow for a minimum velocity of 2 ft/s and a maximum velocity of 5 ft/s.
- B. Sanitary sewer force mains shall not flow down grade into a receiving manhole.
- C. Combination air release/vacuum valves shall be installed in force mains at all high points of elevation and spaced along apparent flat routes as determined by the City Engineer.

4.03 Force Main Material and Size

- A. Force mains and associated fittings shall be ductile iron with a minimum diameter of four (4") inches.
- B. Force main pipe assembly shall be push-on joint unless indicated otherwise.
- C. Force main pipe assembly in a bore casing shall be restrained joint unless indicated otherwise.

4.04 Force Main Location

- A. Force mains shall be situated outside of pavement within a street right-of-way near the boundary of the right-of-way or centered within an easement.
- B. Gravity sewer lines and sewer force mains shall be located on the opposite side of pavement from water distribution and raw water force mains when possible and/or shall have a minimum ten (10') foot horizontal separation.
- C. Force mains constructed parallel to streams shall be located such that the nearest area of disturbed soil is greater than fifty (50') feet from the stream bank.
- D. Force mains crossing streams of width greater than 15' shall have restrained joint piping.
- E. No force main shall be constructed on solid waste landfills.
- F. No force main shall be constructed to serve a component that is constructed on or to be constructed on a solid waste landfill.
- G. Each force main shall be locatable by means of detection tape or wire as approved by the City Engineer.

4.05 Force Main Depth

- A. Force mains shall have a minimum suitable soil cover of four (4') feet. Depth from finish grade to top of pipe shall be determined as follows.
 - 1. As measured from edge of pavement when pipe route existing/finish grade elevation is equal to or greater than adjacent pavement elevation.
 - 2. As measured from pipe route existing/finish grade elevation when the route elevation is less than the adjacent pavement.
 - 3. Other depth approved by the City Engineer
- B. Force main crossing under a creek or ditch shall have a minimum suitable soil cover of two (2') feet.
- C. Water distribution force mains shall have a minimum eighteen (18") inch vertical separation from any sewer.
- D. Force mains eighteen (18") inches in diameter and larger shall be checked for buoyancy when submerged in groundwater or situated within the 100-year flood zone.
- E. Use Detail Nos. 2.1 and 3.1 when applicable.

4.06 Thrust Restraint

- A. Thrust restraint shall be installed at all fittings and other locations deemed necessary by the City Engineer.
- B. Thrust restraint at fittings shall be accomplished by using one of the following methods.
 - 1. Cast-in-place concrete blocking installed to dimensions as shown on thrust block detail.
 - 2. Restrained Joint pipe and fittings installed upon approval by City Engineer.
- C. Use Detail No. 9.1 when applicable.

4.07 Combination Air Vacuum/Release Valves

- A. Combination air vacuum/release valves shall be sized according to the manufacturer's recommendations.
- B. Valves designated for use with water or sewage shall be used on the respective system.
- C. Valve shall be housed in a "dog house" style manhole.
- D. Use Detail No. 22.1 when applicable.

SECTION 5: AERIAL PIPE**5.01 General**

- A. This section shall be used as a guideline for the design of aerial pipe that pertains to water distribution piping and sanitary sewers.
- B. Requirements of Division II, Sections 2, 3 and 4, where applicable, shall apply to the design of aerial piping.
- C. A pipe that crosses over a perennial or intermittent stream must not cause an impedance to navigation or cause water to pool upstream of the pipe.

5.02 Aerial Pipe Material

- A. Aerial pipe shall be ductile iron or steel.
- B. Aerial pipe assembly shall comply with manufacturers' recommendations.
- C. Aerial pipe fittings shall comply with manufacturers' recommendations and specifications herein.

5.03 Aerial Pipe Support

- A. Aerial pipe supports shall be situated on suitable soils. Prior to support design, soils beneath proposed aerial pipe route shall be examined by a soils testing company for bearing capacity and suitability for construction. A soils report shall accompany the proposed aerial route.
- B. Aerial pipe support spacing shall not exceed 40 feet. Aerial pipe support spacing shall be based on results of the soil's bearing capacity and spacing recommendations of the pipe and fitting manufacturers.
- C. Aerial pipe supports shall be comprised of concrete piers set atop concrete spread footings. Spread footing size shall be based on results of the soil's bearing capacity and reactive forces within the aerial pipe.
- D. Minimum pier diameters and footing sizes shall be as summarized in Detail No. 24.1.
- E. Pipe shall be secured to piers as indicated on Detail No. 24.1.
- F. Use Detail No. 24.1 when applicable.

SECTION 6: PUMP STATIONS**6.01 General**

- A. This section shall be used as a guideline for the design of pump stations.
- B. The preferred conveyance method for sewage is gravity. Pump stations will not be permitted unless the Developer can demonstrate that the development cannot be served solely by gravity sewer.
- C. Pumps, motors and associated components that produce a complete pump station shall be furnished as a package by a single manufacturer.
- D. A backup power system shall be provided for each pump station.
- E. An emergency bypass connection shall be provided at all pump stations. Use Detail No. 17.1.
- F. Pump stations shall be equipped with a remote terminal unit (RTU) compatible with the City's existing SCADA supplier. A single supplier shall furnish all components of the SCADA system.
- G. Material requirements specific to pump stations, stand-by power and SCADA are included in this section.
- H. A minimum of two (2) sets of operation and maintenance manuals for each component of the pump station, backup power system and SCADA system shall be provided prior to final acceptance.
- I. The following information shall be submitted and approved prior to plan approval.
 - 1. 100-year flood elevation contour; electrical and mechanical components shall be situated above the 100-year flood elevation.
 - 2. Total Dynamic Head (friction loss through force main, static head, friction loss through pumps and suction piping)
 - 3. Pump Net Positive Suction Head; available and required
 - 4. Pump operating system curve plotted onto manufacturer's pump curve
 - 5. Pump cycle time
 - 6. Wet well buoyancy calculation
 - 7. Radio communication path survey
- J. A 2-inch SDR 21, Class 200 water line with RPZ backflow preventer and ¾" yard hydrant shall be installed at all pump stations. The backflow preventer shall be installed in an above ground insulated closure. Use Detail No. 12.2.
- K. All gravity sewer and force main piping onsite shall be ductile iron pipe.

6.02 Pump Station Package**A. Pumps**

1. A minimum of two (2) pumps shall be provided with capability to pump peak flows with one pump out of service.
2. Pumps shall be generally as follows:
 - a. Pumps shall be submersible.
 - b. Where acceptable to the City, the pumps shall be above ground self-priming.
3. Pumps shall be sized so that the operational system curve intersects the middle one-third portion of the pump operational curve. Each pump shall have the discharge capacity to overcome the development's peak discharge. Components shall be sized to provide two (2) to five (5) pump cycles per hour at average daily flow conditions.
4. Each pump shall be equipped with discharge pressure gauges mounted on a resilient panel. Pressure gauges shall be as follows.
 - a. Four (4") inches in diameter.
 - b. Glycerin filled for "no shock".
 - c. Graduated from a 0-inch to 70-inch water column.
 - d. Equipped with brass shut off valves and fittings.
5. City will determine list of spare pump parts that shall be provided for each pump station upon submitting.
6. Acceptable Manufacturers
 - Submersible Pump: Flygt
 - Above Ground: Smith & Loveless or Gorman-Rupp

B. Electrical

1. Each pump shall be equipped with a motor sized so that the pump operational system curve intersects the middle one-third portion of the pump operational curve. Motor shall not be overloaded at the design condition or at any head in the operational system curve.
2. Electrical control components shall be housed in a NEMA 3R stainless steel panel enclosure.
 - a. Control components shall be mounted to a removable back panel that is secured to the enclosure.

- b. Enclosure door shall be hinged, equipped with captive closing hardware and a neoprene gasket applied.
3. A circuit breaker shall be provided for each pump motor.
4. A padlocking operating mechanism shall be installed on each motor circuit breaker.
5. Operator handles for the mechanism shall be located on the exterior of the control compartment door with interlocks which permit the door to be opened only when circuit breakers are in the “Off” position.
6. A NEMA rated magnetic motor starter shall be provided for each pump motor.
 - a. Power contacts shall be double-break and made of cadmium oxide silver.
 - b. Motor starters shall be equipped to provide under voltage release and overload protection on all three phases.
 - c. Motor starter contacts shall be easily replaceable without removing the motor starter from its mounted position.
 - d. Motors having a 20-horse power rating or larger shall be equipped with soft start.
7. Motor overload relays shall be provided and have visual trip indication with trip-free operation. Reset buttons shall permit resetting of each motor without opening control panel door.
8. Control circuits shall be protected by a circuit breaker which shall be connected in such a manner as to allow control power to be disconnected from all control circuits.
9. A Hand-Off-Auto switch shall be provided for each pump to permit manual start and stop of each pump individually and to select automatic operation of each pump under control of the level control system.
10. A three-position sequence selector shall be provided to select the automatic alternation of the pumps or to select pump number 1 to be the lead pump for each pumping cycle or to select pump number 2 to be the lead pump for each pumping cycle.
11. A run indication light for each pump shall be mounted on the panel enclosure. Light shall indicate that the motor is or should be running.
12. A thermostat shall be mounted on each pump to detect high temperature. Should excessive temperature exist, protection circuitry shall override level control system and turn off pump motors to protect against excessive

temperatures. An indicator light shall be located on front of control panel. Pump shall remain locked out until pump motor is manually reset.

13. Elapsed time indicator shall be mounted on each motor to indicate total run time in hours and tenths of hours.

C. Liquid Level Control

1. Liquid Level in wet well shall be monitored via “Electronic Pressure Switch 2000” (EPS-2000 controller) and shall include integral components to sense pressure conditions. The controller shall be equipped as follows.
 - a. Level control electrical enclosure: NEMA 1 stainless steel
 - b. EMI and RFI suppression
 - c. DC-current power supply and 108 – 132/60/1 AC-current
 - d. Function in temperature range of 0° F through 131° F
 - e. Control range from zero (0) to twelve (12) feet with a repeat capacity of +/- 0.1 feet
 - f. Equipped with pump start delays preset at a fixed time delay of five (5) seconds to prevent simultaneous motor starts
2. Provide high water alarm visible indicator on control panel. Maintain alarm signal until manual reset.
3. Provide high water alarm audio indicator. Maintain alarm signal until manual reset of silence circuit.
4. Discrete output signal wiring shall be installed on pre-wired terminal blocks for SCADA monitoring. The signal output shall be for wet well high level, pump motor temperature and pump operation status.
5. Provide the following liquid level elevations on design drawings: Lead Pump “On”, Lead Pump “Off”, Lag Pump “On”, Lag Pump “Off”, High Water Alarm.

D. Discharge Piping

1. Piping shall be minimum 4-inch diameter, flanged, ductile iron.
2. Discharge pipe shall include flow meter capable of reading gallons per minute and capable 4-20mamp output.

E. Equipment Bids: See Details

6.03 Backup Power System

- A. Each pump station shall be equipped with one (1) preassembled (factory built), skid-mounted, weatherproof, backup power system.

1. The backup power system shall monitor the incoming electrical utility and, should power from the utility be interrupted, supply the power required to operate all pump station pump motors and required controllers.
 2. Backup power system shall perform using a maximum 85% of its rated capacity to operate two (2) motors in series or four (4) motors in staged series based on the pump motor's calculated load. System shall provide for a 10 to 15 second delay for start-up of the second motor(s); a 20 kw generator is a minimum.
 3. Backup power system within 100 feet of an occupied structure shall be equipped with a sound attenuation device to reduce noise levels to less than 80 decibels.
 4. A five (5) year warranty shall be provided for the backup power system
- B. The backup power system shall supply three-phase power and be generally equipped as follows.
1. Enclosure; enclosure shall house all components of the backup power system and shall include as a minimum the following:
 - a. Seamless fiberglass cowling as follows:
 - 1) Fiberglass shall have a gel coating of suitable thickness and density to provide durability, abrasion resistance, color fastness, gloss retention and shall be impervious to sewage, grease, oil, diesel or other common chemicals.
 - 2) Walls and ceiling shall be solid fiberglass having minimum 3/16 inch thickness and constructed in accordance with ASTM D-579.
 - 3) Enclosure shall be capable of withstanding a wind load of 85 miles per hour. The roof shall be capable of withstanding a minimum loading of 30 psf. All beams and trusses shall be fiberglass.
 - 4) Exterior color of enclosure shall be approved by City.
 - 5) Tip-up design equipped with mounted gas cylinders such that operator shall not exert more than 25 pounds of lifting force to tip the enclosure to the full open position.
 - 6) Enclosure shall be hinged securely at one end to a steel base. Hinges shall be for heavy duty use, cadmium plated and epoxy coated.

- b. Steel base as follows:
 - 1) Base shall of size to accommodate fiberglass cowling.
 - 2) Base shall be constructed of steel channel with transverse mid beams supporting a ¼ inch thick steel deck.
 - 3) All steel surfaces shall be prepared to a SSPC –SP6 condition and finished with an epoxy coating system.
 - 4) Steel base shall be fitted with an integral doubled wall fuel tank having such capacity as to supply engine/generator set for a 24-hour continuous operation period. Diesel fuel tank shall be furnished with a bacteria inhibitor to prevent bacteria buildup and shall be fitted with a water separator.
- c. Louvers as follows:
 - 1) Engine intake and exhaust louvers sized to provide sufficient air for both cooling and combustion.
 - 2) Louvers shall be 2-inch multi-blade, minimum 12-gauge anodized aluminum, 6063-T5 alloy with removable 5/8 inch aluminum mesh.
 - 3) A duct assembly shall be provided between the engine radiator and the exhaust louver.
 - 4) Louvers and duct assemblies shall be factory installed.
- 2. Engine/Generator: Engine/generator set shall be manufactured by Onan/Cummings or Caterpillar and include as a minimum the following:
 - a. Electric starter
 - b. Positive displacement full pressure, lubrication oil pump with full flow lubrication oil filters
 - c. Engine speed governor
 - d. Battery and battery charging alternator with solid state regulator
 - e. Fuel system as follows:
 - 1) No.2 diesel fuel.
 - 2) Replaceable dry element air cleaner, air supply, return and vent lines.
 - 3) Fuel filter with replacement element.
 - 4) Engine driven displacement fuel pump.
 - 5) Fuel system piping. Piping shall be black iron.

- a. Engine mounted thermostatically controlled water jacket heaters.
- b. Engine cooling system as follows:
 - 1) Engine mounted radiator system
 - 2) Belt driven pusher fan
 - 3) Coolant liquid and pump
 - 4) Thermostat temperature control
 - 5) Radiator with duct adapter flange
- c. Exhaust system as follows:
 - 1) Spiral type exhaust muffler. Muffler weight shall not be supported by the engine.
 - 2) Exhaust piping shall be routed through the side wall of the backup power system's base and terminated outside enclosure.
 - 3) Piping outside enclosure shall be insulated with a minimum 2-inch thick calcium silicate thermal insulation with aluminum shroud.
 - 4) Provide sound attenuation as required.
- d. Engine protective devices to indicate alarm and engine shutdown as follows.
 - 1) Provide as discreet outputs for SCADA monitoring.
 - 2) Low coolant temperature alarm
 - 3) Low coolant level shutdown
 - 4) Low lubrication oil pressure alarm and shutdown
 - 5) High coolant temperature alarm and shutdown
 - 6) Over speed shutdown
 - 7) Over crank lockout
 - 8) Transfer switch off
 - 9) External warning light. (outside cowling)
- e. Alternator shall be as follows
 - 1) 3-phase, broad range, able to be reconnected with 12 leads
 - 2) Single bearing and directly coupled to the drive engine through a flexible coupling for self-alignment

- 3) 4-pole, revolving field type with static exciter and magnetic amplifier voltage regulator. Voltage regulation shall be within +/- 5% of the rated voltage. Sustained voltage dip shall be less than 12% of rated voltage when full load and rated power factor is applied. Recovery to stable operation shall occur within two (2) seconds
- 4) Alternator, exciter and voltage regulator shall be manufactured by the same manufacturer as the engine/generator
- f. The following set controls shall be included on a lighted unit mounted control module:
 - 1) Oil pressure gauge
 - 2) Coolant temperature gauge
 - 3) Running time meter
 - 4) Charge rate ammeter
 - 5) Manual reset field circuit breaker
 - 6) Manual selector switch (Run-Stop-Remote)
 - 7) Remote two (2) wire start control
 - 8) Automatic engine shutdown
- g. The following set control lamps shall be on a mounted control module:
 - 1) Run
 - 2) Fault
 - 3) Overcrank
 - 4) Overspeed
 - 5) Switch Off
 - 6) Low Engine Temperature
 - 7) Low Oil Pressure
2. Automatic transfer switch shall be manufactured by the same engine/generator set manufacturer and include as a minimum the following:
 - a. Switch shall be rated for:
 - 1) Continuous operation over an ambient temperature range of -25° to 125 ° Fahrenheit.

