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ENVIRONMENTAL PROTECTION DIVISION

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DRINKING WATER PROGRAM
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STANDARDS FOR DESIGN

AND

CONSTRUCTION SPECIFICATIONS

I WATER DISTRIBUTION

II WASTEWATER COLLECTION

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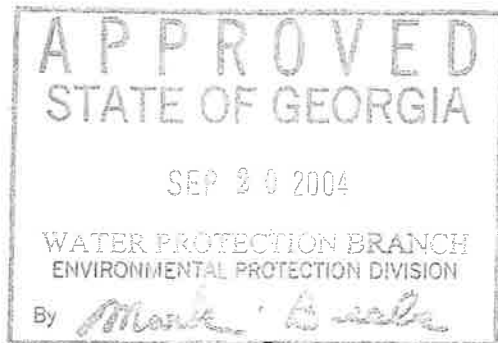


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ARTICLE I
STANDARDS FOR DESIGN
AND
CONSTRUCTION SPECIFICATIONS
FOR
WATER DISTRIBUTION

PREFACE: This Guideline and Standards Book contains information to assist planners and engineers with the design and construction of water facilities. The Macon Water Authority's intent is to ensure uniformity of design concepts, formats, methodologies, procedures, construction materials, types of equipment and quality of work products. These standards have been produced and adopted to encourage exceptional quality while using current technology for all Macon Water Authority facilities.

These Guidelines and Standards are not a substitute for good Engineering. Sound judgment must be exercised in all applications to create quality and cost efficient facilities.

Macon Water Authority management encourages the creation of relationships between project stakeholders that promotes engineering excellence and timely completion of projects. Macon Water Authority staff and consultants are encouraged to take the time at the beginning of all projects to identify common goals, common interests, lines of communication, and a commitment to cooperative problem solving.

SECTION 1.01 - PURPOSE:

This section of the Specifications describes products to be incorporated into the water lines and requirements for the installation and use of these items. The Contractor/Developer shall furnish all products and perform all labor necessary to fulfill the requirements of these Specifications. The word "Authority" used herein shall mean the Macon Water Authority.

SECTION 1.02 - GENERAL:

A Applicable Standards:

Supply all products and perform all work in accordance with applicable American Society for Testing and Materials (ASTM), American Water Works Association (AWWA), National Sanitation Foundation, American National Standards Institution (ANSI), Macon Water Authority (MWA) Cross Connection Control and Backflow Prevention Policy, or other recognized standards. Latest revisions of all standards are applicable. If requested by the Authority, submit evidence that manufacturers have consistently produced products of satisfactory quality and performance for a period of at least two years.

B. Substitutions:

Whenever a product is identified in the Specifications by reference to manufacturer's or vendor's names, catalog numbers, etc., the Contractor/Developer may freely choose from these referenced products which ones he wishes to provide.

Any item or product other than those so designated shall be considered a substitution. The Contractor/Developer shall obtain prior approval for an approved equal from the Authority for all substitutions.

C. Warranty:

Water distribution systems installed by Contractors/Developers which are accepted by the Authority for ownership, operation and maintenance shall be warranted and guaranteed for a period of one year from the date of final acceptance that the completed system is free from all defects due to faulty products or workmanship, and that the Contractor/Developer shall make such corrections as may be necessary by reason of such defects upon notice by the Authority.

D. Easements and Rights of Way:

Water distribution systems installed by a Contractor/Developer which are accepted by the Authority for ownership, operation and maintenance shall be installed in either dedicated streets or easements. Easements shall be properly executed and recorded. The easements shall be cleared of all structures, trees, shrubs, brush, logs, upturned stumps and roots of downed trees and similar items.

No permanent structure shall be built on the easement. Temporary structures such as fence, driveway, etc. can be installed on the permanent easements; but it shall be the responsibility of the owner to remove, if necessary, or repair such structures if they are disturbed when the Authority works on the water and sewer mains within the easement. The Owner shall obtain a written permission of the Authority before the installation of such temporary structures.

The minimum easement width shall be (20) feet for main up to 15 ft deep.

The minimum easement width shall be (30) feet for main up to 20 ft deep.

SECTION 1.03 - CONSTRUCTION DRAWINGS:

The term construction drawings shall mean drawings, prints, descriptive literature, test reports, samples, calculations, schedules, material lists and information and items of similar meaning.

A. Submittals Required:

The Contractor/Developer shall furnish to the Authority for review, in accordance with the procedure outlined below, drawings and descriptive literature for all manufactured or fabricated products. Additional information, such as special drawings, schedules, calculations and curves, shall be provided as specifically requested by the Authority.

B. Contractor/Developer's Review:

The Contractor/Developer shall review and check drawings and submittals. He shall indicate his approval by initials and date. The Contractor/Developer shall furnish the Authority with a minimum of four copies of all submittals. A transmittal form shall accompany each submittal or group of submittals.

C. Authority's Review:

All submittals will be reviewed, stamped, and dated by the Authority before they are returned to the Contractor/Developer.

Acceptable submittals will be approved in writing with two copies returned to the Contractor/Developer and the remaining copies retained by the Authority.

Submittals requiring minor corrections before being acceptable will be so noted. Drawings must be resubmitted for review and approval prior to installation or use.

D. Drawings For Construction:

Drawings or other submittals not bearing the Authority's approval notation shall not be issued to subcontractors or utilized for construction purposes. The Contractor/Developer shall maintain at the job site a complete set of construction drawings bearing the

Authority's approval. The drawings shall be submitted on a 24 inch x 36 inch paper and drawn to a one inch to a (50) ft horizontal and (10) ft vertical scale.

E. "As-Built" Drawings:

The Contractor / Developer shall submit two copies of "as-built" plans and one digital copy in AutoCAD format after the completion of construction but before the project is accepted for operation and maintenance by the Macon Water Authority. The "as-built" plans shall be prepared and stamped by a registered Land Surveyor or Professional Engineer. The plans shall include the following information for the water portion of a project: location of water mains, fire hydrants, valves, bends, width of easements, and any pertinent information.

All water mains (type, size) including gate valves, hydrants, blow offs, water meters, curb stops, shall be located and tied to Georgia State Plane Coordinates.

All other relative information, such as rights-of-way, property corners, stake plans along easements, etc. shall be located and tied to Bibb County State Plane Coordinates.

SECTION 1.04 - MATERIALS:

All materials used which come into contact with drinking water during its distribution shall not adversely affect drinking water quality and public health and must be certified for conformance with American National Standards Institute/National Sanitation Foundation Standard 61 (ANSI/NSF Standard 61). Any pipe, solder, or flux which is used in the installation or repair of the water distribution system shall be lead free with not more than 8.0% lead in pipes and fittings and not more than 0.2% lead in solders and flux.

All materials, unless otherwise specified or approved equal, shall be in accordance with the Buy America requirements of Federal regulations 23 U.S.C. 313 and 23 CFR 635.410. Acceptance will be on the basis of the Authority's inspection and receipt of the manufacturer's written certification that the material was manufactured and tested in accordance with the applicable standards. All pipe, fittings, valves, tapping sleeves, hydrants and all other materials required for completion of the work must comply with the following:

NOTE: Water mains less than 4 inches in diameter will not be allowed within the Macon Water Authority's Water Distribution System.

A. Ductile Iron Pipe (DIP):

Ductile iron pipe shall conform to ANSI/AWWA C151/A21.51 and shall be a minimum of Pressure Class 350 up to a diameter of 12 inches and Pressure Class 350 above 12" diameter. Sizes will be as shown on the Drawings. Pipe and fittings shall be cement lined in accordance with ANSI/AWWA - C104/A21.4. Fittings shall conform to ANSI/AWWA C110/A21.0 or ANSI/AWWA C153/A21.53 with rated working pressure of 350 psi. Pipe and fittings shall be furnished with a bituminous outside coating.

Joints shall be push-on type for pipe and standard mechanical or flanged joints for fittings. Push-on and mechanical joints shall conform to ANSI/AWWA C111/A21.11. Restrained joint pipe (RJP) shall be either the bolted joint type, or modified push-on type with joint restrained using ductile iron components. Restrained joint pipe on piers shall have bolted joints and shall be specifically designed for clear spans of at least 36 feet. Restrained joint pipe where required shall be American, U.S. Pipe, Clow, or approved equal.

Gaskets for mechanical or flange joints shall be made of 1/8- inch thick cloth reinforced rubber; gaskets may be ring type or full face type.

Bolts for flange connections shall be steel with American Regular unfinished square or hexagon heads. Nuts shall be steel with American Standard Regular hexagonal dimensions, all as specified in ANSI B 17.2. All bolts and all nuts shall be threaded in accordance with ANSI B 1.1, Coarse Thread Series, Class 2A and 2B fit.

All pipe shall be furnished in lengths of 18 or 20 feet.

Acceptance will be on the basis of the Authority's inspection and the manufacturer's written certification that the pipe was manufactured and tested in accordance with the applicable standards.

Ductile iron pipe shall be used on all water systems, including systems behind master meters. The systems behind master meters shall be pressure tested, disinfected and the results shall be available for Macon Water Authority's review.

B. Gate Valves (GV):

- (1) Valves (4" through 12") shall be mechanical joint end (Flange x mechanical joint), resilient seated, iron body gate valves with non-rising stem flanged mechanical joint o-ring stem seals and open left. The valve shall be designed for a water working pressure of 250 psi and a test pressure of 500 psi, and shall be designed for installing in a vertical position. This valve shall conform to the lateral Revision of AWWA C-509, for "Ordinary Water Works Service", and shall be Mueller A-2370-20 or an approved equal.
- (2) Valves (14" and larger) shall be mechanical joint, resilient seated, D.I. body, bronze mounted, non-rising stem with O-ring stem seals and open left. The valve shall be designed for water working pressure of 250 psi and a test pressure of 500 psi. The valve shall be designed for horizontal installation and equipped with bevel gearing, gear case, tracks, rollers, scrapers and by-pass valves. The valve shall conform to AWWA standard specification C-500, latest revision for "Ordinary Water Works Service" and shall be Mueller No. A-2380-20 or an approved equal. American Flow Control resilient wedge gate valve series 2500 rated for 250 PSI working pressure can be used in lieu of double disc, iron body gate valve.

(3) Valve Boxes (VB):

All valves shall be equipped with valve boxes. Valve boxes shall be heavy roadway type. The valve boxes shall be heavy roadway type. The valve boxes shall be adjustable to 6" up or down from the nominal required cover over the pipe. Provide a 4 inch thick, 18 inch square or round concrete pad around the valve box. This must be placed at grade. Note: Gate valves Larger than 16" shall be placed in a MH and stack out to grade – See Manholes specs in wastewater section.

(4) Tapping Sleeves and Valves (TS &V)

(a) Tapping sleeves shall be the split sleeve, mechanical joint type. Valves shall be gate valves furnished in accordance with the above specifications. The valves shall have flange x mechanical joint ends. Tapping sleeves shall be Mueller No. 615 or approved equal. Tapping crosses shall be Mueller No. 716 or approved equal. Tapping valves shall be Mueller No. 687 or approved equal. (Mechanical Sleeve required for mains above 16")

(b) As an alternative to the conventional tapping sleeve and valve, a stainless steel tapping sleeve with mechanical joint outlet and a standard MJ gate valve could be installed. The MJ tapping sleeve shall meet or exceed the following material specifications for use with a standard mechanical Joint x mechanical joint, resilient wedge gate valves per ANSI (AWWA C509-94). The mechanical joint outlet shall be a one piece casting with a plain end and MJ gland. The tapping sleeve shall have a MJ outlet gasket. The armor plate, lugs, nuts, bolts shall be 203 (18-8) stainless steel, and gaskets shall be virgin nitrile, Buna-N or equal.

(5) "All stainless tapping sleeves" may be used in lieu of the above and shall conform to the following specifications: Body: 18-8 type 304 s.s. flange CF 8 cast stainless steel equivalent to 18-8 type 304 s.s. with ANSI 150 lb drilling; recessed for tapping valve per MSS-SP-60. Bolts: Type 304 s.s. Branch outlet: Heavy s.s. pipe. Gasket: Full circumferential gasket compounded for use with water, salt solutions, mild acids, bases and sewage.

(6) Tapping Saddles:

For 1-inch and below:

Use service clamps double strapped cc thread or direct tap.

For 1 1/2-inch to 2-inch:

Use service clamps double strapped cc thread.

Above 2-inch:

Tapping saddles shall be ductile iron body type with O-ring gasket and stainless steel straps. Connection shall be flanged or mechanical joint as required.

C. Backflow Preventers:

(1) General:

Backflow preventers shall be selected on the basis of impurities involved and the type of cross connection and shall be approved by the Macon Water Authority.

(2) Approval of Devices:

The backflow preventers shall be certified by the American Society of Sanitary Engineers, as having been tested by a nationally recognized laboratory in accordance with applicable ASSE Standards. Each device shall bear the ASSE seal of approval and shall be individually factory tested.

(3) Specifications and Installation of Devices:

- (a)** Dual check backflow preventer (3/4 inch and 1 inch) shall have bronze body with two compact checks, a union, and "o" ring seals shall be installed at the downstream side of residential water meters to prevent backflow of polluted water into potable water supply. The device shall not be buried but may be installed in a pit below grade. A positive shut-off valve and a union shall be installed on the inlet side of the device.

The device shall meet or exceed the requirements of ANSI/ASSE.

- (b)** Double check valve assembly backflow preventer (1 inch, 1 ½ inch and 2 inch) shall have brass body with replaceable seats, ball valve test cocks, and bronze strainers. The device shall be installed on the downstream side of all residential water meters to prevent backflow of polluted water into potable water supply. This device shall not be buried, but may be installed in a pit below grade, provided ball valve test cocks fitted with brass plugs are used, it should also include a positive shutoff valve and shall be equipped with three (3) leak proof test cocks. A fourth cock shall be provided on the upstream side of the inlet shutoff valve. A strainer with (20) mesh stainless steel screen shall be installed.

The device shall meet or exceed the requirements of ASSE, AWWA or USCFCC Manual for Cross Connection Control.

- (c)** Double check valve backflow preventer assembly (2 ½ inches, 3 inches, 4 inches, 6 inches, 8 inches and 10 inches)

Shall have bronze body (2 ½" and 3 inches) epoxy coated. Cast iron or ductile iron (4 to 10 inches) body bronze seats, and stainless steel internal parts. The device shall be installed on the downstream side of all residential water meters to prevent backflow or polluted water to potable water supply.

This device shall not be buried, but may be installed in a pit below grade provided ball valve test cocks fitted with brass plugs are used. The assembly shall be equipped with three (3) leak proof test cocks, a fourth test shall be provided on the upstream side of the inlet shut-off valve. Also a 20 mesh stainless steel screen shall be installed. The device shall meet or exceed the requirements of ASSE, AWWA or USCFCC Manual of cross connection control.

(d) Double Detector Check Valve Backflow Preventer Assembly (DDC):

A double detector check valve assembly shall be installed at the property line for a building sprinkler system or private fire hydrant system installed for fire protection only. The DDC prevents reverse flow of fire protection system substances (stagnant water) from being pumped or siphoned into the potable water line, also provides a detection point for unauthorized water use.

Shall have bronze body (3 inches) or epoxy coated cast iron body (4 to 10 inches) bronze seats, and stainless steel internal parts. This device shall not be buried, but may be installed in a pit below grade provided ball valve test cocks fitted with brass plugs are used. The unit shall be a complete assembly including US listed OS & Y shut off valves (resilient seated) and test cocks, an auxiliary line consisting of an approved water meter and a backflow preventer. The device shall meet the requirements of AWWA or USCFCC Manual for cross connection control.

(e) Reduced Pressure Zone Backflow Preventer (RPZ):

The RPZ backflow preventer shall be installed at the property line for a service which is considered as "hazardous" to prevent the backsiphonage and back pressure backflow of contaminated water into the potable water supply.

Shall have bronze body (3/4 inch through 2 inches) of epoxy coated cast iron body (2 inches and above), stainless steel springs. This device shall be installed in a vault, above ground with positive drainage. The device shall consist of a pressure differential valve located in a zone between two tightly closing shut off valve (resilient seated) before and after the device, test cocks, protective strainer upstream of No. 1 Gate Valve. The device shall meet or exceed the requirements of AWWA or ASSE.

(f) Reduced Pressure Zone Detector Double Check Valve Assembly:

A reduced pressure principle detector double check valve assembly shall be used to prevent the reverse flow of fire protection system substances (glycerin, wetting agents, water of non-potable quality) from being pumped or siphoned into the potable water line.

This device can detect leaks, and provides a detection point for unauthorized use.

The unit shall have fused epoxy coated cast iron body, removable bronze sheets, stainless steel internal parts, maximum flow at low pressure drop with a 5/8" x 3/4" record all by-pass meter.

The unit shall be a complete assembly, including UL listed OS & Y shut-off valves with FM approval, including an auxiliary line consisting of an approved backflow preventer and a water meter. The device shall meet the basic requirements of AWWA or USCFCC Manual for cross connection control.

D. Corporation Stops:

Corporation stops shall be ball type made of bronze conforming to ASTM B61 or B62; and shall be rated at 150 psi. Ends shall be suitable for solder-joint. Threaded ends for inlet and outlet of corporation stops shall conform to AWWA C800; coupling shall conform to ANSI B16.26.

E. Valve Boxes:

Valve boxes shall be cast iron and shall be adjustable to 6 inches up and down from the nominal required cover over the pipe. Valve stem extension is required for all valves that are over 3 feet in depth.

F. Fire Hydrants (FH):

All fire hydrants shall conform to the requirements of AWWA C502 for 250 psi working pressure. Hydrants shall be the compression type, closing with line pressure. The valve opening shall not be less than 5 1/4 inches. All valves shall open left.

In the event of a traffic accident, the hydrant barrel shall break away from the standpipe at a point above grade and in a manner which will prevent damage to the barrel and stem, preclude opening of the valve, and permit rapid and inexpensive restoration without digging or cutting off the water.

The means for attaching the barrel to the standpipe shall permit facing the hydrant a minimum of eight different directions.

Hydrants shall be fully bronze mounted with all working parts of bronze. Valve seat ring shall be bronze and shall screw into a bronze retainer.

In general, fire hydrants are located at street intersections, but no more than 500 feet apart in single-family residential areas nor more than 300 feet (or as specified on plans) apart in multi-family residential, commercial, and industrial areas.

All working parts, including the seat ring shall be removable through the top without disturbing the barrel of the hydrant. The operating nut shall match those on the existing hydrants. The operating threads shall be totally enclosed in an operating chamber separated from the hydrant barrel by a rubber o-ring stem seal and lubricated by a grease or oil reservoir. A stop nut shall be positioned in the top operating mechanism so that the valve cannot contact the bottom of the shoe when fully open.

Hydrant shall be a non-freezing design and provided with a simple, positive and automatic drain which shall be fully closed whenever the main valve is opened.

Hose and pump connections shall be breech-locked, pinned, or threaded and pinned, to seal them permanently into the hydrant barrel. Each hydrant shall have two 2 ½ inch hose connections using Macon Standard Threads conforming to:

Coupling on 2 ½" hose	Macon Standard Threads
Outside diameter of male end	Three inches
Threaded per inch	Eight
Angle or Pitch	60 degrees

and one 4 inch pumper connection with National Standard threads. Equip each connection with cap and chain.

Hydrants shall be furnished with a mechanical joint shoe connection to the spigot of the 6-inch hydrant lead. A fire hydrant tee shall be installed on the main. The fire hydrant valve shall be directly connected to the tee and to the hydrant lead. All joints shall be fastened with retainer glands and rod all fittings to fire hydrant using threaded rods. A minimum pipe size of 6" is required for the installation of all fire hydrants.

Minimum depth of bury shall be 4.0 feet. Provide extension section where necessary for vertical installation and in accordance with manufacturer's recommendations.

All outside surfaces of the barrel above grade shall be painted with Koppers Glamortex 501 enamel or approved equal, in Safety Yellow ASE #1663 or color as selected by the Owner.

Hydrants shall be Mueller Centurion, Model A-423 (5 1/4") Traffic Model, Dresser M & H 129-01 (5 1/4") Traffic Model, American Flow Control (5 1/4") B-84-B, Metropolitan #250, M-94.

G. Fire Hydrants Location:

All fire hydrants shall be located on the backside of the ditch area one foot within the Right-of-way. Fire hydrants are also required at the end of all water mains.

H. Valves at the end of the Main:

Where future water main extensions are anticipated, or are deemed possible, valves are placed so that no customers are out of service for the connection work. In all cases, this calls for a mechanical joint resilient gate valve with a plug valve at the end of the main.

I. Valves Placement:

Valves are to be placed at street intersections and on each smaller main as it leaves other larger mains. In commercial, residential and industrial locations, all tees and crosses are all valved on all sides.

Valves shall be placed at both ends of the crossing:

1. Under a road, creek and railroad tracks.
2. When crossing a bridge.

Maximum spacing of valves along a water main shall be no more than 1600 feet.

When a fire hydrant is relocated, the old valve shall be kept in service, and a new valve shall be placed within two to three feet of the new fire hydrant.

SECTION 1.05 - HANDLING MATERIALS:

A. Unloading:

Furnish equipment and facilities for unloading, handling, distributing and storing pipe, fittings, valves and accessories. Make equipment available at all times for use in unloading. Do not drop or dump materials. Any materials dropped or dumped will be subject to rejection without additional justification.

B. Handling:

Handle pipe, fittings, valves and accessories carefully to prevent shock or damage. Handle pipe by rolling on skids, forklift, or front loader. Do not use material damaged in handling. Damaged material will not be accepted for installation, and shall be removed and replaced with acceptable materials at the contractors' expense.

C. Distribution:

Distribute and place pipe and materials without interference to traffic. Do not string pipe more than 1,000 feet beyond the area where pipe is being laid. Do not obstruct drainage ditches.

D. Storage:

Store all pipe which cannot be distributed along the route. Make arrangements for the use of suitable storage areas.

SECTION 1.06 - CONSTRUCTION ALONG HIGHWAY, STREETS AND ROADWAY:

Install pipe lines and accessories along highways, streets, roadways in accordance with the applicable regulations of the city of Macon, Bibb County and/or the Department of Transportation with reference to construction operations, safety, traffic control, road maintenance and repair.

A. Protection of Traffic:

Provide and maintain suitable signs, barricades and lights for protection of traffic. Replace all highway signs removed for construction as soon as possible. Do not close or block any highway, street, or roadway without first obtaining permission from the proper authorities.

B. Construction Operations:

Perform all work along highways, streets and roadways to least interfere with traffic.

(1) Stripping:

Where the pipe line is laid along road shoulders, strip and stockpile all sod, topsoil and other material suitable for shoulder restoration.

(2) Trenching, Laying and Backfilling:

Do not open the trench any further ahead of pipe laying operations than is necessary. Backfill and remove excess material immediately behind laying operations. Complete excavation and backfill for any portion of the trench in the same day.

(3) Shaping:

Reshape damaged slopes, side ditches, and ditch lines immediately after completing backfilling operations. Replace topsoil, sod and any other materials removed from shoulders.

(4) Saw cut all driveway, paved parking areas, paved roadways and paved sidewalks.

C. Excavated Materials:

Do not place excavated material along highways, streets and roadways in a manner which obstructs traffic. Sweep all scattered excavated material off of the pavement.

D. Drainage Structures:

Keep all side ditches, culverts, cross drains, and other drainage structures clear of excavated material and free to drain at all times.

E. Maintaining Highways, Streets, Roadways and Driveways:

Maintain streets, highways and roadways in suitable condition for movement of traffic until completion and final acceptance of the work. Use steel running plate to maintain traffic until pavement replacement is completed.

Repair all driveways that are cut or damaged immediately. Maintain them in a suitable condition for use until completion and final acceptance of the work.

SECTION 1.07 - CLEARING:

Clearing of the construction easement is permitted with special care taken to adhere to the requirements of Section 1.19.

SECTION 1.08 - EXCAVATION:

Excavate all materials encountered, including rock, and dispose of excess excavated material not required for backfilling. Perform all excavation in accordance with applicable local, state, and federal regulations, including Occupational Safety and Health Act of 1970 (PL 91-596), as amended.

A. Depth of Trenches:

Excavate trenches to provide a minimum cover of four feet. Within the right-of-way of highways, streets, or roadways, excavate to place the top of the pipe a minimum of four feet below the nearest pavement edge.

B. Width of Trenches:

Excavate trenches wide enough to allow proper installation of pipe, fittings, and other materials, and not less than 6 inches or more than one foot from outside barrel of the pipe on any side at any point.

C. Bell holes:

At each joint, excavate bell holes of ample depth and width to permit the joint to be made properly and to relieve pipe bell of any load.

D. Earth Excavation:

Excavate and prepare the trench bottom to support the pipe uniformly throughout its length.

For ductile iron pipe, the trench shall meet all requirements of Standard Laying Condition Type 2 in accordance with AWWA C 151.

If the trench is excavated to excessive width or depth, provide crushed stone meeting the requirements of Georgia DOT Specification 800.01 for No. 57 stone to achieve Standard Laying Condition Type 4 in accordance with AWWA C151.

E. Rock Excavation:

(1) Definition of Rock:

Any material which cannot be excavated with a backhoe having a bucket curling force rated at not less than 18,300 pounds (caterpillar Model 215 or equal), and occupying an original volume of at least one-half cubic yard.

(2) Excavation:

Where rock is encountered, excavate to the minimum depth and width which will provide 6 inches clearance beyond the outside diameter of the pipe bell.

(3) Blasting:

Blasting must be performed by a certified and bonded contractor. Conduct blasting operations in accordance with all existing ordinances and regulations. Protect all structures from the effects of the blast. Repair any resulting damage.

(4) Removal of Rock:

Do not use excavated rock as backfill material. Dispose of rock which is surplus or not suitable for use as rip rap.