- 2) All classes of load, both inductive and noninductive at 600 volts and tungsten lamp loads at 250 volts.
 - 3) To close on an inrush current up to and including 20 times the continuous rating of the switch without welding or excessive burning of the contacts.
 - 4) To switch loads up to and including its interrupting current capacity.
 - 5) To endure 6,000 cycles of operation at rated current at a rate of 6 cycles per minute without failure; one cycle shall consist of one complete opening and closing of both sets of contacts on an inrush current 10 times the continuous rating of the switch
- b. Switch shall have the following mechanical characteristics:
- 1) Terminal lugs for either copper or aluminum wire with cadmium oxide contacts
 - 2) Mechanical and electrical interlocks to prevent simultaneous energizing of both normal and emergency services
 - 3) Mechanically held on both normal and emergency sides
 - 4) 3-pole with solid neutral
 - 5) 25-amp rated auxiliary contacts: two (2) on the line side, three (3) on the emergency side
- c. Switch shall have the following control logic:
- 1) Signals engine/generator set to start in the event of a power interruption. A solid-state time delay start shall be provided adjustable from 0 to 6 seconds.
 - 2) Monitors each ungrounded line with an adjustable voltage, solid state under voltage sensor to sense a decrease of voltage below a set point or a loss of voltage on any phase of the normal power source.
 - 3) Retransfers the load to the line after normal power restoration
 - 4) Signals engine/generator set to stop after load retransfer to normal source
 - 5) Provides a battery float charger to maintain fully charged cranking batteries

- 6) Provides test switch to simulate an interruption of power from the normal source
 - 7) Provides an exerciser clock and selector switch (Load/Without Load) to automatically start the engine/generator set at regular intervals and allows it to run for a preset time period with load or without load
- d. Indicating lamps and meters shall be mounted for easy reading without opening doors.
- 1) Indicating lamps shall include Green lamp (normal) and Red lamp (emergency) to indicate which source is supplying power to the load.
 - 2) Meter shall include Charge Meter to monitor battery charger output current.
- e. The complete automatic transfer switch shall be mounted in a NEMA 1 rated enclosure, installed within the backup power system enclosure and wired to the engine/generator set at the manufacturer's facility.
- f. Acceptable Manufacturer: Acceptable manufacturer shall be as follows.
- Cummins Onan
 - Caterpillar

6.04 Telemetry

- A. The pump station shall be equipped with a functioning radio-based telemetry system that is compatible with the existing City SCADA system.
- B. The central computer system (CS) for the City SCADA system is located at City Hall.
- C. The pump station SCADA system design shall be completed in two (2) phases.
 1. Phase One. A radio survey shall be performed to determine the feasibility and scope of the radio communication path from the CS to the Pump station site. The radio survey shall be submitted to and approved by the City prior to City approval of the development's proposed sewerage system design.
 2. Acceptable Supplier: J. K. Duren & Company
 3. Phase Two. A single process instrumentation and control system supplier shall provide a complete SCADA system including but not limited to a remote terminal unit (RTU), radio communication equipment, and necessary

accessories. The system supplier shall provide all necessary hardware modifications and software programming of all computers and RTUs associated with SCADA system including necessary program modifications at the CS.

D. Radio Survey – Phase One

1. Complete a radio survey to determine communication path from central SCADA system to pump station site. Coordinate site activities with the City.
2. Record coordinates at each site and identifies their specific location on topography mapping software.
3. Generate terrain and radio path analysis profiles. Profiles shall be used to calculate the line-of-site radio path between the desired locations including projected tower height. Profiles shall then be used to identify potential interference and/or the feasibility of each potential radio path.
4. Transmit controlled radio signals between potential sites of interest and measure the quality and strength of the received signal. Use the specific radio to be used in the actual application using the same power level that will be used under normal operating conditions.
5. Provide results of radio survey and recommendations in the form of a report to the City for review. Include the following items (as a minimum) in the report.
 - a. Topographic map showing central City SCADA system site, proposed pump station site and radio path including repeaters (if necessary).
 - b. Test Methods
 - c. Site Coordinates
 - d. Test Equipment and Recommendations
 - e. Radio Paths Measured
 - f. Antenna Height Recommendations
 - g. System Recommendation
6. The City shall approve the radio survey's results and recommendations prior to proceeding with the design of the pump station SCADA system.

E. Remote Terminal Unit – Phase Two

1. Remote Terminal Unit (RTU) shall provide the interface between field signals and the CS. The RTU shall distribute communication, acquire data

and control functions for the SCADA system. The following is a minimal list of functions required to be monitored; more functions may be required (i.e. for series staged station) or at the discretion of the City.

- a. Generator Fail: Alarm if the generator is in a failed condition
- b. Pumps 1 and 2 Run Status: Display the pump ON or OFF status. Calculate the pump elapsed runtime. Allow the runtime to be manually reset at the operator workstation.
- c. Pumps 1 and 2 Remote Run/Stop: Provide for the pump to be remotely started and stopped. The remote start and stop function shall operate only if the pump local selector switch is in the AUTO position.
- d. Pumps 1 and 2 High Temperature: Alarm on pump high temperature.
- e. Pumps 1 and 2 Pressure: Display continuous and discharge pressures.
- f. Pump station Level: Display continuous pump station wet well liquid level. Alarm on Low Level in wet well (Less than 4.25mA dc signal).
- g. High Water Level Alarm: Display if the High Water Level switch is activated.
- h. RTU Power Monitoring: Alarm on AC power failure or Low Battery Power.
- i. Discharge Meter Monitoring: Display gallon per minute output.

2. Performance

- a. RTU shall operate as a subordinate to the CS. RTU shall have all data acquisition, communication and control functions necessary to interface with CS.
- b. RTU shall support full or partial scan by the CS.
- c. Data acquisition functions shall include but are not limited to the following:
 - 1) RTU shall scan all input points at least every second for current value.
 - 2) Store in buffer memory: currents values of all I/O, pulse input accumulations and filtered values of analog inputs.
 - 3) RTU response to interrogations shall use the buffer memory contents.

- d. All analog inputs have first order exponential digital filtering with programmable filter constants downloaded from the CS.
 - 1) Default values for filter constants stored in ROM.
 - 2) Filter constants expressed as time constants, range from 10 to 100 seconds with corresponding sample intervals ranging from 1 to 10 seconds.
 - 3) As a minimum, filter constants individually adjustable by RTU.
 - 4) Individual filter constants not required per analog input point.
- e. RTU shall utilize real-time, multitasking firmware to implement system communication protocol, local data acquisition and control functions.
 - 1) Shutdown due to loss of power shall not result in the loss of programs.
 - 2) Startup after restoration of power shall not require manual or CS intervention.
 - 3) Upon startup, RTU shall configure itself for its connected inputs and outputs and use default values for all initializations. RTU shall indicate its power reset condition to the CS in its reply to the first scan after reset. The CS shall then download all revised initialization constants. Firmware design utilizes a watchdog timer to monitor proper operation.
- f. All integrated circuits are second sourced.

3. Interfaces

- a. Types
 - 1) With communication circuits to the CS
 - 2) With pump station input and output signals
 - 3) With power source
- b. RTU shall use a radio communication link utilizing a modem suitable for interface with the radio. Radio shall operate at a 4800 or 9,600 baud with characteristics to match limitations of the radio channel. The RTU communicates with the CS at 9,600 baud in a asynchronous or synchronous format in a half-duplex mode over a party line channel.

c. Input/Output

- 1) All Input/Output (I/O) points shall be in accordance with ANSI C37.90.
- 2) Discrete Inputs (DI) shall be external with normally open or normally closed contacts. RTU impresses a dc voltage on the contact to read their status. Internal RTU logic optically isolated from external contacts. Provide means to limit read current to 100 mA maximum. Noise filters or other techniques shall be utilized to reject short time constant noise, contact bounce and 60-Hz pickup.
- 3) Analog Inputs (AI) shall be 4 to 20 mA dc signals in accordance with ISA S50.1 and be fully isolated with a maximum impedance of 250 ohms. Accuracy shall be +/- 0.25% of full scale under all operating temperature conditions. Common mode rejection is at a 100 dB minimum. Normal mode noise rejection is at a 40 dB minimum for frequencies of 60Hz and above.
- 4) Discrete Outputs (DO) shall have interposing relays with SPDT contact. Relays shall have a 5-amp rating and suited for 100,000 operations at 25° C. DO shall be Latch Type or Momentary Type. Latch Type Output shall not change state on loss of power by RTU. Momentary Type Output shall be single pulse with an adjustable duration ranging from 0.2 to 2 seconds.
- 5) Analog Outputs (AO) shall be 4 to 20 mA dc signals in accordance with ISA S50.1, Type 2, Class L and be fully isolated. Accuracy shall be +/- 0.25% of full scale under all operating temperature conditions. Resolution shall be 0.1% of full scale or better.

d. Power

- 1) RTU shall operate on 117-volt rms. The RTU shall have internal power On/Off switch and an On status LED.
- 2) Power supply shall have an ac/dc converter, a battery charger and dc/dc converters. Power supply shall trickle charge battery when ac power is On and fail over to battery when ac power is Off.
- 3) Provide batteries sufficient to power RTU for a minimum of four (4) hours after loss of 117-volt ac power. Battery shall

be of the sealed lead acid/calcium gelled electrolyte maintenance free type with rated trickle charge life in excess of two (2) years.

- 4) RTU shall have an ac power fail detection circuit relay. A Discrete Input shall be created upon detection of an ac power failure.
- 5) Acceptable Manufacturer: J. K. Duren & Company.

F. Panel Fabrication – Phase Two

1. Panel including all components (i.e. instruments, wiring and enclosure) shall be fabricated at the Process Instrumentation and Control System Supplier's factory.
2. Provide temperature control as follows.
 - a. Panel shall be sized to adequately dissipate heat from components mounted inside panel or in panel face.
 - b. Panel shall have thermostatically controlled space heater to maintain internal panel temperature above dew point.
3. Provide electrical as follows:
 - a. Feeder Circuits
 - 1) One or more 120V ac, 60Hz.
 - 2) Provide for feeder circuit conduit entry.
 - 3) Provide terminal board for termination of wires
 - b. Panel Power
 - 1) Provide main circuit breaker and a circuit breaker on each individual branch circuit distributed from panel.
 - 2) Branch circuit shall blow only branch breaker and not trip main breaker.
 - 3) Breakers shall be located to provide clear view and accessibility when panel door is opened.
 - c. Circuit Wiring
 - 1) A maximum of 20 devices shall be on a single circuit.
 - 2) Multiple units shall perform parallel operations.
 - 3) Provide for panel lighting and service duplex outlet on separate 15-amp 120V ac branch circuit.

- d. Signal Distribution
 - 1) 4 to 20 mA dc signals may be distributed as 1 to 5V dc within panel.
 - 2) 4 to 20 mA dc signals shall be isolated outside panel.
 - 3) Signal wiring shall be twisted, shielded pairs.
- e. Signal Switching
 - 1) Use dry circuit type relays or switches.
 - 2) 4 to 20 mA loops shall not be interrupted during switching
- f. Relays
 - 1) General: Plug-in type socket to rail mounting.
 - 2) Provide dust cover and hold-down clips with relay enclosure.
 - 3) Signal switch relay with gold or silver contact material having an expected mechanical life of 10,000,000 operations and expected electrical life at rated load of 100,000 operations with an LED or neon indicator lamp.
 - 4) Control circuit switch relay (non-latching) with silver cadmium oxide alloy contact having an expected mechanical life of 10,000,000 operations and expected electrical life at rated load of 100,000 operations with an LED or neon indicator lamp and push-to-test button.
 - 5) Control circuit switch relay (latching) with silver cadmium oxide alloy contact having an expected mechanical life of 500,000 operations and expected electrical life at rated load of 50,000 operations with an LED or neon indicator lamp.
 - 6) Control circuit switch relay (time delay) with silver cadmium oxide alloy contact having time delay set point and mode of operation with an integral potentiometer adjustment with knob external to dust cover
 - 7) Acceptable Manufacturers:
 - Potter and Brumfield
 - Allen Bradley
 - Omron

- g. Power Supply
 - 1) Provide as required to power instruments requiring external dc power including two-wire transmitters and dc relays.
 - 2) Convert 120V ac, 60Hz power to dc power of appropriate voltage so that instruments will operate within required tolerances.
 - 3) Provide output over voltage and over current protection devices.
 - 4) Enclosure shall be NEMA 1 rated.
 - 5) dc supply line to each individual two-wire transmitted shall be fitted with an indicating type fuse mounted for easy replacement
- h. Internal Light and Service Outlet
 - 1) Provide 100-watt incandescent light operated by switch.
 - 2) Mount inside and in the top of back of panel.
 - 3) Provide protective metal shield for light.
 - 4) Provide three-wire, 120V, 15 amp duplex receptacle.
- i. Use following table for standard pushbutton colors and inscriptions. Use black colored lettering on white and yellow buttons. Use white colored lettering on black, red and green buttons.

TABLE II-6.04.D-1		
PUSHBUTTON STANDARD		
COLORS AND INSCRIPTIONS		
<i>Tag Function</i>	<i>Inscription</i>	<i>Color</i>
O/O	On / Off	Red / Green
O/C	Open / Close	Red / Green
O/C/A	Open / Close / Auto	Red / Green / White
O/O/A	On / off / Auto	Red / Green / White
M/A	Manual / Auto	Yellow / White
S/S	Start / Stop	Red / Green
Reset	Reset	Red
Emergency Stop	Emergency Stop	Red

- j. Use following table for standard light colors and inscriptions. Use black colored lettering on white and amber lenses. Use white colored lettering on red and green lenses.

TABLE II-6.04.D-2		
LIGHT STANDARD COLORS AND INSCRIPTIONS		
<i>Tag Function</i>	<i>Inscription</i>	<i>Color</i>
On	On	Red
Off	Off	Green
Open	Open	Red
Closed	Closed	Green
Low	Low	Green
Fail	Fail	Amber
High	High	Red
Auto	Auto	White
Manual	Manual	Amber
Local	Local	White
Remote	Remote	Amber

- 4. Panel enclosure shall be as follows:
 - a. NEMA 4X rated and constructed of fiberglass. Size shall be 28"H x 20"W x 10"D.
 - b. Enclosure shall have a rubber-gasket door with a continuous hinge. Door shall be secured to enclosure with stainless steel lockable quick-release clamps.
 - c. Acceptable Manufacturers:
 - Hoffman Engineering Co.
 - Vynckier

G. Radio Communication Equipment – Phase Two

- 1. Transceiver
 - a. Transceiver shall contain FM transmitter and FM receiver suitable for operation in the 451.3625 MHz UHF.

- b. Transceiver shall operate from power provided by the RTU; provide solid-state circuitry throughout.
 - c. Designate transmitter emission in accordance with FCC Rules and Regulations.
 - d. Acceptable Manufacturer is Dexter Fortson.
2. Transmission Cable
- a. Cable shall have performance characteristics suited for overall system functional requirements.
 - b. Cable shall have a minimum bend radius of ten (10”) inches.
 - c. Cable shall have a dielectric jacket and be suited for direct burial and other outdoor design environments.
 - d. Acceptable Manufacturer is Beldon RG8.
3. Antenna
- a. Antenna shall be suited for outdoor environments.
 - b. Antenna shall provide a low resistance dc path to ground for lightning protection.
 - c. Acceptable Manufacturers:
 - Omni (Antennex) – Model FG4503, 3dB Omnidirectional Antenna
 - Yagi (Astron) – Model 460-6, 9dB Yagi Antenna
4. Tower and Mast
- a. Tower and mast shall support antenna at an elevation to achieve functional requirements.
 - b. Tower shall be self-supporting (without guide wires).
 - c. Lightning arrestors shall be provided and connected to ground rods by cable.
 - d. Acceptable Manufacturers:
 - Tylon Tital
 - Rohn Industries

6.05 Wet Well

- A. A wet well shall be provided with each pump station. Wet well shall have a minimum 6-foot inside diameter (or equivalent rectangular area).
- B. Wet well shall be sized in conjunction with pump level control to provide 2 to 5 pump cycles per hour at average daily flow conditions.
 - 1. Wet well shall resist floatation during and after construction.
 - 2. Access to the wet well shall be provided via a 2-foot diameter manhole ring and light weight cover situated two (2') feet centered from inside edge of wet well or by a three (3') foot by three (3') foot H-20 aluminum hatch.

6.06 Equipment Pads

Backup power system shall be secured by expansion or cast-in anchors to a monolithically poured steel reinforced concrete slab. The slab shall have a minimum depth of eight (8") inches. The slab shall extend a minimum of six (6") inches beyond all sides of enclosure.

6.07 General Electrical Requirements:

- A. Electrical service to pump station site area shall be 3-phase, AC current.
- B. Service Entrance, main disconnect, mini-power center and SCADA panel shall be secured to a fabricated steel (galvanized) stand.
- C. Service entrance shall meet the requirements of the local electric utility.
- D. Main Disconnect and mini-power center shall be sized to meet NEC code.
- E. Service wire to all components shall be stranded copper cable sized to meet NEC code and placed in conduit. Service wire within fenced site area shall be underground except where entering equipment.
 - 1. Below grade conduit shall be rigid, schedule 40, PVC meeting requirements of NEMA TC-3 and UL 651. Joints shall be slip-on and glued in accordance with manufacturers instructions.
 - 2. At-grade, above-grade and/or concrete encased conduit shall be rigid galvanized steel meeting the requirements of ANSI C80.1 and UL 6. Joints shall be threaded with galvanized fittings meeting the requirements of UL 514B. Set screw and thread less compression fittings shall not be permitted.
 - 3. At-grade or above-grade conduit shall not have horizontal runs greater than 12 inches. Horizontal runs of conduit shall be supported by a minimum of two concrete anchored uni-struts (galvanized).
- F. Area security light shall consist of a photocell having a minimum 150 watt metal halide fixture. The light shall be installed at a minimum height of 15 feet above finished grade. The light pole shall be tubular steel and factory finished with a dark

bronze color coating. The light pole shall be anchored in accordance with the manufacturer's recommendations.

- G. All components shall be grounded to copper grounding rods in accordance with NEC code.
 - 1. Ground rods shall be copper-clad having minimum diameter of 5/8-inch with a length of 10 feet.
 - 2. Ground conductors shall be stranded copper.
 - 3. Ground connections shall be of the exothermic weld type suitable for exposure to elements or direct burial.
- H. Provide electrical site plan with design submittal.