SECTION 1.09 - EXISTING UNDERGROUND UTILITIES AND OBSTRUCTION:

It is the responsibility of the Contractor/Developer to locate all existing utilities along the path of his construction. His drawings shall indicate underground utilities or obstructions that are known to exist. Where these or unforeseen underground utilities are encountered, the location and alignment of the water main may be changed, upon written approval of the Authority, to avoid interference. It is the responsibility of the Contractor to contact the Utilities Protection Centers, Inc. ("Call Before You Dig" - 1-800-282-7411 or 811) prior to the start of any excavation or construction.

A horizontal separation of 10 feet shall be maintained between water mains and sanitary sewers. The distance shall be measured edge to edge. When a water main must cross a sewer, the water main and/or sewer shall be laid such that the top of the sewer is at least 18" below the bottom of the water main. When this requirement cannot be met both the water main and the sewer shall be constructed of ductile iron pipe with ductile iron pipe for a distance of 10 feet on each side of the point of crossing on both the water main and sewer.

SECTION 1.10 - LAYING AND JOINTING PIPE AND FITTINGS:

Lay all pipe fittings to accurately conform to the lines and grades approved by the Authority as follows:

A. Handling:

Use suitable tools and equipment to handle and lay pipe, preventing damage to the pipe and the cement lining. Examine all pipes carefully for cracks and other defects as it is laid. Do not lay pipe or other materials which are known to be defective. Lower pipe, fittings, valves and accessories into the trench by suitable means. Do not drop or dump pipe or accessories into the trench.

Clean pipe and fittings thoroughly before laying. Keep the pipe line clean until final acceptance.

If any pipe or other material is discovered to be defective or damaged after being laid, remove and replace it.

B. Alignment and Gradient:

Lay pipe straight in alignment and gradient or follow true curves as nearly as practicable. Do not deflect any joint more than $\frac{2}{3}$ the maximum deflection recommended by the manufacturer.

Maintain a transit and accessories on the job to lay out angles and ensure that deflection allowances are not exceeded.

The minimum cover for water distribution mains shall be Forty- eight (48) inches.

C. Expediting of Work:

Excavate, lay the pipe, and backfill as closely together as possible. Do not leave unjointed pipe in the trench overnight. Backfill and compact the trench as soon as possible after laying and jointing is completed. Cover the exposed end of the installed pipe each day at the close of work and at all other times when work is not in progress. If necessary to backfill over the end of an uncompleted pipe, close the end with a mechanical joint plug.

D. Laying Pipe in Trenches:

Lay the pipe with solid bearing throughout its length.

(1) Earth Trenches:

Grade the bottom of the trench to a true line. Lay the pipe in clean bedding

material, free of rock, organics and other unsuitable materials.

(2) Rock Trenches:

Bed the pipe in at least six inches of granular bedding material. Backfill with the same material to at least six inches above the pipe.

(3) Wet Trenches:

Do not lay pipe in water. Provide dewatering equipment to maintain a ground water level below the bottom of the pipe while pipe is being laid.

(4) Pipe Joints:

Joints shall be made in accordance with the manufacturer's recommendations.

(5) Cutting:

Cut ductile iron pipe using an abrasive wheel saw. Remove all burrs and smooth the end before jointing.

SECTION 1.11 - CONNECTIONS TO EXISTING PIPE LINES:

Before laying pipe, the Contractor/Developer shall locate the points of connection to existing pipe lines and uncover as necessary for the Authority or an approved contractor to confirm the nature of the connection to be made. The Authority or Contractor shall furnish materials and make the connection to all existing pipe lines. The Contractor/Developer will be charged with a connection fee to cover the expenses of the Authority, only if Authority makes tap.

SECTION 1.12 - THRUST RESTRAINT:

Provide restraint at all points where hydraulic thrust may develop.

A. Retainer Glands:

Install retainer glands on fire hydrants and all associated fittings, valves and related piping. Retainer glands shall be ACIPCO A 90857 or an approved equal.

B. Zinc plated 3/4 inch all threaded rods with USS course thread shall be used where it is required to restrain joints.

C. Concrete Blocking:

Provide concrete blocking for all other bends, tees, valves, and other points where thrust may develop, or as directed by the Engineer. Retainer glands, including mega-lug

retainers, may be used in lieu of concrete blocking, only as approved by the Engineer.

D. Restrained Joints:

Restrained joints type pipe such as American Lock Ring, or Lok-Fast, or an approval equal may be used in accordance with manufacturer's recommendation.

Concrete for blocking shall have a compressive strength of not less than 3000 psi, with not less than 5.5 bags of cement per cubic yard and a slump between 3 and 5 inches. For job mixed concrete, submit the concrete mix design for approval by the Authority. Ready-mixed concrete shall be mixed and transported in accordance with ASTM C94. Reinforcing steel shall conform to the requirements of ASTM A 615, grade 40.

Form and pour concrete blocking at fittings as shown on the Typical Blocking Detail in Appendix A and as directed by the Authority. Pour blocking against undisturbed earth. Increase dimensions when required by over excavation.

SECTION 1.13 - BACKFILLING:

Backfill and compact to prevent settlement and displacement of the pipe.

A. Material:

Backfill trenches with earth only. Do not use rock excavated from trenches in the backfill. If necessary, furnish suitable earth material to backfill the trench.

B. Backfill:

Place backfill material in the bottom of the trench and up to two feet above the pipe in 6-inch layers. Compact with two hand operated air hammers with tamping feet, one on each side of the pipe, operated simultaneously.

Backfill above, shall be compacted as follows:

- (1) In 6-inch layers, if using light power tamping equipment, such as a "jumping jack".
- (2) In two foot layers, if using heavy tamping equipment, such as hammer with tamping feet.

C. Backfill Under Roads:

Backfill under roads shall be compacted to 95% up to top 2' below grade and 98% for top of the maximum dry density as determined by the Standard Proctor Compaction Test (ASTM D698).

D. Settlement:

If trenches settle, refill and grade the surface to conform to the adjacent surface.

E. Compaction:

The backfill in all the trenches shall be compacted as stated herein: shall be 100 percent of the maximum dry-density as determined by Standard Proctor Compaction Test (ASTM D698) for the base material under the pavement. The top (24) inches of backfill shall be compacted to a minimum of (98) percent of the maximum dry density. It shall be 95% outside the pavement but within the road right-of-way and 85% outside road right-of-way. The testing agency shall run as a minimum (1) Proctor for each type of soil encountered or could use "Family of Curves Method - GHD - 67" as approved and utilized by the Georgia Department of Transportation and the U. S. Army Corps of Engineers.

During the backfilling, loose lifts shall not exceed (8) inches in thickness. Field density determination (compaction tests) should be made a minimum of one (1) test per 200 linear feet per two (2) compacted vertical feet. This is a minimum requirement for all the areas. Additional tests may be required for special conditions such as in streets and other critical areas as desired by the Engineer. The range of moisture contents should be maintained within plus or minus three (3) percent of the optimum moisture content as determined in accordance with GHD - 67.

SECTION 1.14 - REMOVING AND REPLACING PAVEMENT:

A. Removing Pavement: Remove existing pavement as necessary for installing the pipeline and appurtenances.

(1) Marking:

Before removing any pavement, mark the pavement neatly paralleling pipe lines and exiting street lines. Space the marks the width of the trench.

(2) Breaking:

Break asphalt pavement along the marks using jack hammers or other suitable tools. Break concrete pavement along the marks by use of jack hammers or by scoring with a rotary saw and breaking below the score by the use of jack hammers or other suitable tools.

(3) Machine Pulling:

Do not pull pavement with machines until completely broken and separated from pavement to remain.

(4) Damage to Adjacent Pavement:

Do not disturb or damage the adjacent pavement. If the adjacent pavement is disturbed or damaged, remove and replace the damaged pavement.

(5) Sidewalk:

Remove and replace sidewalks for their full width.

(6) Curbs:

Remove and replace or tunnel under any curb encountered.

B. Replacing Pavement:

Upon completion of backfilling and consolidation of the backfill, arrange to have the compaction tested by an independent testing laboratory approved by the Authority. After compaction testing has been satisfactorily completed, replace all pavements, sidewalks and curbs removed.

(1) Materials:

Place material for pavement replacement to dimensions shown on the Drawings. Typical replacement details are included in Appendix A.

(a) Graded Aggregate Sub-Base:

Furnish graded aggregate sub-base in two sizes of such gradation that when combined in approximately equal quantities, the resulting mixture is well graded from coarse to fine, meeting the gradation requirements of Section 816 of the State Highway Department of Georgia Standard Specifications.

(b) Black Base:

The base for all paved roadways shall conform to the requirements of the Georgia State Highway Department Specifications for the Black Base (Hot Mix). Use a Pug Mill Rotary Drum type mixer with minimum capacity of not less than 50 tons per hour for asphalt production. Apply and compact the base in two courses by asphalt spreader equipment of design and operation approved by the Authority. After compaction, the

black base shall be smooth and true to established profiles and Sections.

(c) Surface Course:

The surface course for all pavement, including Paint or tack coat when required by the Authority, shall conform to the requirements of the Georgia State Highway Department Specifications for Asphaltic Concrete, Section 400, Type "E" (Modified Top). Produce surface course in an asphalt plant of the same type as noted above for Black Base. Apply and compact the surface course in a manner approved by the Authority. Immediately correct any high, low or defective areas by cutting out the course, replacing with fresh hot mix, and immediately compacting to conform and thoroughly bond to the surrounding area.

(d) Concrete:

Provide concrete and reinforcing for concrete pavement in accordance with the requirements of Georgia State Highway Department Specifications for Portland Concrete Pavement, Section 430.

(2) Supervision and Approval:

Pavement restoration shall meet the requirements of the regulatory agency responsible for the pavement. Obtain agency approval of pavement restorations before requesting final inspection. Obtain the Authority's approval for restoration of pavement such as private roads and drives.

Complete pavement restoration as soon as possible after backfilling.

(3) Replacement:

Prior to replacing pavement, make a final cut in concrete pavement nine inches back from the edge of damaged pavement. Make the cut using a rotary saw. Remove asphalt pavement nine inches back from the edge of damaged pavement using jack hammers or other suitable tools.

Replace all street and roadway pavement as shown on the Drawings. Replace driveways, sidewalks, and curbs with the same material and to the same dimensions as existing.

(4) Failure of Pavement:

Should any pavement restoration or repairs fail or settle during the life of the contract, including the bonded and warranty period, promptly restore or repair defects.

SECTION 1.15 - BORING:

Furnish and install pipe casing and install the pipe line therein in accordance with the drawings and the following specifications:

A. General:

Where groundwater is encountered, operate well points or drainage systems in the vicinity of the casing to prevent the accumulation of ground water in the casing.

B. Pipe Casing:

Furnish all material and equipment and perform all labor required to install steel pipe casing at locations indicated on the Drawings and as specified.

(1) Boring:

The steel casing pipe shall be Schedule 30 steel pipe manufactured from steel plate having minimum yield strength of 35,000 PSI. The steel plate shall also meet the chemical requirements of ASTM A36. Size and thickness shall be as follows:

UNDER RAILROADS

Pipe Dia. In.	Casing Dia In.	Wall Thickness In.
6	14	0.250
8	18	0.250
10	20	0.281
12	22	0.312
14	24	0.344
16	30	0.406
18	30	0.406
20	32	0.469
24	36	0.469
30	42	0.500

UNDER HIGHWAYS

Pipe Dia In.	Casing Dia In.	Wall Thickness In.
6	12	0.250
8	16	0.250
10	16	0.250
12	18	0.250
14	22	0.250
16	24	0.250
18	30	0.312
20	30	0.312
24	36	0.375
30	42	0.375

C. Installation of Pipe:

(1) In Casing:

After installation of the casing is complete, install the pipe line by a method which has received prior approval of the Authority. The carrier pipe shall be supported at each joint or as recommended by the manufacturer. All stainless steel casing spacers as manufactured by Cascade or approved equivalent shall be used.

Close the ends of the casing with 4 inch brick walls, plastered with Portland Cement mortar and waterproofed with asphaltic roofing cement.

Leave a 4 inch x 8 inch opening at the bottom of the lowest closure for drainage.

SECTION 1.16 - STREAM AND DITCH CROSSING:

At all points where banks of streams or drainage ditches are disturbed by excavation or where natural vegetation is removed, carefully compact backfill and place rip rap or an approved erosion control fabric where applicable to prevent subsequent settlement and erosion.

This requirement applies equally to construction alongside a stream or drainage ditch as well as crossing stream or drainage ditch. Place rip rap a distance of not less than 10 feet upstream and 10 feet downstream from any disturbed area. Extend rip rap from 1 foot below streambed to top of bank. Place to conform with the natural slope of the stream bank. Use only one method, either (a) or (b), throughout the job.

A. Stone Rip Rap:

Use sound, tough, durable stones resistant to the action of air and water. Slabby or shaley pieces will not be acceptable. Specific gravity shall be 2.0 or higher.

Maximum weight of individual stones shall be 50 pounds. The maximum allowable dimension for an individual stone is 24 inches. The minimum allowable dimension for an individual stone is 6 inches. At least 50% of the stones shall have a minimum dimension of 12 inches. A geotextile fabric shall be placed over the entire ditch and extend outward on either side a minimum of 10 feet.

Rip rap shall be placed on a (6) inch layer of soil, crushed stone, or sand overlaying the fabric. Rip rap shall be placed with its top elevation conforming with the finished grade or the natural existing slope of the stream bank and stream bottom. The stone shall be dropped no more than three feet during construction.

Embed stone rip rap by hand so as to form a compact layer at least 12 inches thick. Place rip rap in such a way that the smaller stones are not segregated but evenly distributed. Place chinking stones in the crevices between the larger stones so that a dense, well graded mass is produced.

B. Sand-Cement Bag Rip Rap:

Use cement sacks or burlap bags having a capacity of from 1 to 2 cubic feet. Do not use bags previously used for sugar or chemicals. Fill bags with a mixture of one part Portland Cement to five parts sand.

Embed bags by hand to form a compact layer at least 12 inches thick. Place with overlapping joints. The finished surface shall not deviate from that specified by more than 3 inches at any point.

- C.** When the depth of cover on the pipe at the bottom of the creek is less than 24 inches, encase the pipe with concrete. The width and depth shall be a minimum of pipe OD+16" or as directed by the Engineer.

SECTION 1.17 - TESTING:

When a length of pipe approved by the Authority is ready for testing, fill the line with water, bleed out all air and make a leakage test.

A. Preparation:

Provide a test pump, an accurate water meter, and all other accessories required to make

the test. Provide a corporation stop at each high point on the pipe to bleed off air. Provide and remove all temporary bulkheads, plugs, and flanges required to perform the pressure test.

B. Test Pressure and Leakage: (According to AWWA C600)

Or test the pipeline at 150 psi measured at the highest point or 1.25 times the normal static pressure whichever is greater. The pressure can't drop more than 5 psi or leakage shall not exceed 0.12 gallons per hour per inch diameter per thousand feet. Test for a minimum of two hours.

The gate valve when tested at the rated working pressure or at a minimum of 250 psi shall show no leakage through the metal or at flange joints.

If leaks are detected, locate, repair and retest. If results are not totally satisfactory, the Authority may require additional testing.

C. Existing Valves:

Do not operate valves in the existing system without the specific authorization and direct supervision of the Authority.

D. Tapping Sleeve and Tapping Valve: All tapping sleeves and tapping valves shall be air or water tested to a pressure of 200 psi prior to making the tap into an existing main. Any leaks shall be detected by applying a soap solution to all sealing surfaces. The seal and the valve shall be adjusted and retested as necessary until no leaks are observed. After the sleeve and valve have been tested satisfactorily, the existing main can be tapped. All testing and tapping shall be done in the presence and at the discretion of a representative of Macon Water Authority.

SECTION 1.18 - DISINFECTION OF WATER MAINS:

- A.** All new water mains shall be disinfected before they are placed in service. All water mains taken out of service for inspection, repair or other activities that might lead to contamination of water shall be disinfected before they are returned to service.
- B.** Disinfection of the new mains and the disposal of the heavily chlorinated water, following the disinfection, shall be accomplished in accordance with the latest edition of AWWA Standard C651. Field Dechlorination shall be in accordance with AWWA C655-09 or latest edition.

SECTION 1.19 - PROTECTION AND RESTORATION OF WORK AREA:

Protection and Restoration of Work Area shall be in accordance with Section 2.23.

ARTICLE II
STANDARDS FOR DESIGN
AND
CONSTRUCTION SPECIFICATIONS
FOR
WASTEWATER COLLECTION

PREFACE: This Sewer Design Guide is a guide for the Engineer when planning and designing wastewater facilities. This guide summarizes and outlines policy, applicable Codes and Engineering and operational practices and procedures that have been developed to establish a cost effective, reliable, and safe wastewater collection system. Also to be considered and used in conjunction with this design guide are all applicable current standard drawings, specifications, and industry requirements for the planning and design of wastewater infrastructure.

This guide is not a substitute for professional experience, nor is it meant to relieve the engineer from his/her responsibility to use good engineering judgment. The Engineer shall be responsible for providing a design that, within industry standards, can be safely repaired and maintained, will provide good service and life, and will not create a public nuisance or hazard. Under most conditions, this guide serves as a minimum standard.

SECTION 2.01 - PURPOSE:

This section of the Specifications describes products to be incorporated into the sewers and requirements for their installation and use. The Contractor/Developer shall furnish all products and perform all labor necessary to fulfill the requirements of these Specifications. The word "Authority" used herein shall mean the Macon Water Authority.

SECTION 2.02 - GENERAL:

A. Applicable Standards:

Supply all products and perform all work in accordance with applicable American Society for Testing and Materials (ASTM), American Water Works Association (AWWA), American National Standards Institute (ANSI), or other recognized standards. Latest revisions of all standards are applicable. If requested by the Authority, submit evidence that manufacturer has consistently produced products of satisfactory quality and performance over a period of at least two years.

B. Substitutions:

Whenever a product is identified in the Specifications by reference to manufacturer's or vendor's names, trade names, catalog numbers, etc., the Contractor/Developer may freely choose from those referenced products which ones he wishes to provide.

Any item or product other than those so designated shall be considered a substitution. The Contractor/Developer shall obtain prior approval from the Authority for all substitutions.

C. Warranty:

Wastewater collection systems installed by a Contractor/Developer which are accepted by the Authority for ownership, operation and maintenance shall be warranted and guaranteed for a period of one year from the date of final acceptance that the completed system is free from all defects due to faulty products or workmanship and the Contractor/Developer shall make such corrections as may be necessary by reason of such defects upon notice by the Authority.

D. Easements and Rights-of-Way:

Wastewater collection systems installed by a Contractor/Developer which are accepted by the Authority for ownership, operation and maintenance shall be installed in either dedicated streets or easements. Easements shall be properly executed and recorded.

The minimum easement width shall be (20) feet. Additional width may be required depending on depth of the line, soil conditions and accessibility. The easements shall be cleared of all structures, trees, shrubs, brush, logs, upturned stumps and roots of downed trees and similar items.

No permanent structure shall be built on the easement. Temporary structures such as fence, driveway, etc. can be installed on the permanent easements; but it shall be the responsibility of the owner to remove, if necessary, or repair such structures if they are disturbed when the Authority works on the water and sewer mains within the easement. The owner shall obtain written permission of the Authority before the installation of such temporary structures.

SECTION 2.03 - DRAWINGS AND SUBMITTALS:

A. Contractor/Developer's Review:

The Contractor/Developer shall review and check drawings and submittals. He shall indicate his approval by initials and date. The Contractor/Developer shall furnish the Authority with a minimum of four copies of all submittals. A transmittal form shall accompany each submittal or group of submittals.

B. Authority's Review:

All submittals will be reviewed, stamped, and dated by the Authority before they are returned to the Contractor/Developer.

Acceptable submittals will be approved in writing with one copy returned to the Contractor/Developer and the remaining copies retained by the Authority. Submittals requiring minor corrections before being acceptable will be so noted. Drawings must be resubmitted for review and approval prior to installation or use of products.

C. Drawings for Construction:

Drawings or other submittals not bearing the Authority's approval notation shall not be issued to subcontractors or utilized for construction purposes. The Contractor/Developer shall maintain at the job site a complete set of construction drawings bearing the Authority's approval.

D. The Owner/Contractor shall submit two copies of "as-built" plans and one digital copy in AutoCAD format after the completion of construction but before the project is accepted for operation and maintenance by the Macon Water Authority. The "as-built" plans shall be prepared and stamped by a registered Land Surveyor or Professional Engineer. The plans shall include the following information for the sewer portion of a project: Location of sewer mains, manholes, including rim and invert elevations, distance and angles between manholes, distance of each sewer lateral from manholes and their length, width of easements and any pertinent information.

All sewer mains (type, size) and appurtenances such as manholes, laterals, cleanouts, pump stations, etc. shall be located and tied to Bibb County State Plane Coordinates. Also distance between manholes, rim and invert elevations and sewer profiles.

All other relative information, such as rights-of-way, property corners, stake plans along easements, etc. shall also be located and tied to Bibb County State Plane Coordinates.

SECTION 2.04 - PIPE AND ACCESSORIES:

All materials, unless otherwise specified or approved equal, shall be in accordance with the Buy America requirements of Federal regulations 23 U.S.C. 313 and 23 CFR 635.410. Acceptance will be on the basis of the Authority's inspection and receipt of the manufacturer's written certification that the material was manufactured and tested in accordance with the applicable standards. All pipe shall be subject to the inspection of the Authority at the pipe plant, job site, or other point of delivery for the purpose of rejecting pipe not conforming to these Specifications.

A. Ductile Iron Pipe:

Ductile iron pipe shall be utilized in force mains, stream crossings, railroad crossings, all piping inside (carrier pipe) steel casing, and other applications deemed necessary by the Authority. Ductile iron pipe shall be installed at locations where depth of cover is less than 3 feet and more than 20 feet. All pipe shall be furnished in lengths of at least 20 feet. All ductile iron pipe shall be lined with Protecto 401 Epoxy to include fittings for gravity pipe and force mains. **(In any and all applications, ductile iron pipe shall be used only at the direction of the Authority).**

(1) Pipe:

Ductile iron pipe shall conform to ANSI/AWWA C151/A21.51 and shall be a minimum of Pressure Class 350 up to a diameter of (12) inches and Pressure Class 350 above (12)inches diameter. Pipe shall be furnished with a bituminous outside coating and lined with Protecto 401 Ceramic Epoxy coating on the inside.

(2) Joints:

Joints shall be push-on type for pipe and standard mechanical joints for fittings. Joints shall conform to ANSI/AWWA C111/A21.11. Retrained joint pipe (RJP) shall be either the bolted joint type, or modified push-on type with joint restraint using ductile iron components. Retrained joint pipe on piers shall have bolted joints and shall be specifically designed for clear spans of at least 36 feet. Retrained joint pipe where required shall be American, U.S. Pipe, Clow, or equal.

When installed in a casing the pipe shall be supported at every joint, as recommended by the manufacturer. Casing spacers shall be stainless steel as manufactured by Cascade, or approved equal.

(3) Acceptance:

Acceptance will be on the basis of the Authority's inspection and receipt of the manufacturer's written certification that the pipe was manufactured and tested in accordance with the applicable standards.

B. Polyvinyl Chloride Gravity Sewer Pipe:

PVC gravity sewer pipe shall be supplied in lengths not longer than 13 feet. The PVC pipe can be installed between a minimum depth of 3 feet to a maximum depth of 20 feet. Ductile iron pipe shall be installed in depths up to 3 ft and depths beyond 20 feet (**only at the direction of the Authority**).

(1) Pipe:

PVC gravity sewer pipe shall be manufactured with ASTM D3034, SDR 26 pipe.

Nominal Size	Outside Diameter Average Tolerance	Minimum Wall Thickness
8"	8.400 +/- 0.018	0.323
10"	10.500 +/- 0.020	0.404
12"	12.500 +/- 0.024	0.481

Minimum "pipe stiffness" (F/Y) at 5% deflection shall be 46 for all sizes when tested in accordance with ASTM Designation D-2412. External loading properties of plastic pipe shall be determined by Parallel Plate Loading Test.

Installation of PVC sewer pipe shall be in accordance with the provisions of ASTM-2321, "Underground Installation of Flexible Thermoplastic Sewer Pipe" with additional bedding as required in these specifications.

(2) Joints:

Joints for pipe and fittings shall be of the bell and spigot type with a confined elastomeric gasket having the capability of absorbing expansion and contraction without leakage. The joint system shall be subject to the approval of the Authority and shall be identical for pipe and fittings.

Fittings for pipe eight inches and less in diameter shall be of the bell and spigot type with a confined elastomeric gasket having the capability of absorbing expansion and contraction without leakage. The joint system shall be subject to the approval of the Authority and shall be identical for pipe and fittings.

Fittings for pipe eight inches and less in diameter shall be one piece with no solvent-welded joints. Fittings for pipe ten inches and larger may be fabricated using solvent welding. No field fabrication or fittings will be allowed. All such fabrication shall be performed at the factory and the fittings delivered ready for use.

(3) Detection Tape:

Detectable Mylar encased aluminum foil marking tape will be installed over all sewer pipe and sewer lateral. Tape will be "green" in color, at least 3-inches wide and shall bear the printed identification "Caution: Buried Sewer Line Below" (reverse printed), so as to be readable through the Mylar. Surface printing on the tape shall be equal to Lineguard Type II Detectable. Refer to (S-14).

(4) Acceptance:

Acceptance will be on the basis of the Authority's inspection and receipt of the manufacturer's written certification that the pipe was manufactured and tested in accordance with the applicable standards.

C. Check Valves:

Check valves shall be hinged disc type with cast iron body and bronze or bronze-fitted disc. Valves shall be designed for the operating head indicated and shall not slam shut on pump shutdown. Valves shall be equipped with 1/2-inch stop cock at the high point of the valve for bleeding air from the line.

Valves of the outside weight and lever cushioned type shall have the cushion chamber attached to the side of the valve body externally and constructed with a piston operating in a chamber that will effectively prevent hammering action at the pump discharge heads specified. The cushioning shall be by air, and the cushion chamber shall be so arranged that the closing speed will be adjustable to meet the service requirements.

Weight and lever cushioned type valves shall be manufactured by G-A Industries, or equal.

Spring and lever type valves shall be manufactured by G-A Industries, Dresser M & H, Mueller.

D. Automatic Air and Vacuum Valves:

Valves shall be automatic air and vacuum valves designed to allow escape of air, close water-tight when liquid enters the valve and allow air to enter in the vent of a vacuum. The valve body shall be cast iron, designed to facilitate disassembly for cleaning and maintenance. The float shall be stainless steel; the valve seat and all working parts shall be of corrosion resistant materials. Valves shall be recommended by the manufacturer for wastewater service. Air and vacuum valves shall be equal to Apco Valve Corporation, or Val-Matic, or approved equal.

E. Adaptor Couplings:

Adaptors shall be elastomeric plastic sleeves designed to connect pipes of dis-similar materials. Adaptors shall provide a positive seal against infiltration and exfiltration, be root-proof and remain leak proof up to 10 psi. The adaptor manufacturer shall provide steel clamps, adaptor donuts and other required accessories.

Couplings for a DIP/PVC transition joint shall be ductile iron as manufactured by Ford Meter Box Co. or JCM Industries, Inc., or approved equal and shall be installed in accordance with the manufacturer's recommendations.

- F.** In lieu of Ford Transition Coupling, a transition coupling, Flex Seal ARC, manufactured by Mission Rubber Company could be used. The coupling shall be stainless steel shielded sewer coupling with a gasket meeting ASTM C-425-91. The stainless steel shear ring shall have a minimum thickness of 0.012 inches. Nuts, bolts, shearing, clamps shall be of 316 grade stainless steel meeting or exceeding all requirements of ASTM A-167.

G. Materials for Manholes:

Provide materials for construction of manholes in accordance with the following: (ASTM A615, ASTM D4101)

(1) Precast Concrete Sections:

Precast concrete sections shall meet the requirements of ASTM C 478. The minimum compressive strength of the concrete in precast sections shall be 4,000 psi. The minimum shell thickness shall be one twelfth of the inside diameter of the riser.

Seal joints between precast sections by means of rubber "o" ring gaskets or flexible butyl rubber sealant. Butyl rubber sealants shall meet the requirements of ASSHTO -198. Sealant shall be pre-formed type with a minimum nominal diameter of 1-inch. Butyl rubber sealant shall be equal to Kent Seal No. 2 or Kor-N-Seal 300.

(2) Brick and Mortar:

Brick shall be whole and hardburned, conforming to ASTM C32 Grade MS. Concrete bricks, when used, shall conform to the specification for concrete building brick ASTM C55, Grade A. Mortar shall be made of one part Portland Cement and two parts clean sharp sand. Cement shall be type 1 and shall conform to ASTM C150. Sand shall meet ASTM C53.

(3) Iron Castings:

Cast iron manhole frames and covers shall be gray iron, conforming to ASTM A 48 for Class 35B gray iron and applicable local standards. All castings shall be tough, close grained, smooth and free from blow holes, blisters, shrinkage, strains, cracks, cold shots and other imperfections. No casting will be accepted which weighs less than 95% of the design weight. Shop drawings must indicate the design weight and provide sufficient dimensions to permit checking.

Manhole frames and covers shall be equal to the following:

<u>Type</u>	<u>Design Weight</u>	<u>Standard</u>	<u>Clear Opening (In.)</u>	<u>Manufacturer's Reference</u>
Non-Traffic	325 lbs.	ASTM 48, Class 35B	22.375	USF 195E
Traffic	425 lbs.	ASTM 48, Class 35B	22	USF 604
Watertight	360 lbs.	ASTM 48, Class 35B	24	USF 576BH
Watertight Traffic	360 lbs.	ASTM 48, Class 35B	24	USF 576BH
Watertight	400 lbs.	ASTM 48, Class 35B	20.625	USF 420C
Watertight Traffic	400 lbs.	ASTM 48, Class 35B	20.625	USF 420C
Watertight Traffic	380 lbs.	ASTM 48, Class 35B	30	USF 692
Non-Traffic	308 lbs.	ASTM 48, Class 35B	20	Neenah R-1700-A
Traffic	309 lbs.	ASTM 48, Class 35B	21	Neenah R-1713
Traffic	335 lbs.	ASTM 48, Class 35B	22.25	Neenah-R-1726-A
Watertight	342 lbs.	ASTM 48, Class 35B	24	Neenah R-1916-F
Watertight Traffic	342 lbs.	ASTM 48, Class 35B	24	Neenah R-1916-F
Traffic	580 lbs.	ASTM 48, Class 35B	30	Neenah R-1916-H
Watertight (Bolted lid)	580 lbs.	ASTM 48, Class 35B	30	Neenah R-1916-H

All frames and covers shall have machined horizontal bearing surfaces.

Bolt-down covers shall be equipped with four ½ inch stainless steel bolts and a 1/8-inch neoprene o-ring gasket. Covers shall be rotatable and interchangeable. Bolt holes shall be bored through so that debris entering the bolt hole will fall into

the manhole.

Provide neoprene boot seal where sewer enters manhole. Openings for pipes entering or leaving the manholes shall be core drilled at the plant or site. All pipes entering and leaving the manhole shall be provided with neoprene boot seal.

(4) Manhole Steps:

The Authority does not allow manhole steps to be used within our sanitary sewer system. The Macon Water Authority policy mandates that all steps be deleted from the manhole before final inspection of the manhole is performed. Holes shall be grouted with hydraulic cement or approved equivalent.

SECTION 2.05 - LOCATION AND GRADE:

A. The Drawings shall show the alignment and grade of the sewer and the position of manholes and other appurtenances. The grade line shown on the profile and/or called for in the plan shall be the grade of the invert of the pipe. The grade shall be sufficient to maintain a minimum gravity flow velocity of two feet per second when the pipe is flowing half-full.

B. Slopes:

All sewers shall be designed and constructed to generate mean velocities when flowing half-full of not less than 2.0 feet per second based on Manning's formula using an "n" value of 0.013. The following are minimum slopes which should be provided, however, slopes greater than these are desirable.

Sewer Size In.	Minimum Slope Ft./100 Ft.
8	0.40
10	0.28
12	0.22
14	0.17
15	0.15
16	0.14
18	0.12
21	0.10
24 and larger	0.08

Slopes less than 0.08 for pipe sizes larger than 24-inches may be approved by the Authority on a case by case basis. Slopes resulting in mean velocities when flowing full of greater than 10 feet per second must be approved by the Authority before construction. Sewers shall be laid with uniform slope between manholes.

Sewers on slopes of 20 percent or greater shall be anchored securely with concrete anchors or equal. Anchor spacing shall be as follows:

Minimum Center to Center Spacing	Slope
36 feet	20% to 35%
24 feet	35% to 50%
16 feet	Greater than 50%

SECTION 2.06 - EXISTING UNDERGROUND UTILITIES AND OBSTRUCTIONS:

It is the responsibility of the Contractor/Developer to locate all existing utilities along the path of his construction. The drawings of the Contractor/Developer shall indicate underground utilities or obstructions that are known to exist. Where unforeseen underground utilities or obstructions are encountered, the location and alignment of the sewer may be changed, upon written approval of the Authority, to avoid interference. It is the responsibility of the Contractor to contact the Utilities Protection Centers, Inc. ("Call Before You Dig" - 1-800-282-7411 or 811) prior to the start of any excavation or construction.

A horizontal separation of 10 feet shall be maintained between water mains and sanitary sewer. The distance shall be measured edge to edge. When a water main must cross a sewer, the water main and/or sewer shall be laid such that the top of the sewer is at least 18" below the bottom of the water main. When this requirement cannot be met both the water main and the sewer shall be constructed of ductile iron pipe with ductile iron pipe for a distance of 10 feet on each side of the point of the crossing on both the water main and sewer. **(At the discretion of the Authority, the sewer main shall be encased in concrete per MWA standard detail S-11. In any and all applications, ductile iron pipe shall be used only at the direction of the Authority).**

SECTION 2.07 - CONSTRUCTION ALONG HIGHWAYS, STREETS AND ROADWAYS:

Install pipe lines and accessories along highways, streets and roadways in accordance with the applicable regulations of the City of Macon, Bibb County and/or the Department of Transportation with reference to construction operations, safety, traffic control, road maintenance and repair.

A. Protection of Traffic:

Provide and maintain suitable signs, barricades and lights for protection of traffic. Replace all highway signs removed for construction as soon as possible. Do not close or block any highway, street, or roadway without first obtaining permission from the proper authorities.

Provide qualified/certified flagmen to direct and expedite the flow of traffic.

B. Construction Operations:

Perform all work along highways, streets and roadways to least interfere with traffic.

(1) Stripping:

Where the pipe line is laid along road shoulders, strip and stockpile all sod, topsoil and other material suitable for shoulder restoration.

(2) Trenching, Laying and Backfilling:

Do not open the trench any further ahead of pipelaying operations than is necessary. Backfill and remove excess material immediately behind laying operations. Complete excavation and backfill for any portion of the trench in the same day.

(3) Shaping:

Reshape damaged slopes, side ditches and ditch lines immediately after completing backfilling operations. Replace topsoil, sod and any other materials removed from shoulders.

C. Excavated Materials:

Do not place excavated material along highways, streets and roadways in a manner which obstructs traffic. Sweep all scattered excavated material off the pavement.

D. Drainage Structures:

Keep all side ditches, culverts, cross drains, and other drainage structures clear of excavated material and free to drain at all times.

E. Maintaining Highways, Streets, Roadways and Driveways:

Maintain streets, highways, and roadways in suitable condition for movement of the work. Use steel running plate to maintain traffic until pavement replacement is completed.

Repair all driveways that are cut or damaged immediately. Maintain them in a suitable condition for use until completion and final acceptance of the work. Saw cut all driveways, paved parking areas, paved roadways and paved sidewalks.

SECTION 2.08 - CLEARING:

Clear the permanent easement before excavating. Remove all trees, growth, debris, stumps and other objectionable matter. Clear the construction easement only if necessary and take special

care to adhere to the requirements of Paragraph 1.19.

SECTION 2.09 - EXCAVATION:

Excavate trenches by open cut. Perform all excavation in accordance with the Occupational Safety and Health Act of 1970 (PL 91-596), and any subsequent amendments to this Act.

A. Dimensions:

Excavate trenches to the depths shown on the drawings for each class of bedding and for manholes and other structures. Excavate the top portion of the trench to any width within the construction easement which will not cause unnecessary damage to adjoining structures, roadways, pavements, utilities, trees, or private property.

Excavate the lower portion of the trench to a width no greater than the outside diameter of the pipe plus 18 inches. Maintain this width up to two feet above the pipe.

If trenches are excavated to excessive dimensions or collapse because of inadequate or improperly placed bracing and sheeting, lay the pipe with the next better class of bedding. If excavation for manholes and other structures is made to excessive depth, backfill with compacted bedding material to the required grade.

B. Bracing and Sheeting:

When required by regulations or to prevent damage to adjoining structures, roadways, pavements, utilities, trees, or private property, which are specifically required to remain, provide bracing and sheeting.

(1) Timber:

Timber for shoring, sheeting or bracing shall be sound and free of large or loose knots and in good condition. Size and spacing shall be in accordance with OSHA regulations.

Remove bracing and sheeting in units when backfill reaches the point necessary to protect the pipe and adjacent property. Leave sheeting in place when in the opinion of the Authority it cannot be safely removed. Cut off sheeting left in place at least two feet below the surface.

(2) Steel Sheet Piling:

Continuous lockjoint steel sheet piling may be substituted for timber sheeting when approved by the Authority. Steel piling may be removed, without cutting, provided the rate of removal is kept in place with the tamping and backfilling operations to assure complete filling of the void created by the withdrawal of the piling. Complete withdrawal of the piling in advance of the tamping and

backfilling will not be permitted. Piling, where ordered to be left in place by the Authority for reasons of safety, will be cut off where directed.

C. Dewatering Trenches:

Dewater excavation continuously to maintain a water level below the bottom of the trench. Dewater running sand by well pointing. Where soil conditions do not permit use of well point, construct french drains of crushed stone or gravel to conduct water to the sumps.

D. Trench Stabilization:

Wherever the material at the bottom of the trench is unsuitable for the proper installation of the pipe, the Authority will direct the removal and replacement of the unsuitable material.

When so directed, undercut the trench and backfill with bedding material. Place and compact this material to bring the trench to the required grade.

E. Rock Excavation:

(1) Definition of Rock:

Any material which cannot be excavated with a backhoe, having a bucket curling force rated at not less than 18,300 pounds (Caterpillar Model 215 or equal), and occupying an original volume of at least one-half cubic yard.

(2) Excavation:

Where rock is encountered in trenches excavate to the minimum depth which will provide clearance below the pipe barrel of 8 inches for pipe 21 inches in diameter and smaller and 12 inches for larger pipe and manholes. Remove boulders and stones to provide a minimum of 6 inches clearance between the rock and any part of the pipe or manhole.

(3) Blasting:

Provide experienced workmen to perform blasting. Conduct blasting operations in accordance with all existing ordinances and regulations. Protect all structures from the effects of the blast. Repair any resulting damage.

If the Contractor persistently uses excessive blasting charges or blasts in any unsafe or improper manner, the Authority may direct that Contractor/Developer to employ an independent blasting consultant to supervise the preparation for each blast and approve the quantity of each charge.

(4) Removal of Rock:

Do not use excavated rock as backfill material. Dispose of rock which is surplus or not suitable for use as rip rap.

SECTION 2.10 - BEDDING OF SEWER:

Bed pipeline in accordance with the detail drawings included in Appendix A and the following specifications:

A. Bedding Materials:

(1) Ductile Iron Gravity Sewer:

All bedding materials shall be crushed stone unless shown or specified otherwise. Crushed stone bedding material shall meet the requirements of Georgia Department of Transportation Specification 800.01 for No. 57 stone.

(2) PVC:

Bedding materials shall be crushed stone per ASTM D 2774 unless shown or specified otherwise. Crushed stone bedding material shall meet the requirements of Georgia Department of Transportation Specification 800.01 for No. 78 stone.

(3) Manholes:

Bedding material shall be crushed stone unless shown or specified otherwise. Crushed stone bedding material shall meet the requirements of Georgia Department of Transportation Specification 800.01 for No. 57 stone.

(4) Ductile Iron Force Main:

Bedding material shall be coarse sands and gravels with a maximum particle size of 1 ½ inch, including variously graded sands and gravels containing small percentages of fines. These include Unified Soil Classification System (USCS) Soil Types SW, GP, SW, and SP.

B. General:

Compact stone bedding material by tamping or slicing with a flat-blade shovel. Prepare the trench bottom to support the pipe uniformly throughout its length. Provide bell holes to relieve pipe bells of all load. If the trench is excavated to excessive width or depth, provide the next better class of bedding. In rock trenches, bed pipe in at least six inches of suitable earth material.

C. Bedding Classifications:

Bedding shall be prepared in accordance with the following:

(1) Ductile Iron Pipe:

Excavate the trench to a depth of one-fourth the nominal diameter of the pipe or six inches whichever is greater. Place and compact the bedding material to proper grade. Place the pipe over bedding material. Bedding material shall then be placed and hand compacted to provide full support under the pipe and up to one third (1/3) Outside Diameter of the pipe. See detail (OT-2)

(2) PVC Pipe:

Excavate the bottom of the trench flat at a minimum depth shown on the Drawings below the bottom of the pipe barrel. Place and compact bedding material to the proper grade. Bedding shall then be carefully placed by hand and compacted to provide full support under the pipe and to a minimum depth of six inches above the crown of the pipe. See detail (OT-2)

(3) Flexible Pipe:

Embedment materials listed here include a number of processed materials plus the soil types defined according to the Unified Soil Classification System (USCS) in ASTM D2487, Standard Method for Classification of Soils for Engineering Purposes. (See Table 2.10-1 for description of soil classification). These materials are grouped into five broad categories according to their suitability for this application.

- (a) Class I** – Angular, ¼ to 1 ½ inches (6 to 40 mm) graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed shells, and crushed stone.

NOTE – The size range and resulting high voids ratio of Class I material make it suitable for use to dewater trenches during pipe installation. This permeable characteristic dictates that its use be limited to locations where pipe support will not be lost by migration of fine grained natural material from the trench walls and bottom of migration of other embedment materials into the Class I material. When such migration is possible, the material's minimum size range should be reduced to finer than ¼ inch (6 mm) and the gradation properly designed to limit the size of the voids.

- (b) Class II** – coarse sands and gravels with maximum particle size of 1 ½ in (40 mm), including variously graded sands and gravels containing small percentages of fines, generally granular and noncohesive, either wet or dry. Soil Types SW, GP, SW and SP and included in this class.

NOTE – Sands and gravels which are clean, or borderline between clean and with fines, should be included. Coarse-grained soils with less than 12% but more than 5% fines are neglected in ASTM D2487 and the USCS and should be included. The gradation of Class II material includes its density and pipe support strength when loosely placed. The gradation of Class II material may be critical to the pipe support and stability of the foundation and embedment, if the material is imported and is not native to the trench excavation. A gradation other than well graded, such as uniformly graded or gap graded, may permit loss of support by migration into void spaces of a finer grained natural material from the trench wall and bottom.

(c) **Class III** – Fine sand and clayey (clay filled) gravels, including fine sands, sand-clay mixtures, and gravel-clay mixtures. Soil Types GM, GC, SM and SC are included in this class.

(d) **Class IV** – Silt, silty clays, and clays, including inorganic clays and silts of low to high plasticity and liquid limits. Soil Types MH, ML, CH and CL are included in this class.

NOTE – Caution should be used in the design and selection of the degree and method of compaction for Class IV soils because of the difficulty in properly controlling the moisture content under field conditions. Some Class IV soils with medium to high plasticity and with liquid limits greater than 50% (CH, MH, CH-MH) exhibit reduced strength when wet and should only be used for bedding, haunching, and initial backfill in arid locations where the pipe embedment will not be saturated by ground water, rainfall, and/or exfiltration from the pipeline system. Class IV soils with low to medium plasticity and with liquid limits lower than 50% (CL, ML, CH-ML) also require careful consideration in design and installation to control moisture content but need not be restricted in use to arid locations.

(e) **Class V** – This class includes the organic soils OL, OH, and PT as well as soils containing frozen earth, debris, rocks larger than 1 ½ in. (40 mm) in diameter, and other foreign materials. These materials are not recommended for bedding, haunching or initial backfill.

Table 2.10-1 Soil Classification

DESCRIPTION OF EMBEDMENT MATERIAL CLASSIFICATIONS

SOIL CLASS	SOIL TYPE	DESCRIPTION OF MATERIAL CLASSIFICATION
CLASS I SOILS *	—	Manufactured angular, granular material, ¼ to 1½ inches (6 to 40 mm) size, including materials having regional significance such as crushed stone or rock, broken coral, crushed slag, cinders, or crushed shells.
CLASS II SOILS**	GW	Well-graded gravels and gravel-sand mixtures, little or no fines. 50% or more retained on No. 4 sieve. More than 95% retained on No. 200 sieve. Clean.
	GP	Poorly graded gravels and gravel-sand mixtures, little or no fines. 50% or more retained on No. 4 sieve. More than 95% retained on No. 200 sieve. Clean.
	SW	Well-graded sands and gravelly sands, little or no fines. More than 50% passes No. 4 sieve. More than 95% retained on No. 200 sieve. Clean.
	SP	Poorly graded sands and gravelly sands, little or no fines. More than 50% passes No. 4 sieve. More than 95% retained on No. 200 sieve. Clean.
CLASS III SOILS***	GM	Silty gravels, gravel-sand-silt mixtures. 50% or more retained on No. 4 sieve. More than 50% retained on No. 200 sieve.
	GC	Clayey gravels, gravel-sand-clay mixtures. 50% or more retained on No. 4 sieve. More than 50% retained on No. 200 sieve.
	SM	Silty sands, sand-silt mixtures. More than 50% passes No. 4 sieve. More than 50% retained on No. 200 sieve.
	SC	Clayey sands, sand-clay mixtures. More than 50% passes No. 4 sieve. More than 50% retained on No. 200 sieve.
CLASS IV SOILS	ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands. Liquid limit 50% or less. 50% or more passes No. 200 sieve.
	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays. Liquid limit 50% or less. 50% or more passes No. 200 sieve.
	MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts. Liquid limit greater than 50%. 50% or more passes No. 200 sieve.
	CH	Inorganic clays of high plasticity, fat clays. Liquid limit greater than 50%. 50% or more passes No. 200 sieve.
CLASS V SOILS	OL	Organic silts and organic silty clays of low plasticity. Liquid limit 50% or less. 50% or more passes No. 200 sieve.
	OH	Organic clays of medium to high plasticity. Liquid limit greater than 50%. 50% or more passes No. 200 sieve.
	PT	Peat, muck and other highly organic soils.

* Soils defined as Class I materials are not defined in ASTM D2487.

** In accordance with ASTM D2487, less than 5% pass No. 200 sieve.

*** In accordance with ASTM D2487, more than 12% pass No. 200 sieve. Soils with 5% to 12% pass No. 200 sieve fall in borderline classification, e.g., GP-GC.

PVC pipe requires No. 78 crushed stone.

DIP pipe requires No. 57 crushed stone.

Rigid Pipe:

Bedding requirements for rigid pipe materials shall be in accordance to ASTM D 2774. The Macon Water Authority permits the usage of Class “CS” bedding for all rigid pipe materials.

Class “CS” Bedding procedures: The pipe shall be bedded in granular material *carefully placed and* compacted on a firm trench bottom with a minimum thickness beneath the pipe of 4 inches sliced into the haunches of the pipe with a shovel or other suitable tool to the two inches above the crown of the pipe.

Class “D” bedding is NOT allowed for any pipe bedding.

(4) Suitable and Unsuitable Soil Materials:

The major properties of a soil proposed for use as a bedding material that are of concern to the design or construction engineer are its strength, permeability, and consolidation and compaction characteristics. Other features may be investigated for a specific problem, but in general, some or all of the properties mentioned are of primary importance. It is common practice to evaluate the properties of the soils in question by means of laboratory or field tests and to use the results of such tests as a basis for design and construction. The factors that influence strength, consolidation, and other characteristics are numerous, and some of them are not completely understood; consequently it is impractical to evaluate these features by means of a general soils classification. However, the soil groups in a given classification do have reasonably similar behavior characteristics. While such information is not sufficient for design purposes, it will give the engineer an indication of the behavior of a soil when used as a component in construction. This is especially true in the preliminary examination for a project when neither time nor money for a detailed soils-testing program is available.

(See Table 2.10-2)

Major Divisions (1)	(2)	Letter (3)	Symbols		Name (5)	Value As Subgrade When not Subject to Frost Action (7)	Value As Subbase When not Subject to Frost Action (8)	Value As Base When not Subject to Frost Action (9)	Potential Frost Action (10)	Compressibility and Expansion (11)	Drainage Characteristics (12)	Compaction Equipment (13)	Dry Unit Weight (pcf) (14)	Typical Design Values CBR (15) Subgrade Modulus (k lb per cu ft) (16)		
			Hatching (4)	Color (5)												
Coarse-Grained Soils	Gravel and Gravelly Soils	GW		Red	Well-graded gravels or gravel-sand mixtures, little or no fines	Excellent	Excellent	Good	None to very slight	Almost none	Excellent	Crawler-type tractor, rubber-tired roller, steel-wheeled roller	125-140	40-80	300-500	
		GP		Red	Poorly graded gravels or gravel-sand mixtures, little or no fines	Good to excellent	Good	Fair to Good	None to very slight	Almost none	Excellent	Crawler-type tractor, rubber-tired roller, steel-wheeled roller	110-140	30-60	300-500	
		GM _d		Yellow	Silty gravels, gravel-sand-silt mixtures	Good to excellent	Good	Fair to Good	Slight to medium	Very slight	Fair to poor	Poor to practically impervious	Rubber-tired roller, sheepfoot roller, close control of moisture	125-145	40-60	300-500
		GM _u		Yellow	Clayey gravels, gravel-sand-clay mixtures	Good	Fair	Poor to not suitable	Slight to medium	Slight	Poor to practically impervious	Rubber-tired roller, sheepfoot roller	115-135	30-40	200-500	
		GC		Yellow	Clayey gravels, gravel-sand-clay mixtures	Good	Fair	Poor to not suitable	Slight to medium	Slight	Poor to practically impervious	Rubber-tired roller, sheepfoot roller	130-145	20-40	200-500	
		SW		Red	Well-graded sands or gravelly sands, little or no fines	Good	Fair to good	Poor	None to very slight	Almost none	Excellent	Crawler-type tractor, rubber-tired roller, steel-wheeled roller	110-130	20-40	200-400	
	Sand and Sandy Soils	SP		Red	Poorly graded sands or gravelly sands, little or no fines	Fair to good	Fair	Poor to not suitable	None to very slight	Almost none	Excellent	Crawler-type tractor, rubber-tired roller, steel-wheeled roller	105-135	10-40	150-400	
		SM _d		Yellow	Silty sands, sand-silt mixtures	Fair to good	Fair to good	Poor	Slight to high	Very slight	Fair to poor	Rubber-tired roller, sheepfoot roller, close control of moisture	120-135	15-40	150-400	
		SM _u		Yellow	Silty sands, sand-silt mixtures	Fair	Poor to fair	Not suitable	Slight to high	Slight to medium	Poor to practically impervious	Rubber-tired roller, sheepfoot roller	100-130	10-20	100-300	
		SC		Yellow	Clayey sands, sand-silt mixtures	Poor to fair	Poor	Not suitable	Slight to high	Slight to medium	Poor to practically impervious	Rubber-tired roller, sheepfoot roller	100-135	5-20	100-300	
		ML		Green	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity	Poor to fair	Not suitable	Not suitable	Medium to very high	Slight to medium	Fair to poor	Rubber-tired roller, sheepfoot roller, close control of moisture	90-130	15 or less	100-200	
		CL		Green	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	Poor to fair	Not suitable	Not suitable	Medium to high	Medium	Practically impervious	Rubber-tired roller, sheepfoot roller	90-130	15 or less	50-150	
Fine-Grained Soils	OL		Green	Organic silts and organic silt-clays of low plasticity	Poor	Not suitable	Not suitable	Medium to high	Medium to high	Poor	Rubber-tired roller, sheepfoot roller	90-105	5 or less	50-100		
	MH		Blue	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	Poor	Not suitable	Not suitable	Medium to very high	High	Fair to poor	Rubber-tired roller, sheepfoot roller	80-105	10 or less	50-100		
	CH		Blue	Inorganic clays of high plasticity, fat clays	Poor to fair	Not suitable	Not suitable	Medium	High	Practically impervious	Rubber-tired roller, sheepfoot roller	90-115	15 or less	50-150		
	OH		Blue	Organic clays of medium to high plasticity, organic silts	Poor to very poor	Not suitable	Not suitable	Medium	High	Practically impervious	Rubber-tired roller, sheepfoot roller	80-110	5 or less	25-100		
	Pt		Orange	Peat and other highly-organic soils	Not suitable	Not suitable	Not suitable	Slight	Very high	Fair to poor	Compaction not practical	-	-	-		
	Highly Organic Soils															

NOTES: 1. Divisions of the GM and SM groups (column 3) into subdivisions of d and u are applicable to roads and airfields only. Subdivision is based on the LL and Pt; suffix d (for example, GMd) will be used when the LL is 25 or less and the Pt is 5 or less; the suffix u will be used otherwise.