6.08 Property and Site Area

- A. A minimum 60-foot by 60-foot area of property, to be donated to the City, shall be provided for each pump station. The pump station and associated components shall be situated within 40-foot by 40-foot site area; a larger property/site area may be required.
- B. A twelve (12') foot wide access drive situated within a thirty (30') foot wide strip of property, to be donated to the City, shall be provided for each pump station. The access drive shall intersect a public right-of-way. Road material may be changed as approved by the City Engineer.
- C. The property boundary shall be situated no closer than fifty (50') feet from the nearest structure.
- D. Corners of pump station site area shall be at same elevation.
- E. Pump station site area shall be sloped away from slab covering the wet well at a minimum 1.0% slope.
- F. Potable water and a non-freeze yard hydrant with RPZ Backflow Preventer shall be provided at each pump station.
- G. Provide plug valve in force main at a maximum distance of 20 feet from pump station.
- H. Site area (minimum 40-foot by 40-foot) shall be fenced with black vinyl coated chain link fence.
- I. That portion of the pump station site area not in concrete shall be covered with crushed stone at a minimum depth of six (6") inches.
- J. Property area outside fenced area shall be landscaped.

6.09 Fence and Landscaping

- A. A minimum 5-foot clearance shall be provided from fence to major components (i.e. pump station, emergency bypass generator, SCADA tower, electrical stand).
- B. Fence shall have height of six (6') feet with three (3) strands of galvanized barbed wire atop posts.
 - 1. Fence mesh shall be 9-gauge wire (galvanized) and black vinyl coated.
 - 2. Top rail shall be 1-⁵/₈ inch diameter schedule SS40.
 - 3. Intermediate post shall be 2-inch diameter schedule SS40.
 - 4. Corner and gate posts shall be 3-inch minimum diameter schedule SS40.
 - 5. Gate shall have a width of fourteen (14') feet, two 7-foot swing gates positioned in location approved by the City.
 - 6. Gate shall be secured by the City with a keyed lock conforming to the City standard; sergeant lock.
 - 7. "No Trespassing" signs to include pump station name, address and emergency phone numbers shall be installed on all fenced sides by the City conforming to the City standard.
- C. Property outside of the fenced area shall be landscaped.
 - 1. Install weed barrier fabric over all areas to receive landscaping.
 - 2. Install evergreen shrubbery spaced not greater than five (5') feet apart around the fenced area. Shrubby shall have a minimum height of three (3') feet at the time of planting and shall have a mature height of at least six (6') feet. Prepare soil in accordance with shrubbery planting instructions.
 - 3. Install wood mulch, clean of dirt, around shrubbery and to the edge of the easement area. Mulch shall have a depth of three (3") inches.
- D. Use Detail Nos. 28.1 and 29.1 when applicable for paving access roads and affected streets.

SECTION 7 – SOIL EROSION, SEDIMENTATION AND POLLUTION CONTROL PLAN**7.01 General Requirements**

Siltation and soil erosion shall be prevented by the installation of erosion control measures and practices prior to or concurrent with land-disturbing activities. The Contractor shall utilize silt fence, hay bales, mulch, grass, slope drains, and other erosion control devices or machines as necessary. All soil erosion and sedimentation control measures must be installed prior to initiation of construction activity. Siltation and erosion control shall be in compliance with the “Georgia Erosion and Sedimentation Act of 1975” as amended to date and these specifications. Any violations of the Act shall be subject to those penalties and fines as defined by the Act.

7.02 Plan

Provide an erosion and sedimentation control plan including Best Management Practices (BMP), details, legend, drawings and locations shown on the plans.

7.03 Standards and Specifications

All designs will conform to and all work will be performed in accordance with the standards and Specifications of the publication entitled “Manual For Erosion and Sediment Control in Georgia” and in compliance with the “Georgia Erosion and Sedimentation Act of 1975” as amended to date. All materials shall be first-class quality to withstand a 25-year storm event.

7.04 Site Conditions

- A. Protect all adjacent public and private property from erosion and other pollutants due to construction activities.
- B. Erosion control plan must comply with all local and state regulations.
- C. Erosion control details and symbols may be taken directly from the “Manual for Erosion and Sediment Control in Georgia,” latest edition.
- D. Land disturbing activity shall not commence until the land disturbing permit has been issued.
- E. If disturbance is an acre or more of land for the entire project, the owner must file a Notice of Intent (NOI) to be covered under one of the NPDES general construction permits (GAR 100001, GAR 100002 or GAR 100003). Information about filing requirements and copies of the general permits can be found at http://www.gaepd.org/Documents.techguide_wpd.html#sw. If you have any questions regarding this subject, please call the EPD district office listed in the general permit.

7.05 Erosion Control Program

Vegetation and mulch shall be applied to applicable areas **immediately** after grading is completed. Best Management Practices, BMP(s), shall be employed to prevent erosion in areas of bare soils and concentrated water flows. Diversions and dikes shall be installed to divert sediment-laden runoff into the sediment barriers and to protect cut and fill slopes from erosive water flows.

7.06 Temporary Erosion Control

Temporary erosion control shall consist of planting temporary grass of a quick growing species such as millet, rye grass, or cereal grasses suitable to the area. The Contractor shall use all means necessary to control dust on and near the work site and barrow areas when dust is caused by construction operations. The Contractor should thoroughly moisten all surfaces as required to prevent dust from being a nuisance to the public, neighbors and concurrent performance of work on the site. Water for irrigation and dust control shall be provided by the owner.

7.07 Rip Rap

Rip Rap shall consist of stone or bagged sand-cement to a thickness of approximately twelve inches (12"). Stone shall be hard quarry or fieldstone of such quality that it will not disintegrate on exposure to water or weathering. Stone shall range in weight from a minimum of 25-pounds to a maximum of 150-pounds with at least 75-percent of the pieces weighing more than 50-pounds. Bagged sand-cement Rip Rap shall consist of one part cement and five parts of sand in clean cloth bags, approximately one cubic foot in size.

7.08 Grassing of Disturbed Areas

- A. Preparation: The Contractor shall grass all areas that were disturbed by clearing or construction operations. Grassing shall be by conventional seeding or hydroseeding. Before seeding commences, the Contractor shall spread the stored stock piled top soil over the entire area, working the better top soil into the more rocky areas. The entire area shall be smoothed with a drag and all clods broken up. All deleterious material, large stones, roots, limbs, and other debris shall be removed to leave a smooth area that would be suitable for mowing. Grassing (by seeding) shall be completed as soon as practical after finish grading is completed in order to minimize erosion from rainfall and run-off. Any erosion occurring in grassed areas shall be immediately repaired.
- B. Grass Seed: Grass seed selection shall be in accordance with the "Manual for Erosion and Sediment Control in Georgia", as amended to date. Otherwise, the type of grass seed applied shall be determined by site and soil compatibility and City discretion.
- C. Temporary and Permanent Seeding: Temporary seeding is required on any areas exposed longer than 14 days. Permanent seeding shall be done only if it can be completed between March 1 and April 15 or August 15 and November 15. Use temporary seeding during remaining periods. The work of spreading and

compacting topsoil shall be performed by the Contractor, as specified, prior to planting Rye grass. Replacing or repairing of eroded topsoil shall be done as necessary at time of later grassing.

- D. Hydro-seeding: Mix the seed (inoculated if needed), fertilizer, and wood cellulose or wood pulp fiber mulch with water and apply in slurry uniformly over the area to be treated. Apply within one hour after the mixture is made.
- E. Grassing Along Highway Right-of-Way: Grassing along highway right-of-way shall be in accordance with Department of Transportation, State of Georgia, Standard Specifications, Construction of Roads and Bridges, Latest Edition, Section 700.
- F. Grassing through Established Pastures and Lawns: Grassing through established pastures and lawns shall be by seeding with the same type of grass as was disturbed or, if acceptable to the Owner, seeding may be as recommended by the local Soil Conservation Agent.
- G. Grassing of Other Areas: Grassing of other areas shall be by planting grass of a quick growing species that will also give a permanent cover. Permanent seeding shall be a mixture of Bermuda and centipede.
- H. Planting: Preparation of soil along highway right-of-way shall be as set out in highway specifications. The contractor shall use recognized equipment and materials in preparation of the soils. Before planting, a fertilizer of 6-12-12 composition or approved equal shall be evenly applied at the rate of 1,500 pounds per acre and disced or harrowed into the dampened soil.
- I. Maintenance: Temporary grass may be intermixed with permanent grass. However, the contractor shall cut and maintain the temporary grass such that the permanent grass will become established and not be choked out. The contractor will be required to maintain the grass on the site until the job is accepted.

7.09 Seed, Fertilizer, Mulch

Seed, fertilizer, mulch and periodic watering shall be applied in adequate quantities to assure a satisfactory ground cover over the entire disturbed area of construction operations. Water thoroughly as soon as completed and at least twice daily, or more often if necessary to provide continuous growth without setback until all growth from seed is thoroughly established.

The mulching material will consist of dry straw or hay of good quality free of seeds of competing plants, and at the rate of two or two and a half tons per acre, respectively. Straw or hay mulch will be applied uniformly over the disturbed areas, to achieve 75-percent coverage. It must be spread within 24-hours after seeding is done. The spreading must be done by blower-type or other mulch- spreading equipment or by hand and anchored by pressing the mulch into the soil. Anchoring must be done immediately after the mulch is

spread. A disk harrow with the disk set straight or a special “packer disk” may be used. The disk may be smooth or aerated and should be 20-inches or more in diameter and 8- to 12-inches apart. The edges of the disk should be dull enough not to cut the mulch but sharp enough to press into the soil leaving much of it in an erect position.

7.10 Slope Stabilization

Sedimentation shall be controlled by the use of hay mulch on slopes 3:1 or less. On slopes greater than 3:1, the Contractor shall install blankets. Prior to placing the blanket, the grassing shall have been completed and the area left in a smooth, uniform condition, free from stones, lumps, roots, other material, which would prevent from making snug contact with the underlying soil.

A. Fiberglass Blanket: The fiberglass blanket shall be machine produced consisting of uniform layer of continuous, randomly-oriented glass fiber strands. The blanket shall be at least 48-inches wide and weighing a minimum of 0.2-pounds per square yard when used on slopes and 0.4 pounds per square yard when in waterways.

1. Securing and Stapling: All staples shall be driven flush with the ground. Staples for securing the blanket shall be made from cold drawn wire not less than 6-inch lengths of 14-gauge, to form a “U” of 1-inch in width. Longer staples may be required for loose soil.

Each strip of the blanket shall be held firmly in place by means of three rows of staples; one row along each edge and one row along the middle. The staples shall be spaced no more than 3-feet apart in each row with the staples in the middle row spaced alternately with those at the edges. The edge staples shall be placed in the 2-inch overlap. At the end of each blanket, staples shall be placed in a row with spacing of approximately 12-inches.

An anchor slot or trench, 9-inches in depth, shall be dug across the upgrade end of the site. The first 12-inches of the blanket shall be placed in the trench and the backfill tamped solidly in place. Adjacent strip ends shall overlap 2-inches and adjoining ends shall overlap 6-inches with the upstream section on top.

B. Organic Fiber Blanket:

1. Straw Blanket: A machine-produced blanket of clean, weed-free straw from agricultural crops with consistent thickness and the straw evenly distributed over the entire area of the blanket.

- a. Slopes: The top of each blanket shall be covered with a photodegradable plastic mesh having a maximum mesh size of 5/16 × 5/16-inch, which is sewn to the straw using biodegradable thread. The blanket shall be at least 48-inches

wide with a minimum thickness of 3/8-inch and a minimum dry weight of 0.5-pounds per square yard.

- b. Waterways: The blanket shall be the same as for slopes except having the photodegradable plastic mesh on the top and bottom.
2. Excelsior Blanket: A machine produced mat of curled wood excelsior of which 80-percent has 6-inch or longer fiber length, with consistent thickness and the fiber evenly distributed over the entire area of the blanket. The blanket shall be smolder resistant. The top of the blanket shall be clearly labeled.
 - a. Slopes: The top of each blanket shall be covered with a photodegradable plastic mesh having a maximum mesh size of 1½ × 3-inch. The blanket shall be at least 48-inches wide with a minimum thickness of ¼-inch and a minimum dry weight of 0.8-pounds per square yard.
 - b. Waterways: The blanket shall be the same as for slopes except having the photodegradable plastic mesh on the top and bottom.
 3. Securing and Stapling: Staples shall be driven vertically into the ground to anchor the plastic mesh. Staples shall be spaced approximately 2-yards apart on each side of the blanket and one row in the center alternately spaced between each side staple. Where blankets are laid side to side, the staples shall be placed with ½ of the staple anchoring mesh form each blanket. At the beginning of a blanket, staples shall be placed in a row with spacing of approximately 12-inches.

In waterways, there shall be no longitudinal seams unless overlapped at least 6-inches with the upgrade section on top. The first 12-inches of the first row of blankets shall be placed in a 6-inch deep anchor slot stapled in the bottom, the slot shall be backfilled and solidly tamped

7.11 Final Stabilization

When monitoring is required, stabilized means at least 70% of the soil surface is uniformly covered in permanent vegetation unlike the NPDES Storm Water Discharges Associated with Construction Activities, General Permit (GAR 100001, 100002, 100003), which includes installation of equivalent permanent stabilization measures (such as the use of rip-rap, gabions, permanent mulches, or geotextiles). Permanent vegetation consists of planted trees, shrubs, perennial vines; a crop of perennial vegetation appropriate for the season and

region; or a crop of annual vegetation and a seeding of target crop perennials appropriate for the region such that within the growing season a 70% coverage by the perennial crop is achieved. For linear construction projects on agricultural or silvicultural lands, stabilized means stabilizing it for its agricultural or silvicultural use.

Final acceptance of grassing is defined as a full cover, over the seeded area of live and growing grass, when at least 98% of the total areas has no bare spots exceeding one square foot and the ground surface is fully stabilized against erosion.

SECTION 1: DUCTILE IRON PIPE AND FITTINGS**1.01 Pipe Classification**

- A. Ductile iron (push-on) pipe shall be Pressure Class 350 or thickness class 52 in accordance with ANSI/AWWA C151/A21.51, latest revisions.
- B. Ductile iron flanged pipe shall have a minimum pressure rating of 250 psi in accordance with ANSI/AWWA C110/A21.10 and C115/A21.15, latest revisions.
- C. Ductile iron restrained-joint pipe shall be of the flex-ring type having a welded bead lock ring having a minimum pressure rating of 250 psi in accordance with ANSI/AWWA C110/A21.10 and C151/A21.51, latest revisions.

1.02 Fitting Classification

- A. Ductile iron fittings for use with push-on joint pipe shall be standard mechanical, compact series, with a minimum pressure rating of 250 psi in accordance with ANSI/AWWA C110/A21.10 and C153/A21.53, latest revisions.
- B. Ductile iron flanged fittings shall be in accordance with ANSI/AWWA C110/A21.10, latest revision. Flanged fittings up to twelve (12") inches in size shall have a minimum pressure rating of 350 psi. Flanged fittings over twelve (12") inches in size shall have a minimum pressure rating of 250 psi.
- C. Ductile iron restrained-joint fittings shall be of the flex-ring type having a minimum pressure rating of 250 psi in accordance with ANSI/AWWA C110/A21.10 and C153/A21.53, latest revisions.

1.03 Gaskets and Bolted Connections

- A. Gaskets shall be as follows:
 - 1. Gaskets for push-on and standard mechanical joints shall be plain rubber (Styrene Butadiene Copolymer) in accordance with ANSI/AWWA C111/A21.11, latest revisions.
 - 2. Gaskets (FIELD LOK[®]) and (MJ FIELD LOK[®]) used to restrain push-on joint pipe and/or standard mechanical joint fittings, respectively, shall be plain rubber (Styrene Butadiene Copolymer) modified with stainless steel teeth in accordance with ANSI/AWWA C111/A21.11, latest revisions.
 - 3. Gaskets for restrained joint pipe of the flex-ring type and restrained joint fittings of the flex-ring type shall be plain rubber (Styrene Butadiene Copolymer) modified with ductile iron segments in accordance with ANSI/AWWA C111/A21.11, latest revisions.
 - 4. Gaskets for flanged joints shall be 1/8-inch thick, full-faced, clothed reinforced rubber in accordance with ANSI/AWWA C110/A21.10 and C115/A21.15, latest revisions.

- B. Retaining glands and adapter coupling shall be as follows:
1. Retaining gland for use with standard mechanical joint fitting where joint restraint is not required shall be in accordance with ANSI/AWWA C110/A21.10 through C153/A21.53, latest revisions.
 2. Retaining gland (MEGALUG[®]) for use with standard mechanical joint fitting, where the gland acts as the restraining mechanism, shall include gripping wedges with torque limiting twist-off nuts and shall be in accordance with ANSI/AWWA C110/A21.10 through C153/A21.53, latest revisions.
 3. Retaining gland (MJ FIELD LOK[®]) for use with standard mechanical joint fitting, where the gasket acts as the restraining mechanism, shall be in accordance with ANSI/AWWA C110/A21.10 through C153/A21.53, latest revisions.
 4. Adapter coupling (Foster Adapter[®]) shall be a bolt-through positive restraining connector between two standard mechanical joints. Adapter coupling shall be in accordance with ANSI/AWWA C153/A21.53, latest revisions.
- C. Bolts shall be as follows:
1. Bolts and nuts used for standard mechanical connections shall be tee head type with heavy hex nut conforming to ASTM A563 in accordance with AWWA C111.
 2. Bolts and nuts used for flanged connections shall be hex type of low carbon steel; cadmium plated or zinc plated conforming to ASTM A307 in accordance with AWWA C110 and C115.

1.04 Coatings and Linings

- A. Ductile iron pipe and fittings placed on or beneath the ground surface shall have an exterior coating of asphalt (one mil) in accordance with ANSI/AWWA C151/A21.10, latest revisions.
- B. Ductile iron pipe and fittings placed above the ground surface shall have an exterior manufacturer applied universal phenolic primer (one mil) capable of accepting an epoxy coating. Finish coat shall be in accordance with Division III, Section 12.
- C. Ductile iron pipe that crosses or runs parallel to a gas transmission main, which is or may be cathodically protected, shall be encased in polyethylene tubing, eight (8) mil minimum thickness, and taped in accordance with ANSI/AWWA C105/A21.5.
- D. Ductile iron pipe and fittings used in the distribution of potable water shall be cement lined in accordance with ANSI/AWWA C104/A21.4, latest revisions.