D. Manholes:

Excavate to a minimum of 12 inches below the planned elevation of the base of the manhole. Place and compact stone bedding material to the required grade before constructing the manhole.

E. Force Mains:

Force mains shall be bedded in accordance with the detail in Appendix A and the following:

(1) Earth Trenches:

Grade the bottom of the trench to a true line. Lay the pipe in the bedding material.

(2) Rock Trenches:

Bed the pipe in at least six inches of bedding material. Backfill with the same material to at least six inches above the pipe.

(3) Wet Trenches:

Do not lay pipe in water. Provide dewatering equipment to maintain a ground water level below the bottom of the pipe while pipe is being laid.

(4) At end of each workday all open end pipe shall be capped with a plug.

F. Compaction:

Bedding under pipe and manholes shall be compacted to a minimum of 95 percent of the maximum dry density as determined by the Standard Proctor Compaction Test, ASTM D698. The Backfill in all trenches shall be compacted in accordance with section 1.13-C.

SECTION 2.11 - BACKFILL MATERIAL

- A.** The requirements of this Article shall apply to all backfill materials unless otherwise specified.
- B.** All material shall be suitable and free from roots, wood, scrap material, and other vegetable matter and refuse.
- C.** Acceptable material shall generally be a natural or artificial mixture of soil types normally found in natural deposits in the project vicinity or material obtained from the Contractor's excavations.

- D. All material shall be sufficiently dry for compaction and shall not contain excessive amounts of soft or highly plastic clays.
- E. Maximum size of stone shall not exceed four (4) inches.

SECTION 2.12 - SEWER ON PILING:

If unusually poor soil conditions are encountered and adequate dewatering fails to establish a soil condition suitable for laying pipe, the Authority may direct the Contractor/Developer to provide piling supports for pipe and manholes. Dewatering will not be considered adequate unless the water table is lowered to an elevation at least two feet below the trench bottom.

A. Drawings:

Submit to the Authority for review and approval construction drawings for the layout of piling, details of support slabs, saddles and beams, reinforcing and tie straps when required.

B. Piling:

Piles shall meet the requirements of ASTM D25 friction type. Piles shall be pressure tested with creosote to retain 12 pounds of oil per cubic foot. Pressure treatment shall meet the requirements of the American Wood Preserver's Association Standard C 3. Piles shall be 30 feet in length and shall have a minimum tip diameter of 8 inches.

C. Driving:

Drive piles by a mechanical hammer having a rated energy of 15,000 - 20,000 foot pounds. A drop hammer is not acceptable. Submit technical literature on the hammer proposed for use for review by the Authority and determination of specific refusal criteria.

D. Saddles and Manhole Support Slabs:

After driving, cut the pile at the required elevation and pour a concrete saddle or manhole support slab in accordance with the approved construction drawings.

E. Installation of Pipe:

After concrete work is completed, install pipe and manholes in accordance with the details shown on the approved construction drawings. After pipe is secured in position, proceed with backfilling as specified elsewhere.

SECTION 2.13 - MANHOLES:

A. General Design Considerations:

All manholes shall be constructed in accordance with the Macon Water Authority Standards. Typical manhole details are included in appendix A-MWA S2.

B. Required Location:

Manholes shall be required at all of the following locations:

- 1) Change of grade
- 2) Changes in pipe size
- 3) At the intersection of mains
- 4) At the terminus of dead-end sewers
- 5) Change of flow direction

C. Prohibited Locations:

- 1) Inaccessible areas
- 2) Gutters and other depressions or areas subject to inundation
- 3) In freeway ramp
- 4) Between railroad tracks or within the right-of-way of railroad tracks.

D. Distance Between Manholes:

The distance between manholes shall not be greater than those shown in Table A.

TABLE A

Sewer Size (Inches)	Maximum Distance Between Manholes in Feet
8 - 12	400
15 and over	450

E. Precast Concrete:

Handle sections carefully to prevent cracking or chipping. Provide uniform bedding of the bottom section to prevent uneven loading. If preformed openings must be enlarged or altered, or if new openings must be made in the field, minimize the amount of material removed to provide closely matched surfaces for grouting. Install gaskets in accordance with manufacturer's recommendations to produce a watertight structure. Manhole gaskets shall be installed as an integral part of the base section for a proper seal between pipe and the manhole.

F. Brick:

Bed the bottom and sides of every brick in mortar. Apply a smooth coat of mortar, $\frac{3}{4}$ inches thick, on the inside and outside.

G. Inverts:

Form channels as shown on the drawings, rounded and troweled smooth. Maintain consistent grade through the invert. Seal the connection of pipes to the manhole with brick and mortar on the inside and outside.

H. Future Laterals:

Where future laterals have been identified, provide the first length of pipe for future lateral sewers, properly laid to alignment and grade and plugged using a plug specifically designed for the size and material of the pipe. Plug the end of the pipe at the manhole. Extend the lateral up to the road right-of-way or property line and install a cleanout at the property line as shown in Appendix A.

I. Top Elevations:

Build manholes outside of paved area to 18 inches above ground unless otherwise shown on the plans or directed by the Authority. Build manholes in paved areas to existing grades.

J. Drop Connections:

Manholes requiring drop connections shall be shown on the drawings. Construct drop connection of the same materials as the upstream sewer and in accordance with the details shown in Appendix A.

K. PVC Connections:

Make all manhole connections to PVC pipe with the connector specified. Couplings shall be grouted into the manhole opening after jointing with the PVC pipe.

SECTION 2.14 - PUMPING STATIONS:

Pumping stations will be constructed only in locations approved by the Authority. Plans, design criteria and detailed description of the proposed installation and the equipment to be incorporated shall be submitted and written approval of the Authority obtained before any related construction is begun. Installations must meet the following minimum requirements:

A. Site Improvements:

The site shall be fenced with minimum 6-foot high chain link fencing with 16-foot double gate. Access to the site and the size of the fenced area shall permit access by maintenance vehicles. The area within the fence shall have a minimum 6-inch layer of crushed stone placed over a 10 mil sheet of polyethylene. All piping within the fenced area shall be DIP or copper.

B. The Contractor shall furnish and install one factory-built automatic pumping station. The station shall be complete with all needed equipment, factory installed in a fiberglass enclosure.

The principal items of equipment shall include two vertical close-coupled, motor-driven, vacuum primed, "Non-Clog" sewage pumps, valves, internal piping, central control panel with circuit breakers, motor starters and automatic pumping level controls, priming pumps and appurtenances, ventilator heater and all internal wiring.

The unit shall be as manufactured by Smith & Loveless of Lenexa, Kansas, or the Gorman-Rupp Company, Mansfield, Ohio, or approved equal.

C. Operating Conditions:

The pumping station shall be a duplex station designed for the following conditions:

No. of Pumps	Capacity	Total Head	RPM	Min. HP	Voltage
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(Fill in the design conditions for the station)

All openings and passages shall be large enough to permit the passage of a sphere 3" in diameter and any trash or stringy material which can pass through a 4" house-collection system.

D. Pump Chamber:

The station shall be constructed in one complete factory-built assembly. It shall be sized to reason on the top of a standard 6' diameter manhole. The pump chamber shall have a low profile, as shown on the drawings and shall be of fiberglass construction. The floor plate shall be a minimum 3/8" thickness steel plate. The plate chamber shall have a suitable drip lip around the edge and shall have provisions for a weatherproof pin tumbler lock.

The cover shall have a latch mechanism to keep the cover open under any normal load. A cover plate, exterior to the pump chamber, complete with hasp and staple shall be provided integral with station base to provide access to the wet well. Adjustable ventilating louvers shall be provided on each end of the fiberglass cover which are capable of being closed during cold weather operation.

A stanchion with lifting arm shall be provided to lift each pump. The lifting arm shall have a hook over the center of the motor to support a hoist to facilitate easy removal of the motors, impellers and pumps from the station.

E. Welding:

All steel structural members shall be joined by electrical arc welding with welds of adequate section for the joint involved.

F. Protection Against Corrosion:

After welding, all inside and outside surfaces of the structure shall be blasted with steel grit to remove rust, mill scale and weld slag. All weld spatter and surface roughness shall be removed by grinding. Immediately following the cleaning, a single heavy inert coating shall be factory-applied to all inside and outside surfaces prior to shipment. This coating shall be of epoxy resin for abrasion and corrosion resistance. The dry coating shall contain a minimum of 85% epoxy resin with the balance being pigments and thixotropic agents.

A touch-up kit shall be provided for repair of any marks or scratches occurring during installation. The touch-up coating shall contain a minimum of 85% epoxy resin, which is compatible with the original coating.

G. Pumps:

The pumps shall be vertical, non-clog sewage pumps of heavy cast iron construction, especially designed for the use of mechanical seals and vacuum priming. In order to minimize seal wear caused by lineal movement of the shaft, the shaft bearing nearest the pump impeller shall be locked in place so that end play is limited to the clearance within the bearing. To minimize seal wear resulting from shaft deflection caused by the radial thrust of the pump, the shaft from the top of the impeller to the lower bearing supporting the impeller shall have a minimum diameter of 1 7/8" for motor frame sizes 213 through 286; 2 1/8" for motor frame sizes 324 and 326; and 3" for frame 364 and larger. The dimension from the lowest bearing to the top of the impeller shall not exceed 6".

The bearing nearest the impeller shall be designed for the combined thrust and radial load. The upper bearing shall be free to move linearly with the thermal expansion of the shaft and shall carry only radial loads.

The shaft shall be solid stainless steel through motor, pump and bottom bearing to eliminate corrosion within the pump or the mechanical seal. Removable shaft sleeves will not be acceptable if the shaft under the sleeve does not meet the specified minimum diameter.

The pump impellers shall be of the enclosed type made of cross-grained cast iron and

shall be balanced. The impeller shall be keyed with a stainless steel key and secured to the motor shaft by a stainless steel cap screw equipped with a Nylock or other suitable self-locking device. The impeller shall not be screwed or pinned to the motor pump shaft and shall be readily removable without the use of special tools. To prevent the buildup of stringy materials, grit and other foreign particles around the pump shaft, all impellers less than full diameter shall be trimmed inside the impeller shroud. The shroud shall remain full diameter so that close minimum clearance from shroud to volute is maintained. Both the end of the shaft and the bore of the impeller shall be tapered to permit easy removal of the impeller from the shaft.

The pump shall be so constructed so as to permit priming from the low pressure area behind the impeller. Priming from high pressure connections, tending to cause solids to enter and clog the priming system, will not be acceptable. The priming bowl shall be transparent to enable the operator to monitor the priming level.

The pump shall be arranged so that the rotating element can easily be removed from the volute without disconnecting the electrical wiring or disassembling the motor, impeller, backhead or seal, so that any foreign may be removed from the pump or suction line.

The pump shaft shall be sealed against leakage by a single mechanical seal constructed so as to be automatically drained and primed each time the pump is drained and primed. Water which lubricates the mechanical seal shall be automatically drained from around the seal if the pump loses prime, in order to allow both the pump and the seal to be drained, thereby preventing freezing and breakage of the seal during power outages in sub-freezing temperatures.

The seal shall be of carbon and ceramic materials with the mating surfaces lapped to a flatness tolerance of one light band. The rotating ceramic shall be held in mating position with the stationary carbon by a stainless steel spring.

The pump volute shall be furnished with mounting lugs and be bolted to the station floor plate, forming a gas-tight seal.

H. Motors:

The pump motors shall be vertical, solid shaft, NEMA P-base, squirrel-cage induction type, suitable for 3 phase, 60 cycle, 480-volt electric current. They shall have Class F insulation, suitable for temperatures up to 105 deg C. Insulation temperature shall, however, be maintained below 80 deg C. The motors shall have normal starting torque and low-starting current, as specified by NEMA Design B characteristics. They shall be open drip-proof design with forced air circulation by integral fan. Openings for ventilation shall be uniformly spaced around the motor frame. Leads shall be terminated in a cast connection box and shall be clearly identified.

The motors shall have 1.15 service factor. The service factor shall be reserved for the

Owner's protection. The motors shall not be overloaded beyond their nameplate rating, at the design condition, nor at any head in the operating range as specified under Operating Conditions.

The motor-pump shaft shall be centered, in relation to the motor base, within .005". The shaft runout shall not exceed .003".

The motor shaft shall equal or exceed the diameter specified under sewage pumps, at all points from immediately below the top bearing to the top of the impeller hub.

A bearing cap shall be provided to hold the bottom motor bearing in a fixed position. Bearing housings shall be provided with fitting for lubrication as well as purging old lubricant.

The motor shall be fitted with heavy lifting eyes, each capable of supporting the entire weight of the pump and motor.

I. Controls:

The control equipment shall be mounted in a NEMA Type 1 steel enclosure with a removable access cover. The circuit breakers, starter reset buttons, and control switches shall be operable without removing the access cover, for deadfront operation.

A grounding type convenience outlet shall be provided on the side of the cabinet for operation of 115 volt AC devices. This outlet shall be for the Owner's exclusive use. No manufacturer items shall be plugged into this outlet.

Thermal magnetic air circuit breakers shall be provided for branch disconnect service and short circuit protection of all motor control and auxiliary circuits.

Magnetic across-the-line starters with under-voltage release and overload coils for each phase shall be provided for each pump motor to give protection against single phasing. Each single phase auxiliary motor shall be equipped with an over-current protection device in addition to the branch circuit breaker, or shall be impedance protected. All switches shall be labeled and a coded wiring diagram shall be provided.

To control the operation of the pumps with variations of sewage level in the wet well, a minimum of four (4) mercury, displacement switches shall be provided, as a backup level control system. A minimum of 30' of cord shall be provided with each switch to eliminate the hazards created by splicing. The cord shall have a corrosion resistant vinyl jacket and be multi-stranded in order to prevent fatigue. The displacement switches will work as a backup system to the main liquid level control system.

The primary level control of liquid levels in pump station shall be by air bubbler system. To control the operation of the pumps with variations of liquid level in the wet well, an air bubbler system shall be provided, complete with two air compressors, flow indicator, bubbler line, a sensitive pressure switch for each pump, and a storage tank.

The two air compressors shall be of the close-coupled, oil-less type. Each compressor shall have a minimum capacity of 0.2 cubic feet of air per minute at 10 PSI. It shall

incorporate a single phase, 60 cycle, 115 volt, drip-proof brushless type, electric motor. A motor driven timer shall be provided to automatically alternate the compressors every five minutes. Wiring and piping of the air compressors shall be so arranged that one compressor may be removed without removing the other compressor from service.

The pressure switches shall be of the mercury-tube type, with sensitive pressure elements and independent high and low adjustments for each pump capable of a minimum differential of 18" of water.

A push-button operated air switch shall be provided for high pressure purge of wet well bubbler line. Full storage tank pressure shall be diverted from the system to the purge line when purge button is depressed to dislodge any residue build-up in the submerged bubbler line. The bubbler line within the wet well shall be stainless steel with provisions for a cleanout plug and a tee.

The eccentric plug throttling valve shall be provided with an adjustable mechanical stop so that the minimum flow rate can be set at the minimum pumping condition specified under operating conditions.

The entire automatic flow regulating system shall be designed and installed in such a manner as to permit the pump station to operate as a standard on-off pump station if any component in the automatic flow regulating system should become inoperative for any reason.

A separate and independent priming system shall be furnished for each sewage pump, providing complete standby operation. Each priming system shall include a separate vacuum pump. Vacuum pumps shall have corrosion resistant internal components. They shall each be capable of priming the sewage pump and suction piping in not greater than 60 seconds, underrated static suction lift conditions of 20' at mean sea level.

Each priming system shall be complete with vacuum pump, vacuum control solenoid valve, prime level sensing probe, and a float operated check valve installed in the system ahead of the vacuum pump to prevent liquid from entering the vacuum pump. The float-operated check valve shall have a transparent body for visual inspection of the liquid level and shall be automatically drained when the vacuum pump shuts off.

The priming system shall automatically provide positive lubrication of the mechanical seal each time the sewage pump is primed. To prevent excess stoppage due to grease accumulation, no passageway in the priming system through which sewage must pass shall be smaller than the equivalent of a 3" opening.

An automatic alternator with manual switch shall be provided to change the sequence of operation of the pumps every eight hours. The manual switch shall allow for either pump to be selected as base pump or for automatic alternation. Alternating the pumps at less than 8-hour intervals will not be acceptable.

Provisions shall also be made for the pumps to operate in parallel should the level in the wet well continue to rise above the starting level for the low level pump.

A separate and independent priming system shall be furnished for each sewage pump, providing complete standby operation. Each priming system shall include a separate vacuum pump. Vacuum pumps shall have corrosion resistant internal components. They shall each be capable of priming the sewage pump and suction pumping in not greater than 60 seconds, under rated static suction lift conditions of 20' at mean sea level.

Each priming system shall be complete with vacuum pump, vacuum control solenoid valve, prime level sensing probe, and a float operated check valve installed in the system ahead of the vacuum pump to prevent liquid from entering the vacuum pump. The float-operated check valve shall have a transparent body for visual inspection of the liquid level and shall be automatically drained when the vacuum pump shuts off.

The priming system shall automatically provide positive lubrication of the mechanical seal each time the sewage pump is primed. To prevent excess stoppage due to grease accumulation, no passageway in the priming system through which sewage must pass, shall be smaller than the equivalent of a 3" opening.

J. Environmental Equipment:

A ventilating blower shall be provided, capable of delivering 250 cfm at 0.1" static water pressure, in order to remove the heat generated by continuous motor operation. The ventilating blower shall be turned on and off automatically by a pre-set thermostat. The ventilating blower shall be rigidly mounted from the station floor. The discharge outlet shall have a thick resilient gasket which will match with a louvered opening in the fiberglass cover to seal the discharge to the cover when the cover is closed. An electric heater controlled by a pre-set thermostat shall be furnished. The heater shall be rigidly mounted in the station to prevent removal.

K. Sewage Piping:

The pump suction shall be drilled and tapped for a 125 pound American Standard flange for ready connection of the suction riser. The discharge line for each pump shall be fitted with a clapper-type check valve and eccentric plug valve. Size, location, and quantity of check valves and plug valves shall be as shown on the construction drawing.

The check valve shall be of the spring-loaded type with external lever arm and a replaceable resilient seat for added assurance against vacuum leaks. An operating wrench shall be provided for the plug valves. Protrusions through the floor plate shall be gas-tight where necessary to effect sealing between the equipment chamber and the wet well. Bolted and sealed joints shall be provided at the volutes or suction pipes in order to prevent corrosive, noxious fumes from entering the station. The lift station manufacturer shall extend the suction and discharge connections below the floor plate at the factory, so that field connections can be made without disturbing the gas-tight seals.

The manufacturer of the lift station shall provide a compression-type sleeve coupling for installation in the common discharge pipe.

L. Wiring:

The pump station shall be completely wired at the factory except for the power feeder lines. All wiring in the pump station shall be color coded as indicated on the wiring diagram. Wiring diagrams matching the unit wiring shall be provided. Lag-pump lock-outs to prevent simultaneous starting of both pumps under emergency generator operation shall be installed in the control panel. The emergency generator will not be required unless specified for this project.

M. Factory Tests:

All components of the pump station shall be given an operational test of all equipment at the factory to check for excessive vibration, for leaks in all piping or seals, for correct operation of the vacuum priming and control systems and all auxiliary equipment. Pumps shall take suction from a deep well, simulating actual service conditions.

N. Spare Parts:

The contractor shall furnish the following spare parts:

One (1) complete rotating assembly including motor, backhead, priming assembly and one (1) each clockwise and counter clockwise impeller trimmed to design conditions, and spare parts not to exceed \$2,000.00.

It will be the responsibility of the contractor at the time of construction to contact the Macon Water Authority through the Engineer to determine exactly what the Contractor will be required to supply at that time.

O. Non-Standard Equipment:

The lift station shall also be equipped with a High Water Alarm Sensor; three (3) Lapse Time Meters - One (1) non-resettable for each pump and one (1) meter wired for parallel pump operations; one intruder alarm sensor; one auxiliary blower for venting wetwell designed for continuous operation. Provide on/off switch inside station enclosure.

P. Installation and Operating Instructions: Instructions of the pump chamber shall be done in accordance with the written instructions provided by the manufacturer.

Five (5) sets of Operation and Maintenance Manuals shall be furnished which will include A parts list of components and complete service procedures and trouble shooting guide.

All odor control tanks and fuel tanks shall be protected by an additional catch basin in case of a spill.

Q. Experience and Workmanship:

The pump station shall be the product of a manufacturer with a minimum of five (5) years of experience in the design and building of such automatic, vacuum primed, factory-built sewage pumping stations and all workmanship and materials throughout shall be of the highest quality.

R. Guarantee:

The manufacturer of the lift station shall have a minimum of five (5) years experience in the design and manufacture of vacuum-priming type factory-built automatic pumping stations and shall guarantee the structure and all equipment to be free from defects in materials and workmanship for a period of up to one year from date of start-up.

(1) General:

The contractor is responsible for making all arrangements with the lift station manufacturer for the installation of required contracts for the telemetry system specified in this document as required by the Macon Water Authority. The existing telemetry system shall be transferred to the new pumping station by the Macon Water Authority.

(2) Alarm System:

The lift station manufacturer shall provide pressure switch, relay and contacts for the high water level alarm and intrusion alarm. The pressure switch assembly shall be mounted in the control panel and wired to a coded terminal strip.

S. Remote Terminal Unit (RTU)

(1) Remote Terminal Unit:

The Remote Terminal Unit (RTU) shall serve as an interface between control messages received from the Central Terminal Unit (CTU) and specific control points in the field. The RTU shall translate digital messages into contact closures for control of various devices and shall encode contact closures for transmission of device status to the CTU to confirm any control action taken.

The RTU shall initiate a control action only in response to a CTU oriented command. In addition, a confirming transmission shall be made to the CTU following each command response. RTU reset shall be automatic. An integral radio transmitter designed and manufactured by the RTU supplier shall be supplied. All connections except an antenna RF connector shall be integrated into the RTU wiring and the radio shall be of modular design. The RTU shall provide command, status, analog and accumulative data capability.

(2) **System:**

- (a) **Master Location** - Town Creek WTP with repeaters at 790 Second Street, and sub-masters at Breezy Hill Pump Station, Forsyth Road Pump Station, Heath Road Elevated Tank, Airport North Tank, Bowden Elevated Tank and Poplar Street WWTP.
- (b) Radio Path Survey is system manufacturer's responsibility.
- (c) Manufacturer shall ensure that the instrumentation and control (I/C) system is an integral system and should be responsible for the correct operation of the entire system.
- (d) The system manufacturer should be engaged in regular telemetry system work and shall be in business for a minimum of five (5) years at the time of supplying the system.

(e) **Following are the acceptable manufacturers:**

M/R Systems, Norcross, Georgia
Industrial Control Systems, Sandston, Virginia
Transdyn Controls, Norcross, Georgia
GE Automation Services, Pineville, North Carolina

System shall carry one year warranty from the date of acceptance by Macon Water Authority on material and workmanship.

- (f) Equipment furnished and installed shall be from established manufacturers, with proven history of service and support.
- (g) Electrical isolation shall be provided between the input systems and processor units. All wiring shall be protected against lightning and other surges.
- (h) System manufacturer shall provide training courses on site. Length of training shall be for a day for about 10 students.
- (i) Control panels enclosure can be wall mounted, free standing or walk-in as scheduled and shall be NEMA 12 for panels located indoors and NEMA 4X for outdoor locations.
- (j) **Remote Terminal Unit (RTU) Panels:** Small size RTU panels designated as Type 3 enclosures shall accommodate a minimum of two analog and two discharge modicon momentum models. Shall be a minimum 24 inches high, 24 inches wide and 12 inches deep, NEMA (12) for indoor

applications and NEMA 4X for outdoor applications.

- (k) **Programmable Logic Controllers (PLC) for RTU's:** The PLC will receive discrete and analog inputs and through the use of internal ladder logic program. Control output relay operation and perform data handling and telemetry functions. Each controller shall have 50 percent spare memory capacity and 10 percent instrumentation operation (I/O) capacity.

The PLC's shall be as manufactured by Modicon Momentum or approved equal.

The components of PLC's shall be from manufacturers who are manufacturing this type of equipment for a minimum of 5 years.

The PLC's shall be of a modular design with a plug-in processing unit, input/output assemblies, and plug-in peripherals. All parts shall have manufacturer's ID number.

The components of PLC shall be capable of continuous operation at temperatures 0 - 60 degrees centigrade and humidity levels 5 to 95 percent.

Electrical supply voltage to individual controllers shall be 115 vac + 10 percent, 48-63 HZ with adequate overload protection. A failure of one controller shall not disrupt operation of other controllers in the system. Reduced process adapters, communication adapters, input/output devices, program development software and program development PC shall be furnished along with the equipment.

- (l) **Radios:**

Radios shall be by Microwave Data Systems Model 9810 or approved equal. Provide all spread spectrum radios with in-line diagnostics.

Refer to Addendum A for Instrumentation and Control, Surge protection, Control Devices, Loop Descriptions, Control Panels and Scada Hardware.

SECTION 2.15 - LAYING PIPE:

Lay the pipe to conform accurately to the alignment and grade approved by the Authority.

A. Handling:

Use suitable tools and equipment to handle and lay pipe. Prevent damage to the pipe. Examine all pipe for cracks and other defects as it is laid. Do not lay pipe or other

materials which are known to be defective.

If any pipe or other material is discovered to be defective or damaged after being laid, remove and replace it.

B. Sequence:

Excavate, lay the pipe, and backfill as closely together as possible. Do not leave unjointed pipe in the trench overnight. Backfill and compact the trench as soon as possible after laying and jointing is completed. The exposed end of installed pipe at the close of work each day and at all other times when work is not in progress must be capped with a sealed cap. If it is necessary to backfill over the end of an uncompleted pipe, close the end with a plug.

C. Placing and Jointing:

Clean pipe and fittings thoroughly before laying. Before making the joint, clean the sealing surfaces of dust, dirt, gravel and other foreign substances. Apply joint lubricant recommended by the pipe manufacturer.

Center the spigot end in the bell of the preceding pipe and shove home. Apply moderate force to ensure proper seating. Complete jointing no later than five minutes after application of the lubricant.

Immediately after jointing bring the pipe to final alignment and grade.

D. Pressure Piping:

Comply with the regulations for excavation, in addition to the following requirements:

- (1) Make all push-on and mechanical joints in accordance with the manufacturer's recommendations.
- (2) Take special precautions to prevent damage to the cement lining of ductile iron pipe.
- (3) Ensure that force mains are laid flat or to a positive grade. Pipe laid incorrectly at negative grade shall be removed and re-laid.
- (4) Minimum depth of cover for force mains shall be four feet unless shown otherwise on the Drawings and approved by the Authority. Within DOT right-of-way, install force mains at a depth four feet below the nearest pavement edge.

E. Buried Valves:

Resilient sealed gate valves are to be used for force mains and in lift stations. Valves are

to be equipped with appropriate end connections, glands, gaskets, bolts, valve box cover, valve operator extensions and all applicable hardware. Valves shall be furnished with a valve box. If cover exceeds two feet, provide an extension stem to within six inches of the surface.

Outside of structural concrete install all floor stands on an 18 inch square by 9 inch deep concrete pad to terminate the valve box and mount the floor stand.

F. House Connections:

Install wyes or tees in locations designated by the Authority for future connection of service line with proper grade and alignment to the property line. Service lines shall be plugged until put into service using plugs specifically designed for the size and type of pipe. The service lines shall include provisions for cleaning out the line in case of an obstruction. Detailed drawings are included in Appendix A (S - 4).

The location of stubout shall be clearly shown on the as-built drawings. A cleanout embedded in concrete shall be installed at the property line and shall be marked on the curb where a curb is installed.

SECTION 2.16 - CONCRETE COLLARS AND BLOCKING:

A. Concrete:

Concrete shall have a compressive strength of not less than 3000 psi, with not less than 5.5 bags of cement per cubic yard and a slump between 3 and 5 inches. For job mixed concrete, submit the concrete mix design for approval by the Authority. Mix and transport ready-mixed concrete in accordance with ASTM A 615, grade 40.

B. Blocking:

Block bends, tees, valves, and other points where hydraulic thrust may develop. Form and pour concrete blocking as shown on the Drawings and as directed by the Authority. Pour blocking against undisturbed earth. Increase dimensions when required by over-excavation. Retrained joints in lieu of blocking is acceptable.

C. Collars:

Provide concrete collars at all joints between dissimilar pipe materials, and for anti-flotation as required. Construct as shown on the detail drawings in Appendix A.

SECTION 2.17 - BACKFILLING:

Backfill carefully to restore the ground surface to its original condition. Dispose of surplus material.

A. Backfill:

Place initial backfill material carefully over the bedding material covering PVC in uniform 6 inch layers to a depth of at least 24 inches above the pipe bell. Compact each layer thoroughly with suitable hand tools. Do not disturb or damage the pipe. Backfill on both sides of the pipe simultaneously to prevent side pressures. Initial backfill material is earth material excavated from the trench which is clean and free of rock, organics, and other unsuitable material. If materials excavated from the trench are not suitable for use as initial backfill material obtain suitable materials elsewhere.

Backfill above, shall be compacted as follows:

- (1) In 6-inch layers, if using light power tamping equipment, such as a "Jumping jack",
- (2) Where required, detection tape shall be buried 4 to 10 inches beneath the ground surface directly over the top of the pipe. Should detection tape need to be installed deeper, the Contractor shall provide 3 inch wide tap. In no case shall detection tape be buried greater than 20 inches from the finished grade surface.

B. Settlement:

If trenches settle, re-fill and grade the surface to conform to the adjacent surfaces.

C. Backfill Under Roads:

Compact backfill underlying pavement and backfill under dirt and gravel roads to 98% of the maximum dry density as determined by the Standard Proctor Compaction Test (ASTM D 698).

- D.** For sewer laterals laid under the pavement area, compact backfill underlying pavement and backfill on dirt and gravel roads to 98% of the maximum dry density as determined by Standard Proctor Compaction Test (ASTM D 698).

E. Additional Materials:

Where final grades above the pre-existing grades are required to maintain minimum cover, additional fill material will be shown on the Drawings. Utilize excess material excavated from the trench if the material is suitable.

If excess excavated materials are not suitable, or if the quantity available is not sufficient, provide suitable additional fill material.

SECTION 2.18 - REMOVING AND REPLACING PAVEMENT:

A. Removing Pavement:

Remove existing pavement as necessary for installing the pipe line and appurtenances.

(1) Marking:

Before removing any pavement, mark the pavement neatly paralleling pipe lines and existing street lines. Space the marks the width of the trench.

(2) Breaking:

Break asphalt pavement along the marks using jack hammers or other suitable tools. Break concrete pavement along the marks by use of jack hammers or by scoring with a rotary saw and breaking below the score by the use of jack hammers or other suitable tools.

(3) Machine Pulling:

Do not pull pavement with machines until completely broken and separated from pavement to remain.

(4) Damage to Adjacent Pavement: Do not disturb or damage the adjacent pavement. If the adjacent pavement is disturbed or damaged, remove and replace the damaged pavement.

(5) Sidewalk:

Remove and replace sidewalks for their full width.

(6) Curbs:

Remove and replace any curb encountered.

B. Upon completion of backfilling and consolidation of the backfill, arrange to have the compaction tested by an independent testing laboratory approved by the Authority. After compaction testing has been satisfactorily completed, replace all pavements, sidewalks and curbs removed.

(1) Materials:

Place materials for pavement replacement to dimensions shown on the Drawings. Typical pavement replacement details are included in Appendix A.

(a) Graded Aggregate Sub-Base:

Furnish graded aggregate sub-base in two sizes of such gradation that when combined in approximately equal quantities, the resulting mixture is well graded from coarse to fine, meeting the gradation requirements of Section 816 of the State Highway Department of Georgia Standard Specifications.

(b) Black Base:

The base for all paved roadways shall conform to the requirements of the Georgia State Highway Department Specifications for the Black Base (Hot Mix). Use a Pug Mill Rotary Drum type mixer with minimum capacity of not less than 50 tons per hour for asphalt production. Apply and compact the base in two courses by asphalt spreader equipment of design and operation approved by the Authority. After compaction, the Black Base shall be smooth and true to established profiles and sections.

(c) Surface Course:

The surface course for all pavement, including paint or tack coat when required by the Authority, shall conform to the requirements of the Georgia State Highway Department Specifications for Asphaltic Concrete, Section 400, Type "E" (Modified Top). Produce surface course in an asphalt plant of the same type as noted above for Black Base. Apply and compact the surface course in a manner approved by the Authority. Immediately correct any high, low or defective areas by cutting out the course, replacing with fresh hot mix, and immediately compacting to conform and thoroughly bond to the surrounding area.

(d) Concrete:

Provide concrete and reinforcing for concrete pavement In accordance with the requirements of Georgia State Highway Department Specifications for Portland Concrete Pavement, Section 430.

(2) Supervision and Approval:

Pavement restoration shall meet the requirements of the regulatory agency responsible for the pavement. Obtain agency approval of pavement restorations before requesting final payment.

Obtain the Authority's approval of restoration of pavement not the responsibility of regulatory agency, such as private roads and drives.

Complete pavement restoration as soon as possible after backfilling.

(3) Replacement:

Prior to replacing pavement, make a final cut in concrete pavement 12 inches back from the edge of damaged pavement. Make the cut using a rotary saw. Replace all street and roadway pavement as shown on the Drawings. Replace driveways, sidewalks, and curbs with the same material and to the same dimensions as existing.

(4) Failure of Pavement:

Should any pavement restoration or repairs fail or settle during construction and warranty periods, promptly restore or repair defects.

SECTION 2.19 - BORING:

Furnish and install pipe casing and install the pipe line therein in accordance with the following specifications:

A. General:

Operate well points or drainage systems in the vicinity of casing construction to prevent the accumulation of flood water in the casing and to maintain the ground water table below the casing in invert. Directional bores will not be allowed, pipe and steel casing shall be jack and bored.

B. Boring:

Furnish all material and equipment and perform all labor required to install steel pipe casing at locations indicated on the drawings and as specified.

(1) Materials:

The steel casing pipe shall be Schedule 30 steel pipe manufactured from steel conforming to ASTM A 139, Grade B. Size and thickness shall be as follows:

UNDER RAILROADS

Pipe Dia. In.	Casing Dia. In.	Wall Thick In.
6	14	0.250
8	18	0.250
10	20	0.281
12	22	0.312
14	24	0.344
16	30	0.406
18	30	0.406
20	32	0.469
24	36	0.469
30	42	0.500

UNDER HIGHWAYS

Pipe Dia. In.	Casing Dia. In.	Wall Thick In.
6	12	0.250
8	16	0.250
10	16	0.250
12	18	0.250
14	22	0.250
16	24	0.250
18	30	0.312
20	30	0.312
24	36	0.375
30	42	0.375

- (2) **Installation of Casing:** Install the steel pipe casing by the dry boring method. Bore the hole and install the casing through the soil simultaneously by a cutting head on a continuous auger mounted inside the casing pipe. Fully weld lengths of casing pipe to the preceding section in accordance with the AWS recommended procedures. After the boring and installation of the casing is complete, install a cleaning plug on the rig and clean the casing. All piping inside (carrier pipe) steel casing shall be ductile iron pipe. The carrier pipe shall be supported at each joint and as recommended by manufacturer. Spacers as manufactured by Cascade or approved equivalent shall be used. **(In any and all applications, ductile iron pipe shall be used only at the direction of the Authority).**

In the event that rock is encountered during the installation of the pipe casing which, in the opinion of the Authority, cannot be removed through the casing then the Authority shall direct the Contractor/ Developer to complete the crossing by

installing a tunnel.

C. Installation of Pipe:

(1) Boring:

After installation of the casing is complete, install the pipe line by a method which has received prior approval of the Engineer.

Close the ends of the casing with 4 inch brick walls, plastered with Portland Cement mortar and waterproofed with asphaltic roofing cement.

D. Safety:

(1) Boring: Provide all necessary bracing, bulkheads, and shields to ensure complete safety to all traffic at all times during the work.

Perform the work in such a manner as to not permanently damage the roadbed or interfere with normal traffic over it. If in the opinion of the Engineer the installation is being conducted in an unsafe manner, the Contractor will be required to stop work and bulkhead the heading until suitable agreements are reached between the Contractor and the Engineer. The Owner will not be responsible and shall be saved harmless in the event of delays to the Contractor's work resulting from any cause whatsoever.

SECTION 2.20 - STREAM AND DITCH CROSSING:

At all points where banks of streams or drainage ditches are disturbed by excavation or where natural vegetation is removed, carefully compact backfill and place rip rap to prevent subsequent settlement and erosion.

This requirement applies equally to construction alongside a stream or drainage ditch as well as crossing stream or drainage ditch. Place rip rap a distance of not less than 10 feet upstream and 10 feet downstream from any disturbed area. Extend rip rap from 1 foot below streambed to top of bank. Place to conform with the natural slope of the stream bank. The pipe material for stream and ditch crossings shall be ductile iron pipe. A geotextile fabric shall be placed over the entire ditch and extend outward on either side a minimum of (10) ft. **(In any and all applications, ductile iron pipe shall be used only at the direction of the Authority).**

Use only one method, either (a) or (b), throughout the job.

A. Stone Rip Rap:

Use sound, tough, durable stones resistant to the action of air and water. Slabby or shaley pieces will not be acceptable. Specific gravity shall be 2.0 or higher.

Minimum weight of individual stones shall be 50 pounds. The maximum allowable dimension for an individual stone is 24 inches. The minimum allowable dimension for

an individual stone is 6 inches. At least 50% of the stones shall have a minimum dimension of 12 inches.

Embed stone rip rap by hand so as to form a compact layer at least 12 inches thick. Place rip rap in such a way that the smaller stones are not segregated but evenly distributed. Place chinking stones in the crevices between the larger stones so that a dense, well graded mass is produced.

B. Sand-Cement Bag Rip Rap:

Use cement sacks or burlap bags having a capacity of from 1 to 2 cubic feet. Do not use bags previously used for sugar or chemicals. Fill bags with a mixture of one part Portland Cement to five parts sand.

Embed bags by hand to form a compact layer at least 12 inches thick. Place with overlapping joints. The finished surface shall not deviate from that specified by more than 3 inches at any point.

SECTION 2.21 - CONCRETE PIERS:

Construct piers as shown on the Drawings and in accordance with the following requirements:

A. Material:

Concrete shall have a compressive strength of not less than 3000 psi, with not less than 5.5 bags of cement per cubic yard and a slump between 3 and 5 inches. For job mixed concrete, submit the concrete mix design for approval by the Engineer. Ready-mixed concrete shall be mixed and transported in accordance with ASTM C 94. Reinforcing steel shall conform to the requirements of ASTM A 615, grade 40.

B. Bearing:

(1) Earth:

Where excavation reveals undisturbed earth subsurface, construct piers with spread footing foundations as shown in the Appendix.

(2) Rock:

Where excavation reveals level or benched rock having a minimum safe bearing value of 20,000 psf, construct piers with a foundation bearing directly on rock. Drill a minimum of four holes into the rock under each pier and grout dowels into place to anchor the pier to the rock. Hole and dowel sizes shall be in accordance with the requirements of the table at the end of this section.

Grout holes from the bottom up using a group pump. Take extreme care to ensure that the entire hole is filled with grout prior to inserting the dowel.

C. Installation:

Employ experienced form work carpenters to construct forms.

Build formwork sufficiently strong to resist movement and distortion during pouring and to protect the pier from caving in or lateral movement.

Before placing concrete, dewater the bottom of the hole and clean out all mud, loose earth, and extraneous matter.

Pour concrete as soon as possible after the forms have been approved. Do not leave the excavation open for prolonged periods of time. Protect the excavation from surface water. Do not allow water to accumulate in the excavation or in surrounding areas.

Take all necessary precautions to protect the work and personnel on the site. Cover open holes when work is not in progress. Examine all surrounding excavations and embankments for possible hazards.

ANCHORAGE REQUIREMENTS FOR PIERS ON ROCK

Carrier Pipe Size	Grout Hole Diameter, Inches	Grout Hole Depth, Feet	Reinforcing Bar Dowel Size
8-24	2.5	8	5
27-36	4	8	6
42-48	4	8	6
54	4	8	6

D. Inspection Select and, with the approval of the Engineer, employ a consulting soil and foundation Engineer to perform the following:

- (1) Inspect the bearing material and evaluate its suitability.
- (2) Inspect pneumatically drilled grout holes where applicable.
- (3) Check dimensions and plumbness of forms to ensure conformity with Drawings and Specifications.
- (4) Evaluate material penetrated by excavation with regard to lateral stability and uplift resistance.
- (5) Recommend remedial measures should insufficient lateral stability or uplift resistance exist.

SECTION 2.22 - INSPECTION AND TESTING:

The Authority will televise and will inspect all projects to ensure compliance with these specifications. Unless other provisions have been specifically approved by the Authority, sewer lines and related facilities will be inspected and tested by the Authority before acceptance or tie-in to the Authority's system is permitted. All lines must be clean and all obstruction removed prior to requesting inspection and testing. When requested by the Authority, flush out lines and manholes before testing and inspection. The Authority will televise for construction or material defects, and will inspect all PVC sewers for excessive deflection. A fee for testing and any retesting will be charged by the Authority in accordance with the Sewer Inspection Policy. This fee can be established by contacting the Authority.

Procedure for Final Inspection:

- * During installation the Authority will visually inspect all sewers for construction or material defects
- * After installation and before acceptance, all sewer segments will be televised by closed circuit camera for construction or material defects and acceptable alignment.
- * All sewer segments will undergo low pressure air testing as per Section (b). All segments containing PVC pipe will be tested for excessive deflection.
- * Any re-testing will be charged by the Authority in accordance with the Sewer Inspection Policy. This fee can be established by contacting the Authority.
- * The Contractor shall perform all tests in the presence of a Macon Water Authority Inspector. Copy of such records will be given to the Engineer or the Owner.

A. Gravity Sewers:

Pipe lines shall be straight and show a uniform grade between manholes. Correct any discrepancies discovered during inspection.

- (1) Pipe joints for sewers 30 inches in diameter and larger shall be air tested individually. The joint tester assembly shall be placed over the joint and shall pressurize the joint area to 4 psi. The pressure shall not drop more than 2 psi in 10 seconds. The joint tester assembly shall be equal to Cherne Industries, Inc. and shall be provided by the Contractor.

(a) Lamping

Pipelines shall be straight and show a uniform grade between manholes. Evidence of straight and uniform grade will be determined by placing a closed circuit TV camera in the invert of the first manhole and in the second manhole a light source sufficient to illuminate the manhole. Acceptable alignment is indicated by a full circle (full moon) of light visible and centered in view from manhole one. Televising will be performed by the Authority for a fee according to current Authority policy.

(b) Low Pressure Air

All sewers less than (30) inch diameter shall be subject to low pressure air test as stated herein.

- (i)** Prior to air testing, the section of sewer between manholes shall be thoroughly cleaned and wetted. Immediately after cleaning or while the pipe is water soaked, the sewer shall be tested with low-pressure air. At the Contractor's option, sewers may be tested in lengths between manholes or in short sections (25 feet or less) using Air-Lock balls pulled through the Line from manhole to manhole. Air shall be slowly supplied to the plugged sewer section until internal air pressure reaches approximately 4.0 psi. After this pressure is reached, and the pressure allowed to stabilize (approximately two to five minutes), the pressure may be reduced to 3.5 psi before starting the test. If a 1.0 psi drop does not occur within the test time, then the line has passed the test. If the pressure drops more than 1.0 psi during the test time, the line is presumed to have failed the test, and the Contractor will be required to locate the failure, make necessary repairs, and retest the line. Minimum test time for various pipe sizes, in accordance with ASTM F 1417 is as follows:

Nominal Pipe Size (Inches)	T(time) Min/100 (Feet)	Nominal Pipe Size (Inches)	T(time) Min/100 Fee
8	1.2	27	4.2
10	1.5	30	4.8
12	1.8	33	5.4
15	2.1	36	6.0
18	2.4	39	6.6
21	3.0	42	7.3
24	3.6	48	8.6
		54	9.8

- (ii)** Required test equipment, including Air-Lock balls, braces, air hose, air source, timer, rotometer as applicable, cut-off valves, pressure reducing valve, 0-15 psi pressure gauge with gradations in 0.1 psi and accuracy of plus or minus 2 percent, shall be provided by the Contractor.
- (iii)** The Contractor shall perform all tests in presence of Macon Water Authority personnel. Copy of such records will be given to the Engineer or the Owner. Such records shall show date, line number and stations, operator, and such other pertinent information as required by the Engineer.

- (iv) The Contractor is cautioned to observe proper safety precautions in performance of the air testing. It is imperative that plugs be properly secured and that care be exercised in their removal. Every precaution shall be taken to avoid the possibility of over-pressurizing the sewer line.

B. PVC Deflection Test (Mandrel Test):

Test PVC gravity sewer for excessive deflection by passing a mandrel "pig" through the line with a diameter equal to 95 percent of the normal inside diameter of the pipe. Excavate and install properly any section of pipe not passing this test. Re-test until results are satisfactory. This test shall be performed within the first 10 days of installation and during final inspection, at the completion of this contract. (Refer to ASTM 2122)

- (1) Procedure for Conducting a Mandrel Test: Installed pipe shall be tested ensure that vertical deflections for plastic pipe do not exceed the maximum allowable deflection. Maximum allowable deflections shall be governed by the mandrel requirements stated herein and shall nominally be:
 - (a) 3 percent of the maximum average ID for PVC Composite Pipe.
 - (b) For all plastic pipe PVC Composite Pipe, the percentage listed of maximum average ID shall be as follows:

TABLE 2.21-1

Nominal Pipe Size		Percentage Deflection Allowed
Millimeters	Inches	
Up to and including 300 mm	Up to and including 12 in.	5.0
Over 300 –to and including 750 mm	Over 12 –to and including 30 in.	4.0
Over 750 –to and including 1500 mm	Over 30 –to and including 60 in.	3.0
Over 1500 –to and including 2250 mm	Over 60 –to and including 90 in.	2.5
Over 2250 –to and including 3000 mm	Over 90 –to and including 120 in.	2.0
Over 3000 mm	Over 120 in.	1.5

The maximum average ID shall be equal to the average OD per applicable ASTM Standard minus two minimum wall thicknesses per applicable ASTM Standards. Manufacturing and other tolerances shall not be considered for determining maximum allowable deflections.

Deflection tests shall be performed not sooner than 30 days after completion of Placement and densification of backfill. The pipe shall be cleaned and inspected for Offsets and obstructions prior to testing.

For all pipes 600 mm (24 inch) ID or smaller, a mandrel shall be pulled through the pipe by hand to ensure that maximum allowable deflections have not been exceeded. Prior to use, the mandrel shall be certified by the Engineer or by another entity approved by the Engineer. Use of an uncertified mandrel or a mandrel altered or modified after certification will invalidate the test. If the mandrel fails to pass, the pipe will be deemed to be overdeflected.

Unless otherwise permitted by the Engineer, any overdeflected pipe shall be uncovered and, if not damaged, reinstalled. Damaged pipe shall not be reinstalled, but shall be removed from the Work site. Any pipe subjected to any method or process other than removal, which attempts, even successfully, to reduce or cure any overdeflection, shall be uncovered removed from the Work site, and replaced with new pipe.

The mandrel shall:

- (1) Be a rigid, non-adjustable, odd-numbered leg (9 legs minimum) mandrel having an effective length not less than its nominal diameter
- (2) Have a minimum diameter at any point along the full length as follows:
- (3) Be fabricated of steel, be fitted with pulling rings at each end, be stamped or engraved on some segment other than a runner indicating the pipe material specification, nominal size, and mandrel OD (e.g., PVC D3034-200mm-187.10mm; PVC D3034-8"-7.366"; and be furnished in a suitable carrying case labeled with the same data as stamped or engraved on the mandrel.

Table 2.21-2

Pipe Material	Nominal Size		Minimum Mandrel Diameter
	MM	Inches	Inches
PVC-ASTM D 3034 (SDR 26)	150	6	5.33
	200	8	7.11
	250	10	8.87
	300	12	10.55
	375	15	12.90

C. Force Main Pressure and Leakage Test:

- (1) All sections of pipeline subject to internal pressure shall be pressure tested in accordance with AWWA C 600. A section of line will be considered ready for testing after completion of all thrust restraint and backfilling. Each segment of pipeline between line valves shall be tested individually.
- (2) **Test Preparation:**
 - (a) Flush pipeline section thoroughly at flow velocities adequate to remove

debris from pipe and valve seats. Partially operate valves and hydrants to clean out seats. Provide correctly sized temporary outlets in number adequate to achieve flushing velocities.

- (b) Provide temporary blocking, bulkheads, flanges and plugs as necessary to assure all new pipe, valves and appurtenances will be pressure tested.
- (c) Before applying test pressure, air shall be completely expelled from the pipeline and all appurtenances. Unless permanent air vents are in place, insert temporary corporation stops at highpoints to expel air as line is filled with water.
- (d) Fill pipeline slowly with water. Provide a suitable pump with an accurate water meter to pump the line to the specified pressure. Differential pressure at valves and hydrants shall equal the maximum possible, but shall not exceed manufacturer's pressure rating.

(3) Test Pressure:

Test the pipeline at 150 psi. The test pressure shall not vary by more than 5 psi for the test duration(2 hours). Should the pressure drop more than 5 psi at any time during the test period, the pressure shall be restored to the specified test pressure. Provide an accurate pressure gauge with gradation not less than 5 psi.