- E. Ductile iron pipe and fittings used in sanitary sewer systems shall be cement lined in accordance with ANSI/AWWA C104/A21.4, latest revision and cement lining sealed with asphalt in accordance with ANSI 21.10, latest revision and AWWA C110, C115, C151 or C153, latest revisions.
- F. For sewer pipe applications, ductile iron pipe and fittings in lieu of an asphalt coating and cement lining may be lined with Protecto 401 Ceramic Epoxy. Lining shall be applied according to the manufacturer's recommendations. Protecto 401 lining cannot be used as a potable water lining.
- G. Ductile iron fittings in lieu of an asphalt coating and cement lining may be coated and lined with five (5) to eight (8) mils of fusion bonded epoxy in accordance with AWWA/ANSI C550 and C121/A21.16. Fittings shall be listed by a certifying agency that the coating complies with ANSI/NSF 61.

1.05 Pipe Marking:

The following information shall be cast in or stamped on each pipe:

- A. Weight, class or nominal thickness
- B. Casting period
- C. Manufacturer's identifying mark
- D. Year the pipe was manufactured
- E. The letters "DI" or "DUCTILE"
- F. Acceptable Manufacturers: Ductile iron pipe and fittings shall be domestically manufactured. The following manufacturers are acceptable.
 - American Cast Iron Pipe Company – pipe and fittings.
 - U.S. Pipe Company – pipe and fittings.
 - S&B Technical Products - FIELD LOK[®] and MJ FIELD LOK[®] gasket.
 - EBAA Iron Sales, Inc. - MEGALUG[®] gland.
 - U.S. Pipe Company, Tyler/Union - MJ FIELD LOK[®] gland.
 - Infact Corporation - Foster Adapter[®].
 - Other Approved.

SECTION 2: STEEL PIPE AND FITTINGS**2.01 Pipe Classification**

- A. Steel pipe shall have a minimum wall thickness of 0.25 inches and be in accordance with ASI standards.
- B. Wall thickness shall be increased as necessary to minimize deflection and deformation.

2.02 Transition Coupling

- A. Coupling used to connect pipes of differing material shall be as follows:
 - Middle ring shall be carbon steel in accordance with ASTM A513, ASTM A635 or ASME SA675 GR60.
- B. Followers shall be ductile iron.
- C. Bolts and nuts shall be carbon steel in accordance with ANSI/AWWA C111/A21.11.
- D. Gaskets shall be Buna (S blend).

2.03 Coatings and Linings

- A. Steel pipe used for water distribution and sewer shall be coated and lined in accordance with Division III, Section 12.
- B. Steel pipe used as casing shall not require a coating or lining unless otherwise indicated.
- C. Acceptable Manufacturers: Steel pipe and fittings shall be domestically manufactured. Acceptable manufacturers are as follows:
 - As approved – pipe.
 - Dresser – Transition Coupling.
 - Smith Blair – Transition Coupling.
 - Other Approved.

SECTION 3: POLYETHYLENE PIPE AND FITTINGS**3.01 Polyethylene Tubing**

- A. Polyethylene tubing shall be AWWA C901, Copper Tubing Size (CTS), DR 9 with PE material PE 3408, 200 PSI pressure rated, NSF certified:
- B. Fittings: AWWA C901 molded. No fittings allowed under roadway.
- C. Joints: Compression type utilizing a totally confined grip seal and coupling nut. Stainless steel tube stiffener insert shall also be used for tubing services. No joints in pipe under roadway.
- D. Markings: Tubing shall be fully labeled at intervals of not more than five (5') feet with brand name and manufacturer, the nominal size, PE 3408, the work TUBING and SDR9, PC200, AWWA C901-88, and the seal or mark of the testing agency.
- E. Color: Black.

SECTION 4: PVC PIPE**4.01 Casing for Polyethylene Pipe**

- A. PVC pipe shall be used as a casing for polyethylene water service lines that are to be installed under pavement.
- B. PVC pipe used as a casing shall be a minimum of Schedule 40, Class 200.
- C. PVC casing pipe shall have a minimum diameter of two (2") inches.

4.02 Sewer Pipe Classification

- A. PVC pipe used as sewer shall be SDR 26 push-on joint type with O-rings in accordance with ASTM 3034.
- B. Gaskets shall be plain rubber.

4.03 Sewer Pipe Fitting Classification

- A. PVC fittings shall be in accordance with ASTM 3034.
- B. Acceptable Manufacturers: PVC pipe shall be domestically manufactured by approved acceptable manufacturers.

SECTION 5: VALVES**5.01 Gate Valve**

- A. Gate valves smaller than three (3") inches in diameter shall be as follows.
 - 1. Valves shall be all brass or bronze construction.
 - 2. Valves shall have solid wedge gate, rising stem, and threaded bonnet.
 - 3. Valve end connections shall be compatible with pipe material in which valve is installed.
- B. Gate valves three (3") inches in diameter and larger shall be as follows.
 - 1. Water supply service shall be in accordance with AWWA 509 for resilient seated valves.
 - 2. Water supply service shall be in accordance with AWWA 515 for reduced wall thickness resilient seated valves.
 - 3. Valve body shall be ductile iron with all exterior surfaces coated with a fusion-bonded epoxy coating.
 - 4. Valves shall be bronze mounted, beveled geared, with a non-rising stem and O-ring stem seals.
 - 5. All exposed fasteners, nuts and bolts shall be stainless steel.
 - 6. Valves shall open in a counter-clockwise direction.
 - 7. Valve end connections shall be flanged or standard mechanical.
 - 8. Buried valves shall be nut operated; non-buried valves shall have hand-wheel operators.
- C. Gate valves used in conjunction with a tapping saddle shall be as follows:
 - 1. Offset type that allows the tapping device to mount to the pipe and pass through the opened valve.
 - 2. End connection to the tapping sleeve shall be flanged. End connection to accept pipe shall be mechanical joint.
- D. Gate valves three (3") inches and larger shall be coated with six (6) to eight (8) mils of fusion bonded epoxy in accordance with AWWA/ANSI C550 and C121/A21.16. Fittings shall be listed by a certifying agency that the coating complies with ANSI/NSF 61.
- E. All gate valves shall be rated for a minimum working pressure of 200 psi. Valves shall remain water tight at working pressure after installation.

- F. All gate valve shall be installed in a valve box within a 18” square by 4” thick protective concrete pad. Provide extension stem where required to bring operating nut to within 12 inches of ground surface.
- G. The following information shall be cast in or stamped on each gate valve:
1. Manufacturer’s identifying mark
 2. Pressure Class
 3. The letters “DI” or DUCTILE
 4. Place of Manufacturing
- H. Acceptable Manufacturers: Valves shall be by a domestic manufacturer that produces only ductile iron bodied valves. Acceptable Manufacturers are as follows:
- American Darling
 - U.S. Pipe Company
 - Mueller Company - Ductile Iron Valves only
 - M&H Valve Company - Ductile Iron Valves only.

5.02 Butterfly Valve

- A. Valves shall be in accordance with AWWA C504.
- B. Materials used in the fabrication of the valve shall meet all related requirements of ASTM.
- C. Valve bodies shall be ductile iron with integrally cast flanged ends or standard mechanical ends. Flange drilling shall be in accordance with ANSI B16.1. Two (2) trunnions for shaft bearings shall be integrally cast with valve body.
- D. Valves shall be bubble tight at 250 psi with flow in either direction and shall be capable of throttling service.
- E. Valve disc shall rotate 90° from full open position to tight shut position.
- F. Valves shall be tight closing, rubber seated with seats applied to the body or disc. Valve seats on 30 inch and larger diameter valves shall be field adjustable and replaceable without dismounting operator, disc or shaft and without removing valve from pipe. Mating seat shall be stainless steel or Monel.
- G. Valves shall be fitted with sleeve type bearings contained in hubs of valve body. Bearings shall be corrosion resistant and self-lubricating.
- H. Valve operators shall hold valve in any intermediate position between full open and full close without creeping or fluttering.

1. Manual operators shall be worm gear or traveling nut type and shall be fully enclosed.
 2. Valves for buried service shall be furnished with a ground level valve position indicator unless otherwise approved by the City Engineer.
 3. Valves for above ground service shall be furnished with a valve position indicator arrow to give valve position at any point from full open to full close.
 4. Valves shall open when turning operator in a counter-clockwise direction.
- I. Valves shall be coated as follows.
1. Valve placed on or beneath the ground surface shall have an exterior coating of asphalt (one mil) in accordance with ANSI/AWWA C151/A21.10, latest revisions.
 2. Valve in lieu of an asphalt coating may be coated with six (6) to eight (8) mils of fusion bonded epoxy in accordance with AWWA/ANSI C550 and C121/A21.16.
 3. Valve placed above the ground surface shall have an exterior manufacturer applied universal phenolic primer (one mil) capable of accepting an epoxy coating. Finish coat shall be in accordance with Division III, Section 12.
 4. Acceptable Manufacturers: Acceptable manufacturers are as follows:
 - M&H
 - Pratt
 - Mueller
 - Clow
 - Dezurik

5.03 Double Check Valve (Backflow Preventers)

- A. Double check valves shall be in accordance with AWWA 506, ASSE 1013 and USC-FCCC. Check valves shall be UL listed and approved by FMR.
- B. Double check valves $\frac{3}{4}$ inch in diameter through two (2") inches in diameter shall be bronze bodied having corrosion resistant moving parts with bronze threaded unions on both sides of the device.
- C. Double check valves 2-1/2 inch in diameter and larger shall be bronze, cast iron or ductile iron bodied having corrosion resistant moving parts with flanged end connections.
- D. Double check valves with reduced pressure zone assemblies shall have a sufficient air gap at the relief port and discharge shall drain away from the assembly.

- E. Double check valve assemblies shall be equipped as standard with four (4) test cocks and two (2) resilient seated shut off valves.
- F. Valve may be coated with six (6) to eight (8) mils of fusion bonded epoxy in accordance with AWWA/ANSI C550 and C121/A21.16.
- G. Valve may have an exterior manufacturer applied universal phenolic primer (one mil) capable of accepting an epoxy coating. Finish coat shall be in accordance with Division III, Section 12.
- H. Acceptable Manufacturers are as follows:
- Watts - Double Check (3/4" to 2"): U007QT.
 - Watts - Double Check (3" to 10"): 709 or 757 w/OSY Valves.
 - Wilkins - Double Check (3" to 10"): 350A or 950 w/OSY Valves.
 - Conbraco/Apollo – Double Check (3/4" to 2"): 40-100 T Series.
 - Conbraco/Apollo – Double Check (3" to 10"): 4S DC Series w/OSY Valves.
 - Conbraco/Apollo – Double Check (3" to 10"): 4D-100 Defender w/OSY Valves.
 - Watts - Reduced Pressure Zone Check Valve (3/4" to 2"): 909S-QT.
 - Watts - Reduced Pressure Zone Check Valve (3" to 6"): 909 w/OSY Valves.
 - Febco – Double Check (3/4" to 2"): 850 BV
 - Wilkins - Reduced Pressure Zone Check Valve (3" to 6"): 375 or 975 w/OSY Valves.
 - Conbraco/Apollo – Reduced Pressure Zone (3/4" to 2"): 40-200 T Series.
 - Conbraco/Apollo – Reduced Pressure Zone (3" to 4"): 40-200 w/OSY Valves.
 - Conbraco/Apollo – Reduced Pressure Zone (6" to 10"): 4S-RP w/OSY Valves.
 - Other Approved.

5.04 Corporation Valve

- A. Corporation valves shall be of the ball valve type and manufactured of bronze in conformance with ASTM B61, ASTM B62 and NSF 61.
- B. Corporation valves shall withstand a working pressure of 150 psi.

- C. Corporation valves shall have crosscut threading, for direct tap into pipe, and a compression copper outlet. If a tapping saddle is used, the valve shall be saddle thread by compression copper outlet.
- D. Corporation valves shall be ¾ inch or one (1) inch in size as required by the service.
- E. Acceptable Manufacturers: Corporation valves shall be domestically manufactured. Acceptable manufacturers are as follows:
 - Ford Meter Box Co.
 - Mueller Brass
 - A.Y. McDonald Mfg.
 - Other Approved

5.05 Curb Stop

- A. Curb stops shall be of the ball valve type and manufactured of bronze in conformance with ASTM B61, ASTM B62 and NSF 61.
- B. Curb stops shall withstand a working pressure of 150 psi.
- C. The internal ball shall be manufactured of low carbon steel coated with brass.
- D. Internal O-rings and seats shall be of Buna-N.
- E. Curb stops shall be fitted with iron pipe threads on the influent side and appropriate meter nut on the discharge side.
- F. Curb stops shall be fitted with wing locks suitable to accept a keyed padlock.
- G. Curb stops shall be ¾ inch, one (1") inch or two (2") inches in size as required by the service.
- H. Acceptable Manufacturers: Curb stops shall be domestically manufactured. Acceptable manufacturers are as follows:
 - Ford Meter Box Co. for ¾ inch and 1 inch sizes.
 - Mueller Brass.
 - A.Y. McDonald Mfg.
 - Other Approved.

5.06 Plug Valve

- A. Plug shall be as follows.
 1. Eccentric plug (non-lubricated) having a standard port design.
 2. Plug shall be cast iron in accordance with ASTM A126.

3. Plug shall have a resilient facing of carboxylic acrylonitrile butadiene or chloroprene.
- B. Valve shall be generally comprised as follows:
1. Body shall be cast iron, Class B, in accordance with ASTM A126.
 2. Seat shall be nickel, raised and welded to the body.
 3. Bearings shall be oil impregnated permanently lubricated stainless steel Type 316 in accordance with ASTM A743 Grade CF-8M.
 4. Packing shall be acrylonitrile butadiene V-type.
- C. End connections shall be as follows:
1. Non-buried service shall have flanged ends having an ANSI 125/150 pound rating standard face and drilled.
 2. Buried service shall have standard mechanical joint ends in accordance with AWWA C111-64 with retaining gland that acts as a restraining mechanism.
- D. Actuator type shall be as follows:
1. Non-buried service shall have G-series worm gear with 8-inch diameter hand wheel actuator input, clockwise to close.
 2. Buried service shall have G-series worm gear for buried service, with 2-inch square nut actuator input, clockwise to close.
- E. Valve interior and exterior surfaces shall have one (1) coat, 4 to 5 mils of TNEMEC 140 Pota-Pox Plus epoxy paint, surface preparation of SSPC-SP10.
- F. Acceptable Manufacturers: Acceptable manufacturers shall be as follows:
- Dezurik
 - Other Approved

5.07 Combination Air/Vacuum Release Valve

- A. Air/Vacuum release valves shall be installed at the following locations:
- i. All high points along force mains
 - ii. At abrupt increases in down slope or abrupt decreases in up slope
 - iii. At intervals of a quarter mile to a half mile along long ascending or long descending sections of pipe lines
- B. Valve shall automatically release large quantities of air during pipeline filling and automatically allow air to reenter the pipeline when internal pressure of the pipeline approaches a negative value (vacuum). Valve shall automatically release small quantities of air from the pipeline while under normal pressure conditions.

- C. Valve shall be suitable for the respective service (water or sanitary sewer) having a working pressure of 150 psi and a test pressure of 225 psi.
- D. Valve inlet and outlet shall be sized as required. Where the option permits, ANSI 125 pound flanged connections shall be utilized.
- E. Valve body, cover and baffle shall be cast iron, Class B in accordance with ASTM A126.
- F. Seat and orifice button shall be Buna-N.
- G. All internal components shall be stainless steel T304 in accordance with ASTM A240, A269, A276 and PH 15-7 MO.
- H. Acceptable Manufacturers: Combination Air/Vacuum Release Valve shall be domestically manufactured. Acceptable manufacturers are as follows:
 - Crispin
 - Other approved

5.08 Valve Box

- A. Valve boxes shall be of the two-piece type and manufactured of ABS resin.
- B. Valve boxes shall have an internal diameter of 5.25 inches.
- C. Valve boxes shall be fitted with a cover with the word “WATER” or “SEWER” integrally cast in the cover depending on the service and compatible with the City’s radio read meter equipment.
- D. Acceptable Manufacturers: Acceptable manufacturers shall be as follows:
 - Bingham-Taylor
 - East Jordan
 - Other approved.

SECTION 6: TAPPING SLEEVES**6.01 Tapping Sleeve**

- A. Tapping sleeves shall be of the split type and manufactured of ductile iron or stainless steel (preferred). Stainless steel sleeve shall be used when tapping cast iron pipe. Ductile iron shall conform to ANSI/AWWA standards. Stainless Steel shall be type 304 (18-8).
- B. Gaskets shall be virgin nitrile (Buna-N, NBR).
- C. Sleeve outlet shall be flanged or mechanical joint in accordance with ANSI/AWWA C110/A21.1.
- D. Acceptable Manufacturers: Acceptable manufacturers shall be as follows:
- U.S. Pipe – T28 on ductile iron main only.
 - Power Seal– Part No. 3490 (stainless steel) on cast iron and ductile iron mains
 - Smith Blair – Part No. 663 or 665 (stainless steel) on cast iron and ductile iron mains
 - Ford Meter Box– FTSS (stainless steel)
 - Romac for 1-1/2 inch and 2 inch taps
 - Other Approved.

6.02 Tapping Saddle

- A. Tapping saddles shall be stainless steel. Ductile iron shall conform to ANSI/AWWA standards. Stainless Steel shall be type 304 (18-8).
- B. Stainless steel saddles shall be used when tapping for 1-1/2 inch or 2 inch service lines.
- C. Tapping saddles shall seal with pipe by an O-ring gasket virgin nitrile (Buna-N, NBR).
- D. Saddle outlet to pipe shall be flanged or tapped with pipe threads.
- E. Acceptable Manufacturers: Acceptable manufacturers are as follows:
- Smith Blair - 313 with 015 stainless steel bales (4" to 16") for 2" iron pipe threads
 - Smith Blair - 366 with 015 stainless steel straps (18" to 40") for 2" iron pipe threads
 - Smith Blair – 372 for pipe diameters 4 inches through 12 inches

- Powerseal – 3412AS for pipe diameters 3 inches through 12 inches
- Powerseal – 3416AS for pipe diameters 14 inches through 36 inches
- Ford Meter Box– FS 303
- Romac - 306 for pipe diameters 3 inches through 12 inches
- Romac - 305 for pipe diameters 14 inches through 24 inches
- Other Approved

SECTION 7: WATER METERS

7.01 Residential, Irrigation and Light Commercial

- A. Water meters shall be positive displacement type with oscillating piston or rotating disk having a magnetic drive conforming to AWWA C-700 and a sealed register conforming to AWWA C-707.
- B. Meters shall be capable of operating up to a working pressure of 150 psi and have an operating flow range shown on the following table.

TABLE 7-1 METER REQUIREMENTS		
<i>Size</i>	<i>Operating Flow Range</i>	<i>Low Flow Registration</i>
5/8"	0.25 to 25 gpm	98.5% at 1/4 gpm
3/4"	0.75 to 35 gpm	97% at 3/8 gpm
1"	1.25 to 70 gpm	95% at 3/4 gpm
1-1/2"	2.5 to 120 gpm	95% at 1-1/4 gpm
2"	2.5 to 170 gpm	95% at 2 1/2 gpm

- C. Meter outer case shall be constructed of Water Works bronze (minimum 75% copper content) and shall be split case. External fasteners shall be corrosion resistant.
- D. The size of the meter and a flow direction arrow shall be cast in raised figures on the outer casing. The manufacturer’s serial number shall be permanently affixed to the outer case and shall be visible from the topside.
- E. The sealed register shall be of the straight reading type and have a full test dial on the face. The register shall be fitted with an external or internal locking device so that the register can only be removed with specialized tools.
- F. Meters shall have a corrosion resistant strainer that is easily removed without the meter itself being disconnected from the service line.
- G. The register shall measure flow in gallons and shall be read by visual inspection and remote data relay. The electronic register shall be provided to function with reading devices as manufactured by Itron.
- H. Meter connections to 5/8 inch and one (1”) inch service lines shall be with a meter spud. Meter connections to 1-1/2 inch and two (2”) inch service lines shall be with a two (2) bolt flange.
- I. Acceptable Manufacturers: Acceptable manufacturers should be integrated and are acceptable as follows:

- Hersey

7.02 Commercial and Industrial

- A. Water meters shall be Class I or II turbine type with magnetic drive, reduction gearing and straightening vanes conforming to AWWA C-700 and the register shall be permanently hermetically sealed conforming to AWWA C-707.
- B. Meters shall be capable of operating up to a working pressure of 150 psi and have an operating flow range shown on the following table.

TABLE 7-2 METER OPERATION		
<i>Size</i>	<i>Operating Flow Range (gpm)</i>	<i>Low Flow Registration</i>
* 1-1/2"	4 to 200	98.5% at 2.5 gpm
* 2"	4 to 310	95% at 2.5 gpm
3"	5 to 550	95% at 4 gpm
4"	4 to 1,250	95% at 2.5 gpm
6"	4 to 2,500	95% at 2.5 gpm
8"	4 to 4,500	95% at 2.5 gpm
10"	4 to 7,000	95% at 2.5 gpm

* For fire service in building and irrigation service only.

- C. Meter outer case shall be constructed of Water Works bronze (minimum 75% copper content) and shall be split case. External fasteners shall be corrosion resistant.
- D. The size and model of the meter and a flow direction arrow shall be cast in raised figures on both sides of the outer casing. The manufacturer’s serial number shall be permanently affixed to the outer case and shall be visible from the topside.
- E. Meters shall have a separate measuring chamber that shall be easily removable from the outer case. The measuring chamber shall be constructed of Water Works bronze (minimum 85% copper content).
- F. The register shall be of the straight reading type and have a full test dial on the face. The register shall be fitted with an external or internal locking device so that the register can only be removed with specialized tools.
- G. The register shall measure flow in gallons and shall be read by visual inspection and remote data relay. The electronic register shall be provided to function with reading devices as manufactured by Itron.

- H. The meter shall have internal straightening vanes installed on the meters inlet. The straightening vanes shall be easily removable. The straightening vanes shall not be cast as part of the main case or molded as part of the measuring chamber.
- I. The meter shall be equipped with either an internal or external strainer as shown in the following table and detailed in items “K” and “L”.

TABLE 7-3	
METER STRAINERS	
<i>Meter Strainer Size</i>	<i>Strainer Configuration</i>
1-½" to 4"	Internal with Test Port
1-½" to 4"	External Bronze
6" to 10"	External Ductile Iron/Cast Iron

- J. Where meters are equipped with an internal strainer, the strainer shall be cast as part of the meter’s main case. The internal strainer screen and cover plate shall be located at the meter’s inlet between the inlet flange and measuring chamber. The internal strainer screen shall be of the V-shape design and externally accessible without disturbing the meter’s pipeline setting or measuring chamber assembly. A test port of adequate capacity shall be located on the meter’s main case adjacent to the outlet flange. The strainer shall be listed by UL and approved by FM.
- K. Where meters are equipped with an external strainer, the strainer and cover plate shall be located at the meter’s inlet between the inlet flange and measuring chamber. The strainer screen shall be of the V-shape design and accessible without disturbing the meter’s pipeline setting or measuring chamber assembly. The strainer shall be listed by UL and approved by FM.
- L. Meter connection to the service line shall be flanged, Class 125# and conform to ANSI 16.1 for diameter, drilling pattern and thickness. Where companion flanges are required, flanges shall be cast iron and tapped with American Standard internal taper pipe threads. Bolts, nuts and gaskets associated with companion flanges shall be provided for connection to the meter only.
 - 1. Acceptable Manufacturer: Hersey

7.03 Fire Service

- A. Water meters shall be Class II turbine type with magnetic drive, reduction gearing and straightening vanes conforming to AWWA C-703 and the register shall be permanently hermetically sealed conforming to AWWA C-707.
- B. Meters shall be capable of operating up to a working pressure of 150 psi and have an operating flow range shown on the following table.

TABLE 7-4		
METER FLOW RANGE		
<i>Size</i>	<i>Operating Flow Range (gpm)</i>	<i>Low Flow Registration</i>
4"	10 to 1,250	95% at 6 gpm
6"	20 to 2,500	95% at 15 gpm
8"	30 to 4,500	95% at 20 gpm
10"	50 to 7,000	95% at 30 gpm

- C. Meter outer case shall be constructed of Water Works bronze (minimum 75% copper content) and shall be split case. External fasteners shall be corrosion resistant.
- D. The size and model of the meter and a flow direction arrow shall be cast in raised figures on both sides of the outer casing. The manufacturers’ serial number shall be permanently affixed to the outer case and shall be visible from the topside.
- E. Meters shall have a separate measuring chamber that shall be easily removable from the outer case. The measuring chamber shall be constructed of Water Works bronze (minimum 85% copper content).
- F. The register shall be of the straight reading type and have a full test dial on the face. The register shall be secured by means of a locking device located in the interior of the outer case so that the register can only be removed with specialized tools.
- G. The register shall measure flow in gallons and shall be read by visual inspection and remote data relay. The electronic register shall be provided to function with reading devices as manufactured by Itron.
- H. The meter shall have internal straightening vanes installed on the meters inlet. The straightening vanes shall be easily removable. The straightening vanes shall not be cast as part of the main case or molded as part of the measuring chamber.
- I. The meter shall be equipped with an external strainer as listed by UL and approved by FM. The strainer assembly shall be ductile iron and located upstream of the meter’s inlet flange. The strainer screen shall be stainless steel and V-shape design. The strainer screen shall have a net open area at least four (4) times that of the pipe opening. The strainer screen shall be accessible without disturbing the meter’s pipeline setting or measuring chamber assembly.
- J. Meter connection to the service line shall be flanged, Class 125# and conform to ANSI 16.1 for diameter, drilling pattern and thickness. Where companion flanges are required, flanges shall be cast iron and tapped with American Standard internal taper pipe threads. Bolts, nuts and gaskets associated with companion flanges shall be provided for connection to the meter only.

- K. Acceptable Manufacturer: Hersey

7.04 Fire/Domestic Combination Service

- A. The fire portion of the combination service shall comply with Division III, Section 7.03.
- B. The domestic portion of the combination service shall comply with Division III, Section 7.01 and be accomplished via by-pass piping. By-pass piping shall be brass with threaded connections. Domestic service piping shall be 1-1/2 inches in diameter for a four (4) inch fire service. Domestic service piping shall be two (2) inches in diameter for a six (6) inch and larger fire service.
- C. The by-pass assembly shall be fitted with a bronze bodied check valve situated immediately downstream of the meter. The check valve shall be UL listed and approved by FM. The use of electronic switching devices or spring loaded check valves shall be prohibited.
- D. The by-pass assembly shall be fitted with two (2) lockable bronze bodied ball valves; one (1) situated upstream of the meter and one (1) situated downstream of the check valve.

7.05 Water Meter Boxes (Residential and Light Commercial)

- A. Meter assemblies ranging in size from 5/8 inch to two (2) inches shall be housed in meter boxes manufactured from high-density polyethylene or fiber reinforced plastic.
- B. Meter box lids shall be fiber reinforced plastic. Minimum outside dimensions of the lid shall be 16-5/8 inches by 11-7/16 inches. Down legs on each corner shall be a minimum of 1-1/2 inches long.
- C. Acceptable Manufacturers:
- D/FW Plastics.
 - CDR – 24 inches by 60 inches for 1-1/2 inch and 2 inch meter assemblies.
 - Other Approved.

7.06 Water Meter Vaults (Commercial and Industrial)

- A. Vaults shall be constructed of precast concrete.
- B. Vaults shall be designed to withstand a minimum H-10 Live Load. Additional design strength may be required.
- C. Vaults for 3-inch and larger meter/back flow assemblies shall have a minimum 18” clearance between any flanges, piping, valves, meters and all walls. The minimum depth shall be 6 feet.

- D. Meter vaults shall have a minimum six (6") inch thick concrete reinforced base slab. A 12 in x 12 in drain opening shall be cast in the slab. The drain shall be serviced by a 12 inch bed No. 57 stone wrapped with geofabric. The bed of No. 57 stone shall extend to the edges of the excavation.
- E. Vaults constructed of concrete block are prohibited.
- F. Vaults shall be constructed of polymer concrete, precast concrete or cast-in-place concrete.
- G. Where vaults are constructed of pre-cast or cast-in-place concrete, the walls shall be a minimum of six (6) inches thick and steel reinforced. Wall reinforcing shall be tied to the slab reinforcing.

Vaults shall be covered with a removable pre-cast concrete cover. The cover shall be a minimum of six (6") inches thick and steel reinforced. Cover shall be sealed to top of walls using neoprene gasket material.
- H. Where two (2) pre-cast vaults are situated together to form one (1) larger vault, each of the two (2) vaults shall have a separate cover.
- I. An aluminum access hatch, minimum 36 inches by 36 inches in size shall be cast in the cover slab. The access hatch shall be situated as shown on details.
- J. Bottom side of the meter assembly shall have a minimum twelve (18") inch clearance from the top of the floor slab.
- K. Meter assembly shall be supported at a minimum of two (2) points by galvanized pipe saddles. Backflow assembly shall be supported at a minimum of one (1) point by galvanized pipe saddles. Pipe saddles shall be capable of carrying the weight of the assembly. Pipe saddle height shall be adjustable via screw jack. Pipe saddle shall have a minimum four (4") inch square base, one-quarter (1/4") inch thick.
- L. Pipe penetrations (annulus between concrete and outside face of pipe) shall be sealed with a mechanical type rubber modular seal or seal approved by the City Engineer such as LinkSeal.
- M. Vault cover shall extend three (3") inches above finished grade.

7.07 Vault Access Hatches

- A. Vault access shall be via aluminum double hatch having a minimum clear opening of 36 inches by 36 inches. Clear opening dimensions may be increased.
- B. Access shall be rated to withstand a minimum H-10 Live Load. Design strength of access hatch may be increased.
- C. Access hatch shall have a manual locking arm device to prevent hatch lids from closing.

- D. Access hatch shall be capable of being secured using a keyed lock.

SECTION 8: HYDRANTS**8.01 Fire Hydrant**

- A. Fire hydrants shall be of the compression type, closing with line pressure, complying with AWWA C502 for 150 psi working pressure and NFPA, latest applicable revision.
- B. Hydrants shall have a 5-¹/₄ inch main valve and a non-freeze design with an automatic drain that closes fully when main valve is opened.
- C. Hydrants shall be furnished having factory burying depths of 4'-6" or 5'-0". Deeper burying depths shall be accomplished using extension kits provided by same manufacturer. Break-away device shall be situated ± three (3") inches from finished grade.
- D. Hydrant standpipe, fittings and upper barrel shall be ductile iron. Parts designed to break away may be cast iron.
- E. Hydrant bolts below ground level shall be stainless steel.
- F. Hydrant lead to main line connection shall be mechanical joint with thrust blocking or restrained joint.
- G. The means of attaching the barrel to the standpipe shall permit 360° rotation of the barrel.
- H. Hydrant barrel shall break away from the standpipe at an elevation above ground level without causing damage to the standpipe and stem. When barrel is broken away, internal valve shall function and repairs shall be permitted without excavating or turning off water supply.
- I. Hydrants shall be bronze mounted and all internal working parts shall be bronze. Valve seat shall screw into retainer. However, stainless steel is preferred.
- J. Internal working parts shall be removable without disturbing the barrel.
- K. The operating nut situated atop the hydrant shall be hexagonal and constructed of ductile iron or cast iron and open in a counter clockwise direction. The threads shall be enclosed in an operating chamber separated from the hydrant barrel by a rubber O-ring stem seal lubricated by a grease or oil reservoir.
- L. Hydrant shall be equipped with two 2-1/2 inch threaded (7.5 threads per inch) hose connections and one 4-1/2 inch threaded (4 threads per inch) hose connection. Hose and pump connections shall be threaded and pinned to seal the connection to the barrel. Threads shall comply with National Standard Threads. Each connection shall be equipped with a cap and chain.
- M. Hydrants shall have all stainless steel stems.

- N. Acceptable Manufacturers: Approved manufacturers must produce only ductile iron fire hydrants. Acceptable manufacturers are as follows:
- American - Darling
 - Mueller Company
 - M&H

8.02 Yard Hydrant

- A. Yard hydrant shall be self-draining, non-freeze and operated by lever handle. Lever handle shall be capable of being secured with a keyed lock.
- B. Yard hydrant shall be fitted for a standard three-quarter ($\frac{3}{4}$ ") inch hose connection.
- C. Exterior casing shall be schedule 40 galvanized steel and internal operating parts shall be of bronze and the plunger shall be neoprene.
- D. Acceptable Manufacturers: Acceptable manufacturers are as follows:
- Josam Series 71450
 - Murdock
 - Approved equal

SECTION 9: MANHOLES AND WET WELLS**9.01 General**

- A. Manholes and wet wells shall be cylindrical and constructed of steel reinforced pre-cast concrete or other concrete structure approved by the City Engineer.
- B. Manholes shall have a minimum inside diameter of four (4') feet and be fitted at grade with a cast iron ring and cover.
- C. Wet wells shall have a minimum inside diameter of six (6') feet and be accessed via an aluminum hatch that shall be lockable, and a minimum opening of 60" x 60".
- D. An existing or newly installed manhole intersected by a sanitary sewer force main and the next downstream manhole shall be lined in accordance with Division III, Section 12 "Environmental Coatings".
- E. A newly installed lift station wet well and underside of slab over wet well shall be lined in accordance with Division III, Section 12 "Environmental Coatings".

9.02 Pre-cast

- A. Pre-cast sections shall be manufactured, tested and marked in accordance with ASTM C478.
- B. Minimum compressive 28-day strength of concrete in all sections shall be 4,000 psi.
- C. Maximum allowable absorption of moisture by concrete shall not exceed 8% of dry weight.
- D. Pre-cast sections shall consist of a base section, riser section and eccentric cone top or flat slab top section, as conditions require. Top cone section of manhole housing for an air release valve shall be concentric. The sections shall form a continuous uniform assembly.
- E. Joints between each section shall be tongue and groove type sealed with a preformed gasket meeting requirements of Federal Specification SS-S-00210, "Sealing Compound, Preformed Plastic for Pipe.
- F. Each section shall have no more than two (2) holes for purposes of handling. The holes used for handling shall be tapered and shall be plugged with rubber stoppers or grout after installation.
- G. Pipe openings in sections shall be fitted with an integrally cast flexible rubber boot or other approved flexible joint connector. A manufacturer supplied stainless steel band shall be used to seal boot to pipe.
- H. Manhole sections shall be fitted with solid cast iron steps of standard pattern conforming to ASTM A-48 or polypropylene plastic coated steel steps conforming

to ASTM A615 and ASTM D-4101 and shall be integrally cast into manhole sections. Steps shall be twelve (12") inches wide and spaced at 1'0" on center.

- I. Wet well sections shall not be fitted with steps.
- J. Manhole base section's invert shall be constructed of cast-in-place concrete or brick and mortar. Invert shall have a "U" shaped channel that matches inverts of the influent and effluent pipes. Invert shelf above "U" shaped channel shall have a minimum 12:1 slope.