(4) Leakage:

- (a) Leakage shall be defined as the quantity of water that must be pumped into the test section equal to the sum of the water, to maintain pressure with 5 psi of the specified test pressure for the test duration plus water required to return line to test pressure at the end of the test. Leakage shall be the total cumulative amount measured on a water meter.
- (b) The Owner assumes no responsibility for leakage occurring through existing valves.

(5) Test Results:

No test section shall be accepted if the leakage exceeds the limits determined under Section 4 of AWWA C600. The leakage test shall be repeated until the test section is accepted. All visible leaks shall be repaired regardless of leakage test results.

(6) Completion:

After a pipeline section has been accepted, relieve test pressure. Record type, size and location of all outlets on record drawings.

D. Manholes:

Prior to testing manholes for a water-tightness all liftholes shall be plugged with a non-shrink grout, all joints between precast sections shall be properly sealed and all pipe openings shall be temporarily plugged and properly braced. Each manhole shall pass one of the following tests. The tests shall be performed after all the backfill and the road bed is in place.

(1) Vacuum Tests:

The manhole, after proper preparation as noted above. The test head shall be placed at the inside of the top of the cone section and the compression head inflated to 40 psi to effect a seal between the vacuum base and the manhole structure. Connect the vacuum pump to the outlet port with the valve open. A vacuum of 10 inches of mercury shall be measured for the vacuum to drop to 9 inches. The manhole shall pass if the time is greater than 60 seconds for 48 inch diameter manholes. If the manhole fails the initial test, necessary repairs shall be made and the manhole re-tested. Re-testing shall proceed until a satisfactory test is obtained. All the tests shall be witnessed by Macon Water Authority inspectors. The Macon Water Authority will not allow the usage of concrete sewer pipe. (Reference ASTM C1244 Standards - Test Method for concrete Sewer Vacuum Testing of Manholes).

(2) Exfiltration Tests:

This test applies to the pump station wet wells only. The manhole, after proper preparation as noted above, shall be filled with water. The maximum allowable leakage shall not exceed 8 gallons per foot of depth per 24 hours for 48-inch diameter manholes. Tests shall last a minimum of eight hours. The manholes may be backfilled prior to testing.

(3) Infiltration Tests:

Measurement shall be performed by the Macon Water Authority on any lines with a visible flow of water. In no case will an infiltration rate greater than 25 gallons per inch diameter of pipe per mile of sewer pipe per day be allowed. All visible or audible leaks must be dug up and repaired unless it is found to be in a joint and can be repaired by chemical grouting. All test procedures shall be in accordance with ASTM C-1091 (Infiltration testing) or ASTM C969.

SECTION 2.23 - PROTECTION AND RESTORATION OF WORK AREA:
(Section applies to water and wastewater design projects)

A. General:

Return all items and all areas disturbed, directly or indirectly, by work under these Specifications, to their original condition or better, as quickly as possible after work is started. Any bypassing of raw wastewater on to the ground or into a receiving stream is prohibited.

B. Man-Made Improvements:

Protect or remove and replace with the Authority's approval, all fences, piers, docks, walkways, mail boxes, pipe lines, drain culverts, power and telephone lines and cables and other improvements that may be encountered in the work.

C. Cultivated Growth:

Do not disturb cultivated trees or shrubbery outside the easement unless approved by the property owner. Any such trees or shrubbery which must be removed shall be heeled in and replanted under the direction of an experienced nurseryman.

D. Cutting of Trees:

Do not cut trees for the performance of the work outside the easement except as absolutely necessary. Protect trees that remain in the vicinity of the work from damage from equipment. Do not store spoil from excavation against the trunks. Remove excavated material stores over the root system of trees within 30 days to allow proper natural watering of the root system. Repair any damaged tree over 3 inches in diameter, not to be removed, under the direction of an experienced nurseryman. All trees and brush that require removal shall be promptly and completely removed by the Contractor. No stumps, wood piles or trash piles will be permitted on the work site or within the easement area unless specifically approved by the Authority.

E. Grassing:

Replant grass removed or damaged in residential areas using the same variety of grass and at the first appropriate season. Outside of residential areas, plant the entire area disturbed by the work in rye, fescue, bermuda, clover or other suitable ground cover on completion of work in any area. In all areas, promptly establish successful strands of grass. Grass areas will be considered acceptable when a viable stand of grass covers at least 98% of the total area with no bare spots exceeding one square foot and the ground surface is fully stabilized against erosion. (Georgia D.O.T. Section 700,890 Manual for Erosion and Sedimentation Control in Georgia).

(1) Description:

This section consists of the furnishing and sowing of grass seed and furnishing and applying mulch, water and fertilizer. Hydroseeding shall be employed where shown on the plans.

(2) Soil Analysis and Report:

The Contractor shall obtain from the Agricultural Extension Service a soil analysis and report. Analysis of fertilizer and application rates shall be as recommended by the County Extension Service Report and in accordance with this schedule:

FERTILIZER REQUIREMENTS				
TYPE OF SPECIES	YEAR	ANALYSIS OR EQUIVALENT N-P-K	RATE	N TOP DRESSING RATE
1. Cool season grasses	First	6-12-12	1,500 lbs/ac	50-100 lbs/ac ^{1,2}
2. Cool season grasses and legumes	First	6-12-12	1,500 lbs/ac	0-50 lbs/ac ¹
3. Ground covers	First	10-10-10	1,300 lbs/ac ³	-
4. Temporary cover crops seeded alone	First	10-10-10	500 lbs/ac	30 lbs/ac ⁴
5. Warm season grasses	First	6-12-12	1,500 lbs/ac	50-100 lbs/ac ^{2,5}

- 1 Apply in spring following seeding.
- 2 Apply in split applications when high rates are used
- 3 Apply in three (3) split applications
- 4 Apply to grass species only
- 5 Apply when plants grow to a height of 2 to 4 inches

(3) Areas to be Grassed:

The areas to be grassed shall be all disturbed areas not occupied by a structure, including but not limited to, the storage areas, easements highway right-of-ways, and designed areas. All disturbed areas will be stabilized as quickly as possible and in no case will ungrassed and unmulched areas be permitted more than 1,000 feet behind the pipe laying operation.

(4) Materials:

(1) Site Operations and Materials: The following materials and rates of application are suggested. The Contractor is solely responsible for the success of grassing.

(a) Commercial Fertilizer:

Shall be a slow release, complete fertilizer. The nitrogen content of which shall be derived from either organic or inorganic sources and meet the following minimum requirements of plant food by weight. Should the soil analysis and report indicate a need for a different fertilizer mixture, the recommended mixture shall be furnished and applied at the Contractor's expense. All State and Federal laws relating to fertilizer must be complied with.

(b) Ammonium Nitrate:

Shall be commercial product in dry powder form of recent manufacture and shall be delivered in the original unopened containers each bearing the manufacturer's guaranteed statement of analysis. It shall contain not less than 33.5% Nitrogen.

(c) Ground Limestone:

Shall be ground dolomitic limestone containing not less than 85 percent of total carbonates and shall be ground to a fineness such that more than 50 percent will pass through a 100-mesh sieve and 90 percent will pass through a 20-mesh sieve. Coarser material will be acceptable, provided the specified rates of application are increased proportionately on the basis of quantities passing the 100-mesh sieve.

(d) Seed:

Seed shall be delivered to the site in the original sacks, and each sack shall be tagged in accordance with the agricultural seed laws of the United States and the State of Georgia. Each sack shall be tagged showing the dealer's guarantee as to the year grown, percentage of purity, percentage of germination and the date of the test by which the percentages of purity and germination were determined. All seed sown shall have a date of test within six months of the date of sowing.

Any seed delivered prior to use, shall be stored in such a manner that it will be protected from damage by heat, moisture, rodents, or other cause.

Permanent seeding shall be in accordance with the following schedule:

SEEDS	LBS/ ACRE	DEPTH OF COVER	DATE OF PLANTING
BERMUDA GRASS-HULLED	10	¼" - ½"	3/15 - 5/31
BERMUDA GRASS-UNHULLED	10	¼" - ½"	10/1 - 2/28
BAHIA, PENSACOLA	60	¼" - ½"	3/1 - 6/15

(5) Execution:

(a) Hydroseeding:

Hydroseeding may be used on any area to be grassed. Under this method of seeding, the seed and fertilizer, at the specified rates, with Wood Fiber Mulch shall be distributed over the area to be seeded in the form of a slurry. Seeds of all sizes may be mixed together.

- (i)** Wood Fiber Mulch is required to be used as a metering agent and seedbed when hydroseeding is used. The application rate for Wood Fiber Mulch shall be approximately 500 pound per acre and is required regardless of which mulching method is chosen.
- (ii)** Ground preparations for hydroseeding shall be the same for conventional seeding.
- (iii)** Equipment for mixing and applying the slurry shall be especially designed for this purpose. It shall be capable of applying a uniform mixture over the entire area to be seeded. The slurry mixture shall be agitated during application to keep the ingredients thoroughly mixed. All materials shall be discharged within one hour after being combined in the hydroseeder. Hydroseeding shall not be performed when winds prevent an even, thorough application. The equipment manufacturer's discretions shall be closely observed unless modifications ion methods of application are ordered by the Engineer.
- (iv)** The entire hydroseeded area shall be mulched as specified below.

(b) Fertilizing and Liming:

Approximately two (2) days prior to start of grassing operations, apply ground limestone at a rate of ½ ton per acre. Either in conjunction with the above operation or immediately afterwards, apply the specified commercial fertilizer over all areas. The fertilizer shall consist of a minimum of 85 pounds of nitrogen per acre, 60 pounds of phosphorus per acre, and 80 pounds of potassium per acre or as recommended by the soil analysis. Spread fertilizer and work into the top 4" - 6" of ground using disc harrow.

(c) Water:

The Contractor shall be responsible for providing water to the newly planted grass. On site sources such as stream and groundwater may be available. Permission from governing jurisdictions must be obtained before withdrawing water. The Contractor shall be responsible for providing temporary above-ground irrigation equipment.

(d) Soil Preparation:

Before sowing grass, the existing soil shall be loosened to a minimum 12" depth by using "Knife Point Type Sub-Soiler Attachment" (maximum spacing of tines 8" on centers). Prepare the bed by thoroughly cultivating discing and hand raking, as necessary to produce a smooth even grade free of hollows or other inequalities. Areas sown must be smoothed to a point such that the usage of the Owner's maintenance equipment in the area does not cause abnormal wear or damage to the equipment and does not induce discomfort to the equipment operator. Smoothness shall be developed to the level acceptable to the Owner.

(e) Seeding:

Before any seed is sown, the area to be seeded shall be soil conditioned as required herein, and brought to a pleasing finished grade in conformance with the plans and as directed. In the event that prior conditioned soil has become compacted by rain, equipment or other sources, the entire area or compacted portions thereof shall be again conditioned as directed, in such a manner as to present a finely pulverized, smooth, even seed bed of not less than two inches (2") in depth at time of sowing.

After sowing the seed, the entire area shall be lightly raked or dragged, either by hand or mechanical equipment, to cover all seed in accordance with the table.

All areas within the seeding limits of this project, except paved, building and other areas designated, shall be seeded as herein

specified. Grass seed shall be sown evenly by hand or mechanical broad cast in two operations of equal amounts, and at right angles to each other.

No seeding shall be done when wind velocities exceed five miles per hour, or when poor results are being obtained due to adverse soil or weather conditions.

(f) Mulching:

All areas planted in grass seed shall be mulched within twenty-four (24) hours after seeding operations have been completed. Wheat straw mulch shall be uniform, loose (not matted) and a maximum depth of one (1) inch. Recommended application is two and a half (2 ½) tons per acre. Hay is not acceptable.

(g) Watering:

Soak soil bed to a minimum depth of 6" immediately after seeding. Do not wash away soil or seed. Keep all surfaces continuously moist thereafter until 30 calendar days after the area has been seeded.

(h) Maintenance and Protection:

(i) Maintenance of grass consist of watering, weeding, cutting, repair of any erosion and reseeded, as necessary to establish a uniform stand of the specified grass, and shall continue until acceptance.

(ii) All areas that do not show satisfactory growth within 15 days after sowing shall be re-sown and re-fertilized as directed until a satisfactory growth is established. Approximately 3 weeks after sowing the last seed, but not before the seed has taken hold and the grass is growing well, apply sulphate of ammonia or sodium nitrate at the rate of 300 pounds to the acre and immediately water in. A 12" by 12" grassed area shall be considered established when it is reasonably free from weeds, green in appearance and the specified grass is vigorous and growing well. It is not required that the area be as thick and heavy as an old established lawn, but the runners must be interlaced over the entire area. (At least 98% grass cover with no bare spots exceeding one square foot and the surface is fully stabilized against erosion).

(iii) Established coverage is required in 60 days.

(i) Protection:

All areas shall be protected until accepted. All eroded and damaged areas, regardless of cause, shall be immediately repaired and re-established.

(j) Final Review and Acceptance:

- (i)** As soon as the grassed areas have become established as required above, a final review of the areas will be made, provided a written request for such review is given to the Engineer or representative of the Owner. If the Work is found to be satisfactory and in accordance with all requirements of the contract documents, the Work will be accepted.
- (ii)** The Contractor may request review for acceptance 60 days after completing all seeding Work.
- (iii)** The Engineer may reject any areas of grassing in which any square foot of area is not covered by at least one runner of the type grass specified.

(k) Planting Times:

Planting is recommended between August 15 and October 15 or between May 1 and June 1, or during the season or seasons which are normal for such Work as determined by weather conditions and accepted practice in the locality.

A temporary vegetative cover shall be required if seasonal requirements for planting are not correct at the time grading operations are complete. Seeding shall be performed in the manner outlined in these specifications. Before permanent grassing is begun, the Contractor shall restore and prepare the ground surface as required by these specifications. Temporary grassing shall be at the Contractor's expense. Temporary seeding shall be as follows:

Temporary Seeding	LBS/Acre	Depth of Cover	Date of Planting
Annual Ryegrass	40	1/4" - 1/2"	8/15 - 3/31
Pearl Millet	50	1/4" - 1/2"	5/1 - 8/15

Grassing will be done as soon as practical after grading operation for utility installations and in no case will the grassing operation fall more than 1,000 feet behind the utility installation.

E. Sodding:

- (1) **Scope** - Sodding shall consist of establishing certain critical areas with sod as designed on the Drawings.
- (2) **Products:**
 - (a) **Sod:**
 - (i) Sod shall consist of a live, dense, well-rooted growth of turf grass species as noted on the Drawings. The sod shall be free from Johnson grass, nut grass and other obnoxious grasses and shall be of suitable character for the purpose intended and for the soil in which it is to be planted. It shall be un-injured at the time of planting.
 - (ii) Sod shall be uniform in thickness, having not over 2 inches or less than 1-inch of soil.
 - (iii) Sod strips shall have a consistent width of 12 or 18 inches.
 - (b) **Fertilizer:**
 - (i) Fertilizer (10-10-10) used in connection with sodding, shall contain 10 percent nitrogen, 10 percent phosphoric acid and 10 percent potash. The fertilizer shall be furnished in standard containers with the name, weight and guaranteed analysis of the contents clearly marked. The containers shall ensure proper protection in handling and transporting the fertilizer. All commercial fertilizer shall comply with local, state and federal fertilizer laws.
 - (ii) Ammonium nitrate shall be a standard commercial product, shall conform to the requirements for other commercial fertilizers as specified above, and shall have a minimum of 32 ½ percent nitrogen.
 - (iii) Lime - Agricultural limestone shall be dolomitic and contain not less than 85 percent of calcium carbonate and magnesium carbonate combined, and shall be crushed so that at least 85 percent will pass the No. 10 mesh sieve and 50 percent will pass a No 40 mesh screen.
- (3) **Weather Limitations** - Sod shall be planted only when the soil is moist and favorable to growth. No planting shall be done between October 1 and April 1 unless weather and soil conditions are considered favorable and permission is granted by the Engineer.

(4) Execution:

(a) Sodding:

- (i)** The area to be sodded shall be constructed to the lines and grades indicated on the Drawings or as directed by the Engineer, and the surfaces loosened to a depth of not less than 3 inches with a rake or other device. If necessary, it shall be sprinkled until saturated at least 1 inch in depth, and kept moist until the sod is placed thereon. Immediately before placing the sod, the fertilizer shall be uniformly applied at the rate of 12 pounds of Grade 10-10-10, or equivalent, per 1,000 square feet. Agricultural limestone shall be applied at the rate of 50 pounds per 1,000 square feet.
- (ii)** The entire area shall be thoroughly covered with sod. The sod shall be placed on the prepared surface with the edges in close contact and, as far as possible, with staggered joints.
- (iii)** The sod shall be maintained moist from time of removal until reset but shall be placed as soon as practicable after removal from place where growing. Immediately after placing it shall be rolled with a lightweight roller or hand tamped to the satisfaction of the Engineer.
- (iv)** Sod on slopes steeper than 3 to 1 shall be held in place by wooden pins about 1 inch square and 6 inches long, driven through the sod into the soil until they are flush with the top of the sod.

(b) Watering and Maintenance:

- (i)** The sod shall be watered as directed by the Engineer for a period of two weeks after which ammonium nitrate shall be applied at the rate of three pounds per 1,000 square feet and the sod given a final watering.
- (ii)** The Contractor shall not allow any equipment or material to be placed on any planted area and shall erect suitable barricades and guards to prevent Contractor's equipment, labor or the public from traveling on or over any area planted with sod.

- (iii) It shall be the obligation of the Contractor to secure a satisfactory growth of grass before final acceptance of the project.

Tables 2.22-1A ~ Some Permanent Plant Species, Seeding Rates, and Planting Dates

Species	Rates per Acre	Rates per 1,000 sq. ft.	Planting Dates by Region			Remarks
			M-L	P	C	
Bahia, Pensacola Alone or with temporary cover With other perennials	60 lbs. 30 lbs.	1.4 lbs. 0.1 lb.	---	4/1-5/31	3/1-5/31	Low growing; sad producing; will spread into Bermuda lawns.
Bahia, Wilmington Alone or with temporary cover With other perennials	60 lbs. 30 lbs.	1.4 lbs. 0.1 lb.	3/15-5/31	3/1-5/31	---	Same as above.
Bermuda, Common (Hulled seed) Alone With other perennials	10 lbs. 6 lbs.	0.2 lb. 0.1 lb.	---	4/1-5/31	3/15-5/31	Quick cover; low growing; sad forming; needs full sun.
Bermuda, Common (Unhulled seed) With temporary cover With other perennials	10 lbs. 6 lbs.	0.2 lb. 0.1 lb.	---	10/15-2/28	11/1-1/31	Plant with Winter annuals. Plant with Tall Fescue
Bermuda Sprigs Common lawn and Forage hybrids	40 cu. ft. Sad plugs 3'x3'	0.9 cu. ft.	4/1 5-6/1 5	4/1-6/1 5	4/1-5/31	1 cu. ft. = 650 sprigs; 1 bu. = 1.25 cu. ft. or 800 sprigs

Table 2.22-1B ~ Some Permanent Plant Species, Seeding Rates, and Planting Dates (Continued)

Species	Rates per Acre	Rates per 1,000 sq. ft.	Planting Dates by Region			Remarks
			M-L	P	C	
Crown Vetch With winter annuals or cool season grasses	15 lbs.	0.3 lb.	9/1-10/15	9/1-10/15	--	Mix with 30 lbs. Tall Fescue or 15 lbs. Rye; inoculate seed; plant only North of Atlanta.
Fescue, Tall Alone With other perennials	50 lbs. 30 lbs.	1.1 lbs. 0.7 lb.	3/1-4/1 or 8/15-9/30	8/15-10/15 or 2/15-4/15	--	Mix with perennial Lespedezas or Crown Vetch; not for droughty soils or heavy use areas.
Lespedeza, Sericea Scarified	60 lbs.	1.4 lbs.	4/1-5/31	3/15-5/31	3/1-5/15	Widely adapted and low maintenance; takes 2-3 years to establish; inoculate seed with EL inoculant.; mix with Weeping Lovegrass, Common Bermuda, Bahia or Tall Fescue.

Table 2.22-1C ~ Some Permanent Plant Species, Seeding Rates, and Planting Dates (Continued)

Species	Rates per Acre	Rates per 1,000 sq. ft.	Planting Dates by Region			Remarks
			M-L	P	C	
Lespedeza, Sericea (cont.) Unscarified	75 lbs.	1.7 lbs.	9/1-2/28	9/1-2/28	9/1-2/28	Mix with Tall Fescue or winter annuals.
Seed-bearing hay	3 tons	138 lbs.	10/1-2/1	10/1-2/28	9/15-1/15	Cut when seed is mature but before it shatters. Add Tall Fescue or winter annuals.
Lespedeza, Ambro Virgata or Appalaw Scarified	60 lbs.	1.4 lbs.	4/1-5/31	3/15-5/31	3/1-5/15	Spreading growth with height of 18"-24"; good in urban areas; slow to develop good stands; mix with Weeping Lovegrass, Common Bermuda, Bahia Tall Fescue or winter annuals; do not mix with Sericea Lespedeza; inoculate seed with EL inoculant.
Unscarified	75 lbs.	1.7 lbs.	9/1-2/28	9/1-2/28	9/1-2/28	

Table 2.22-1D ~ Some Permanent Plant Species, Seeding Rates, and Planting Dates (Continued)

Species	Rates per Acre	Rates per 1,000 sq. ft.	Planting Dates by Region			Remarks
			M-L	P	C	
Lespedeza, Shrub (Lespedeza Bicolor or Lespedeza Thumbergii) Plants	3'x3' spacing		11/1-3/31	11/1-3/15	11/15-2/28	Plant in small clumps for wildlife food and cover.
Lovegrass, Weeping Alone	4 lbs.	0.10 lb.	4/1-5/31	3/15-5/31	3/1-5/31	Quick cover; drought tolerant; grows well with Sericea Lespedeza on road-banks and other steep slopes; short lived.
With other perennials	2 lbs.	0.05 lb.				
Maidencane sprigs	2'x3' spacing		2/1-3/31	2/1-3/31	2/1-3/31	For very wet sites such as riverbanks and shorelines. Dig sprigs locally.
Panicgrass, Atlantic Coastal	20 lbs.	0.5 lb.	---	3/1-4/30	3/1-4/30	Grows well on coastal sand dunes; mix with Sericea Lespedeza but not on sand dunes.
Reed Canary Grass Alone	50 lbs.	1.1 lbs.	8/15-10/15	9/1-10/15	---	Grows similar to Tall Fescue; for wet sites.
With other perennials	30 lbs.	0.7 lb.				

Table 2.22-1E ~ Some Permanent Plant Species, Seeding Rates, and Planting Dates (Continued)

Species	Rates per Acre	Rates per 1,000 sq. ft.	Planting Dates by Region			Remarks
			M-L	P	C	
Sunflower, Aztec Maximillian	10 lbs.	0.2 lb.	4/15-5/31	4/15-5/31	4/1-5/31	Mix with Weeping Lovegrass or other low growing grasses or legumes.
Switch grass	20 lbs.	0.4 lb.	4/1-5/31	4/1-5/31	4/1-5/31	For streambank plantings, drainage ditches, and wet areas.

1. Rates are for broad casted seed. If a seed drill is used, reduce the rates by one-half.

2. PLS is an abbreviation for Pure Live Seed.

Suggested Seedbed Depths

Slope	Seedbed Depth
3:1 or Flatter	Less than 4" Depth
2:1 to 3:1	1 " to 4" Depth
2: 1 or Steeper	Depressions every 6"-8" hand dug, if necessary

G. Erosion Control:

Plan excavation work to prevent erosion and the washing of soil into adjacent streams. Limit the amount of open excavation at any one time. Place spoil in the proper place and keep natural water routes open. Install appropriate erosion barriers or blankets as required to prevent sediment from leaving the immediate work site. All sewer line trenches will not be excavated more than 400 feet in advance of pipe laying.

(1) Submittals and Permits:

- (a)** The Contractor/Developer shall submit description, drawings and schedule for proposed temporary and permanent erosion and sedimentation controls to the MWA. The description and drawings shall meet the requirements of the Georgia Erosion and Sedimentation Act of 1975 as amended, and local soil and sedimentation control ordinances. The Contractor/Developer shall acquire Land Disturbance Permits from the appropriate authority and shall pay any fees for said permits. The Contractor/Developer shall be responsible for submitting to the appropriate authority sufficient documents such that the authority can acquire approval from the local Soil and Water Conservation District. All fines imposed for improper erosion and sedimentation control shall be paid by the Contractor/Developer. All erosion and sedimentation control measures and BMP' s must be in compliance with the Act of 1975.
- (b)** If applicable to project, the Contractor/Developer shall file a Notice of Intent (NOI) with the Environmental Protection Division to be covered under the General Permit for Stormwater Discharge Associated with Construction.
- (c)** Land disturbance activity shall not commence until the Land Disturbance Permit is issued. All erosion and sedimentation control measures will be installed in accordance with the Manual for Erosion and Sedimentation Control in Georgia, latest edition.
- (d)** All erosion and sedimentation controls must be installed prior to initiation of construction activity.

(2) Basic Principles:

- (a)** Conduct the earthwork and excavation activities in such a manner to fit the topography, soil type and condition.
- (b)** Minimize the disturbed area and the duration of exposure to erosion elements.

- (c) Stabilize disturbed areas immediately.
 - (d) Safety convey run-off from the site to an outlet such that erosion will not be increased off site.
 - (e) Retain sediment on site that was generated on site.
 - (f) Minimize encroachment upon watercourses.
 - (g) Clean-up and grassing operations shall be maintained within 1000 feet of the pipe laying operation and shall occur within seven days after the pipe has been installed.
- (3) **Temporary Erosion and Sedimentation Control:** In general, temporary erosion and sedimentation control procedures shall be directed toward:
- (a) Preventing soil erosion at the source
 - (b) Preventing silt and sediment from entering any waterway if soil erosion cannot be prevented.
 - (c) Preventing silt and sediment from migrating downstream in the event it cannot be prevented from entering the waterway.
- (4) **Permanent Erosion Control:**

Permanent erosion control measures shall be implemented to prevent sedimentation of the waterways and to prevent erosion of the Project site.