9.03 Precast "Dog House"

- A. Precast and cast-in-place "Dog House" Manholes shall comply with this section.
- B. Dog house opening shall be precast by the manufacturer. Field cutting-in dog house opening shall be prohibited.
- C. Size of dog house opening shall be as recommended by the manhole manufacturer.
- D. Annulus between pipe and opening shall be grouted water tight with non-shrink grout.
- E. Dog house manholes used in gravity sewer shall have a reinforced concrete bottom slab. Dog house manholes used for air and vacuum release valves shall have gravel bottom.

9.04 Brick and Mortar

- A. Brick used as part of manhole construction shall be either solid or cored, medium hard or better, Grade MA conforming to ASTM C-32 for sewer and manhole brick.
- B. Mortar used as part of manhole construction shall be comprised of one (1) part Portland cement to two (2) parts clean sand. The sand shall conform to ASTM C-144.
- C. Water shall be clean, potable and free from deleterious amounts of alkalis, acids and organic matter.

9.05 Frames and Covers

- A. Manhole rims, toe pockets, frames and covers shall be cast iron conforming to ASTM A-48 for Class 35B Gray Iron Castings.
- B. Manhole frames and covers shall be a nominal twenty-four (24") inches in diameter and weigh not less than 370 pounds.
- C. Manhole covers shall have the word "SEWER", cast on top in letters two (2") inches high.
- D. Manhole frames and covers shall be thoroughly cleaned and painted or coated with a bituminous paint. Defective castings that have been plugged or otherwise treated shall not be used.

- E. Manhole covers required to be bolt-down shall be secured with not less than four (4) stainless steel bolts as provided by the manufacturer.
- F. Covers situated in paved areas shall be raised to finished grade using no more than five (5) courses of brick and mortar.
- G. Covers situated in non-paved areas shall be integrally cast in the top cone section.
- H. Acceptable Manufacturers:
 - Us Foundry, Model: 223 BN
 - Neenah, Model: R-1423-BN
 - East Jordan, Model: V1349

SECTION 10: CAST-IN-PLACE CONCRETE**10.01 Concrete Design**

- A. Concrete mix design shall be in accordance with ACI 318-89.
 - 1. 28-Day Strength: 4,000 psi, unless otherwise noted.
 - 2. Type: Normal Weight
 - 3. Slump Range: 3 inch to 5 inch
 - 4. Weight: 135 pcf to 160 pcf
 - 5. Air Content: 5% to 7%
 - 6. Water-Cement Ratio: 0.45 Maximum
 - 7. Fly Ash: If Type I cement is used
 - 8. Chlorides: Do Not Use
 - 9. The use of admixtures shall require the approval of the City Engineer
- B. Concrete materials shall be in accordance with applicable ASTM standards.
 - 1. Portland Cement: Meeting ASTM C150, Type I/II natural color, domestic manufacturer. Use only one brand of cement throughout project.
 - 2. Fine Aggregates: Meeting ASTM C33-86.
 - 3. Coarse Aggregates: Meeting ASTM C33-86, No. 57 Stone.
 - 4. Water: Clean, potable and free from deleterious amounts of alkalis, acids and organic matter.

10.02 Reinforcement

- A. Reinforcement bars shall be in accordance with ASTM A615, Grade 60, deformed.
- B. Welded wire fabric shall be in accordance with ASTM A185. Use size as indicated on drawings.
- C. Bar supports, chairs and spacers shall comply with the CRSI Manual for Placing Reinforcing Bars.
- D. Reinforcement shall be secured in proper position using No. 16-1/2 or No. 16 gauge black soft-annealed wire.

10.03 Formwork

- A. Forms shall be as follows.
 - 1. Pre-engineered steel
 - 2. Pre-engineered reinforced fiberglass

3. Lumber: No. 2 Southern Yellow Pine
 4. Plywood for exposed finish: HDO-EXT-APA overlay plywood or B-B Plyform-EXT-APA
 5. Plywood for unexposed finish: C-C Ext-APA
 6. Earth, provided earth is dry, level and stable.
- B. Form ties shall be break-back type with 5/8 inch removable vinyl sleeve or one (1") inch diameter break-back cone type.

10.04 Curing and Sealing Compounds

- A. Moisture retaining cover shall meet ASTM C171-69 (1980): Waterproof paper, polyethylene film or burlap.
- B. Curing and sealing compound shall meet ASTM C309-81, Type 1, Class B: Clear acrylic base.

10.05 Epoxy Bonding Agent

- A. The use of an epoxy, bonding agent shall require the approval of the City Engineer.
- B. A bonding agent shall be used during the placement of reinforcing steel into existing concrete and shall be of a two (2) component, 100% epoxy resin adhesive system.

10.06 Acrylic Latex Bonding Agent

- A. The use of an acrylic, latex, bonding agent shall require the approval of the City Engineer.
- B. A bonding agent shall be used as an aid in applying a concrete surface patch or finish to existing concrete and shall be an acrylic polymer emulsion base chemical bonding system.

SECTION 11: MASONRY AND GROUT**11.01 Mortar and Grout Materials**

- A. Portland Cement shall meet ASTM C150, Type I, natural color, domestic manufacturer. Use only one brand of cement throughout project.
- B. Masonry cement shall meet ASTM C91-89, non-staining, 22% maximum air content by volume.
- C. Hydrated lime shall meet ASTM C207-79 (1988), Type S.
- D. Aggregates for mortar shall meet ASTM C144-87 and ASTM C404-87, size 2 natural and shall be clean, hard and washed sand.
- E. Aggregates for cement grout shall meet ASTM C404-87, fine aggregate, size 1.
- F. Water reducing and plasticizing admixtures are acceptable.
- G. Admixtures containing calcium chloride shall be prohibited.
- H. Water shall be clean, potable and free from deleterious amounts of alkalis, acids and organic matter.
- I. Non-shrink Grout: Submit products for approval by City Engineer.

11.02 Mortar and Grout Proportions

- A. Proportion materials by volume in accordance with ASTM C270-88a or as follows:
 - 1. Mortar: One (1) part Masonry cement to ½ part Portland cement to aggregate proportioned at not less than 2-1/4 nor more than three (3) times the volume of cementitious material used.
 - 2. Grout: One (1) part Portland cement and ¼ to ½ parts hydrated lime to aggregate proportioned at not less than three (3) times the combined volume cement and lime used.

11.03 Concrete Masonry Units

- A. Concrete masonry units shall be in accordance with ASTM C90-85, light-weight, Grade N, Type 1.
- B. Concrete masonry units shall have a nominal face dimension of 8" x 8" x16" or 8" x 12" x16".
- C. Concrete masonry units shall have a minimum compressive strength of 2,500 psi, based on net area.
- D. Concrete masonry units damaged in any manner shall not be used.

11.04 Joint Reinforcement

- A. Horizontal joints between concrete masonry units shall be reinforced as follows:

1. Use cold drawn wire meeting ASTM A82-88.
2. Longitudinal rods shall be nine (9) gauge galvanized deformed wires with nine (9) gauge galvanized cross wires welded to form triangular style pattern.
3. Width of reinforcement shall be two (2") inches less than the total wall thickness.
4. Provide reinforcement in ten (10') foot lengths with prefabricated corners and tees at intersecting walls of same design and finish.

SECTION 12: ENVIRONMENTAL COATINGS

12.01 Materials Requiring Coatings

- A. Materials for buried surface shall be coated as indicated in their respective section.
- B. The following materials shall have exterior coatings manufacturer applied or field applied.
 - 1. Piping and appurtenances
 - 2. Supports
 - 3. Pumps
 - 4. Valves
 - 5. Equipment and appurtenances
- C. The following materials shall be lined by the manufacturer or field applied:
 - 1. Manhole intersected by a sanitary sewer force main and next downstream manhole.
 - 2. Lift station wet well and slab area above wet well.

12.02 Coating Schedule

A. Non-Submerged Ferrous Metal

Minimum Surface Preparation: SSPC – SP6

Generic System Type: Aliphatic Polyurethane

Coat No.	Induron		Tnemec	
	DFT	Product	DFT	Product
1	3.0	P-14	2.0	#69
2	3.0	Armorgaurd	2.0	#69
3	2.0	5500	2.0	#74

B. Submerged Ferrous Metal

Minimum Surface Preparation: SSPC – SP10

Generic System Type: Polyamide Epoxy

Coat No.	Induron		Tnemec	
	DFT	Product	DFT	Product
1	5.0	PE-54	5.0	#20 P-Pox

2	5.0	PE-54	5.0	#20 P-Pox
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C. Non-Submerged Non-Ferrous and Galvanized Metal

Minimum Surface Preparation: SSPC – SP6 (non-ferrous); SP1 (galvanized)

Generic System Type: Aliphatic Polyurethane

Coat No.	Induron		Tnemec	
	DFT	Product	DFT	Product
1	0.5	VW Prime	5.0	#69
2	2.0	5500	2.0	#74

D. Submerged Non-Ferrous and Galvanized Metal

Minimum Surface Preparation: SSPC – SP10 (non-ferrous); galvanized per coating manufacturer.

Generic System Type: Polyamide Epoxy

Coat No.	Induron		Tnemec	
	DFT	Product	DFT	Product
1	0.5	VW Prime	5.0	#69-1211
2	5.0	PE-54	5.0	#69

E. Acceptable Manufacturers: Acceptable manufacturers are as follows:

- Induron
- Tnemec
- Carboline
- Sherwin Williams

12.03 Manhole and Wet Well Lining

- C. Line existing concrete manhole with a modified aliphatic amine epoxy mortar or aggregate filled epoxy coating system or other coating system approved by the City Engineer.
- D. Materials required for concrete surface preparation/restoration, lining and finishing shall be supplied by the same manufacturer.
- E. Line new manhole, wet well and underside of slab over wet well with an integrally cast polyvinyl chloride or high density polyethylene liner.

- F. Acceptable Manufacturers: Acceptable manufacturers are as follows:
- Madewell Mainstay ML-72 Microsilica and DS-5 Epoxy
 - Raven 705 CA Calcium Aluminate and 405 Epoxy
 - Sewpercoat
 - A-LOK Products, Inc. - Duraplate 100 (new manhole, wet well, slab integrally cast liner)
 - Agru America - AGRU Sure Grip (new manhole, wet well, slab integrally cast liner) as approved.

SECTION 13: MISCELLANEOUS MATERIALS**13.01 Stabilization Stone**

- A. Stabilization stone shall be No. 57 size and conform to ASTM C33-78 unless noted otherwise.
- B. Maximum stone size shall be 1-½ inches unless noted otherwise.
- C. Stone shall be clean, tough, uniform quality, durable fragments of crushed rock, free from flat, elongated, soft or disintegrated pieces, or other objectionable matter occurring either free or as coating on stone.

13.01 Detectable Underground Utility Marking Tape

- A. Wire shall have a minimum overall gage of 10 gauge mils.
- B. Tape shall be color coded in accordance with the American Public Works Association as follows:
 - 1. “Blue” for potable water and associated lines.
 - 2. “Green” for sanitary sewer and associated lines.
 - 3. Acceptable Manufacturers: Acceptable manufacturers as approved.

13.02 Other Materials

Materials not covered in Division III, Material Requirements shall be in accordance with the approved plans.

SECTION 1: GENERAL**1.01 Contractor**

- A. A licensed Utility Contractor shall install any underground utility or component thereof.
- B. Prior to commencing construction activities on a City approved project, the City Clerk or System Superintendent shall receive a copy of the Utility Contractor's License.

1.02 Utility Notification

- A. The Official Code of Georgia, Title 25, Chapter 9 requires that existing utilities be located in the proposed work area prior to commencing any clearing, grading or excavation activity.
- B. The Utilities Protection Center can be reached at 811.
- C. The Utilities Protection Center shall be notified at least three (3) business days prior to commencing work.

1.03 Work Commencement

- A. Clearing and grubbing activities shall not commence on any project until local issuing authority has issued a Land Disturbance Activity Permit.
- B. Work on a water distribution system and/or sanitary sewerage system shall not begin until the City approves the development plans.
- C. The City Engineer shall receive a 48-hour notice prior to commencing construction activities on a water distribution system and/or sanitary sewerage system.
- D. A set of plans stamped approved by the City shall be present on the job site during all phases of construction of the water distribution system and/or the sanitary sewerage system.
- E. The installation of water distribution piping shall not begin until curb and gutter has been installed, if applicable.

1.04 Miscellaneous Standards:

Construction standards not covered in Division IV, Construction Standards, shall be in accordance with the approved plans. Construction should comply with the Department of Labor, Occupational Safety and Health Administration, 29 Code of Federal Regulations Part 1926, Subpart P, and revised July 1, 1995.

SECTION 2: MATERIAL DISTRIBUTION**2.01 General**

- A. Work covered by this section shall include all labor, equipment and accessories required to distribute material.
- B. All materials installed as part of an extension to the existing water distribution system and sanitary sewerage system shall be new.

2.02 Delivery:

Equipment and facilities shall be furnished for unloading and distributing pipe, equipment and materials.

2.03 Handling

- A. Pipe shall be handled by use of forklift or excavator using choker straps or cable.
- B. Any pipe, equipment or material dropped or dumped during handling procedures shall be subject to rejection by the City without further justification.

2.04 Storage

- A. Pipe shall not be strung more than 1,000 feet beyond the point where pipe is being laid.
- B. Drainage ditches shall not be obstructed.
- C. Necessary arrangements shall be made to store pipe, fittings, valves and accessories that cannot be distributed along the route.

2.05 Maintenance and Protection

- A. The contractor shall be responsible for maintenance and protection of all pipe, equipment and material.
- B. All equipment shall be boxed, crated or otherwise completely enclosed and protected during transportation, handling and storage.
- C. Equipment shall be stored above ground level and adequately supported on wood blocking or other approved support material.
- D. All equipment shall be protected from exposure to elements and shall be kept dry at all times.
- E. Pumps, motors, valves, control panels, instrumentation, electrical equipment and other equipment having anti-friction or sleeve bearings shall be stored in a weather-tight enclosure which is maintained at a minimum air temperature of 60°F.
- F. Any pipe, equipment or material damaged by impact, vibration, abrasion, discoloration or other damage shall be repaired in accordance to manufacturer instructions or replaced at the discretion of the City.

SECTION 3: SITE PREPARATION**3.02 Clearing and Grubbing**

- A. Prior to commencing clearing activities, areas designated by the plans to be cleared shall be demarcated using survey ribbon, stakes or other suitable means.
- B. In areas to be cleared, all trees, stumps, buried logs, brush, grass and other unsatisfactory materials shall be removed.
- C. Trees to remain in or near work area shall be protected from clearing activities.
- D. All damaged trees over three (3") inches in diameter shall be repaired by an experienced nursery expert.
- E. Tap roots and other projections exceeding 1-inch in diameter shall be grubbed out to a depth of at least 18 inches.
- F. All holes remaining after grubbing activities shall be filled with suitable material and properly compacted in layers to density required for in-place backfill.
- G. All materials cleared and grubbed shall be disposed of off-site in accordance with applicable local, state and federal regulations.
- H. Burning of any material or debris shall not be permitted on City property.
- I. Prior to and upon completion of clearing and grubbing activities, install erosion control and sedimentation measures as identified on the Erosion Control and Sedimentation Plan prepared by the Design Engineer.
- J. Prior to commencing any other job site activity, installed erosion control and sedimentation measures shall be inspected and approved by the local issuing authority.

3.03 Topsoil Stockpiling

- A. Remove topsoil to full depth encountered in areas to be graded and stockpile soil and install erosion control devices as indicated on drawings.
- B. Soil shall be placed such that the integrity of an excavation or proposed excavation is not jeopardized.
- C. Soil shall not be stockpiled against tree trunks.
- D. Stockpile shall be shaped to drain.

3.04 Removing Pavement

- A. Removal of pavement shall be performed so as not to endanger roadway activity. Work shall be coordinated and be in compliance with the appropriate road and highway agencies.
- B. Pavement shall be marked squarely and neatly to size of excavation.

- C. Pavement shall be scored and broke along the marked lines using a rotary saw and jackhammer. Pavement shall not be machine pulled for initial brake.
- D. Upon removal, pavement shall be loaded and disposed of off-site.
- E. Adjacent pavement damaged during construction shall be removed as described above.
- F. Driveways and sidewalks shall be removed to their full width from the edge of curb or road pavement to the nearest construction/control joint.
- G. Curbs shall be removed for the entire length from control joint to control joint.

SECTION 4: EXCAVATION**4.01 Standards**

The following publications, referred to hereafter by basic designation only, form a part of this specification to the extent indicated by the references thereto:

- ASTM D448 “Standard Classification for Sizes of Aggregate for Road and Bridge Construction.”
- ASTM D698 Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³))
- ASTM D1556 Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
- ASTM D2487 Classification of Soils for Engineering Purposes (Unified Soil Classification System)
- ASTM D2922 Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
- ASTM D3017 Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
- ASTM D4253 Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
- ASTM D4254 Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density

Any other testing required by these specifications and not specifically referenced to a standard shall be performed under ASTM or other appropriate standards as designated by the Engineer.

Reference herein or on the drawings to soil classifications shall be understood to be according to ASTM D2487, Classification of Soils for Engineering Purposes (Unified Soil Classification System).

4.02 Definitions

- A. Maximum Density: Maximum weight in pounds per cubic foot of a specific material.
- B. Optimum Moisture: Percentage of water in a specific material at maximum density.
- C. Muck: Materials unsuitable for foundation because of organic content, saturation to the extent that it is somewhat fluid and must be moved by dragline, dredge or other special equipment are designated as muck.

- D. Unsuitable Material: Earth material unsatisfactory for its intended use and as classified by the soils technicians. In addition to organic matter, sod, muck, roots and rubbish, highly plastic clay soils of the CH and MH descriptions and organic soils of the OL and OH descriptions, as defined in the United Soil Classification System shall be considered as unsuitable material.
- E. Suitable Material: Earth or materials designated as being suitable for their intended use by soils technicians or the soils engineer. Suitable material shall be designated as meeting the requirements of the Unified Soil Classification System types SW, GW, GC, SC, SM, ML, CI or as designated in these specifications.
- F. Select Material: Granular material to be used where indicated on the drawings or where specified herein consisting of soils conforming to the Unified Soil Classification types SW, SM, GW or GM or as otherwise approved by the Engineer as select fill. Select material shall contain no stones or rubble larger than 1 ½ inch in diameter.
- G. Crushed Stone (Gravel): No. 57 aggregate or equal conforming to ASTM C-33.
- H. Excavation: Excavation of every description regardless of materials encountered.

4.03 Soil Excavation

- A. Excavation shall include those measures necessary to establish grades indicated on drawings for utilities, structures and appurtenances.
- B. Excavated soil shall be placed in a location such that the integrity of the excavation is not jeopardized.
- C. Excavation walls shall be sloped or stepped in accordance with recognized industry standards.
- D. The Contractor shall assume the responsibility for design and construction of excavation shoring and bracing capable of supporting excavations and construction loads.
- E. The excavation shall provide space for foundation work and inspection.
- F. Excavations shall be covered in accordance with applicable regulations and/or barricaded and roped-off with identifying tape during work progress.

4.04 Dewatering Trenches

- A. Where groundwater is encountered, the Contractor shall make the effort necessary to secure a dry trench bottom before laying pipe.
- B. In sandy and in other suitable type soils, dewatering shall be done by well pointing.
- C. If, in the opinion of the Engineer, the Contractor has failed to obtain an absolutely dry trench bottom by insufficient use of all known methods of trench dewatering,

the Engineer may order the Contractor to excavate below grade and place not less than 6 inches of graded crushed stone fill material over the trench bottom to form trench drains to suitable located sumps and the water removed by bailing or pumping.

- D. The graded crushed stone fill material shall be of such depth that there shall be no water in bell holes at the time of coupling pipe.
- E. All unsuitable excavated material must be properly disposed of in a manner acceptable to the Engineer and in a manner that will not adversely impact the environment.

4.05 Crushed Stone Stabilization

- A. Wherever the subgrade is by nature too soft or mucky, in the opinion of the Engineer, for the proper installation of the pipe, he may order the Contractor to undercut the trench and backfill with crusher run stone or crushed stone ¾-inch in size and less. The stone shall be brought to the subgrade required by the class of bedding for the particular location and compacted.
- B. All unsuitable excavated material must be properly disposed of in a manner acceptable to the Owner public works department in a manner that will not adversely impact the environment.

4.06 Rock Excavation

- A. Excavation shall include those measures necessary to establish grades indicated on drawings for utilities, structures and appurtenances.
- B. Rock shall be excavated to a minimum depth of six (6") inches below grades indicated on drawings.
- C. The Contractor shall be responsible for determining methods required for removal of rock or hard materials.
- D. Perform blasting only after receiving written approval from the City Engineer and regulatory agencies.
- E. A licensed explosive contractor shall perform blasting operations.
- F. Blasting operations shall be conducted in accordance with all local, state and federal regulations.
- G. Excavated rock shall not be used as backfill in the pipe trench.

4.07 Pipe Trench Excavation

- A. Pipe trenching shall comply with excavation and rock excavation specifications.
- B. Trench should be excavated to natural undisturbed soil.

- C. Where unsuitable material is encountered, over excavate through unsuitable material and backfill to required grade with No. 57 stone. The City Inspector shall determine depth of over excavation.
- D. Where encountered, remove rock to a minimum of six (6") inches below required bottom of trench elevation and backfill to required grade with No. 57 stone.
- E. Bottom of trenches shall be prepared so that the entire length of the pipe barrel is supported.
- F. Maintain trenches dry at all times using pumps, well points or other dewatering means.
- G. Limit trenching to not greater than 300 feet ahead of completely backfilled work.
- H. In populated areas, cover or barricade open trenches until completely backfilled.
- I. Open trenches shall be made safe at all times.

SECTION 5: INSTALLATION**5.01 Pipe Bedding**

- A. PVC sewer shall be laid atop a minimum of four (4") inches of No. 57 stone. No. 57 stone shall be extended to the top of pipe. Stone shall be shovel sliced from beneath the pipe up to one-half (½) the pipe diameter. Bedding of PVC pipe shall be in accordance with ASTM D2321 as amended to date.
- B. DIP shall be bedded according to details No. 8.1 for water and No. 8.2 for sewer.
- C. Valves shall be laid atop a minimum of eight (8") inches of No. 57 stone. No. 57 stone shall be extended up to one-third (1/3) the valve diameter. Stone shall extend twelve (12") inches in all directions of valve. Stone shall be shovel sliced.
- D. Fire hydrants shall be set atop a minimum of eighteen (18") inches of No. 57 stone. Stone shall extend up six (6") inches above drain holes. Stone shall extend eighteen (18") inches to the sides of the hydrant.
- E. Yard hydrants shall be set atop a minimum of six (6") inches of No. 57 stone. Stone shall extend up six (6") inches above drain hole. Stone shall extend twelve (12") inches to the sides of the hydrant.
- F. Class D Bedding is not allowed for use with gravity sewers.
- G. Class I materials shall be used for bedding and haunching in all conditions. Class II, III, IV and V materials will not be permitted for bedding and haunching under any condition.
- H. Bedding material shall be used to provide uniform longitudinal support for the pipe. Trench shall be undercut to allow for a minimum of six inches (6") of bedding material. Bell holes shall be excavated in the bedding material to allow for unobstructed assembly of the joint, but care shall be taken to ensure that bell hole is no larger than necessary to accomplish proper joint assembly. After joint assembly, material shall be placed underground around the entire length of pipe and compacted. Compaction to the springline of the pipe shall be of the same material used in the bedding. Backfill with Class I, II, III or IV material shall then be carried to a point six inches (6") above the top of pipe, using hand tools for tamping, Class IV material will not be allowed in a wet ditch. If the remaining backfill material contains large particles, which could damage the pipe from impact during placement, the initial backfill shall be increased to twelve inches (12") above the top of the pipe. Puddling will not be allowed as a method of compaction. The remaining backfill shall be as specified in "General Backfill" paragraph of these specifications. Pipe shall have at least thirty inches (30") of cover before wheel

loading and at least forty-eight inches (48") of cover before using heavy-duty tamping equipment such as a hydrohammer.

I. Class I, II, III, IV and V materials are defined as follows:

- | | |
|-----------|---|
| Class I | Angular ¼ to ¾-inches graded stone. Latest revision of ASTM C 33 - Gradation #67 (ASTM #67) or #57 (ASTM #57) are acceptable. |
| Class II | Coarse sands and gravels with maximum particle size of ¾-inches including variously graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry. |
| Class III | Fine sand and clayey (clay filled) gravels, including fine sands, sand-clay mixtures and gravel-clay mixtures. |
| Class IV | Silt, silty clays and clays, including inorganic clays and silts of medium to high plasticity and liquid limits. |
| Class V | This class includes organic soils as well as soils containing frozen earth, debris, rocks larger than 1½-inches in diameter, and other foreign materials. |

J. Ductile iron pipe for gravity sewers and force mains shall be laid as specified using the following type of bedding required for the depth of cover for the various sizes of pipe to be installed. Type 4 and 5 Bedding as shown and described in Ductile/Cast Iron Handbook - Fourth Addition Page 182-208 may be used for additional depths if approved by the Engineer.

1. Type 1 - Flat Bottom Trench: Flat bottom trench on undisturbed earth with excavation for Bells. Loose backfill shall be as specified in the "Selected Backfilling" and "General Backfilling" paragraphs.
2. Type 2 - Flat Bottom Trench: Flat Bottom Trench on undisturbed earth with excavation for Bells. Lightly consolidated backfill to centerline of pipe, additional backfill shall be as specified in the "Select Backfilling" and "General Backfilling" Paragraphs.
3. Type 3 - Loose Soil Bedding: Pipe bedded in 4-inch minimum Loose Soil. Backfill lightly consolidated to top of pipe. Additional Backfill shall be as specified in the "Select Backfill" and "General Backfill" Paragraphs.
4. Cover: Maximum depth of cover for ductile iron pipe of the various classes and sizes to be installed are as shown on the following page.

Laying Condition - Maximum Depth of Cover (Feet)

Pipe Size	Pressure Class (PSI)	Nominal Thickness (Inch)	Type1	Type2	Type3
4"	350	0.25	53	61	69
6"	350	0.25	26	31	37
8"	350	0.25	16	20	25
10"	350	0.26	11	15	19
12"	350	0.28	10	15	19

K. Bedding Classes A, B, C or crush stone as described in ASTM C12 shall be used and carefully compacted for all rigid pipe provided the proper strength pipe is used with the specified bedding to support the anticipated load based on the type soil encountered and potential groundwater conditions. Class D bedding is not allowed for use with gravity sewer.

1. Class A Bedding: This bedding shall consist of a continuous concrete cradle conforming to the plan details.
2. Class B Bedding: Material shall be excavated to a depth of 12-inches below the bottom of the pipe grade and to a width equal to the external diameter of the pipe plus 1-foot. The excavated area shall be backfilled with select fill material to form a bed that is at least 15 percent of the pipe height above the lower face (invert) of the pipe. The material shall be thoroughly compacted to provide a firm uniform foundation. The foundation shall then be shaped (cradled) to fit the lower part of the pipe, and the pipe shall be laid on a 3-inch thick layer of suitable granular material. The Contractor shall ensure that the cradle is constructed at an elevation such that after placing the 3-inches of granular material in the cradle, the flow line elevation of the pipe is correct. Select fill material shall then be placed in 6-inch layers and compacted with mechanical tampers to at least 30 percent of the overall pipe height.

When the pipe foundation is entirely in new embankment constructed with select fill material, the 12-inch undercut will be waived.

3. Class C Bedding: This bedding shall consist of an earth or granular cradle of uniform density shaped to fit the lower part of the pipe for at least 10 percent of its overall height.

5.02 Pipe, Fitting, Valve and Fire Hydrant Installation

- A. Prior to placement, the interior of pipes, fittings and valves shall be cleaned free of dirt and debris.
- B. Pipe, fittings, valves and accessories shall not be laid or jointed while water is in the trench.
- C. Pipe, fittings, valves and accessories shall be lowered into their respective positions using an excavator with choker straps or cables. A slight hole shall be dug where pipes are to be jointed to relieve pipe bell of any load. Pipe barrel shall be supported for its entire length.
- D. Gravity flow pipe shall be laid to the consistent grade change as indicated on drawings and aligned straight using pipe laser or transit.
- E. Pressure flow pipe shall be aligned to follow route. Pipe alignment shall not be deflected greater than 75% of the manufacturer's recommended maximum deflection.
- F. Install compression type gaskets in accordance with manufacturer's instructions to ensure proper joint sealing.
- G. Pipe shall be jointed in accordance with manufacturer's instructions. The mating ends (bell and spigot) shall be thoroughly cleaned and soaped before jointing. The mating ends shall be aligned and shoved together using a steady force.
- H. Connections of fittings, valves and fire hydrants shall be with bolts and nuts as supplied with the component. Upon tightening, a minimum of two (2) bolt threads shall be exposed to ensure proper thread engagement.
- I. Retaining gland of mechanical joint shall be evenly spaced from the fitting or valve for its entire circumference upon installation.
- J. After jointing pipe, repair any damage to pipe's protective coating in accordance with manufacturer's instructions or replace pipe.
- K. Prior to jointing consecutive pipe, backfill previously jointed pipe with sufficient material to prevent movement.
- L. Place a plug in the open end of uncompleted laid piping at the end of each day.
- M. Any component of a piping system disturbed after installation may be required to be taken up and reinstalled.

5.03 Thrust Blocking

- A. Thrust blocking shall be installed at all bends, tees, valves, fire hydrants and points where thrust may develop in pressurized piping.

- B. Thrust blocking shall consist of cast-in-place concrete, tie rods, combinations thereof or other method approved by the City Engineer.
- C. Cast-in-place concrete blocking shall be formed to the required dimensions and installed against undisturbed earth. Blocking size may be increased based on soil bearing capacity.
- D. Concrete shall have a minimum 3,000 psi compressive strength at 28 days.
- E. Bolts and nuts shall be protected from concrete coverage.

5.04 Manhole and Wet Well Installation

- A. Manholes and Wet Wells shall be set atop a twelve (12) inch bed of No. 57 stone that extends a minimum of twelve (12) inches beyond all exterior sides.
- B. The bedding of No. 57 stone may be replaced with a six (6) inch layer of steel reinforced cast-in-place concrete.
- C. The bed shall be prepared so that the manhole is set level.
- D. Manhole sections shall be handled with lifting straps or hooked cables using a minimum of two (2) of the manufactured manhole lifting holes.
- E. Manhole sections shall be positioned such that influent and effluent piping enter the center of their respective opening not pinching the rubber boot seal. Pipe shall not rest on invert of opening.
- F. Stainless steel boot clamps shall be tightened in accordance with the manufacturer's instructions.
- G. Annulus between pipe and rubber boot shall be grouted with non-shrink grout prior to commencing backfill operations.
- H. An invert shall be built in each manhole to transition flow from the influent pipe to the effluent pipe.
- I. The built invert shall be shaped as a "U" channel and match the inverts of the influent and effluent pipes.
- J. Inverts shall be built of cast-in-place concrete or brick and mortar. Note that brick and mortar inverts shall be finished on top with a ½-inch layer of mortar.
- K. Prior to jointing consecutive sections, tongue-and-grooved ends shall be cleaned free of dirt and debris.
- L. Tongue-and-grooved ends shall be fitted with preformed gasket sealing compound.
- M. Manhole sections shall be stacked level and plumb at all times.
- N. Manhole sections shall be stacked such that interior steps are vertically aligned.

- O. Manhole lifting holes shall be sealed using non-shrink grout throughout the entire depth of hole.
- P. Upon bringing manhole to finished grade with brick and mortar (if applicable), set ring and cover with non-shrink grout.
- Q. Manholes shall be kept free of dirt and debris.
- R. Drop manholes will be used where there is greater than two (2') foot drop between influent and effluent pipe. See Detail Nos. 21.2 and 25.2.
- S. Doghouse manholes shall be placed in accordance to Detail No. 21.3.

5.05 Meter Box and Vault Installation

- A. Meter boxes shall be installed as follows.
 - 1. Meter box shall be set atop undisturbed or compacted soil. Backfill around box shall be compacted using a hand tamp.
 - 2. Top of meter box shall be set flush with finished grade. Meter box shall not be set in a depression.
 - 3. Soil level within meter box shall be even with the bottom of the meter assembly and free of debris.
- B. Meter vaults shall be installed as follows:
 - 1. Meter vault shall be bedded atop undisturbed or compacted soil. Backfill around vault shall be compacted in accordance with Division IV, Section 6.
 - 2. Vaults shall be set atop a minimum (12") inch layer of No. 57 stone that extends a minimum of twelve (12") inches beyond the outside face of all walls.
 - 3. The bedding of No. 57 stone may be replaced with a six (6") inch layer of steel reinforced cast-in-place concrete.
 - 4. The stone filled sump beneath vault drain shall be fully encased in a geofabric membrane.
 - 5. The bed shall be prepared so that vault is set level.
 - 6. Annulus between pipe and wall openings shall have a flexible water tight seal installed prior to commencing backfill operations.
 - 7. Prior to installing vault cover, abutting ends shall be cleaned free of dirt and debris.
 - 8. Abutting ends of vault and cover shall be fitted with preformed gasket sealing compound.

9. Vault lid lifting holes shall be sealed using non-shrink grout throughout the entire depth of hole.
10. Vault shall be kept free of dirt and debris.
11. Top of vault lid shall be set three (3") inches above finished grade. Vault shall not be set in a depression.

5.06 Borings and Casings

- A. Construction shall be performed so as not to interfere with, interrupt or endanger roadway and railway surface and activity thereon, and minimize movement of the surface, structures and utilities above and in the vicinity of the casing.
- B. Work shall be coordinated and be in compliance with the appropriate highway and railroad agencies and their policies.
- C. Contractor shall monitor ground movement during construction. Contractor shall be responsible for all settlement or up heave resulting from casing operations and shall repair and restore moved or damaged property to its original condition.
- D. Work shall not interfere with storm water drainage devices. Storm water and/or groundwater shall be controlled and shall not enter any excavation or boring.
- E. Boring and jacking operations shall be performed from an excavation located at one end of the section to be bored. The excavation shall be kept dry at all times.
- F. Boring and jacking of casings shall be completed by dry auger boring without jetting, sluicing or wet boring. Free boring (boring without casing) shall be prohibited. The boring diameter shall be essentially the same as the outside diameter of the casing.
- G. Boring may be advanced slightly ahead of jacked casing in a manner that will prevent voids forming in the earth around the perimeter of the casing. Horizontal and vertical alignment of the casing shall be frequently checked.
- H. When rock is encountered, the Utility Contractor at his option may continue to install the casing by removing the rock through the casing. Should the City or other governing agencies determine the rock cannot be removed through the casing then an alternate means of crossing shall be determined.
- I. Casings damaged during installation shall be repaired. Should the damaged casing prevent the installation of the pipe, then that boring and casing shall be abandoned.
- J. Casing lengths shall be as long as practical. Jointing shall be accomplished by single grooved butt welding for the entire circumference of the pipe.
- K. Casing shall be cleaned free of dirt and debris prior to installing pipe.

- L. After casing installation is complete, the proposed pipe can be installed. The pipe shall be installed to proper grade and alignment according to the contract documents.
- M. Pipe shall be supported within casing to limit radial movement to a maximum of one (1") inch.
- N. A minimum of one (1) spacer shall be provided for each nominal section of pipe. Casing spacers shall be attached to the pipe at a maximum of 18' to 20' intervals.
- O. The annulus between the pipe and casing, at each end, shall be sealed using brick and mortar.