NOTE: Macon Water Authority policy states that for all projects budgeted by the Macon Water Authority, a consultant shall be hired to monitor the maintenance of erosion control and sedimentation controls on a 24 hour, every day basis. For private projects, the Macon Water Authority requires the contactor/owner to hire an individual to monitor the erosion and sedimentation controls on a 24 hour, every day basis.

H. Disposal of Rubbish:

Dispose of all material cleaned and grubbed during the construction of the project in accordance with the applicable codes and rules of the appropriate regulatory agencies, county, state and federal.

I. Excavated Area:

Any excavated area left open overnight shall be properly protected with flashing lights and barricades.

J. Rip Rap:

(1) Stone Rip Rap:

Use sounds, tough, durable stones resistant to the action of air and water Slabby or shaley pieces will not be acceptable. Unless shown or specified otherwise, stone rip rap shall be Type 1.

(2) Type 1 Rip Rap: Rip rap size shall conform to Section 805.01 of the Georgia Department of Transportation Standard Specification for Type 1 Stone Dumped Rip Rap.

(3) Type 3 Rip Rap:

Rip rap size shall conform to Section 805.01 of the Georgia Department of Transportation Standard Specifications for Type 3 Stone Dumped Rip Rap.

K. Filter Fabric:

(1) Filter fabric shall conform to the Georgia Department of Transportation Standard Specifications, Section 881.06 for woven fabrics.

(2) Filter fabric shall be an approved product on the Georgia Department of Transportation Qualified Product List No 28, latest edition.

L. Silt Fences:

(1) Sediment Barriers:

A temporary structure constructed of silt fences, straw or hay bales, brush, logs, gravel or other filtering material. They are installed to prevent sediment from leaving the site or from entering natural drainage ways or storm drainage systems. They are not to be used on high-risk areas or where there will be a possibility of failure. A non-reinforced silt fence is installed for areas less than ¼ acre per 100 feet of fence. This applies only if the area is flat or has a slope of less than 2%. For specs greater than 2% refer to Table 1. Two heights of silt fences are available (36 in and 22 in). In order to determine which to use, the project duration, slope gradient, and slope length must be known. Approved silt fence fabrics are listed in the Georgia Department of Transportation List #36.

To install a silt fence properly, a 4 inch or 6 inch trench is due and 2 inches of the fence is folded vertically to the direction of the flow. All undercutting or erosion of the toe anchor trench must be repaired immediately with compacted backfill material. A silt fence is never to be placed in ditches, waterways, across streams, or other areas where concentrated flow is to be expected. In these areas, rock

checkdams, sediment traps or basins are to be used. Silt fencing is to be installed parallel to existing contours or constructed in level alignments. Ends of fencing must be extended 10 feet, traveling upslope at 45 degrees to the alignment of the main fencing section.

The fence is to be inspected after every rainfall and on a weekly basis. Any necessary repairs are to be made immediately. Any unaccumulated sediment is to be removed as required to keep the fence functional (removal of deposits where accumulation reaches 1/2 the above ground height of the fence for wire raked fence and 1/3 of the above ground height for standard fence). The contractor must maintain sediment barriers until the project is vegetated or accepted. Sediment barriers are to be replaced whenever damage has occurred or has deteriorated to such an extent that its effectiveness is greatly reduced.

SLOPE	MAXIMUM SLOPE LENGTH BEHIND FENCE IN FEET
<2	100
2 to 5	75
5 to 10	50
10 to 20	25
>20	15

M. Dust Control:

The Contractor is required to use all means necessary to control dust and other airborne particles on and/or near the work and all off-site borrow areas. The contractor shall thoroughly moisten all surfaces as required to prevent dust being a nuisance to the public, neighbors, and concurrent performance of work on the site.

ADDENDUM A

**PUMP STATION INSTRUMENTATION,
PANELS, SURGE CONTROL, LOOP
DESCRIPTIONS, CONTROL DEVICES,
LOGIC CONTROLLERS, GROUNDING**

TELEMETRY AND SCADA HARDWARE

PART I GENERAL

1.01 SCOPE

- A. Work provided under this Division includes final system design, furnishing all components, system configuration, system installation services, required support services and complete documentation for the Instrumentation and Control (I/C) system. This work shall include, but not be limited to, all materials, labor and tools required to fabricate, deliver, unload, handle, erect, adjust, calibrate, and test a complete and operable I/C system as indicated on the Drawings and Specifications. Install all panels and designated instrumentation devices and provide all electrical, mechanical and pneumatic interconnection between the various components and their local sources of supply.
- B. It is the intent of these Specification for the System Manufacturer to provide a complete and operational I/C system. Additional items of equipment, materials or labor not specifically called for by these Specifications, and which may reasonably be considered to make the system complete and operational, shall be supplied as part of this work.
- C. Conductors: Discrete signal conductors, twisted pair analog signal conductor terminations are provided under this Section. This shall include, but not be limited to, terminations for all control panels and field devices. Where it is necessary to extend existing wiring, provide any required junction boxes, wiring and conduit. Termination within junction boxes shall be made by using terminal blocks as specified in Section 17100.

1.02 SYSTEM DESCRIPTION

- A. The system consists of one remote site which shall be fitted with new telemetry hardware and polled from an existing master PLC located at the Macon Town Creek Water Plant. Existing operator interface graphics shall be updated at the Town Creek facility, Martin Luther King (MLK) Boulevard facility and Poplar Street WWTP facility.
- B. The existing telemetry system has the following master, repeater and submaster locations:
 - 1. Town Creek WTP (Master).
 - 2. 790 Second Street (Repeater).

3. Breezy Hill Pump Station (Submaster).
 4. Forsyth Road Pump Station (Submaster)
 5. Heath Road Elevated Tank (Submaster).
 6. Airport North Tank (Submaster).
 7. Bowden Elevated Tank (Submaster)
 8. Poplar Street WWTP Lime Silo (Submaster).
- C. The System Manufacturer shall verify and guarantee all radio paths as a part of this project. Path verification shall include field signal strength verification by the System Manufacturer. The System Manufacturer shall confirm which radio paths are viable and shall inform the Engineer of any sites which may be accessed via radio.
- D. Prior to the bid, a site tour will be set up so that each of the prospective bidders may see what work is required at each site.

1.03

QUALITY ASSURANCE

- A. The System Manufacturer shall ensure that the I/C system is an integrated system, and the System Manufacturer shall provide all of the equipment and appurtenances – regardless of manufacture – and be responsible for correct operation of the entire system.
- B. The System Manufacturer shall be responsible for the detailed design and the proper functioning of the I/C system, programming and/or configuration of all digital hardware, preparation of required submittal data, including operations and maintenance manuals, tests, start-up including operational demonstrations, providing for installation and connection to equipment, and training of the Owner’s operating personnel.
- C. The System Manufacturer shall be regularly engaged in the type of work called for under these Specifications and must have capital facilities, personnel, plant and service capabilities required to successfully prosecute the work. The System Manufacturer shall have employed competent personnel experienced in the design, manufacturer, and programming of equipment and systems required.
- D. Acceptable Manufacturers
1. U. S. Filter Control Systems, Ames, Iowa

1.04

SUBMITTALS

- A. Make submittals in accordance with the requirements of Macon Water Authority's Shop Drawings, Product Data and Samples. Divide submittal into separate sections as listed below. Refer to related work sections for additional requirements.
- B. Field Devices: This volume includes primary elements, transmitters, etc. List all dimensions, enclosure types, ranges, and signal form or value. Provide data on special cables between sensing elements and electronics units and any special equipment used for calibration of a particular device.
- C. Control Panels: This volume includes dimensions, terminal block designations, front panel arrangement, bank panel layout, and ladder logic diagrams for both discrete component type control panels and sensor sampling panels. Provide cut sheets for all panel components, including PLC equipment, indicator ranges and nameplate schedule. All connections for new instruments terminating in the System Manufacturer's panels shall be clearly shown. Any miscellaneous equipment not clearly falling into one of the above volumes should not be included in the control panel section.

1.05 **RECORD DRAWINGS**

- A. Provide all information listed in Article 1.05 above, corrected to reflect the system as-built. Include also any instruction books, operation manuals, and other information pertaining to service and maintenance.
- B. Bind record drawings in three ring, hardback notebooks complete with tabs and index. Include manufacturers name, address, and telephone numbers to contact for service. For all major components, provide a recommended spare parts list.

1.06 **ENVIRONMENT**

- A. Local Control Panels: Local control panels shall be capable of operating between 32 degrees and 140 degrees F and 5 to 95 percent relative humidity without condensation. A 120 VAC (+ 10 percent) single phase three wire grounded power source will be supplied.
- B. Field Devices: Unless otherwise noted, field devices shall be housed in NEMA 4XD enclosures made of stainless steel, fiberglass or as noted in individual Specifications. Ambient temperature rating shall be suitable for the Project locale. All enclosures located out-of-doors shall be provided with adequate sunscreens.

1.07 **WARRANTY AND EXTENDED MAINTENCE**

- A. System Acceptable: See Article 3.04.
- B. Warranty: One year from the date of acceptance of the system by the Owner. The date of system acceptance does not necessarily coincide with the date of substantial completion of the Project.

PART 2 PRODUCTS

2.01 EQUIPMENT

- A. Quality Standards: It is not the intention of these specifications to detail every component, accessory, signal conditioning device, etc that is required to provide a complete system. The System Manufacturer shall select these items from established manufacturers with a proven history of service and support.
- B. Electronic Equipment: All solid state, printed circuit boards and components shall be suitable for the specified environment. Provide complete circuit diagrams for troubleshooting and repair. All parts shall be replaceable with standard commercial components without degrading the performance of the complete assembly.

PART 3 EXECUTION

3.01 INSTALLATION

- A. The system, peripherals, and accessory equipment shall be installed in accordance with the manufacturer's instructions and located as discussed in the pre-bid conference unless otherwise approved by the the Engineer.
- B. All work shall be executed in full accordance with all applicable codes and local rulings. Should any work be performed contrary to said rulings, ordinances, or regulations, the System Manufacturer shall bear the full responsibility for such violations and assume all costs arising therefrom.

3.02 SYSTEM NOISE REJECTION

- A. Electrical isolation shall be provided between input systems and the processor units. Noise rejection for common mode shall be at least 1000 decibels (db), from 0 to 100 Hertz, and up to 175 volts. Normal voltage rejection shall be not less than 35 db at 60 Hertz.

- B. All instrument signal wiring, control wiring and AC power wiring shall be protected against lightning, spikes, and other transient surges at all field and control panel termination points. Lightning and surge protection shall protect the instrumentation and control system from induced surges in analog, discrete and control circuitry and power supply lines. The protective devices shall not interfere with the normal operation of the instrument and control system hardware and shall be designed not to have a maximum clamping voltage in excess of what the protected device is capable of withstanding. Grounding for all surge protection devices shall be per the vendor's recommendations. Protection devices for all analog and discrete control writing and digital data transmission lines which enter or exit buildings or which are located out-of-doors shall be at both ends of the wire and as close as possible to the item being protected. Protection devices for all instrumentation and control system power supplies shall be installed on individual 120 VAC supply wiring to control panels, cabinets and each field instrument. Field instruments and antennas shall be protected by individual surge suppressors.

3.03 **GROUNDING**

- A. Bond all instrument and control panel enclosures to the power system ground.
- B. Ground analog signal conductor shields at the control panel end only.

3.04 **TESTS AND ACCEPTANCE**

- A. The equipment and programs shall be factory tested prior to shipment for compliance with the conditions of this section, these specifications and for environmental conditions.
- B. After installation of the complete system, the System Manufacturer shall provide services of a qualified systems engineer to test the complete system under the observation of the Engineer to verify that all functions specified are performed without error malfunction. As a part of the tests procedure, Contractor's personnel, when requested of the System Manufacturer, shall cause each remote process to change state or value three times to verify all functions during the checkout period, as required. This shall be repeated until the system performs correctly to the satisfaction of the Owner.

3.05 **TRAINING**

- A. The System Manufacturer shall provide training courses for Owner's

personnel as follows. The courses shall be taught by professional, full-time instructors. All course materials as required to adequately support the material presented must be included. The Owner will bear the cost of student transportation and board.

1. Operator Familiarization

- a) Length: 1 day
- b) Number of Students: 10
- c) Location: Owner's plant site
- d) This course will be taught on-site to ensure the plant operating and maintenance personnel will be thoroughly familiar with the system as delivered.

END OF SECTION

PART I GENERAL

1.01 SCOPE

- A. In general, simple analog and discrete control logic and indication requirements are depicted on the Process and Instrumentation Diagrams (P & ID) supplied as part of this package. Where additional information is necessary, it is included in the descriptions that follow.
- B. The items described in Article 1.02 are loop descriptions for typical plant unit operations. It is intended that these descriptions, in conjunction with the P & I Diagrams, provide sufficient system configuration information for the majority of simple control systems. Where additional descriptions are necessary or where control logic deviates from these general descriptions, it is described in Article 1.04.

1.02 LOOP DESCRIPTIONS – GENERAL

- A. Equipment protection interlocks and safety interlocks (motor temperature and moisture switches emergency stops, low-low level shutdowns, etc.) shall be hardwired and shall not reside in the plant control system. Hardwired equipment protection interlocks and safety interlocks shall be functional at all times, regardless of operating mode (hand, auto, local, remote, etc.)
- B. All motor control logic in the plant control system shall include “command disagree” logic. The plant control system shall generate a “command disagree” alarm to alert the operator that a fault has occurred for any of the following conditions:
 - 1. If a motor is called to run by the control system and no run feedback is received by the plant control system within a preset, adjustable period of time. This shall only be applied to those motors that have run feedback to the plant control system.
 - 2. If a motor is running based on a manual command generated through the plant control system or based on an automated sequence in the plant control system, and run feedback is lost by the plant control system for a preset, adjustable period of time. This shall only be applied to those motors which have run feedback to the plant control system.

3. If a motor is called to run based on a manual command generated through the plant control system or based on an automatic sequence in the plant control system, and the feedback from the “Hand/Off/Auto” or similar field mounted switch indicates that the unit is not in the “Automatic” mode. This shall only be applied to those motors which have “Unit in Auto” feedback to the plant control system.
- C. All analog inputs shall be monitored by the plant control system to identify “out of range” signals (less than 4 mA or more than 20 A). If the control system detects an “out of range” signal which continues for more than five minutes, an alarm signal shall be generated by the plant control system. The alarm shall identify the particular analog signal that is out of range.
 - D. In general, all analog input scaling shall be performed in the operator interface software.

1.03

TYPICAL LOOP DESCRIPTIONS

- A. Typical Motor Status Monitoring – Constant Speed Motors
 1. Motor run (typically designated “XI” and annotated “Run”) and overload (typically designated “XA” and annotated “Over Load”) status will be indicated in the plant control system.
 2. Where conditions other than motor overload are sensed in the MCC (e.g., motor temperature or moisture switch activated), the fault condition is combined with motor overload and the resulting fault (typically designated “XA” and designed “Fault”) status will be indicated in the control system.
 3. Total unit run time (typically designated “KQI” and annotated (“Run Time”)) will be provided for the motor in the plant control system.
- B. Typical Motor Status Monitoring – Variable Speed Motors
 1. Motor run (typically designated “XI” and annotated “Run) and combination VFD fault and motor overload (typically designated “XA” and annotated “Fault”) status will be indicated in the plant control system.
 2. Where conditions other than VFD fault and motor overload are sensed in the MCC (e.g., motor temperature or moisture switch activated), the fault condition is combined with motor overload

and VFD fault and the resulting fault (typically designated “XA” and annotated “Fault”) status will be indicated in the control system.

3. Total unit run time (typically designated “KQI” and annotated “Run Time”) will be provided for the motor in the plant control system.

END OF SECTION

SECTION 17100
Control Panels

PART I GENERAL

1.01 **SCOPES**

Control panels

1.02 **SUBMITTALS**

A. The Contractor shall furnish the following items from the System Manufacturer for approval prior to fabrication:

1. Layout drawings of the front of the panel showing mounting dimensions for all instruments and associated hardware.
2. Assembly drawings shall include:
 - a) Details of panel fabrication including outline and locations of rear of panel mounted equipment
 - b) Wiring layout
 - c) Wiring and tubing interconnection diagrams
3. Electrical wiring and termination drawings
4. Complete bill of materials describing all panel components.

1.03 **RECORD DRAWINGS**

Submit shop drawings as listed under Article 1.02 above plus operation and maintenance information.

1.04 **DELIVERY, STORAGE AND HANDLING**

- A. Wrap the completed panel in polyethylene plastic and crate in a wooden shipping crate with sufficient packing to avoid damage in shipment.
- B. Support the base of the shipping crate with the cross members of sufficient strength and clearance to allow movement of the entire crated panel by fork lift trucks.

PART 2 PRODUCTS

ENCLOSURE

- A. Provide wall mounted, free standing, or walk-in enclosures as scheduled.
- B. Provide NEMA 12 enclosures for control panels located indoors and NEMA 4X for outdoor locations unless otherwise noted. All NEMA 4X panels shall be 316 stainless steel. All outdoor panels shall be provided with sunscreens.
- C. In all NEMA 4X outdoor enclosures, provide a thermostat controlled space heater and corrosion inhibitor blocks. Provide NEMA 4 X rated devices or mount devices on interior panel and provide door mounted tempered glass or polycarbonate viewing window.
- D. Free-standing enclosures are a minimum of 24-inches deep.
- E. Steel enclosures shall be fabricated from a minimum 14 gauge steel with all seams ground smooth, all corners rounded and all flat surfaces smooth with no ripples, dimples, or surface imperfections and no screws, bolts, or nuts visible from outside. Thoroughly clean and degrease the steel shell before painting. Apply one coat of a rust inhibiting primer and two coats of air dry enamel or acrylic with flattening agent to produce a smooth semigloss finish. Colors are to be chosen by the Engineer.
- F. Install a continuous hinged front access door. For free-standing enclosure, furnish a three point latch. A single point latch is acceptable for wall-mounted enclosures. Wire door mounted instruments and controls to stationary components with suitable flexible connections and protection where wiring crosses the hinge. Provide double or multiple doors as required for stability and smooth mechanical operation.
- G. Terminate all tubing and electrical connections at the bottom of the panel to bulkhead fittings and terminal boards, with all external connections properly identified for field connections.
- H. Provide a circuit breaker rated 20 amps, single pole, 22,000 AIC, mounted in the rear of the panel to disconnect power. Mount an engraved nameplate (white letters, red background) to read “WARNING – This panel energized by foreign control power sources. Equipment will be live with panel disconnect in either on or off position.”
- I. Internal panel sub-feeds of 120 VAC power shall be divided into

separate circuits protected by properly sized circuit breakers or fuses. As a minimum, the following separate circuit divisions shall be provided:

- 1) Panel light(s) and panel fans (where used) shall have a separate, suitably sized circuit breaker.
 - 2) Each receptacle shall be provided with a separate, suitably sized circuit breaker.
 - 3) Power to the panel UPS shall be provided with a separate, suitably sized circuit breaker.
 - 4) Where panels are provided with thermostatically controlled heaters, the heater power feed shall be provided with a separate, suitably sized circuit breaker.
 - 5) Each power supply, include 24 volt power supplies, power supplies for PLC's, power supplies for fiber optic transceivers, etc. shall be provided with separate, suitably sized fuses.
 - 6) Where panels provide 120 volt power to field mounted instruments, each instrument shall be provided with a separate suitably sized fuse.
- J. Provide a ¼ x 3 / 12 inch copper ground bus in the rear of the panel. Bond to the metal enclosure, power system ground, and control and signal circuit grounds.
- K. Provide a minimum 25 percent spare, continuous panel/subpanel mounting area to accommodate future panel expansion.
- L. The System Manufacturer shall investigate the spaces allocated for control panels at the telemetry sites and inform the Engineer of any potential problems.
- M. The System Manufacturer shall wire all furnished I/O to terminal blocks.

2.02

WIRING

- A. Install a minimum of #16 AWG copper stranded, 600 volt, extra flexible type for all control wiring 50 volts and above, and a minimum of #18 AWG twisted shielded pair for analog signal conductors. Color code wires as follows:
- 1) Ground: Green
 - 2) Neutral: White
 - 3) Line Conductor (150 volts or less to ground): Black
 - 4) Control (150 volts AC or less): Red
 - 5) Control (150 volts DC or less): Blue

- 6) Interlock control circuits supplied from external power source: Yellow or pink.
 - 7) Signal, Shielded and Special Cables: Identify with wire markers.
- B. Mark all wires with approved wire markers at all terminations. Clearly mark all terminal blocks with typewritten or ink markings. Label all devices mounted on the steel sub panel. Label all devices mounted on the panel front with engraved lamacoid nameplates, fastened with crews, of colors chosen by the Engineer.
- C. Neatly bundle and secure all wirings with plastic ties. Route back-panel wiring in slotted plastic wireways with snap-on covers.
- D. Terminal blocks shall be provided for all field wiring connections to the panel. This includes shield terminals for shielded cables. Terminal blocks may be mounted horizontally or vertically and shall be easily accessed from panel door(s). Terminal blocks shall be DIN rail mounted, screw clamp, feed through type with 600 volt minimum rating. A minimum of 20 percent extra terminals shall be provided on the terminal blocks. Each terminal shall be clearly and permanently marked. Provide fused terminal blocks for all 120 VAC discrete inputs and outputs. All terminal blocks shall be suitably sized for #12 AWG (minimum) stranded wire. All terminal blocks shall be grouped apart, depending upon type of signal per Paragraph E below.
- E. AC or DC power wiring shall not run in any raceway with any type of instrument wiring. Wiring is to be divided into categories and shall be carried in separate raceways. The minimum acceptable groupings are:
- 1) 120 VAC, 60 Hz AC power wiring and chart drive power wiring.
 - 2) DC power to electronic instruments (does not include loop powered instruments), contact closure input and output wiring.
 - 3) All wiring carrying pulsed information.
 - 4) Standard range analog DC signals, thermocouple and up to 200 mV DC signals.
- F. Provide separate dc power supplies for field transmitter power and for PLC module power.
- G. All PLC modules and associated devices shall be fused per manufacturer's recommendations. This shall include, but not be limited to, fusing for PLC power wiring and fusing for field I/O wiring.

- H. All control panels furnished under this Section shall carry a UL label which certifies the control panel meets the requirements of UL-508A (latest revision).

2.03

RTU PANELS

- A. Small sized RTU panels designated as Type 3 enclosures shall conform to the general requirements of IO.4 with the following comments/exceptions:
 - 1) The panel layout shall accommodate a minimum two analog and two discrete Modicon Momentum modules.
 - 2) Space does not need to be provided for a future bridge/mux unit.
 - 3) The minimum panel size shall be 24 inches high, 24 inches wide and 12 inches deep for NEMA 12 (indoor) applications. The minimum panel size shall be 24 inches high, 24 inches wide and 12 inches deep for NEMA 4X (outdoor) applications.

2.04

DRAWINGS

A. Panel Construction Drawings

- 1) Shop Drawings and Catalog Cuts: Provide detailed shop drawings and catalog cuts for all panels, instrument racks and enclosures. Drawings shall show the location of all front panel and internal sub-panel mounted devices to scale and shall include a panel legend and bill of material. Layout drawings shall show all major dimensions as well as elevations in inches from the base up, of all rows of components.
- 2) The panel legend shall list and identify all front of panel devices by their assigned tag numbers, all nameplate inscriptions, service legends, and annunciator inscriptions.
- 3) The bill of materials shall include all devices including those mounted within the panel that are not listed in the panel legend, and shall include the device tag number, description, manufacturer, and complete model number.

B. Panel Wiring Diagram

- 1) Wiring diagrams shall be similar to those diagrams shown on the Drawings, but with the addition of all auxiliary devices, such as additional relays, alarms, fuses, lights, surge protection, etc.
- 2) Provide complete terminal identification of all external primary elements, panels and junction boxes that interface directly to the panel wiring being shown. Polarity of analog signals shall be shown at each terminal.
- 3) All external wiring that the electrical contractor must provide and wire shall be shown as a dotted line. Special cables that are provided with the instrument shall be clearly identified.
- 4) Panel wiring diagrams shall identify wire numbers and types, terminal numbers, and tag numbers. Wiring diagrams shall show all circuits individually. No common diagrams will be allowed.
- 5) Provide panel power wiring diagrams for all panels. The diagrams shall include the grounding requirements.

C. Interconnecting Wiring Diagrams: Diagrams shall show all component and termination cabinet identification numbers and external wire, fiber and cable numbers. This diagram shall be coordinated with the electrical supplier and shall bear its mark that this has been done.

2.05 **PANEL SCHEDULE**

Panel No.	Mounting Type	Enclosure Rating	Light/Receptacle	Locations
RTU	Stand-Mounted	NEMA 4X	No/No	Pump Station SCADA

PART 3 EXECUTION

3.01 **TESTING AND CALIBRATION**

- A. Thoroughly shop test the complete panel. Confirm that all lamps burn. Remove, box and label all parts that may come loose or detached in shipment, so that after installation, they may be easily replaced.
- B. Perform preliminary calibrations in the fabricator's shop, and final calibrations at start-up by qualified personnel.

END OF SECTION

**SECTION 17120
Surge Protection**

PART 1 GENERAL

1.01 SCOPE

Comprehensive surge protection for all instrumentation devices supplied as part of these Specifications.