5.07 Pipe and Valve Identification

- A. The marking of utilities immediately after installation is required as detailed in the Official Code of Georgia, Code 25-9 "Georgia Utility Facility Protection Act".
- B. Install mylar detection tape and/or other detectable wire, during backfill operations, above nonferrous pipe or any pipe having more than six (6) feet of cover. Detection tape or wire shall be installed centered, approximately 12 to 18 inches above the pipe.
- C. Service lines and valves shall be locatable via marked curbing or other City approved method. Adjacent street curb to service line and valves shall be marked via saw-cut as follows. Curb markings shall be a minimum of four (4") inches in height.
 - 1. "W" for water service location
 - 2. "V" for water valve location
 - 3. "S" for sewer service location

SECTION 6: BACKFILL AND COMPACTION**6.01 Backfill**

- A. Excavations shall be backfilled using suitable material meeting the requirements of Class I, II or III backfill material as defined by ASTM D2487.
- B. Place no backfill until any poured concrete has developed design compressive strength.
- C. Place backfill against below grade walls in uniform level lifts to prevent wedging action.
- D. Backfill shall not be placed on surfaces that are saturated, frozen or containing frost or ice.
- E. Place backfill in excavations as follows.
 - 1. Backfill in loose lifts not exceeding six (6") inches when compacting using manual tamping devices (jumping jack).
 - 2. Backfill in loose lifts not exceeding twelve (12") inches when compacting using vibrating/ramming devices (sheep-foot vibratory roller).
- F. Any settlement shall be filled and compacted to conform with adjacent surfaces.
- G. Material remaining after completion of backfill operations shall be disposed off-site.

6.02 Compaction

- A. Backfill shall be compacted using manual tamping devices or vibrating/ramming devices.
- B. Use manual tamping devices as follows.
 - 1. When area is inaccessible to vibrating devices and within five (5') feet of below grade walls (includes manholes).
 - 2. From bottom of pipe trench to twelve (12") inches above the top of pipe.
- C. Compaction requirements are as follows.
 - 1. Backfill, beneath and within ten (10') feet of the building line of any structure, proposed structure or other area determined by the City, shall be compacted for the entire depth to a minimum of 100% of the maximum dry density as determined by a Standard Proctor Analysis.
 - 2. Backfill, beneath any road, walk, proposed improvement or area determined by the City shall be compacted for the entire depth to a minimum of 100% of the maximum dry density as determined by a Standard Proctor Analysis.

3. Backfill in road right-of-way and not described above shall be compacted the entire depth to a minimum of 95% of the maximum dry density as determined by a Standard Proctor Analysis.
4. Backfill not described above shall be compacted for the entire depth to a minimum of 90% of the maximum dry density as determined by a Standard Proctor Analysis.

6.03 Compaction Testing

- A. Soil samples from the proposed construction area shall be analyzed for maximum dry density in accordance with ASTM 698 – Method C.
- B. The extent of testing required shall be dependent upon soil conditions, Contractor's methods of construction and regulatory requirements.
- C. Minimum compaction testing shall be as follows.
 1. Backfill in excavations shall be tested at 2-foot lift intervals per 1,000 square feet of fill or as deemed necessary by the City Inspector.
 2. Backfill in trench excavations shall be tested at 2-foot intervals per 400 linear feet of fill or as deemed necessary by the City Inspector.

SECTION 7: SITE COMPLETION**7.01 Grading**

- A. Grade areas to lines and elevations indicated on drawings or to surrounding surface grades.
- B. Graded areas shall be within 0.10 foot of required subgrade elevation and shall not permit the ponding of water.
- C. In areas to receive grassing, redistribute stockpiled topsoil over graded areas to a minimum depth of four (4") inches. Provide additional topsoil to achieve required depth.
- D. Where finish grade meets or abuts curbs, walks or pavement, uphill grades shall be slightly higher than curb or pavement to permit drainage.
- E. Excess soil and debris shall be removed from the jobsite.
- F. Stabilize site in accordance with the approved soil erosion and sedimentation control plan.

7.02 Replacing Pavement

- A. Existing pavement shall be replaced in accordance to the standards required by Dawson County Department of Transportation and/or the Georgia Department of Transportation.
- B. Construction shall be performed so as not to endanger roadway activity. Work shall be coordinated and be in compliance with the appropriate road and highway agencies.
- C. Pavement shall be reinstalled immediately after completing backfill operations and compaction requirements.
- D. Driveways and sidewalks shall be replaced to their full width from the edge of curb or road pavement to the nearest construction/control joint.
- E. Curbs shall be replaced for the entire length from control joint to control joint.
- F. Removed pavement shall be disposed offsite.
- G. Use Detail Nos. 28.1 and 29.1 when applicable.

SECTION 8: TESTING**8.01 General**

- A. The following tests shall be performed as indicated at the expense of the Developer/Utility Contractor.
- B. Water distribution systems and/or sanitary sewer systems failing the required tests shall be repaired at the expense of the Developer/Utility Contractor.

8.02 Hydrostatic (Water Main and Force Main)

- A. Water distribution piping and force mains shall be subjected to a hydrostatic pressure test in accordance with AWWA Standard C600, latest revision.
- B. Combination air/vacuum release valves, corporations and curb stops and fire hydrant shall be installed at the high point of elevation in the pipe line system to release air.
- C. Pipe shall be filled with potable water to a pressure of 250 psi and pipe pressure allowed to stabilize.
- D. Pressure shall be maintained, without the addition of water, for a minimum period of two (2) hours.
- E. Test shall be considered acceptable when a water pressure of 250 psi is maintained for a period of two (2) hours.

8.03 Air Pressure (Gravity Flow)

- A. All gravity sewer pipe shall be subjected to a low air pressure test in accordance with Unibell UNI-B-6-90.
- B. Pipe shall be free of dirt and debris.
- C. During testing, personnel shall not be permitted in manholes connected to pipe being testing.
- D. The internal air pressure of the pipe shall be raised to approximately 10-15 psi.
- E. The test shall begin when the stabilized pressure is at a minimum of 10 psi.
- F. Test shall be considered acceptable when an air pressure equivalent to the stabilized pressure is maintained for a period of 10 minutes.

8.04 Televising (Gravity Flow)

- A. Sanitary sewers shall be televised to ensure integrity.
- B. Pipe shall be free of dirt and debris.
- C. Televising cable attached to a video monitor shall be directed through pipe to view for the following deficiencies.

1. Cracks in pipe and liner material
 2. Rolled gaskets
 3. Leaking joints
 4. Deviations from line and grade – Sewer pipe shall be viewed from one manhole to the next adjacent illuminated manhole. Pipeline shall show more than three-quarters (3/4) of the opening at the opposite end of the pipeline.
 5. Pipe deformations
 6. Other deficiencies.
- D. Test shall be considered acceptable when the televised pipe does not reveal the deficiencies indicated in Item C.

8.05 Mandrel (Gravity Flow)

- A. Sanitary sewers shall be tested for deformation using a mandrel in accordance with ASTM D 3034.
- B. Pipe shall be tested when backfill and compaction are complete. Pipe shall be free of dirt and debris.
- C. Chords shall be attached to each end of the mandrel. One chord shall be passed through the section of pipe being tested. One chord shall be used to retrieve the mandrel should the pipe not allow passage.
- D. The mandrel shall be sized such that its outside dimension is 5% less than the actual inside diameter of the pipe.
- E. Test shall be considered acceptable when mandrel passes freely through pipe.

8.06 Static Water Level (Wet Well)

- A. Test wet well for infiltration/exfiltration after receiving field approval of wet well lining installation.
- B. Visually inspected wet well for infiltration.
- C. Fill wet well with potable water to a level equal to the high water alarm elevation and mark that elevation.
- D. Test shall be considered acceptable when a water level drop of less than one-quarter (1/4") inch is measured after a 24 hour period.
- E. Wet well sections exhibiting infiltration/exfiltration shall be replaced.

8.07 Vacuum Test (Sewer Manhole)

- A. All manholes shall be vacuum tested in accordance with ASTM C 1244, “Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test” as amended to date. All pipes entering the manhole should be plugged, taking care to securely place the plug from being drawn into the manhole. The test head shall be placed near the top of the manhole frame and cover and the seal inflated in accordance with the manufacturer's recommendations. A vacuum pump of ten-inches (10") of mercury shall be drawn and the vacuum pump shut off. With the valves closed, the time shall be measured for the vacuum to drop to nine-inches (9"). Following are minimum allowable test times for manhole acceptance at the specified vacuum drop:

Depth (Feet)	Time (Seconds)		
	48-inch Diameter	60-inch Diameter	72-inch Diameter
4	10	13	16
8	20	26	33
12	30	39	49
16	40	52	67
20	50	65	81
24	59	78	97
Add 2-ft. more depth	5	6.66	8

Note: These numbers have been taken from ASTM C 1244-93 (reapproved 2000).

1. If the manhole fails the initial test, repairs and adjustments necessary due to extenuating circumstances (i.e. pipe joint, plug sealing) should be made. Retesting shall proceed until a satisfactory test is obtained.
2. A final visual inspection shall be made by the Inspector and contractor. Any deficiencies noticed shall be repaired accordingly.
3. The cost for testing each manhole shall be included in the cost per vertical foot to install the pre-cast concrete manhole. Retest cost required due to defects in the Contractor’s work, shall be paid by the Contract.
4. Testing shall be performed on all new or refurbished manholes.

SECTION 9: DISINFECTION**9.01 General**

- A. All newly installed water distribution piping and piping affected during construction shall be disinfected in accordance with AWWA C651.
- B. All disinfection procedures shall be coordinated with the City inspector.
- C. City personnel shall operate existing valves during disinfection procedures.
- D. The City shall be involved in disinfecting the following in-place piping.
 - 1. Water mains.
 - 2. Service connections up to and including water meters and back flow prevention devices.
- E. The City shall supply an appropriate chlorine solution and complete disinfection procedures.
- F. Water for disinfection shall be provided by the City at no expense to the contractor. Excessive use of water during disinfection procedures, as determined by the City, may be reason for charges to be levied against the contractor.
- G. Collection and testing of water samples shall be performed by the City.
- H. No water piping system shall be placed in service until written approval is received from the City Engineer.
- I. The Contractor shall be responsible for preventing soil erosion associated with disinfecting procedures.

9.02 Initial Flushing

- A. Prior to disinfection, the Contractor shall flush piping system with sufficient water to create a minimum velocity in the pipe of 2.5 feet per second (fps).
- B. Flushing shall be performed by pushing water through a laid section of pipe with one end of section open to the atmosphere above existing grade.
- C. Piping shall be flushed until water sampled from the piping yields a turbidity measurement of 0.5 NTUs or less.
- D. All piping and components associated with service connections shall be thoroughly flushed with fresh potable water prior to installation.
- E. Upon completion of flushing, laid pipe with one end open to atmosphere shall be re-laid to depth indicated in Construction Drawings.

9.03 Chlorination and Flushing

- A. The City shall introduce a chlorine solution having a concentration of 50 to 100 milligrams per liter (mg/l) into the water main.
- B. Upon introducing the chlorine solution, all valves associated with the water main shall be fully operated to ensure complete disinfection.
- C. All piping and components associated with service connections shall be thoroughly flushed with a 200 mg/l chlorine solution.
- D. Water main shall have a minimum 25 mg/l chlorine residual after a 24-hour retention period.
- E. After the 24-hour retention period, flush heavy chlorinated water from system through fire hydrants. When necessary, the Contractor shall provide sodium thiosulfate to neutralize the chlorine residual. Contractor shall apply sodium thiosulfate in accordance with manufacturer's recommendations.
- F. Flushing shall continue until water in main has a residual chlorine concentration of 1 mg/l.
- G. Water usage for filling and flushing will be billed at \$6.78 per thousand (1,000) gallons based upon a minimum of four (4) times the volume of the pipe. (Example: 5,000 LF 8" pipe x 2.89 gallons/feet x \$6.78/thousand gallons x 4 = \$391.88)

9.04 Disinfection Testing

- A. After chlorination and flushing is complete, the City shall collect water samples from the system and perform 24-hour analyses in accordance with the Georgia Rules for Safe Drinking Water.
- B. After the initial 24-hour analysis is complete and acceptable, a volume of water determined by the City Inspector shall be flushed from the water system and water samples shall be collected for a second 24-hour analysis.
- C. After the second 24-hour analysis is complete and acceptable, the water main may be put into service.
- D. Disinfection of the water main shall be repeated until testing is acceptable.
- E. Laboratory analyses shall be performed and certified by a laboratory selected by the City.

SECTION 10: CONCRETE**10.01 Formwork**

- A. Formwork shall comply with ACI 347R-94.
- B. Contractor shall be responsible for design and construction of concrete formwork capable of supporting construction loads. Forms shall be as follows.
 - 1. Pre-engineered steel
 - 2. Pre-engineered reinforced fiberglass
 - 3. Wood
 - 4. Earth
- C. Construct formwork to lines and elevations as shown on drawings.
- D. Construct forms to be removed without hammering or prying against concrete.
- E. Plug holes in existing forms to prevent leakage of cement.
- F. Clean forms of dirt and debris prior to each use.
- G. Form ties shall be as follows:
 - 1. Break-back type with $\frac{5}{8}$ -inch removable sleeve or 1-inch cone type
 - 2. For retaining walls and walls below liquid level, provide ties with positive water stop projection at center of wall.
- H. Prior to placement of reinforcing steel, apply form release agent to formwork. Release agent shall be evenly applied and compatible with type form being used.
- I. Construct bulkheads with shear keys at separation of pours.
- J. Shear key width shall be $\frac{1}{3}$ of the wall or slab thickness.
- K. Removal of formwork shall take place only after concrete has developed sufficient strength to support itself and resist damage during removal.
- L. Forms used below grade shall be removed prior to backfill.

10.02 Steel Reinforcement

- A. Shop fabricate reinforcement to shape and dimensions as indicated on drawings.
- B. Use no bars or wire mesh with kinks or bends not shown on the drawings.
- C. Secure reinforcement in forms in accordance with the drawings, ACI 315, ACI 318 and CRSI "Recommended Practice for Placing Reinforcing Bars".
- D. Steel reinforcement shall set atop concrete bricks and/or be spaced using steel highchairs. When highchairs are used as a form spacer, the highchair feet shall be plastic dipped.

- E. Concrete coverage over reinforcing shall be as follows:
 - 1. Concrete cast against earth.....3 inches
 - 2. Formed concrete exposed to earth or weather.....2 inches
 - 3. Slabs and walls exposed to wet conditions.....2 inches
 - 4. Interior slabs and walls..... $\frac{3}{4}$ inch
- F. Splice reinforcement a minimum of 48 times (x) bar diameter. Mechanical splices shall be prohibited.
- G. Steel reinforcement, at the time cement is placed, shall be free of dirt, rust and debris. Reinforcement with flaking rust shall not be used.
- H. Conduits and pipes shall have same concrete coverage as reinforcing steel.
- I. Tie wire shall be used to secure reinforcing.
- J. Joints in wire mesh shall be lapped one wire spacing plus two (2") inches. Wire mesh shall have one (1") inch of concrete cover at forms.

10.03 Placement

- A. Place concrete in accordance with ACI 301-89, Chapter 8.
- B. Place no concrete until all embedded items and reinforcement have been placed in accordance with the plans.
- C. A City Inspector shall approve formwork layout and placement of steel reinforcement prior to placing concrete. Provide 24-hour notice prior to placing concrete.
- D. Concrete shall not be placed on loose, saturated or frozen soil.
- E. Concrete shall not be placed in water unless approved by the City Engineer.
- F. Concrete shall be placed only when ambient temperature is at 40° F and rising or place concrete in accordance with ACI 306-R88.
- G. During hot weather (>80°F), place concrete in accordance with ACI 305-R89.
- H. Saw control joints as soon as concrete can be traveled by foot without leaving impressions. Saw joint depth shall be $\frac{1}{4}$ of the slab depth.
- I. Consolidate all placed concrete with vibrator of suitable vibrations per minute.
- J. Do not pull or push concrete with vibrator.
- K. Do not drop concrete more than four (4') vertical feet.

10.04 Finishing

- A. Screed floor slabs or tops of walls by use of straight edge or screed board.

- B. Concrete shall be finished as follows:
 - 1. Interior slab to receive setting bed.....float finish
 - 2. Interior slab exposed.....trowel finish
 - 3. Exterior slab exposed.....broom finish
 - 4. Exterior wall/column exposed.....rubbed finish
 - 5. Unexposed concrete.....form finish

10.05 Curing

- A. Prevent freshly placed concrete from premature drying and protect from excessive hot or cold temperatures.
- B. Maintain freshly placed concrete, without drying, at a relatively constant temperature.
- C. Begin curing after placement and finishing of concrete as soon as free water has disappeared from concrete surface.
- D. Curing methods shall be by the continuous application of water or by applying a liquid membrane forming curing-sealing compound to the fresh concrete surface.
 - 1. Curing by the continuous application of water shall occur for a period of not less than 72 hours.
 - 2. After application of liquid membrane forming curing-sealing compound, maintain continuity of coating and recoat areas damaged during curing period. Curing period shall be not less than 72 hours.
- E. Do not apply liquid curing sealing compound to concrete that is to be finished with a coating material such as paint, flooring material, etc.

SECTION 11: ENVIRONMENTAL COATINGS**11.01 Environmental Coatings**

- A. Priming, painting and special coating of all surfaces shall include but are not limited to the following.
 - 1. Piping and appurtenances
 - 2. Supports
 - 3. Pumps
 - 4. Valves
 - 5. Equipment and appurtenances
 - 6. Concrete and masonry
 - 7. Structural and miscellaneous metals
- B. Priming, painting and special coating of all surfaces shall be in accordance with the coating manufacturer's recommendations.
- C. A manufacturer's representative of the approved coating system shall field approve all surface preparation and coating application when lining manholes and wet wells.