1.02 GENERAL

- A. It is the responsibility of the System Manufacturer to provide appropriate protection against transients and surge for all field instruments, field wiring, and devices interfacing with control panels. All instrument signal wiring, control wiring, telephone wiring and data transmission wiring which enters or exits buildings shall be protected against lightning spike, and other transient surges at all control panel termination points. All instrument signal wiring, control wiring, telephone wiring and data transmission which in outdoor control panels shall be protected against lightning spikes, and other transient surges at all control panel termination points. All AC control power wiring shall be protected against lightning spikes, and other transient surges at all control panel termination points. Lightning and surge devices shall protect the system from induced surges in analog, discrete and control circuitry and power supply lines. The protection devices shall not interfere with the normal operation of the panel hardware and shall be designed not to have a maximum clamping voltage in excess of what the protected device is capable of withstanding.
- B. All field instruments located indoors or out-of-doors provided by the System Manufacturer under this contract shall be supplied with surge protection for 120 VAC power to the instrument.
- C. Surge protectors shall include a combination of surge suppression technologies including metal oxide varistor, gas discharge tubes, diodes, and 3 AG size fuses for line-to-line and line-to-ground protection.

1.03 SUBMITTALS

Submit detailed product data.

PART 2 PRODUCTS

2.01 FIELD INSTRUMENTS – ANALOG SIGNALS

- A. Direct mounted surge protectors for analog signals shall screw directly into the unused conduit entry hub of the instrument. The surge protector housing shall be 304 stainless steel minimum. Surge protectors shall be specifically manufactured for protecting field instruments.
- B. Where direct mount is not possible, the surge protectors for analog signals shall be located as close to the field instrument as practical. The surge protector shall be rated NEMA 4X, or shall be mounted in a 304 stainless steel NEMA 4X enclosure.

2.02 **FIELD INSTRUMENTS – DISCRETE SIGNALS**

Surge protectors for discrete signals wiring shall be located as close to the field instrument as practical. The surge protector shall be NEMA 4X, or shall be mounted in a 304 stainless steel NEMA 4x enclosure.

2.03 **CONTROL PANELS**

- A. All instrument analog and discrete signal wiring, data transmission wiring and 120 VAC power supply wiring which enters or exits buildings or which terminates in outdoor control panels shall be individually protected against lightning spikes and other transient surges at all control panel termination points.
- B. Provide surge protectors for all power wiring to control panels whether located indoors or out-of-doors.
- C. Provide surge protection for all telephone connections.

2.04 **INSTRUMENT POWER WIRING**

Provide surge protectors for all power wiring to individual instrument devices whether located indoors or out-of-doors. For instrument devices, protection shall be located as close to the device as practical. The surge protector shall be NEMA 4X, or shall be mounted in a NEMA 4x enclosure. Outdoor enclosures shall be NEMA 4x, 316 stainless steel. Indoor enclosures shall be NEMA, 4X, fiberglass.

2.05 **ANTENNAS**

Provide RF surge protectors for all antennas.

2.06 **MISCELLANEOUS DIGITAL EQUIPMENT**

Provide surge protection for all computers, printers, uninterruptible

power supplies, digital equipment power supplies, PLC, fiber optic modems, telephone modems, digital signal converters and other miscellaneous digital hardware to include communications wiring and 120 VAC power supply wiring for each device.

2.07 ACCEPTABLE PRODUCTS

SURGE PROTECTOR ACCEPTABLE MODEL NUMBERS		
Field Instrument Analog Signals Directed Mounted	TP48	S-PT1-2PE-24VDC
Field Instrument Analog Signals Remote Mounted	SD Series	UFBK-M2-PE Series
Analog Signals Control Panel	SD Series	UFBK-MS-PE Series
120 VAC Power Control Panel	MA Series	UAK2-PE/S Series
Discrete Inputs/Outputs Control Panel	SD Series	UFBK-2/2 Series
RS-232	NP Series	MT Series, D-UFB Series
RS-485	NP Series	MT Series, D-UFB Series
Telephone Line	DP200 Series	TELETRAB-4X Series
Ethernet	NP Series	D-ETH Series
Antenna Cable	CA Series	COAXTRAB Series

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install all surge protection equipment in strict accordance with manufacturer’s guidelines.
- B. For surge protectors located out-of-doors and for antenna surge protectors, surge protector grounding shall use individual ground rods located as close to the surge protector as possible. The grounding conductor shall be sized in accordance with manufacturer’s recommendations and be routed via the shortest path possible. Bends in the grounding conductor shall be avoided. If bends in the grounding conductor are unavoidable then the number of bends shall be kept to an absolute minimum.
- C. Provide installation for all field mounted surge protection equipment. Provide for all wiring terminations for surge protection equipment.

- D. If a particular piece of equipment is protected by two surge protectors in series, ensure that the resulting equipment protection is not diminished.

END OF SECTION

**SECTION 17200
CONTROL DEVICES**

PART I GENERAL

1.01 SCOPE

General purpose control components

1.02 SUBMITTALS

Submit product data.

PART 2 PRODUCTS

2.01 GENERAL PURPOSE CONTROL COMPONENTS

- A. Manual Operators: 30.5 mm heavy duty, oil tight; industrial grade pushbuttons and selector switches with octagonal ring; contacts rated 10 amps continuous, 6 amps break at 120 VAC. Provide flush head for “start” pushbuttons, extended head for “stop” pushbuttons and spring return for “jog” selector switches.
- B. Pilot Lights: 30.5 mm, heavy duty, oil tight; industrial grade transformer type pilot light with octagonal ring; 6 volt LED lamp.
- C. Elapsed Time Indicators: Six-digit, hour, non-reset, 3 ½ inch square case; equal to Yokogawa Type 240.
- E. Acceptable Manufacturers (Manual Operators and Pilot Lights): Allen-Bradley, Cutler-Hammer, General Electric, or Square D.

2.02 RELAYS

- A. Relays which interface with motor controls shall be heavy duty industrial grade; 600 volt; contacts rated 10 amps continuous, 6 amps break (5 and 3 amps respectively for time delay forms); 120 VAC; convertible contacts; coils suitable for continuous duty. Relays shall be manufactured by Allen Bradley, General Electric, or Square D.
- B. Interposing relays for non-motor control applications shall be double pole (minimum) relay contacts, rated 10 amps (minimum) at 120 VAC. Coil duty shall be continuous, with coil voltage suitable for application. Open contact breakdown voltage shall be 500 volts rms (minimum) Provide with polycarbonate dust cover, DIN rail mount

socket and holddown spring. The unit shall have a minimum expected life of 100,000 operations at rated loads. Relays shall be equal to Potter & Brumfield, Type KAP or KUP.

2.03 LOOP INSTALLATION

- A. Type: Current-to-current loop isolator
- B. Input: 4-20 mADC.
- C. Output: 4-20 mADC.
- D. Accuracy: +0.1 percent span
- E. Schedule: As Required
- F. Acceptable Manufacturers: Action Instruments, Newport, Moore Industries

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 17250
Programmable Logic Controllers

PART I GENERAL

1.01 SCOPE

Programmable logic controllers (PLC) for the remote terminal units

1.02 SYSTEM DESCRIPTION

- A. This Sections covers the technical requirements for programmable logic controllers (PLC) which will receive discrete and analog inputs, and through the use of an internal ladder logic program, control output relay operations and perform data handling and telemetry functions.
- B. The capabilities of the individual PLCs shall be as required to perform the control functions associated with the particular control panel or system.
- C. The System Manufacturer shall determine the actual amount of memory and I/O requirements necessary for each control panel to function as specified or shown on the Drawings. Each controller shall have 50 percent spare memory capacity (not less than 1K) and 10 percent spare I/O capacity (not less than four discrete inputs and four discrete outputs, and not less than two analog inputs and two analog outputs).

1.03 SUBMITTALS

- A. For each individual equipment item using PLCs, the following shall be furnished in addition to documentation requirements in other Sections.
 - 1. Complete software documentation, including ladder logic diagram printout. Printout shall include, or shall have added to it, a complete set of comments identifying relays, function of logic blocks, I/O points, etc.
 - 2. Narrative description of the sequence of operation. Description shall reference, as applicable, the ladder diagram.
 - 3. Wiring diagrams showing terminal block designations and interconnections to remote devices.
- B. For the PLC system, documentation shall consist of descriptive literature and installation operation and instruction manuals.

- C. The above items shall be included in prints for approval and prints for record. In addition, record drawings shall include PLC manufacturer's recommended list of spare parts with prices, and availability/cost of maintenance contracts and similar support services available.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

PLC to be Modicon Momentum.

2.02 GENERAL REQUIREMENTS

- A. All components in the PLC system shall be the product of a company who regularly manufactures and services this type of equipment. Wherever possible, all assemblies and sub-assemblies performing similar functions in separate controllers purchased under this Section shall be interchangeable.
- B. Components: In compliance with normally recognized industry standards and regularly sold to heavy industry installations. All connecting cables shall be constructed so as to withstand, without damage, all normal use and handling.
- C. The PLC system shall be of a modular design with a plug-in processing unit, input/output frames or assemblies, and plug-in peripherals. All necessary cables shall be included.
- D. Mark all major assemblies, sub-assemblies, circuit cards, and devices with the manufacturer's part or identification number.
- E. All components of the PLC system shall be capable of continuous operation at temperatures of 0-60 degrees C, and humidity levels of 5-95 percent.
- F. Electrical supply voltage to the individual controllers shall be 115 VAC + 10 percent, 48 – 63 Hz. Controller system power supplies shall have circuit breakers or fuses for overload protection.
- G. Each controller, including output devices, shall orderly shut down and alarm in the event of a disruption of program execution or scan, a loss of logic power, loss of communication between controller essential devices, or a memory error. A failure of one controller shall not disrupt operation of other controllers in the system.

2.03

PROCESSOR ADAPTER (PLC)

- A. The Processor Adapter shall be a full-fledged PLC containing a CPU, RAM, and Flash Memory.
- B. The Processor Adapter shall contain a minimum of 256K of RAM, one RS-232 port and one I/O bus port.
- C. One Option Adapter is required for each Processor Adapter. The Option Adapter shall contain a Modbus (RS232/485) Option Adapter, TOD Clock and battery backup.
- D. The status of latch relays and one-shorts, and all data from timers, counters, and math functions shall be retained during any power outage as specified above.

2.04

COMMUNICATION ADAPTERS

- A. Where communications to additional I/O Module Buses is required, it shall be via Interbus (I/O bus) protocol. An Interbus Communication Adapter shall be used with the I/O Module Base.
- B. Where communications to radios, modems, programming PC's, etc. is required, it shall be via Modbus protocol.

2.05

INPUT/OUTPUT (I/O) DEVICES

A. Discrete Inputs/Outputs

- 1) Discrete inputs shall be available in 24 and 115 Vac/dc. Discrete outputs shall be available in 24 Vdc, and 115 Vac. Discrete inputs and outputs shall be 115 Vac unless otherwise noted.
- 2) Discrete inputs shall be guaranteed if at least 78 percent of nominal voltage is present. Discrete inputs shall be guaranteed off if 20 percent or less of the nominal voltage is present.
- 3) Each discrete output shall have an individual interposing relay. See Specification 17200 for interposing relays.

B. Analog Inputs/Outputs

- 1) Analog inputs shall be available in 16 channel single-ended input module. Analog outputs shall be available in 4 channel output 4-20 mA modules.

2) All analog input and output modules shall be isolated. Where isolated input modules are not available, provide individual loop isolators for each input.

- C. All PLC terminal blocks shall be 300 V minimum NEM rated, and accommodate no fewer than #15 gauge wires.
- D. Marker strips shall be attached adjacent to the field wiring and the status indicating lights to allow easy identification of inputs and outputs by the user. These markers shall not change when devices are replaced during repair or maintenance. Color code marker strips according to voltage.
- E. Field wiring shall not have to be disconnected from the terminal in order to replace an I/O device during repair or maintenance.

2.06 **PROGRAM DEVELOPMENT SOFTWARE**

- A. Provide a Windows based programming software which will run on an IBM compatible PC.
- B. The programming software shall be: Modicon (Concept).

2.07 **PROGRAM DEVELOPMENT PC**

A program development PC is not included in this project. An electronic copy of the program development software and the updated (as-built) software program shall be provided to the Owner within 10 days after the I & C System Acceptance Test is complete.

PART 3 EXECUTION

3.01 **INSTALLTION**

See Remote Terminal Unit Drawing for typical RTU panel layout.

END OF SECTION

SECTION 17300
Instrumentation Devices

PART 1 GENERAL

1.01 **SCOPE**

- A. Primary elements
- B. Transmitters
- C. Receivers

1.02 **SYSTEM DESCRIPTION**

- A. System consists of all field and panel mounted instrumentation devices as noted, complete with all necessary signal converters, isolators, amplifiers, power supplies, and other appurtenances necessary for interfacing with other components.
- B. Except as noted, scale all indicators in engineering units.

1.02 **SUBMITTALS**

Submit product data.

PART 2 ALARM HORN

- A. Type: Electro-mechanical diaphragm.
- B. Mounting: As required by schedule, provide cast aluminum neoprene-gasketed weatherproof housing for outside mounted units and gasketed panel mounting kit for panel-mounted units.
- C. Diaphragm Material: Stainless steel
- D. Grille Material: Die-cast aluminum
- E. Power: 120 VAC
- F. Sound Intensity: 100 Db at 10 feet

G. Schedule

Tag
XA-1024

Mounting
Panel

H. Acceptable Manufacturer: Federal Signal Corporation Model 27XST Series C

2.02 **ALARM LIGHT (STROBE TYPE)**

- A. Type: High-intensity strobe warning light
- B. Enclosure: Corrosion-resistant NEMA 4X, suitable for outdoor service. Unit shall be suitable for mounting in Class 1, Group D, Division 2 rated areas.
- C. Power: 120 VAC
- D. Dome Color: Red, blue, or amber, as required by schedule.
- E. Schedule:

Tag	Color
XL-1024	Yellow
AAH-1023A	Red

F. Acceptable Manufacturer: Federal Signal Corporation

PART 3 EXECUTION

3.01 **INSTRUMENT TAGGING**

Provide stainless steel identification tags attached with stainless steel wire or screws for all field instruments.

3.02 **TESTS AND CALIBRATION**

- A. Perform continuity and insulation resistance tests on instrumentation conductors in accordance with Section 17120.
- B. Field calibrate each instrument to its published accuracy. Submit calibration sheets, including the instrument tag number or name, the date, name of individual performing calibration, procedures and equipment used, and results obtained.

END OF SECTION

SECTION !7400
Telemetry and SCADA System Hardware

Part 1 GENERAL

1.01 **SCOPE**

Telemetry and SCADA hardware.

1.02 **SYSTEM DESCRIPTION**

- A. The telemetry system hardware consists of radio and telephone telemetry equipment, coaxial cabling, antennas, panels, surge suppression devices, wiring and conduit for housing telemetry equipment and other telemetry equipment required to make a complete and workable system.
- B. All computer hardware shall comply with the latest amendment to Part 15 of the FCC Rules and Regulations, Dockets No. 20780 and 80-284 relating to restricted radiation devices and low power communication devices.

1.03 **SUBMITTALS**

Submit product data.

PART 2 PRODUCTS

2.01 **GENERAL REQUIREMENTS**

- A. All digital hardware shall be modular construction to provide for future hardware expansion.
- B. All remote telemetry unit PLCs shall continuously perform on-line diagnostics and provide failure reporting to the master operator interface units. Software shall be provided which keeps track of communications statistics for all radio sites, including, but not limited to, communication tries and fails.

2.02 **REDUNDANCY/FAIL-OVER REQUIREMENTS**

- A. Where redundant equipment is specified, the failure of either device in a redundant pair shall not alter the performance of the plant

control system. The fail-over shall be fully automatic and shall require no action on the part of the operator to effect the transfer from one device to its back-up.

- B. Where a failed device contains real-time control system data, the swap-over to the redundant device shall be such that no more than 3 seconds of data shall be lost.
- C. Where the failed device contains control system intelligence such as graphics or programs, the redundant device shall have this intelligence internally resident and shall not require the downloading of graphics or programming to resume system control.
- D. No degradation in control system performance shall occur when a redundant device is operating in a fail-over mode. No degradation of performance shall occur while redundant equipment is undergoing preventive or corrective maintenance.

2.03 **REMOTE TERMINAL UNITS AND I/O SUBSTRUCTURE**

Remote terminal unit PLCs and I/O substructure shall be per Section 17250.

2.04 **TELEMETRY COMMUNICATIONS**

All telemetry communications shall be Modbus for both radio and telephone telemetry equipment communicating with the master polling PLC.

2.05 **UNINTERRUPTIBLE POWER SUPPLIES**

- A. Provide uninterruptible power supply for each RTU panel containing control system processors, I/O racks or modems. Operator interface units shall have a minimum of one UPS unit for each master operator interface unit and one UPS for the 'slave' station. Each UPS unit shall be sized to provide nominal power requirements for a minimum of 15 minutes. The following devices, as a minimum, shall be provided with UPS based power:
 - 1) Modems for all forms of telemetry and digital LAN communications
 - 2) Loop powered analog devices
 - 3) Power supplies for control system processors and I/O hardware
- B. Acceptable Manufacturer: Best Power Systems

2.06

RADIOS

Radios shall be by Microwave Data Systems, Model 9810. Provide all spread spectrum radios with on-line diagnostics.

2.07

OPERATOR INTERFACE TERMINALS – TYPE 1 RTU PANELS

- A. The System Manufacturer shall provide one Operator Interface Terminal (OIT) in each Type 1 control panel. The OIT shall communicate directly with the associated PLC located in the control panel and shall be used by the operator to make adjustments to PLC software settings and to acknowledge the intrusion alarm.
- B. The OIT shall contain a fully configurable graphics touch screen display. The touch screen shall be configured with a security system login page requiring a correct operator login to proceed. The operator shall log in by selecting his/her name and entering a 4-digit personal identification number. The login page shall be configured for up to 15 operators. A correct login shall automatically acknowledge the intrusion alarm and bring up the system overview page. In addition, the central SCADA terminal at the Town Creek facility shall indicate the individual who has logged on at the remote station.
- C. Operator adjustments shall consist of changing the setpoints for analog switches. This page shall consist of appropriate graphic showing current analog signal status and current analog switch setpoints.
- D. A logout option shall be provided for operator use. The operator shall be able to logout at any time. Logging out shall return the OIT display to the security system login page. The OIT shall also be configured to automatically logout after 10 minutes of idle time. The system shall also be configured to allow the logging out of an operator from the central SCADA terminal at the Town Creek facility.
- E. The OIT shall communicate to the PLC using the PLC manufacturer's standard PLC communications protocol (Mobile Plus, Data Highway Plus, GE Genius, etc.).
- F. The OIT shall be provided with Windows compatible programming software, downloading cable, and 24 VDC power supply.
- G. The OIT shall be mounted on the door of the control panel approximately 5 feet above the floor.

H. The OIT shall be a 5” LCD monochrome type, 240 x 320 pixel resolution, black and white, NEMA 4/13. The manufacturer shall be Total Control Products (5” Quick Panel Jr).

2.08 **INTRUSION ALARM (TYPE 2 AND TYPE 3 RUT PANELS)**

Provide a small, momentary switch on the exterior of all Type 2 and Type 3 control panels. This switch shall be located in a nondescript location on the bottom of the panel, and shall be wired into the panel PLC. Once an intrusion is detected, if this switch is not activated in a preset, adjustable length of time (initial setting – 2 minutes), an intrusion alarm shall be activated at the central SCADA terminal at the Town Creek facility.

2.09 **MISCELLANEOUS TELEMETRY COMPONENTS**

Provide antennas, coaxial cabling and other miscellaneous components per the Specifications/cut-sheets provided in Section F of the attached Bristol Babcock report.

2.10 **RTU SECURITY**

All outdoor RTU’s shall be lockable using padlocks provided by the Owner.

2.11 **ANTENNA GROUNDING**

- A. Provide grounding kits for each site which requires an antenna. Provide grounding kit for each site equal to Andrew Model 204989-2.
- B. Provide grounding for each antenna and antenna surge arrestor at each site which requires an antenna.
- C. Provide ground rods at each site per the following specifications:
 - a. Bare Conductors: ASTM B-8; stranded; hard drawn copper. Size unless otherwise noted is #4/0 AWG.
 - b. Ground Rods: UL 425H; 5/8 inch x 8 feet; high strength steel core with metallically bonded copper jacket.
- D. Observe the following installation requirements:
 - a. Use insulated ground conductors only where installed in a raceway. Use bare conductors for the ground rod

connections. Where a conductor is installed in a raceway use only non-metallic raceways. Provide UL approved connections to ground rods.

- b. Drive ground rods so the top is 3 to 6 inches below finished grade. If rock is encountered then rods may be driven at an angle or grounding plates, as approved by the Engineer, may be used.
- c. Provide at least one driven ground rod per site. The System Manufacturer shall test each site and provide a list of sites to the engineer which have resistance to ground measurements of more than 10 ohms. Make resistance to ground measurements in normal, dry weather conditions not less than 24 hours after rainfall. Make measurements using the fall of potential method per IEEE Standard No. 142.
- d. It shall be the contractor's responsibility to provide as part of SCADA system hardware, the appropriate tower (height, type) for the SCADA antenna.

END OF SECTION

SECTION 17500
Grounding

PART I GENERAL

1.01 **SCOPE**

- A. Power system grounding.
- B. Electrical equipment and raceway grounding and bonding.

1.02 **SYSTEM DESCRIPTION**

- A. The system consists of ground clusters for supplemental electrodes, and connections thereto of structures, equipment and electrical systems.
- B. Within this Section the following definitions apply:
 - 1) Ground Cluster: An assembly of three or more driven ground rods; spaced not closer than eight feet apart; each rod connected to the others in a closed delta configuration; and providing a resistance to ground of not more than 10 ohms.
 - 2) Connect or Bond: For underground or otherwise inaccessible locations – a permanent connection made by exothermic welding, brazing, or similar process. For exposed and accessible locations – a connection made with clamps, bolts or similar fittings approved for the purpose.

1.03 **SUBMITTALS**

Submit product data.

PART 2 PRODUCTS

2.01 **MATERIALS**

- A. Bare Conductors: ASTM B-8; stranded; hard drawn copper. Size unless otherwise noted is #4/0 AWG.
- B. Ground Rods: UL 425H; 5/8 inch x 8 feet; high strength steel core with metallurgically bonded copper jacket.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Except as noted, use insulated ground conductors only where installed in a raceway. Use bare conductors for ground rod connections, and bonding of structures etc. Where a bare conductor is installed in a raceway use only non-metallic raceway; do not install bare conductors in metallic raceway.
- B. Drive ground rods so the top is 3 to 6-inches below finished grade. If rock is encountered then rods may be driven at an angle or grounding plates, as approved by the Engineer, may be used.
- C. Construct ground clusters as follows: Start with three driven ground rods and measure the resistance to ground of each rod. If the parallel combination exceeds 10 ohms then add sections and drive the rods deeper, or drive additional rods until the specified value is obtained. Connect each rod to every other rod in the cluster. Exception: not more than three additional rods of sections (six total) are required for any one cluster.
- D. Where bare conductors emerge from concrete encasement, provide a 4-inch length of Schedule 40 PVC conduit set in the concrete to protect the conductor.

3.02 SERVICE ENTRANCE EQUIPMENT

- A. Bond service entrance equipment ground bus to a ground cluster with a I/O conductor, unless otherwise noted.
- B. Provide one ground cluster at the closest practical location to the service entrance equipment and bond to ground bus with a I/O conductor, unless otherwise noted.
- C. Prior to energizing the system, remove the neutral link and meggar the system neutral. Repair any grounds then replace the neutral link.

3.03 SEPARATELY DERIVED SYSTEMS

- A. Ground enclosures where solidly grounded systems are indicated, the secondary neutral to a ground cluster.

3.04

FIELD QUALITY CONTROL

- A. Inspect grounding and bonding system conductors for tightness and proper installation.
- B. Compile and submit a list of ground resistance measurements for each ground rod in ground clusters. Measure and submit resistance to ground of service equipment ground bus.
- C. Make resistance to ground measurements in normal, dry weather conditions not less than 24 hours after rainfall. Make measurements using the fall of potential method per IEEE Standard No. 142.

END OF SECTION

APPROVED
STATE OF GEORGIA
ENVIRONMENTAL PROTECTION DIVISION
MAR 25 2022
DRINKING WATER PROGRAM
ENGINEER SIG. *[Signature]*
VALID ONLY FOR DRINKING WATER PORTION OF PROJECT

Standards for Design and Construction Specifications For Water and Wastewater

ACRONYMS

<u>Abbreviation</u>	<u>Meaning</u>
ACIPCO	American Cast Iron Pipe Company And Transportation Officials
ANSI	American National Standards Institute
ASSE	American Society of Sanitary Engineers
ASSHTO	American Association of State Highway
ASTM	American Society for Testing & Materials
AWS	American Welding Society
AWWA	American Water Works Association
CF	Cubic Feet
CFM	Cubic Feet Per Minute
CTU	Central Terminal Unit
DDC	Double Detector Check Valve
DIA	Diameter
DIP	Ductile Iron Pipe
DOT	Department of Transportation
FH	Fire Hydrant
FM	Force Main
GV	Gate Valve
HP	Horse Power
HZ	Hertz
I/C	Integrated Circuit
I/O	Instrumentation Operation
IN	Inch
MG/L	Milligrams Per Liter
MJ	Mechanical Joint
MWA	Macon Water Authority
NEMA	National Electrical Manufacturers Assn.
OHSA	Occupational Safety and Health Administration
PLC	Programmable Logic Controller
PSI	Pounds per Square Inch
PVC	Polyvinyl Chloride
RJP	Restrained Joint Pipe

RPM	Rotation per Minute
RPZ	Reduced Pressure Zone
RTU	Remote Terminal Unit
SDR	Standard Thermoplastic Pipe Dimension Ratio
TS & V	Tapping Sleeve and Valve
UL	Underwriters Laboratory
USCFCC	University of Southern California
USCS	Unified Soil Classification System
USF	U S Foundry
USS	U S Steel
VAC	Vacuum
VB	Valve Box
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant