

# TECHNICAL SPECIFICATIONS

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## **Item C-001 Special Provision: GDOT Standard Specifications**

**001-1 General.** All work related to the project, unless otherwise included in a detailed specification in the project documents, shall be performed by the Contractor such that the work meets the requirements as detailed in the Georgia Department of Transportation (GDOT) *Standard Specifications Construction of Transportation Systems 2021*. All GDOT Supplemental Provisions for the applicable specifications shall also apply. It is the responsibility of the Contractor to become familiar with and strictly adhere to the applicable specifications. The Contractor shall account for all applicable specifications, special provisions, and incidental items when preparing their bid proposal. Any reference to “GDOT” or “the Department” with regard to shop drawing review, material submittals, and construction materials testing/acceptance shall mean the Engineer or RPR.

### **METHOD OF MEASUREMENT**

**001-2 Basis of measurement and payment.** Pay items that are governed by the GDOT *Standard Specifications Construction of Transportation Systems 2021* shall be measured for payment as detailed on the plans. Any items that are required per the GDOT *Standard Specifications Construction of Transportation Systems 2021* or as shown on the plans, and not specifically included as a separate pay item, shall be considered incidental to the project; and no separate measurement shall be made for those items.

### **BASIS OF PAYMENT**

**001-3 Payment.** Payment shall be made at the contract unit price for that item; and shall be full compensation for furnishing all materials, for preparing and placing these materials, and for all labor, equipment tools, and incidentals necessary to complete the item.

## ITEM C-102 TEMPORARY AIR AND WATER POLLUTION, SOIL EROSION, AND SILTATION CONTROL

### DESCRIPTION

**102-1.** This item shall consist of temporary control measures as shown on the plans or as ordered by the Resident Project Representative (RPR) during the life of a contract to control pollution of air and water, soil erosion, and siltation through the use of silt fences, berms, dikes, dams, sediment basins, fiber mats, gravel, mulches, grasses, slope drains, and other erosion control devices or methods.

Temporary erosion control shall be in accordance with the approved erosion control plan; the approved Construction Safety and Phasing Plan (CSPP), AC 150/5370-2, *Operational Safety on Airports During Construction*, and the latest edition of the *Manual For Erosion And Sediment Control In Georgia*. The temporary erosion control measures contained herein shall be coordinated with the permanent erosion control measures specified as part of this contract to the extent practical to assure economical, effective, and continuous erosion control throughout the construction period.

Temporary control may include work outside the construction limits such as borrow pit operations, equipment and material storage sites, waste areas, and temporary plant sites.

Temporary control measures shall be designed, installed and maintained to minimize the creation of wildlife attractants that have the potential to attract hazardous wildlife on or near public-use airports.

### MATERIALS

**102-2.1 Grass.** Grass that will not compete with the grasses sown later for permanent cover per Item T-901 shall be a quick-growing species (such as ryegrass, Italian ryegrass, or cereal grasses) suitable to the area providing a temporary cover. Selected grass species shall not create a wildlife attractant.

**102-2.2 Mulches.** Mulches may be hay, straw, fiber mats, netting, bark, wood chips, or other suitable material reasonably clean and free of noxious weeds and deleterious materials per Item T-908. Mulches shall not create a wildlife attractant.

**102-2.3 Fertilizer.** Fertilizer shall be a standard commercial grade and shall conform to all federal and state regulations and to the standards of the Association of Official Agricultural Chemists.

**102-2.4 Slope drains.** Slope drains may be constructed of pipe, fiber mats, rubble, concrete, asphalt, or other materials that will adequately control erosion.

**102-2.5 Silt fence.** Silt fence shall consist of polymeric filaments which are formed into a stable network such that filaments retain their relative positions. Synthetic filter fabric shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life. Silt fence shall meet the requirements of ASTM D6461.

**102-2.6 Other.** All other materials shall meet commercial grade standards and shall be approved

by the RPR before being incorporated into the project.

## **CONSTRUCTION REQUIREMENTS**

**102-3.1 General.** In the event of conflict between these requirements and pollution control laws, rules, or regulations of other federal, state, or local agencies, the more restrictive laws, rules, or regulations shall apply.

The RPR shall be responsible for assuring compliance to the extent that construction practices, construction operations, and construction work are involved.

**102-3.2 Schedule.** Prior to the start of construction, the Contractor shall submit schedules in accordance with the approved Construction Safety and Phasing Plan (CSPP) and the plans for accomplishment of temporary and permanent erosion control work for clearing and grubbing; grading; construction; paving; and structures at watercourses. The Contractor shall also submit a proposed method of erosion and dust control on haul roads and borrow pits and a plan for disposal of waste materials. Work shall not be started until the erosion control schedules and methods of operation for the applicable construction have been accepted by the RPR.

**102-3.3 Construction details.** The Contractor will be required to incorporate all permanent erosion control features into the project at the earliest practicable time as outlined in the plans and approved CSPP. Except where future construction operations will damage slopes, the Contractor shall perform the permanent seeding and mulching and other specified slope protection work in stages, as soon as substantial areas of exposed slopes can be made available. Temporary erosion and pollution control measures will be used to correct conditions that develop during construction that were not foreseen during the design stage; that are needed prior to installation of permanent control features; or that are needed temporarily to control erosion that develops during normal construction practices, but are not associated with permanent control features on the project.

Where erosion may be a problem, schedule and perform clearing and grubbing operations so that grading operations and permanent erosion control features can follow immediately if project conditions permit. Temporary erosion control measures are required if permanent measures cannot immediately follow grading operations. The RPR shall limit the area of clearing and grubbing, excavation, borrow, and embankment operations in progress, commensurate with the Contractor's capability and progress in keeping the finish grading, mulching, seeding, and other such permanent control measures current with the accepted schedule. If seasonal limitations make such coordination unrealistic, temporary erosion control measures shall be taken immediately to the extent feasible and justified as directed by the RPR.

The Contractor shall provide immediate permanent or temporary pollution control measures to minimize contamination of adjacent streams or other watercourses, lakes, ponds, or other areas of water impoundment as directed by the RPR. If temporary erosion and pollution control measures are required due to the Contractor's negligence, carelessness, or failure to install permanent controls as a part of the work as scheduled or directed by the RPR, the work shall be performed by the Contractor and the cost shall be incidental to this item.

The RPR may increase or decrease the area of erodible earth material that can be exposed at any time based on an analysis of project conditions.

The erosion control features installed by the Contractor shall be maintained by the Contractor during the construction period.

Provide temporary structures whenever construction equipment must cross watercourses at frequent intervals. Pollutants such as fuels, lubricants, bitumen, raw sewage, wash water from concrete mixing operations, and other harmful materials shall not be discharged into any waterways, impoundments or into natural or manmade channels.

**102-3.4 Installation, maintenance and removal of silt fence.** Silt fences shall extend a minimum of 16 inches (41 cm) and a maximum of 34 inches (86 cm) above the ground surface. Posts shall be set no more than 10 feet (3 m) on center. Filter fabric shall be cut from a continuous roll to the length required minimizing joints where possible. When joints are necessary, the fabric shall be spliced at a support post with a minimum 12-inch (300-mm) overlap and securely sealed. A trench shall be excavated approximately 4 inches (100 mm) deep by 4 inches (100 mm) wide on the upslope side of the silt fence. The trench shall be backfilled, and the soil compacted over the silt fence fabric. The Contractor shall remove and dispose of silt that accumulates during construction and prior to establishment of permanent erosion control. The fence shall be maintained in good working condition until permanent erosion control is established. Silt fence shall be removed upon approval of the RPR.

**102-3.5 Materials.** Materials used in Construction of Erosion Control shall be governed by applicable technical section and details shown on the Plans. Concrete shall be in accordance with P-610.

## METHOD OF MEASUREMENT

**102-4.1** This is a Lump Sum Item and thus there is no measurement for payment. The Item shall be completed per the requirements of this specification.

## BASIS OF PAYMENT

**102-5.1** The lump sum price bid shall include the cost of furnishing all labor, equipment, instruments, and all other material necessary to satisfactorily complete all requirements of this specification. Partial payments may be made at the discretion of the Engineer as the work progresses.

Payment will be made under:

Item C-102-5.1	Temporary Air and Water Pollution, Soil Erosion, And Siltation Control – per lump sum
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Where other directed work falls within the specifications for a work item that has a contract price, the units of work shall be measured and paid for at the contract unit price bid for the various items.

Temporary control features not covered by contract items that are ordered by the RPR will be paid for in accordance with Section 90, Paragraph 90-05 *Payment for Extra Work*.

## REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

### Advisory Circulars (AC)

AC 150/5200-33      *Hazardous Wildlife Attractants on or Near Airports*

AC 150/5370-2      *Operational Safety on Airports During Construction*

### ASTM International (ASTM)

ASTM D6461      *Standard Specification for Silt Fence Materials*

### United States Department of Agriculture (USDA)

FAA/USDA Wildlife Hazard Management at Airports, A Manual for Airport Personnel

**END OF ITEM C-102**

## **ITEM C-103: PROJECT SURVEY, STAKEOUT, AND RECORD DRAWINGS**

### **DESCRIPTION**

**103-1.1** Under this item, the Contractor shall do all necessary surveying required to construct all elements of the Project as shown on the Plans and specified in the Proposal and Specifications. This shall include but not be limited to stakeout, layout and elevations for pavements, structures, forms and appurtenances as shown and required, consistent with the current practices and shall be performed by competently qualified personnel acceptable to the Engineer. The stakeout survey shall proceed immediately following the award of the Contract and shall be expeditiously progressed to completion in a manner and at a rate satisfactory to the Engineer. The Contractor shall keep the Engineer fully informed as to the progress of the stakeout survey. All survey work shall be provided under the direction of a licensed land surveyor.

### **MATERIALS**

**103-2.1** All instruments, equipment, stakes, and any other material necessary to perform the work satisfactorily shall be provided by the Contractor.

All stakes used shall be of a type approved by the Engineer. It shall always be the Contractor's responsibility to maintain these stakes in their proper location and position.

Record drawing deliverables shall meet the requirements of the Sections 100-4.1 and 100-4.2 as applicable to the project.

### **CONSTRUCTION DETAILS**

**103-3.1** The Contractor shall trim trees, brush, and other interfering objects, not consistent with the Plans, from survey lines in advance of all survey work to permit accurate and unimpeded work by his stakeout survey crews and cross-section and topographic survey crews.

The exact position of all work shall be established from control points, baseline transit points or other points of similar nature which are shown on the Plans and/or modified by the Engineer. Any error, apparent discrepancy, or absence in or of data shown or required for accurately accomplishing the stakeout survey shall be referred to the Engineer for interpretation.

Permanent survey marker locations shall be established and referenced by the Contractor.

The Contractor shall be responsible for the accuracy of his work and shall maintain all reference points, stakes, etc., throughout the life of the Contract. Damaged or destroyed points, benchmarks or stakes, or any reference points made inaccessible by the progress of the construction, shall be replaced or transferred by the Contractor. Any of the above points which may be destroyed or damaged shall be transferred by the Contractor before construction begins. All control points shall be referenced by ties to acceptable objects and recorded. Any alterations or revisions in the ties shall be so noted and the information furnished to the Engineer immediately. All computations necessary to establish the



exact position of the work from control points shall be made and preserved by the Contractor. All computations, survey notes and other records necessary to accomplish the work shall be neatly made. Such computations, survey notes and other records shall be made available to the Engineer upon request and delivered to the Engineer not later than the date of acceptance of the Contract, to become the property of the Owner.

The Engineer may check all or any portion of the stakeout survey work or notes made by the Contractor. Any necessary correction to the work shall be made immediately by the Contractor. Such checking by the Engineer shall not relieve the Contractor of any responsibilities for the accuracy or completeness of his work.

Prior to the final cross-section and topo survey of the Project by the Contractor, the Contractor shall re-establish centerline or baseline points and stationing as required by the Engineer.

During the progress of the construction work, the Contractor will be required to furnish all of the surveying and stakeout incidental to the proper location by line and grade for each phase of the work. For paving and any other operation requiring extreme accuracy, the Contractor will restake with pins or other acceptable hubs located directly adjacent to the work at a spacing directed by the Engineer.

Any existing stakes, iron pins, survey monuments or other markers defining property lines which may be disturbed during construction shall be properly tied into fixed reference points before construction begins and accurately reset in their proper position upon completion of the work.

The Contractor shall set nails or pins flush with finished grade on the centerline of the runway pavement at each runway threshold. The set points shall be located, elevated and referenced to the project coordinate system. The as-built runway threshold elevation and coordinates shall be given to the Engineer.

Just prior to completion of the Contract, the Contractor shall reestablish if necessary, and retie all control points as permanently as possible, to the satisfaction of the Engineer.

## **AS-BUILT DRAWINGS**

**103-4.1. REDLINE DRAWINGS.** The Contractor shall be provided one (1) set of full-size construction drawings by the Engineer for the sole purpose of recording as-built conditions. The Contractor shall mark each sheet of the non-reproducible drawings in red pencil and record thereon in a legible manner, (heretofore known as redline drawings) any and all field changes and conditions as they occur. A complete file of approved field sketches, diagrams, and other approved changes/modifications shall be maintained and attached to the redline drawings.

A Redline set of As-Built drawings shall be kept current during the progress of the work. All deviations from the proposed drawings shall be noted. Special attention shall be given to note any shift in the location of underground items (utilities, pipes, etc) to facilitate accurately locating underground items on the final As-Built drawings.

Redline drawings shall be reviewed by the Engineer for accuracy as often as deemed necessary by

the Engineer. Errors or omissions that are identified shall be promptly corrected. The Engineer may withhold the monthly progress payment request until such time as the redline drawings have been updated by the Contractor. At the completion of the work, each sheet of the redline drawings, plus all approved field sketches and diagrams shall be certified by the Contractor as reflecting the as-built conditions of the work. The Contractor shall thereafter submit to the Engineer the original redline drawings, referenced above, for approval prior to release of any retainage and establishing the value of the work.

**103-4.2. FINAL AS-BUILT AND ELECTRONIC DRAWINGS.** Horizontal datum shall be State Plane Coordinates derived from North American Datum of 1983 (NAD 83). Vertical Datum shall be North American Vertical Datum of 1988 (NAVD 1988). The location and elevation all benchmarks used shall be shown on the As-Built drawings.

The As-Built drawings shall accurately reflect and shall encompass all alterations that occurred during the progress of the work. The term As-Built Condition, referenced in this specification, shall be defined as the result of construction alterations. All proposed lines and proposed features on the design drawings that do not accurately reflect the As-Built condition shall not be shown on the As-Built drawings. Such proposed lines and features shall be erased and redrawn or otherwise modified on the As-Built drawings to accurately reflect the As-Built Condition. All proposed notes on the design drawings that do not reflect the As-Built Condition shall not be shown on the As-Built drawings. Such notes shall be erased and replaced, struck-through and corrected, or otherwise modified to accurately reflect the As-Built Condition. Design elevations that deviate from As-Built elevations shall be struck-through, and the As-Built elevation shall be noted adjacent to the struck-through design elevation.

The Contractor shall provide original and finished grade, As-Built topographic survey of all areas altered during construction. Unless otherwise noted, As-Built elevations shall be measured at 50 foot intervals (50 feet grid), at changes in surface slope, and at limits of construction alteration (grading, clearing or otherwise). This spacing requirement applies to paved and unpaved surfaces that do not have specific topographic measurement spacing requirements defined elsewhere. A topographic digital terrain model (DTM) that can be utilized in .dwg, CAD format, version 2004 or later shall be provided for all areas altered during construction. DTM shall mean the AutoCAD surface generated from surface data points (location and elevation) connected by TIN (triangulated irregular network) lines.

Ditches: As-Built elevations shall be measured along the centerline, at toes of slopes, and at tops of bank. These measurements shall be taken at 50 foot intervals and at the beginning and end points of the ditch alteration.

Storm Drains, Structures, and Retention/Detention Ponds: All piping, wyes, tees, manholes, inlets, cleanouts and points of connection to the existing system shall be located and shown on the As-Built Drawings. Runs of storm sewers shall be identified (i.e. 300' of 15" RCP at S=.004). Elevations shall be given for top of rim/grate of all manhole covers and inlets. Elevations shall be given for all manhole, inlet, and catch basin inverts. Elevations shall be given for underdrain inverts at the location of cleanouts. Elevations shall be given for control structure weirs, orifices, and outfall elevations. Elevations shall be given for inverts of all outfall pipes. Elevations shall be given for the bottom of

pond and top of bank for Retention/Detention ponds. Elevations may be required for any other pertinent design data not listed here.

A review-set of Final As-Built drawings shall be submitted to the Engineer (electronic PDF or CAD files is acceptable) and if requested modifications shall be made. When modifications are required, the Contractor shall make the requested modifications and submit a revised review-set. Written approval from the Engineer shall be given prior to submitting the Final As-Built drawings described in the below paragraph.

The Final As-Built drawings shall be prepared, signed, and sealed by a licensed Professional Surveyor. These drawings shall describe all alterations that occurred during the construction project. The Contractor shall provide one (1) set of Redline As-Built drawings, five (5) sets of signed and sealed Final As-Built drawings, and one (1) electronic copy of the As-Built drawings in CAD (version 2018 or later) including a DTM of all topographic information. Final payment for this project will not be made until the As-Built drawings have been reviewed and accepted by the engineer. Cost of producing the As-built drawings shall be considered incidental to the contract unless a specific pay item is provided.

#### **METHOD OF MEASUREMENT**

**103-7.1** This is a Lump Sum Item and thus there is no measurement for payment. The Item shall be completed per the requirements of this specification.

#### **BASIS OF PAYMENT**

**103-8.1** The lump sum price bid shall include the cost of furnishing all labor, equipment, instruments, and all other material necessary to satisfactorily complete all requirements of this specification. Partial payments may be made at the discretion of the Engineer as the work progresses.

Payment will be made under:

Item C-103-8.1 - Project Survey, Stakeout, and Record Drawings – per lump sum

**END ITEM C-103**

## ITEM C-105 MOBILIZATION

**105-1 Description.** This item of work shall consist of, but is not limited to, work and operations necessary for the movement of personnel, equipment, material and supplies to and from the project site for work on the project except as provided in the contract as separate pay items.

**105-2 Mobilization limit.** Mobilization shall be **limited to 10 percent of the total project cost.**

**105-3 Posted notices.** Prior to commencement of construction activities, the Contractor must post the following documents in a prominent and accessible place where they may be easily viewed by all employees of the prime Contractor and by all employees of subcontractors engaged by the prime Contractor: Equal Employment Opportunity (EEO) Poster “Equal Employment Opportunity is the Law” in accordance with the Office of Federal Contract Compliance Programs Executive Order 11246, as amended; Davis Bacon Wage Poster (WH 1321) - DOL “Notice to All Employees” Poster; and Applicable Davis-Bacon Wage Rate Determination. These notices must remain posted until final acceptance of the work by the Owner. Links to the posters are available at: <https://www.faa.gov/airports/engineering/>

**105-4 Engineer/RPR field office.** An Engineer/RPR field office is included in Item C-109-3.1.

### METHOD OF MEASUREMENT

**105-5 Basis of measurement and payment.** Based upon the contract lump sum price for “Mobilization” partial payments will be allowed as follows:

- a. With first pay request, 25%.
- b. When 25% or more of the original contract is earned, an additional 25%.
- c. When 50% or more of the original contract is earned, an additional 40%.
- d. After Final Inspection, Staging area clean-up and delivery of all Project Closeout materials as required by Section 90, paragraph 90-11, *Contractor Final Project Documentation*, the final 10%.

### BASIS OF PAYMENT

**105-6 Payment will be made under:**

Item C-105-6.1 Mobilization – per Lump Sum

### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

Office of Federal Contract Compliance Programs (OFCCP)

Executive Order 11246, as amended

EEOC-P/E-1 – Equal Employment Opportunity is the Law Poster

United States Department of Labor, Wage and Hour Division (WHD)

WH 1321 – Employee Rights under the Davis-Bacon Act Poster

**END OF ITEM C-105**

## ITEM D-701: PIPE FOR STORM DRAINS AND CULVERTS

### DESCRIPTION

**701-1.1** This item shall consist of the construction of pipe culverts and storm drains in accordance with these specifications and in reasonably close conformity with the lines and grades shown on the plans.

### MATERIALS

**701-2.1** Materials shall meet the requirements shown on the plans and specified below. Underground piping and components used in drainage systems for terminal and aircraft fueling ramp drainage shall be noncombustible and inert to fuel in accordance with National Fire Protection Association (NFPA) 415.

**701-2.2 Pipe.** The pipe shall be of the type called for on the plans or in the proposal and shall be in accordance with the following appropriate requirements:

	American Association of State Highway and Transportation Officials (AASHTO) M167 Standard Specification for Corrugated Steel Structural Plate, Zinc-Coated, for Field-Bolted Pipe, Pipe-Arches, and Arches
AASHTO M190	Standard Specification for Bituminous-Coated Corrugated Metal Culvert Pipe and Pipe Arches
AASHTO M196	Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains
AASHTO M219	Standard Specification for Corrugated Aluminum Alloy Structural Plate for Field-Bolted Pipe, Pipe-Arches, and Arches
AASHTO M243	Standard Specification for Field-Applied Coating of Corrugated Metal Structural Plate for Pipe, Pipe-Arches, and Arches
AASHTO M252	Standard Specification for Corrugated Polyethylene Drainage Pipe
AASHTO M294	Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter
AASHTO M304	Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Wall Drain Pipe and Fittings Based on Controlled Inside Diameter
AASHTO MP20	Standard Specification for Steel Reinforced Polyethylene (PE) Ribbed Pipe, 300- to 900-mm (12- to 36-in.) Diameter
AASHTO R73	Standard Practice for Evaluation of Precast Concrete Drainage Productions
ASTM A760	Standard Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains

ASTM A761	Standard Specification for Corrugated Structural Steel Plate, Zinc-Coated, for Field-Bolted Pipe, Pipe-Arches, and Arches
ASTM A762	Standard Specification for Corrugated Steel Pipe, Polymer Precoated for Sewers and Drains
ASTM A849	Standard Specification for Post Applied Coatings, Pavings, and Linings for Corrugated Steel Sewer and Drainage Pipe
ASTM B745	Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains
ASTM C14	Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe
ASTM C76	Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C506	Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe
ASTM C507	Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe
ASTM C655	Standard Specification for Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe
ASTM C1433	Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers
ASTM C1479	Standard Practice for Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations
ASTM C1577	Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers Designed According to AASHTO LRFD
ASTM C1786	Standard Specification for Segmental Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers Designed According to AASHTO LRFD
ASTM C1840	Standard Practice for Inspection and Acceptance of Installed Reinforced Concrete Culvert, Storm Drain, and Storm Sewer Pipe
ASTM D3262	Standard Specification for “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe
ASTM D4161	Standard Specification for “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals
ASTM F667	Standard Specification for 3 through 24 in Corrugated Polyethylene Pipe and Fittings
ASTM F714	Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter

ASTM F794	Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
ASTM F894	Standard Specification for Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
ASTM F949	Standard Specification for Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings
ASTM F2435	Standard Specification for Steel Reinforced Polyethylene (PE) Corrugated Pipe
ASTM F2562	Specification for Steel Reinforced Thermoplastic Ribbed Pipe and Fittings for Non-Pressure Drainage and Sewerage
ASTM F2736	Standard Specification for 6 to 30 in. (152 to 762 mm) Polypropylene (PP) Corrugated Single Wall Pipe and Double Wall Pipe
ASTM F2764	Standard Specification for 30 to 60 in. (750 to 1500 mm) Polypropylene (PP) Triple Wall Pipe and Fittings for Non-Pressure Sanitary Sewer Applications
ASTM F2881	Standard Specification for 12 to 60 in. (300 to 1500 mm) Polypropylene (PP) Dual Wall Pipe and Fittings for Non-Pressure Storm Sewer Applications
ASTM D3034	Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings

**701-2.3 Concrete.** Concrete for pipe cradles shall have a minimum compressive strength of 2000 psi (13.8 MPa) at 28 days and conform to the requirements of ASTM C94.

**701-2.4 Rubber gaskets.** Rubber gaskets for rigid pipe shall conform to the requirements of ASTM C443. Rubber gaskets for PVC pipe, polyethylene, and polypropylene pipe shall conform to the requirements of ASTM F477. Rubber gaskets for zinc-coated steel pipe and precoated galvanized pipe shall conform to the requirements of ASTM D1056, for the “RE” closed cell grades. Rubber gaskets for steel reinforced thermoplastic ribbed pipe shall conform to the requirements of ASTM F477.

**701-2.5 Joint mortar.** Pipe joint mortar shall consist of one part Portland cement and two parts sand. The Portland cement shall conform to the requirements of ASTM C150, Type I. The sand shall conform to the requirements of ASTM C144.

**701-2.6 Joint fillers.** Poured filler for joints shall conform to the requirements of ASTM D6690.

**701-2.7 Plastic gaskets.** Plastic gaskets shall conform to the requirements of ASTM C990.

**701-2.8. Controlled low-strength material (CLSM).** Controlled low-strength material shall conform to the requirements of Item P-153. When CLSM is used, all joints shall have gaskets.

**701-2.9 Precast box culverts.** Manufactured in accordance with and conforming to ASTM C1433.



**701-2.10 Precast concrete pipe.** Precast concrete structures shall be furnished by a plant meeting National Precast Concrete Association Plant Certification Program or American Concrete Pipe Association QCast Plant Certification program.

## **CONSTRUCTION METHODS**

**701-3.1 Excavation.** The width of the pipe trench shall be sufficient to permit satisfactory jointing of the pipe and thorough tamping of the bedding material under and around the pipe, but it shall not be less than the external diameter of the pipe plus 12 inches (300 mm) on each side. The trench walls shall be approximately vertical.

The Contractor shall comply with all current federal, state and local rules and regulations governing the safety of men and materials during the excavation, installation and backfilling operations. Specifically, the Contractor shall observe that all requirements of the Occupational Safety and Health Administration (OSHA) relating to excavations, trenching and shoring are strictly adhered to. The width of the trench shall be sufficient to permit satisfactorily jointing of the pipe and thorough compaction of the bedding material under the pipe and backfill material around the pipe, but it shall not be greater than the widths shown on the plans trench detail.

Where rock, hardpan, or other unyielding material is encountered, the Contractor shall remove it from below the foundation grade for a depth of at least 8 inch (200 mm) or 1/2 inch (12 mm) for each foot of fill over the top of the pipe (whichever is greater) but for no more than three-quarters of the nominal diameter of the pipe. The excavation below grade should be filled with granular material to form a uniform foundation.

Where a firm foundation is not encountered at the grade established, due to soft, spongy, or other unstable soil, the unstable soil shall be removed and replaced with approved granular material for the full trench width. The RPR shall determine the depth of removal necessary. The granular material shall be compacted to provide adequate support for the pipe.

The excavation for pipes placed in embankment fill shall not be made until the embankment has been completed to a height above the top of the pipe as shown on the plans.

**701-3.2 Bedding.** The bedding surface for the pipe shall provide a foundation of uniform density to support the pipe throughout its entire length.

**a. Rigid pipe.** The pipe bedding shall be constructed uniformly for the full length of the pipe barrel, as required on the plans. The maximum aggregate size shall be 1 in when the bedding thickness is less than 6 inches, and 1-1/2 in when the bedding thickness is greater than 6 inches. Bedding shall be loosely placed uncompacted material under the middle third of the pipe prior to placement of the pipe.

**b. Flexible pipe.** For flexible pipe, the bed shall be roughly shaped to fit the pipe, and a bedding blanket of sand or fine granular material shall be provided as follows:

### Flexible Pipe Bedding

Pipe Corrugation Depth		Minimum Bedding Depth	
inch	mm	inch	mm
1/2	12	1	25
1	25	2	50
2	50	3	75
2-1/2	60	3-1/2	90

**c. Other pipe materials.** For PVC, polyethylene, polypropylene, or fiberglass pipe, the bedding material shall consist of coarse sands and gravels with a maximum particle size of 3/4 inches (19 mm). For pipes installed under paved areas, no more than 12% of the material shall pass the No. 200 (0.075 mm) sieve. For all other areas, no more than 50% of the material shall pass the No. 200 (0.075 mm) sieve. The bedding shall have a thickness of at least 6 inches (150 mm) below the bottom of the pipe and extend up around the pipe for a depth of not less than 50% of the pipe's vertical outside diameter.

**701-3.3 Laying pipe.** The pipe laying shall begin at the lowest point of the trench and proceed upgrade. The lower segment of the pipe shall be in contact with the bedding throughout its full length. Bell or groove ends of rigid pipes and outside circumferential laps of flexible pipes shall be placed facing upgrade.

Paved or partially lined pipe shall be placed so that the longitudinal center line of the paved segment coincides with the flow line.

Elliptical and elliptically reinforced concrete pipes shall be placed with the manufacturer's reference lines designating the top of the pipe within five degrees of a vertical plane through the longitudinal axis of the pipe.

**701-3.4 Joining pipe.** Joints shall be made with (1) cement mortar, (2) cement grout, (3) rubber gaskets, (4) plastic gaskets, (5) coupling bands.

Mortar joints shall be made with an excess of mortar to form a continuous bead around the outside of the pipe and shall be finished smooth on the inside. Molds or runners shall be used for grouted joints to retain the poured grout. Rubber ring gaskets shall be installed to form a flexible watertight seal.

**a. Concrete pipe.** Concrete pipe may be either bell and spigot or tongue and groove. Pipe sections at joints shall be fully seated and the inner surfaces flush and even. Concrete pipe joints shall be sealed with rubber gaskets meeting ASTM C443 when leak resistant joints are required, or the concrete pipe joints shall be sealed with butyl mastic meeting ASTM C990 or mortar when soil tight joints are required. Joints shall be thoroughly wetted before applying mortar or grout.

**b. Metal pipe.** Metal pipe shall be firmly joined by form-fitting bands conforming to the requirements of ASTM A760 for steel pipe and AASHTO M196 for aluminum pipe.

**c. PVC, Polyethylene, or Polypropylene pipe.** Joints for PVC, Polyethylene, or Polypropylene pipe shall conform to the requirements of ASTM D3212 when leak resistant

joints are required. Joints for PVC and Polyethylene pipe shall conform to the requirements of AASHTO M304 when soil tight joints are required. Fittings for polyethylene pipe shall conform to the requirements of AASHTO M252 or ASTM M294. Fittings for polypropylene pipe shall conform to ASTM F2881, ASTM F2736, or ASTM F2764.

**d. Fiberglass pipe.** Joints and fittings shall be as detailed on the plans and in accordance with the manufacturers recommendations. Joints shall meet the requirements of ASTM D4161 for flexible elastomeric seals.

**701-3.5 Embedment and Overfill.** Pipes shall be inspected before any fill material is placed; any pipes found to be out of alignment, unduly settled, or damaged shall be removed and re-laid or replaced at the Contractor's expense.

#### **701-3.5-1 Embedment Material Requirements**

**a. Concrete Pipe.** Embedment material and compaction requirements shall be in accordance with the applicable Type of Standard Installation (Types 1, 2, 3, or 4) per ASTM C1479. If a concrete cradle or CLSM embedment material is used, it shall conform to the plan details.

**b. Plastic and fiberglass Pipe.** Embedment material shall meet the requirements of ASTM D3282, A-1, A-2-4, A-2-5, or A-3. Embedment material shall be free of organic material, stones larger than 1.5 inches in the greatest dimension, or frozen lumps. Embedment material shall extend to 12 inches above the top of the pipe.

**c. Metal Pipe.** Embedment material shall be granular as specified in the contract document and specifications, and shall be free of organic material, rock fragments larger than 1.5 inches in the greatest dimension and frozen lumps. As a minimum, backfill materials shall meet the requirements of ASTM D3282, A-1, A-2, or A-3. Embedment material shall extend to 12 inches above the top of the pipe.

#### **701-3.5-2 Placement of Embedment Material**

The embedment material shall be compacted in layers not exceeding 6 inches (150 mm) on each side of the pipe and shall be brought up one foot (30 cm) above the top of the pipe or to natural ground level, whichever is greater. Thoroughly compact the embedment material under the haunches of the pipe without displacing the pipe. Material shall be brought up evenly on each side of the pipe for the full length of the pipe.

When the top of the pipe is above the top of the trench, the embedment material shall be compacted in layers not exceeding 6 inches (150 mm) and shall be brought up evenly on each side of the pipe to one foot (30 cm) above the top of the pipe. All embedment material shall be compacted to a density required under Item P-152.

Concrete cradles and flowable fills, such as controlled low strength material (CLSM) or controlled density fill (CDF), may be used for embedment provided adequate flotation resistance can be achieved by restraints, weighing, or placement technique.

It shall be the Contractor's responsibility to protect installed pipes and culverts from damage due to construction equipment operations. The Contractor shall be responsible for installation of any extra strutting or backfill required to protect pipes from the construction equipment.

### **701-3.6 Overfill**

Pipes shall be inspected before any overfill is in place. Any pipes found to be out of alignment, unduly settled, or damaged shall be removed and re-laid or replaced at the Contractor's expense. Evaluation of any damage to RCP shall be evaluated based on AASHTO R73.

Overfill material shall be placed and compacted in layers as required to achieve compaction to at least 95 percent standard proctor per ASTM D698. The soil shall contain no debris, organic matter, frozen material, or stones with a diameter greater than one half the thickness of the compacted layers being placed.

### **701-3.7 Inspection Requirements**

An initial post installation inspection shall be performed by the RPR no sooner than 30 days after completion of installation and final backfill. Clean or flush all lines prior to inspection.

Use a camera with lighting suitable to allow a clear picture of the entire periphery of the pipe interior. Center the camera in the pipe both vertically and horizontally and be able to pan and tilt to a 90 degree angle with the axis of the pipe rotating 360 degrees. Use equipment to move the camera through the pipe that will not obstruct the camera's view or interfere with proper documentation of the pipe's condition. The video image shall be clear, focused, and relatively free from roll, static, or other image distortion qualities that would prevent the reviewer from evaluating the condition of the pipe.

For pipe sizes larger than 48 inches, a walk-through visual inspection shall be performed.

Incorporate specific inspection requirements for the various types of pipes beneath the general inspection requirements.

Reinforced concrete pipe shall be inspected, evaluated, and reported on in accordance with ASTM C1840, "Standard Practice for Inspection and Acceptance of Installed Reinforced Concrete Culvert, Storm Drain, and Storm Sewer Pipe." Any issues reported shall include still photo and video documentation. The zoom ratio shall be provided for all still or video images that document any issues of concern by the inspection firm.

Flexible pipes shall be inspected for rips, tears, joint separations, soil migration, cracks, localized buckling, settlement, alignment, and deflection. Determine whether the allowable deflection has been exceeded by use of a laser profiler for internal pipe diameters of 48 inches or less, or direct measurement for internal pipe diameters greater than 48 inches. Laser profile equipment shall utilize low barrel distortion video equipment. Deflection of installed pipe shall not exceed the limits provided in the table below, as a percentage of the average inside diameter of the pipe.

### Maximum Allowable Pipe Deflection

Type of Pipe	Maximum Allowable Deflection (%)
Corrugated Metal Pipe	5
Concrete Lined CMP	3
Thermoplastic Pipe	5
Fiberglass	5

If deflection readings in excess of the allowable deflection are obtained, remove the pipe with excessive deflection and replace with new pipe. Isolated areas may exceed allowable by 2.5% with concurrence of RPR. Repair or replace any pipe with cracks exhibiting displacement across the crack, bulges, creases, tears, spalls, or delaminations. The report for flexible pipe shall include as a minimum, the deflection results and final post installation inspection report. The inspection report shall include: a copy of all video taken, pipe location identification, equipment used for inspection, inspector name, deviation from design line and grade, and inspector's notes.

### METHOD OF MEASUREMENT

**701-4.1** The quantity of 18" RCP (Class III) shall be measured in linear feet of pipe in place, completed, and approved. It shall be measured along the centerline of the pipe from end or inside face of structure to the end or inside face of structure, whichever is applicable. The several classes, types, and size shall be measured separately. All fittings shall be included in the footage as typical pipe sections in the pipe being measured.

**701-4.2.** The quantity of 24" RCP (Class III) shall be measured in linear feet of pipe in place, completed, and approved. It shall be measured along the centerline of the pipe from end or inside face of structure to the end or inside face of structure, whichever is applicable. The several classes, types, and size shall be measured separately. All fittings shall be included in the footage as typical pipe sections in the pipe being measured.

### BASIS OF PAYMENT

**701-5.1** Payment will be made at the contract unit price per linear foot (meter) for 18" RCP (Class III)

**701-5.2** Payment will be made at the contract unit price per linear foot (meter) for 24" RCP (Class III)

Payment will be made under:

Item D-701-5.1 – 18" RCP (Class III) – per linear foot

Item D-701-5.2 – 24" RCP (Class III) – per linear foot

## REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

### American Association of State Highway and Transportation Officials (AASHTO)

AASHTO M167	Standard Specification for Corrugated Steel Structural Plate, Zinc-Coated, for Field-Bolted Pipe, Pipe-Arches, and Arches
AASHTO M190	Standard Specification for Bituminous-Coated Corrugated Metal Culvert Pipe and Pipe Arches
AASHTO M196	Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains
AASHTO M219	Standard Specification for Corrugated Aluminum Alloy Structural Plate for Field-Bolted Pipe, Pipe-Arches, and Arches
AASHTO M243	Standard Specification for Field Applied Coating of Corrugated Metal Structural Plate for Pipe, Pipe-Arches, and Arches
AASHTO M252	Standard Specification for Corrugated Polyethylene Drainage Pipe
AASHTO M294	Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter
AASHTO M304	Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Wall Drain Pipe and Fittings Based on Controlled Inside Diameter
AASHTO MP20	Standard Specification for Steel Reinforced Polyethylene (PE) Ribbed Pipe, 300- to 900-mm (12- to 36-in.) Diameter

### ASTM International (ASTM)

ASTM A760	Standard Specification for Corrugated Steel Pipe, Metallic Coated for Sewers and Drains
ASTM A761	Standard Specification for Corrugated Steel Structural Plate, Zinc Coated, for Field-Bolted Pipe, Pipe-Arches, and Arches
ASTM A762	Standard Specification for Corrugated Steel Pipe, Polymer Precoated for Sewers and Drains
ASTM A849	Standard Specification for Post-Applied Coatings, Pavings, and Linings for Corrugated Steel Sewer and Drainage Pipe
ASTM B745	Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains
ASTM C14	Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe
ASTM C76	Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C94	Standard Specification for Ready Mixed Concrete

ASTM C144	Standard Specification for Aggregate for Masonry Mortar
ASTM C150	Standard Specification for Portland Cement
ASTM C443	Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C506	Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe
ASTM C507	Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe
ASTM C655	Standard Specification for Reinforced Concrete D-Load Culvert, Storm Drain and Sewer Pipe
ASTM C990	Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM C1433	Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers
ASTM D1056	Standard Specification for Flexible Cellular Materials Sponge or Expanded Rubber
ASTM D3034	Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D3212	Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D3262	Standard Specification for "Fiberglass" (Glass-Fiber Reinforced Thermosetting Resin) Sewer Pipe
ASTM D3282	Standard Practice for Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
ASTM D4161	Standard Specification for "Fiberglass" (Glass-Fiber Reinforced Thermosetting Resin) Pipe Joints Using Flexible Elastomeric Seals
ASTM D6690	Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
ASTM F477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F667	Standard Specification for 3 through 24 in. Corrugated Polyethylene Pipe and Fittings
ASTM F714	Standard Specification for Polyethylene (PE) Plastic Pipe (DR PR) Based on Outside Diameter
ASTM F794	Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe & Fittings Based on Controlled Inside Diameter

ASTM F894	Standard Specification for Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
ASTM F949	Standard Specification for Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings
ASTM F2435	Standard Specification for Steel Reinforced Polyethylene (PE) Corrugated Pipe
ASTM F2562	Specification for Steel Reinforced Thermoplastic Ribbed Pipe and Fittings for Non-Pressure Drainage and Sewerage
ASTM F2736	Standard Specification for 6 to 30 in. (152 to 762 mm) Polypropylene (PP) Corrugated Single Wall Pipe and Double Wall Pipe
ASTM F2764	Standard Specification for 30 to 60 in. (750 to 1500 mm) Polypropylene (PP) Triple Wall Pipe and Fittings for Non-Pressure Sanitary Sewer Applications
ASTM F2881	Standard Specification for 12 to 60 in. (300 to 1500 mm) Polypropylene (PP) Dual Wall Pipe and Fittings for Non-Pressure Storm Sewer Applications

National Fire Protection Association (NFPA)

NFPA 415	Standard on Airport Terminal Buildings, Fueling Ramp Drainage, and Loading Walkways
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**END ITEM D-701**



## **ITEM D-751: MANHOLES, CATCH BASINS, INLETS AND INSPECTION HOLES**

### **DESCRIPTION**

**751-1.1** This item shall consist of construction of manholes, catch basins, inlets, and inspection holes, in accordance with these specifications, at the specified locations and conforming to the lines, grades, and dimensions shown on the plans or required by the RPR.

### **MATERIALS**

**751-2.1 Brick.** The brick shall conform to the requirements of ASTM C32, Grade MS.

**751-2.2 Mortar.** Mortar shall consist of one part Portland cement and two parts sand. The cement shall conform to the requirements of ASTM C150, Type I. The sand shall conform to the requirements of ASTM C144.

**751-2.3 Concrete.** Plain and reinforced concrete used in structures, connections of pipes with structures, and the support of structures or frames shall conform to the requirements of Item P-610.

**751-2.4 Precast concrete pipe manhole rings.** Precast concrete pipe manhole rings shall conform to the requirements of ASTM C478. Unless otherwise specified, the risers and offset cone sections shall have an inside diameter of not less than 36 inches (90 cm) nor more than 48 inches (120 cm). There shall be a gasket between individual sections and sections cemented together with mortar on the inside of the manhole. Gaskets shall conform to the requirements of ASTM C443.

**751-2.5 Corrugated metal.** Corrugated metal shall conform to the requirements of American Association of State Highway and Transportation Officials (AASHTO) M36.

**751-2.6 Frames, covers, and grates.** The castings shall conform to one of the following requirements:

- a. ASTM A48, Class 35B: Gray iron castings
- b. ASTM A47: Malleable iron castings
- c. ASTM A27: Steel castings
- d. ASTM A283, Grade D: Structural steel for grates and frames
- e. ASTM A536, Grade 65-45-12: Ductile iron castings
- f. ASTM A897: Austempered ductile iron castings

All castings or structural steel units shall conform to the dimensions shown on the plans and shall be designed to support the loadings, aircraft gear configuration and/or direct loading, specified.

Each frame and cover or grate unit shall be provided with fastening members to prevent it from being dislodged by traffic but which will allow easy removal for access to the structure.

All castings shall be thoroughly cleaned. After fabrication, structural steel units shall be galvanized to meet the requirements of ASTM A123.

**751-2.7 Steps.** The steps or ladder bars shall be gray or malleable cast iron or galvanized steel. The steps shall be the size, length, and shape shown on the plans and those steps that are not galvanized shall be given a coat of asphalt paint, when directed.

**751-2.8 Precast inlet structures.** Manufactured in accordance with and conforming to ASTM C913.

## CONSTRUCTION METHODS

### 751-3.1 Unclassified excavation.

**a.** The Contractor shall excavate for structures and footings to the lines and grades or elevations, shown on the plans, or as staked by the RPR. The excavation shall be of sufficient size to permit the placing of the full width and length of the structure or structure footings shown. The elevations of the bottoms of footings, as shown on the plans, shall be considered as approximately only; and the RPR may direct, in writing, changes in dimensions or elevations of footings necessary for a satisfactory foundation.

**b.** Boulders, logs, or any other objectionable material encountered in excavation shall be removed. All rock or other hard foundation material shall be cleaned of all loose material and cut to a firm surface either level, stepped, or serrated, as directed by the RPR. All seams or crevices shall be cleaned out and grouted. All loose and disintegrated rock and thin strata shall be removed. Where concrete will rest on a surface other than rock, the bottom of the excavation shall not be disturbed and excavation to final grade shall not be made until immediately before the concrete or reinforcing is placed.

**c.** The Contractor shall do all bracing, sheathing, or shoring necessary to implement and protect the excavation and the structure as required for safety or conformance to governing laws. The cost of bracing, sheathing, or shoring shall be included in the unit price bid for the structure.

**d.** All bracing, sheathing, or shoring involved in the construction of this item shall be removed by the Contractor after the completion of the structure. Removal shall not disturb or damage finished masonry. The cost of removal shall be included in the unit price bid for the structure.

**e.** After excavation is completed for each structure, the Contractor shall notify the RPR. No concrete or reinforcing steel shall be placed until the RPR has approved the depth of the excavation and the character of the foundation material.

### 751-3.2 Brick structures.

**a. Foundations.** A prepared foundation shall be placed for all brick structures after the foundation excavation is completed and accepted. Unless otherwise specified, the base shall consist of reinforced concrete mixed, prepared, and placed in accordance with the requirements of Item P-610.

**b. Laying brick.** All brick shall be clean and thoroughly wet before laying so that they will not absorb any appreciable amount of additional water at the time they are laid. All brick shall be laid in freshly made mortar. Mortar not used within 45 minutes after water has been added shall

be discarded. Retempering of mortar shall not be permitted. An ample layer of mortar shall be spread on the beds and a shallow furrow shall be made in it that can be readily closed by the laying of the brick. All bed and head joints shall be filled solid with mortar. End joints of stretchers and side or cross joints of headers shall be fully buttered with mortar and a shoved joint made to squeeze out mortar at the top of the joint. Any bricks that may be loosened after the mortar has taken its set, shall be removed, cleaned, and re-laid with fresh mortar. No broken or chipped brick shall be used in the face, and no spalls or bats shall be used except where necessary to shape around irregular openings or edges; in which case, full bricks shall be placed at ends or corners where possible, and the bats shall be used in the interior of the course. In making closures, no piece of brick shorter than the width of a whole brick shall be used; and wherever practicable, whole brick shall be used and laid as headers.

**c. Joints.** All joints shall be filled with mortar at every course. Exterior faces shall be laid up in advance of backing. Exterior faces shall be plastered or parged with a coat of mortar not less than 3/8 inch (9 mm) thick before the backing is laid up. Prior to parging, all joints on the back of face courses shall be cut flush. Unless otherwise noted, joints shall be not less than 1/4 inch (6 mm) nor more than 1/2 inch (12 mm) wide and the selected joint width shall be maintained uniform throughout the work.

**d. Pointing.** Face joints shall be neatly struck, using the weather-struck joint. All joints shall be finished properly as the laying of the brick progresses. When nails or line pins are used, the holes shall be immediately plugged with mortar and pointed when the nail or pin is removed.

**e. Cleaning.** Upon completion of the work all exterior surfaces shall be thoroughly cleaned by scrubbing and washing with water. If necessary to produce satisfactory results, cleaning shall be done with a 5% solution of muriatic acid which shall then be rinsed off with liberal quantities of water.

**f. Curing and cold weather protection.** The brick masonry shall be protected and kept moist for at least 48 hours after laying the brick. Brick masonry work or pointing shall not be done when there is frost on the brick or when the air temperature is below 50°F (10°C) unless the Contractor has, on the project ready to use, suitable covering and artificial heating devices necessary to keep the atmosphere surrounding the masonry at a temperature of not less than 60°F (16°C) for the duration of the curing period.

**751-3.3 Concrete structures.** Concrete structures which are to be cast-in-place within the project boundaries shall be built on prepared foundations, conforming to the dimensions and shape indicated on the plans. The construction shall conform to the requirements specified in Item P-610. Any reinforcement required shall be placed as indicated on the plans and shall be approved by the RPR before the concrete is placed.

All invert channels shall be constructed and shaped accurately to be smooth, uniform, and cause minimum resistance to flowing water. The interior bottom shall be sloped to the outlet.

**751-3.4 Precast concrete structures.** Precast concrete structures shall be furnished by a plant meeting National Precast Concrete Association Plant Certification Program or another RPR approved third party certification program.

Precast concrete structures shall conform to ASTM C478. Precast concrete structures shall be constructed on prepared or previously placed slab foundations conforming to the dimensions and locations shown on the plans. All precast concrete sections necessary to build a completed

structure shall be furnished. The different sections shall fit together readily. Joints between precast concrete risers and tops shall be full-bedded in cement mortar and shall: (1) be smoothed to a uniform surface on both interior and exterior of the structure or (2) utilize a rubber gasket per ASTM C443. The top of the upper precast concrete section shall be suitably formed and dimensioned to receive the metal frame and cover or grate, or other cap, as required. Provision shall be made for any connections for lateral pipe, including drops and leads that may be installed in the structure. The flow lines shall be smooth, uniform, and cause minimum resistance to flow. The metal or metal encapsulated steps that are embedded or built into the side walls shall be aligned and placed in accordance to ASTM C478. When a metal ladder replaces the steps, it shall be securely fastened into position.

**751-3.5 Corrugated metal structures.** Corrugated metal structures shall be prefabricated. All standard or special fittings shall be furnished to provide pipe connections or branches with the correct dimensions and of sufficient length to accommodate connecting bands. The fittings shall be welded in place to the metal structures. The top of the metal structure shall be designed so that either a concrete slab or metal collar may be attached to allow the fastening of a standard metal frame and grate or cover. Steps or ladders shall be furnished as shown on the plans. Corrugated metal structures shall be constructed on prepared foundations, conforming to the dimensions and locations as shown on the plans. When indicated, the structures shall be placed on a reinforced concrete base.

**751-3.6 Inlet and outlet pipes.** Inlet and outlet pipes shall extend through the walls of the structures a sufficient distance beyond the outside surface to allow for connections. They shall be cut off flush with the wall on the inside surface of the structure, unless otherwise directed. For concrete or brick structures, mortar shall be placed around these pipes to form a tight, neat connection.

**751-3.7 Placement and treatment of castings, frames, and fittings.** All castings, frames, and fittings shall be placed in the positions indicated on the plans or as directed by the RPR, and shall be set true to line and elevation. If frames or fittings are to be set in concrete or cement mortar, all anchors or bolts shall be in place before the concrete or mortar is placed. The unit shall not be disturbed until the mortar or concrete has set.

When frames or fittings are placed on previously constructed masonry, the bearing surface of the masonry shall be brought true to line and grade and shall present an even bearing surface so the entire face or back of the unit will come in contact with the masonry. The unit shall be set in mortar beds and anchored to the masonry as indicated on the plans or as directed by the RPR. All units shall set firm and secure.

After the frames or fittings have been set in final position, the concrete or mortar shall be allowed to harden for seven (7) days before the grates or covers are placed and fastened down.

**751-3.8 Installation of steps.** The steps shall be installed as indicated on the plans or as directed by the RPR. When the steps are to be set in concrete, they shall be placed and secured in position before the concrete is placed. When the steps are installed in brick masonry, they shall be placed as the masonry is being built. The steps shall not be disturbed or used until the concrete or mortar has hardened for at least seven (7) days. After seven (7) days, the steps shall be cleaned and painted, unless they have been galvanized.

When steps are required with precast concrete structures they shall meet the requirements of ASTM C478. The steps shall be cast into the side of the sections at the time the sections are manufactured or set in place after the structure is erected by drilling holes in the concrete and cementing the steps in place.

When steps are required with corrugated metal structures, they shall be welded into aligned position at a vertical spacing of 12 inches (300 mm).

Instead of steps, prefabricated ladders may be installed. For brick or concrete structures, the ladder shall be held in place by grouting the supports in drilled holes. For metal structures, the ladder shall be secured by welding the top support to the structure and grouting the bottom support into drilled holes in the foundation or as directed by the RPR.

### **751-3.9 Backfilling.**

**a.** After a structure has been completed, the area around it shall be backfilled with approved material, in horizontal layers not to exceed 8 inches (200 mm) in loose depth, and compacted to the density required in Item P-152. Each layer shall be deposited evenly around the structure to approximately the same elevation. The top of the fill shall meet the elevation shown on the plans or as directed by the RPR.

**b.** Backfill shall not be placed against any structure until approved by the RPR. For concrete structures, approval shall not be given until the concrete has been in place seven (7) days, or until tests establish that the concrete has attained sufficient strength to withstand any pressure created by the backfill and placing methods.

**c.** Backfill shall not be measured for direct payment. Performance of this work shall be considered an obligation of the Contractor covered under the contract unit price for the structure involved.

**751-3.10 Cleaning and restoration of site.** After the backfill is completed, the Contractor shall dispose of all surplus material, dirt, and rubbish from the site. Surplus dirt may be deposited in embankments, shoulders, or as approved by the RPR. The Contractor shall restore all disturbed areas to their original condition. The Contractor shall remove all tools and equipment, leaving the entire site free, clear, and in good condition.

## **METHOD OF MEASUREMENT**

**751-4.1** Manholes, catch basins, inlets, and inspection holes shall be measured by the unit.

## **BASIS OF PAYMENT**

**751-5.1** The accepted quantities of manholes, catch basins, inlets, and inspection holes will be paid for at the contract unit price per each in place when completed. This price shall be full compensation for furnishing all materials and for all preparation, excavation, backfilling and placing of the materials; furnishing and installation of such specials and connections to pipes and other structures as may be required to complete the item as shown on the plans; and for all labor equipment, tools and incidentals necessary to complete the structure.

Payment will be made under:

Item D-751-5.1	Type C Drop Inlet - per each unit
Item D-751-5.2	48" Stormwater Manhole - per each unit

### **REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

#### ASTM International (ASTM)

ASTM A27	Standard Specification for Steel Castings, Carbon, for General Application
ASTM A47	Standard Specification for Ferritic Malleable Iron Castings
ASTM A48	Standard Specification for Gray Iron Castings
ASTM A123	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A283	Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A536	Standard Specification for Ductile Iron Castings
ASTM A897	Standard Specification for Austempered Ductile Iron Castings
ASTM C32	Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale)
ASTM C144	Standard Specification for Aggregate for Masonry Mortar
ASTM C150	Standard Specification for Portland Cement
ASTM C443	Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
ASTM C478	Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM C913	Standard Specification for Precast Concrete Water and Wastewater Structures.

#### American Association of State Highway and Transportation Officials (AASHTO)

AASHTO M36	Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains
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**END OF ITEM D-751**

## **ITEM D-752 CONCRETE CULVERTS, HEADWALLS, AND MISCELLANEOUS DRAINAGE STRUCTURES**

### **DESCRIPTION**

**752-1.1** This item shall consist of concrete culverts, headwalls, and miscellaneous drainage structures constructed in accordance with these specifications, at the specified locations and conforming to the lines, grades, and dimensions shown on the plans or required by the RPR.

### **MATERIALS**

**752-2.1 Concrete.** Reinforced concrete shall meet the requirements of Item P-610.

### **CONSTRUCTION METHODS**

#### **752-3.1 Unclassified excavation.**

**a.** Trenches and foundation pits for structures or structure footings shall be excavated to the lines and grades and elevations shown on the plans. The excavation shall be of sufficient size to permit the placing of the full width and length of the structure or structure footings shown. The elevations of the bottoms of footings, as shown on the plans, shall be considered as approximate only; and the RPR may approve, in writing, changes in dimensions or elevations of footings necessary to secure a satisfactory foundation.

**b.** Boulders, logs, or any other objectionable material encountered in excavation shall be removed. All rock or other hard foundation material shall be cleaned of all loose material and cut to a firm surface either level, stepped, or serrated, as directed by the RPR. All seams or crevices shall be cleaned out and grouted. All loose and disintegrated rock and thin strata shall be removed. When concrete will rest on a surface other than rock, the bottom of the excavation shall not be disturbed and excavation to final grade shall not be made until immediately before the concrete or reinforcing steel is placed.

**c.** The Contractor shall do all bracing, sheathing, or shoring necessary to perform and protect the excavation and the structure as required for safety or conformance to governing laws. The cost of bracing, sheathing, or shoring shall be included in the unit price bid for excavation.

**d.** All bracing, sheathing, or shoring shall be removed by the Contractor after the completion of the structure. Removal shall not disturb or damage the finished concrete. The cost of removal shall be included in the unit price bid for excavation.

**e.** After each excavation is completed, the Contractor shall notify the RPR. No concrete or reinforcing steel shall be placed until the RPR has approved the depth of the excavation and the character of the foundation material.

#### **752-3.2 Backfilling.**

**a.** After a structure has been completed, backfilling with approved material shall be accomplished by applying the fill in horizontal layers not to exceed 8 inches (200 mm) in loose

depth, and compacted. The field density of the compacted material shall be at least 90% of the maximum density for cohesive soils and 95% of the maximum density for noncohesive soils. The maximum density shall be determined in accordance with ASTM D698. The field density shall be determined in accordance with ASTM D1556.

**b.** No backfilling shall be placed against any structure until approved by the RPR. For concrete, approval shall not be given until the concrete has been in place seven (7) days, or until tests establish that the concrete has attained sufficient strength to withstand any pressure created by the backfill or the placement methods.

**c.** Fill placed around concrete culverts shall be deposited on each side at the same time and to approximately the same elevation. All slopes bounding or within the areas to be backfilled shall be stepped or serrated to prevent wedge action against the structure.

**d.** Backfill will not be measured for direct payment. Performance of this work shall be considered as a subsidiary obligation of the Contractor, covered under the contract unit price for “unclassified excavation for structures.”

**752-3.3 Weep holes.** Weep holes shall be constructed as shown on the plans.

**752-3.4 Cleaning and restoration of site.** After the backfill is completed, the Contractor shall dispose of all surplus material, dirt, and rubbish from the site. Surplus dirt may be deposited in embankment, shoulders, or as approved by the RPR. The Contractor shall restore all disturbed areas to their original condition. The Contractor shall remove all tools and equipment, leaving the entire site free, clear, and in good condition.

### **METHOD OF MEASUREMENT**

**752-4.1** The quantity of 18” Flared End Section shall be measured by the number installed as completed units in place, ready for operation, and accepted by the RPR.

**752-4.2** The quantity of 24” Flared End Section, Including Riprap Outlet Protection shall be measured by the number installed as completed units in place, ready for operation, and accepted by the RPR.

### **BASIS OF PAYMENT**

**752-5.1** Payment will be made at the contract unit price per each unit for 18” Flared End Section.

**752-5.2** Payment will be made at the contract unit price per each for 24” Flared End Section, Including Riprap Outlet Protection.

These prices shall be full compensation for furnishing all materials and for all preparation, excavation, and placing the materials, and for all labor, equipment, tools, and incidentals necessary to complete the structure.

Payment will be made under:

Item D-752-5.1	18” Flared End Section - per each unit
Item D-752-5.2	24” Flared End Section, Including Riprap Outlet Protection - per each unit



## REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

- |            |   |
|------------|---|
| ASTM D698  | Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft <sup>3</sup> (600 kN-m/m <sup>3</sup> )) |
| ASTM D1556 | Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method   |

**END OF ITEM D-752**

## **ITEM MWA-101: MACON WATER AUTHORITY SPECIFICATIONS FOR WATER AND SEWER**

### **DESCRIPTION**

**MWA-101-1.1** This item shall consist of the construction of potable water and sanitary sewer pipes and appurtenances in accordance with the Macon Water Authority specifications included in this section and in reasonably close conformity with the lines and grades shown on the plans.

### **MATERIALS**

**MWA-101-2.1** Materials shall meet the requirements shown on the plans and specified below.

### **CONSTRUCTION METHODS**

**MWA-101-3.1** Construction methods shall meet the requirements shown on the plans and in the Macon Water Authority specifications included in this section.

### **METHOD OF MEASUREMENT**

Work required under this specification section will be performed as scheduled or directed by the RPR. Completed and accepted work will be measured as follows:

**MWA-101-4.1** The quantity of 8" PVC SDR 26 Sanitary Sewer shall be measured by the number of linear feet installed in place, ready for operation, and accepted by the RPR. It shall be measured along the centerline of the pipe from end or inside face of structure to the end or inside face of structure, whichever is applicable.

**MWA-101-4.2.** The quantity of 48" Sanitary Manholes shall be measured by the number installed as completed units in place, ready for operation, and accepted by the RPR.

**MWA-101-4.3.** The quantity of 6" C900 PVC Waterline shall be measured by the number of linear feet installed in place, including all required fittings, ready for operation, and accepted by the RPR. It shall be measured along the centerline of the pipe.

**MWA-101-4.4.** The quantity of 8" C900 PVC Waterline shall be measured by the number of linear feet installed in place, including all required fittings, ready for operation, and accepted by the RPR. It shall be measured along the centerline of the pipe.

**MWA-101-4.5.** The quantity of Fire Hydrant Assembly Including Gate Valve and Valve Box, Spool Pieces Concrete Collar, Crushed Stone, and Anchor Couplings, Installed, Complete shall be measured by the number installed as completed units in place, ready for operation, and accepted by the RPR.

## **BASIS OF PAYMENT**

Accepted quantities of Macon Water Authority work ordered by the RPR and measured as provided in the Method of Measurement section of this specifications will be paid for under:

Payment will be made under:

Item MWA-101-5.1	8" PVC SDR 26 Sanitary Sewer – per linear foot
Item MWA-101-5.2	48" Sanitary Manholes – per each
Item MWA-101-5.3	6" C900 PVC Waterline – per linear foot
Item MWA-101-5.4	8" C900 PVC Waterline – per linear foot
Item MWA-101-5.5	Fire Hydrant Assembly Including Gate Valve and Valve Box, Spool Pieces Concrete Collar, Crushed Stone, and Anchor Couplings, Installed, Complete – per each

## **REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

Macon Water Authority	Standards for Design and Construction Specifications (Included as Appendix A of this specification)
	Section I - Water Distribution
	Section II - Wastewater Collection

**END ITEM MWA-101**

**APPENDIX A**

Macon Water Authority Standards for Design and Construction Specifications

**APPROVED**

STATE OF GEORGIA  
ENVIRONMENTAL PROTECTION DIVISION

MAR 25 2022

DRINKING WATER PROGRAM  
ENGINEER SIG.  
VALID ONLY FOR DRINKING WATER PORTION OF PROJECT



Macon Water Authority  
790 Second Street  
Macon, Georgia 31202  
(478) 464-5620 \* FAX (478) 741-1239

## STANDARDS FOR DESIGN

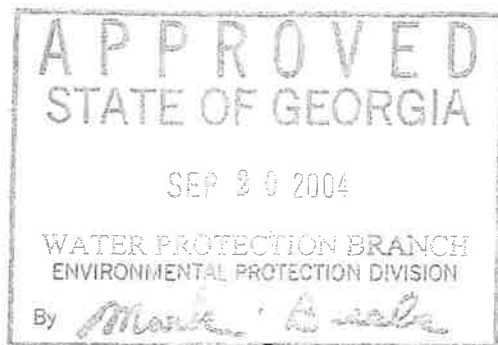
AND

## CONSTRUCTION SPECIFICATIONS

### I WATER DISTRIBUTION

### II WASTEWATER COLLECTION

Original 1984  
Revised April 2004  
Revised May 2004



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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.

<b>Nominal Size</b>	<b>Outside Diameter Average Tolerance</b>	<b>Minimum Wall Thickness</b>
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 ½-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.

<b>Sewer Size In.</b>	<b>Minimum Slope Ft./100 Ft.</b>
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:

<b>Minimum Center to Center Spacing</b>	<b>Slope</b>
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		
			Hatching (4)	Color (5)												
Course-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	31-61	300-500	
		GM <sub>d</sub>		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	41-61	300-500
		GM <sub>u</sub>		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	31-61	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	21-40	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	21-40	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 <sub>d</sub>		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 <sub>u</sub>		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**

<b>Sewer Size (Inches)</b>	<b>Maximum Distance Between Manholes in Feet</b>
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:

<u>No. of Pumps</u>	<u>Capacity</u>	<u>Total Head</u>	<u>RPM</u>	<u>Min. HP</u>	<u>Voltage</u>
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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**

<b>Carrier Pipe Size</b>	<b>Grout Hole Diameter, Inches</b>	<b>Grout Hole Depth, Feet</b>	<b>Reinforcing Bar Dowel Size</b>
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:

<b>Nominal Pipe Size (Inches)</b>	<b>T(time) Min/100 (Feet)</b>	<b>Nominal Pipe Size (Inches)</b>	<b>T(time) Min/100 Fee</b>
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**

<b>Nominal Pipe Size</b>		<b>Percentage Deflection Allowed</b>
<b>Millimeters</b>	<b>Inches</b>	
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:

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

- 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:**

<b>SEEDS</b>	<b>LBS/ ACRE</b>	<b>DEPTH OF COVER</b>	<b>DATE OF PLANTING</b>
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.	4/15-6/15	4/1-6/15	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 With other perennials	4 lbs. 2 lbs.	0.10 lb. 0.05 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.
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 With other perennials	50 lbs. 30 lbs.	1.1 lbs. 0.7 lb.	8/15-10/15	9/1-10/15	---	Grows similar to Tall Fescue; for wet sites.

**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**

<b>SURGE PROTECTOR ACCEPTABLE MODEL NUMBERS</b>		
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



## Item P-152 EXCAVATION, SUBGRADE, AND EMBANKMENT

### DESCRIPTION

**152-1.1** This item covers excavation, disposal, placement, and compaction of all materials within the limits of the work required to construct safety areas, runways, taxiways, aprons, and intermediate areas as well as other areas for drainage, building construction, parking, or other purposes in accordance with these specifications and in conformity to the dimensions and typical sections shown on the plans.

**152-1.2 Classification.** All material excavated shall be classified as defined below:

**a. Unclassified excavation.** Unclassified excavation shall consist of the excavation and disposal of all material, regardless of its nature.

**152-1.3 Unsuitable excavation.** Unsuitable material shall be disposed in designated waste areas as shown on the plans. Materials containing vegetable or organic matter, such as muck, peat, organic silt, or sod shall be considered unsuitable for use in embankment construction. Material suitable for topsoil may be used on the embankment slope when approved by the RPR.

### CONSTRUCTION METHODS

**152-2.1 General.** Before beginning excavation, grading, and embankment operations in any area, the area shall be cleared or cleared and grubbed in accordance with Item P-151.

The suitability of material to be placed in embankments shall be subject to approval by the Engineer and/or RPR. All unsuitable material shall be disposed of in waste areas as shown on the plans. All waste areas shall be graded to allow positive drainage of the area and adjacent areas. The surface elevation of waste areas shall be specified on the plans or approved by the Engineer and/or RPR.

When the Contractor's excavating operations encounter artifacts of historical or archaeological significance, the operations shall be temporarily discontinued and the RPR notified per Section 70, paragraph 70-20. At the direction of the RPR, the Contractor shall excavate the site in such a manner as to preserve the artifacts encountered and allow for their removal. Such excavation will be paid for as extra work.

Areas outside the limits of the pavement areas where the top layer of soil has become compacted by hauling or other Contractor activities shall be scarified and disked to a depth of 4 inches to loosen and pulverize the soil. Stones or rock fragments larger than 4 inches in their greatest dimension will not be permitted in the top 6 inches of the subgrade.

If it is necessary to interrupt existing surface drainage, sewers or under-drainage, conduits, utilities, or similar underground structures, the Contractor shall be responsible for and shall take all necessary precautions to preserve them or provide temporary services. When such facilities are encountered, the Contractor shall notify the RPR, who shall arrange for their removal if necessary. The Contractor, at their own expense, shall satisfactorily repair or pay the cost of all damage to such facilities or structures that may result from any of the Contractor's operations during the period of the contract.

**a. Blasting.** Blasting shall not be allowed.

**152-2.2 Excavation.** No excavation shall be started until the work has been staked out by the Contractor and the RPR has obtained from the Contractor, the survey notes of the elevations and measurements of

the ground surface. The Contractor and RPR shall agree that the original ground lines shown on the original topographic mapping are accurate, or agree to any adjustments made to the original ground lines.

Digital terrain model (DTM) files of the existing surfaces, finished surfaces and other various surfaces were used to develop the design plans.

Volumetric quantities were calculated by comparing DTM files of the applicable design surfaces and generating Triangle Volume Reports. Electronic copies of DTM files and a paper copy of the original topographic map will be issued to the successful bidder.

Existing grades on the design cross sections or DTM's, where they do not match the locations of actual spot elevations shown on the topographic map, were developed by computer interpolation from those spot elevations. Prior to disturbing original grade, Contractor shall verify the accuracy of the existing ground surface by verifying spot elevations at the same locations where original field survey data was obtained as indicated on the topographic map. Contractor shall recognize that, due to the interpolation process, the actual ground surface at any particular location may differ somewhat from the interpolated surface shown on the design cross sections or obtained from the DTM's. Contractor's verification of original ground surface, however, shall be limited to verification of spot elevations as indicated herein, and no adjustments will be made to the original ground surface unless the Contractor demonstrates that spot elevations shown are incorrect. For this purpose, spot elevations which are within 0.1 foot of the stated elevations for ground surfaces, or within 0.04 foot for hard surfaces (pavements, buildings, foundations, structures, etc.) shall be considered "no change". Only deviations in excess of these will be considered for adjustment of the original ground surface. If Contractor's verification identifies discrepancies in the topographic map, Contractor shall notify the RPR in writing at least two (2) weeks before disturbance of existing grade to allow sufficient time to verify the submitted information and make adjustments to the design cross sections or DTM's. Disturbance of existing grade in any area shall constitute acceptance by the Contractor of the accuracy of the original elevations shown on the topographic map for that area.

All areas to be excavated shall be stripped of vegetation and topsoil. Topsoil shall be stockpiled for future use in areas designated on the plans or by the RPR. All suitable excavated material shall be used in the formation of embankment, subgrade, or other purposes as shown on the plans. All unsuitable material shall be disposed of as shown on the plans.

The grade shall be maintained so that the surface is well drained at all times.

When the volume of the excavation exceeds that required to construct the embankments to the grades as indicated on the plans, the excess shall be used to grade the areas of ultimate development or disposed as directed by the RPR. When the volume of excavation is not sufficient for constructing the embankments to the grades indicated, the deficiency shall be obtained from borrow areas.

**a. Selective grading.** When selective grading is indicated on the plans, the more suitable material designated by the RPR shall be used in constructing the embankment or in capping the pavement subgrade. If, at the time of excavation, it is not possible to place this material in its final location, it shall be stockpiled in approved areas until it can be placed. The more suitable material shall then be placed and compacted as specified. Selective grading shall be considered incidental to the work involved. The cost of stockpiling and placing the material shall be included in the various pay items of work involved.

**b. Undercutting.** Rock, shale, hardpan, loose rock, boulders, or other material unsatisfactory for safety areas, subgrades, roads, shoulders, or any areas intended for turf shall be excavated to a minimum depth of 12 inches (300 mm) below the subgrade or to the depth specified by the RPR. Muck, peat, matted roots, or other yielding material, unsatisfactory for subgrade foundation, shall be removed to the depth specified. Unsuitable materials shall be disposed of at locations shown on the plans, or as directed to by the Engineer. This excavated material shall be paid for at the contract unit price per cubic yard for unclassified excavation. The excavated area shall be backfilled with suitable material obtained from the grading operations or borrow areas and compacted to specified densities. The necessary backfill will

constitute a part of the embankment. Where rock cuts are made, backfill with select material. Any pockets created in the rock surface shall be drained in accordance with the details shown on the plans. Undercutting will be paid as unclassified excavation.

**c. Over-break.** Over-break, including slides, is that portion of any material displaced or loosened beyond the finished work as planned or authorized by the RPR. All over-break shall be graded or removed by the Contractor and disposed of as directed by the RPR. The RPR shall determine if the displacement of such material was unavoidable and their own decision shall be final. Payment will not be made for the removal and disposal of over-break that the RPR determines as avoidable. Unavoidable over-break will be classified as "Unclassified Excavation."

**d. Removal of utilities.** The removal of existing structures and utilities required to permit the orderly progress of work will be accomplished by the Contractor, or as indicated on the plans. All existing foundations shall be excavated at least 2 feet below the top of subgrade or as indicated on the plans, and the material disposed of as directed by the RPR. All foundations thus excavated shall be backfilled with suitable material and compacted as specified for embankment or as shown on the plans.

**152-2.3 Borrow excavation.** Borrow areas are not required.

**152-2.4 Drainage excavation.** Drainage excavation shall consist of excavating drainage ditches including intercepting, inlet, or outlet ditches; or other types as shown on the plans. The work shall be performed in sequence with the other construction. Ditches shall be constructed prior to starting adjacent excavation operations. All satisfactory material shall be placed in embankment fills; unsuitable material shall be placed in designated waste areas or as directed by the RPR. All necessary work shall be performed true to final line, elevation, and cross-section. The Contractor shall maintain ditches constructed on the project to the required cross-section and shall keep them free of debris or obstructions until the project is accepted.

**152-2.5 Preparation of cut areas or areas where existing pavement has been removed.** In those areas on which a subbase or base course is to be placed, the top 12 inches of subgrade shall be compacted to not less than 100% of maximum density for non-cohesive soils, and 95% of maximum density for cohesive soils as determined by ASTM D698. As used in this specification, "non-cohesive" shall mean those soils having a plasticity index (PI) of less than 3 as determined by ASTM D4318.

**152-2.6 Preparation of embankment area.** All sod and vegetative matter shall be removed from the surface upon which the embankment is to be placed. The cleared surface shall be broken up by plowing or scarifying to a minimum depth of 6 inches and shall then be compacted per paragraph 152-2.10.

Sloped surfaces steeper than one (1) vertical to four (4) horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material. When the subgrade is part fill and part excavation or natural ground, the excavated or natural ground portion shall be scarified to a depth of 12 inches and compacted as specified for the adjacent fill.

No direct payment shall be made for the work performed under this section. The necessary clearing and grubbing and the quantity of excavation removed will be paid for under the respective items of work.

**152-2.7 Control Strip.** The first half-day of construction of subgrade and/or embankment shall be considered as a control strip for the Contractor to demonstrate, in the presence of the RPR, that the materials, equipment, and construction processes meet the requirements of this specification. The sequence and manner of rolling necessary to obtain specified density requirements shall be determined. The maximum compacted thickness may be increased to a maximum of 12 inches upon the Contractor's demonstration that approved equipment and operations will uniformly compact the lift to the specified density. The RPR must witness this demonstration and approve the lift thickness prior to full production.

Control strips that do not meet specification requirements shall be reworked, re-compacted, or removed and replaced at the Contractor's expense. Full operations shall not begin until the control strip has been accepted by the RPR. The Contractor shall use the same equipment, materials, and construction methods

for the remainder of construction, unless adjustments made by the Contractor are approved in advance by the RPR.

**152-2.8 Formation of embankments.** The material shall be constructed in lifts as established in the control strip, but not less than 6 inches nor more than 12 inches of compacted thickness.

When more than one lift is required to establish the layer thickness shown on the plans, the construction procedure described here shall apply to each lift. No lift shall be covered by subsequent lifts until tests verify that compaction requirements have been met. The Contractor shall rework, re-compact and retest any material placed which does not meet the specifications.

The lifts shall be placed, to produce a soil structure as shown on the typical cross-section or as directed by the RPR. Materials such as brush, hedge, roots, stumps, grass and other organic matter, shall not be incorporated or buried in the embankment.

Earthwork operations shall be suspended at any time when satisfactory results cannot be obtained due to rain, freezing, or other unsatisfactory weather conditions in the field. Frozen material shall not be placed in the embankment nor shall embankment be placed upon frozen material. Material shall not be placed on surfaces that are muddy, frozen, or contain frost. The Contractor shall drag, blade, or slope the embankment to provide surface drainage at all times.

The material in each lift shall be within  $\pm 2\%$  of optimum moisture content before rolling to obtain the prescribed compaction. The material shall be moistened or aerated as necessary to achieve a uniform moisture content throughout the lift. Natural drying may be accelerated by blending in dry material or manipulation alone to increase the rate of evaporation.

The Contractor shall make the necessary corrections and adjustments in methods, materials or moisture content to achieve the specified embankment density.

The Contractor will take samples of excavated materials which will be used in embankment for testing and develop a Moisture-Density Relations of Soils Report (Proctor) in accordance with ASTM D698. A new Proctor shall be developed for each soil type based on visual classification.

Density tests will be taken by the Contractor for every 5,000 SF of compacted embankment for each lift which is required to be compacted, or other appropriate frequencies as determined by the RPR.

If the material has greater than 30% retained on the 3/4-inch (19.0 mm) sieve, follow AASHTO T-180 Annex Correction of maximum dry density and optimum moisture for oversized particles.

Rolling operations shall be continued until the embankment is compacted to not less than 100% of maximum density for non-cohesive soils, and 95% of maximum density for cohesive soils as determined by ASTM D698. Under all areas to be paved, the embankments shall be compacted to a depth of 12 inches and to a density of not less than 98% percent of the maximum density as determined by ASTM D698. As used in this specification, "non-cohesive" shall mean those soils having a plasticity index (PI) of less than 3 as determined by ASTM D4318.

On all areas outside of the pavement areas, no compaction will be required on the top 4 inches, which shall be prepared in accordance with Item T-904.

The in-place field density shall be determined in accordance with ASTM D1556. The Contractor's laboratory shall perform all density tests in the RPR's presence and provide the test results upon completion to the RPR for acceptance. If the specified density is not attained, the area represented by the test or as designated by the RPR shall be reworked and/or re-compact and additional random tests made. This procedure shall be followed until the specified density is reached.

Compaction areas shall be kept separate, and no lift shall be covered by another lift until the proper density is obtained.

During construction of the embankment, the Contractor shall route all construction equipment evenly over the entire width of the embankment as each lift is placed. Lift placement shall begin in the deepest portion of the embankment fill. As placement progresses, the lifts shall be constructed approximately parallel to the finished pavement grade line.

When rock, concrete pavement, asphalt pavement, and other embankment material are excavated at approximately the same time as the subgrade, the material shall be incorporated into the outer portion of the embankment and the subgrade material shall be incorporated under the future paved areas. Stones, fragmentary rock, and recycled pavement larger than 4 inches in their greatest dimensions will not be allowed in the top 12 inches of the subgrade. Rockfill shall be brought up in lifts as specified or as directed by the RPR and the finer material shall be used to fill the voids forming a dense, compact mass. Rock, cement concrete pavement, asphalt pavement, and other embankment material shall not be disposed of except at places and in the manner designated on the plans or by the RPR.

When the excavated material consists predominantly of rock fragments of such size that the material cannot be placed in lifts of the prescribed thickness without crushing, pulverizing or further breaking down the pieces, such material may be placed in the embankment as directed in lifts not exceeding 2 feet in thickness. Each lift shall be leveled and smoothed with suitable equipment by distribution of spalls and finer fragments of rock. The lift shall not be constructed above an elevation 4 feet below the finished subgrade.

Payment for compacted embankment will be made under embankment in-place and no payment will be made for excavation, borrow, or other items.

**152-2.9 Proof rolling.** Not Used.

**152-2.10 Compaction requirements.** The subgrade under areas to be paved shall be compacted to a depth of 12 inches and to a density of not less than 95 percent of the maximum dry density as determined by ASTM D698. The subgrade in areas outside the limits of the pavement areas shall be compacted to a depth of 12 inches and to a density of not less than 95 percent of the maximum density as determined by ASTM D698.

The material to be compacted shall be within  $\pm 2\%$  of optimum moisture content before being rolled to obtain the prescribed compaction (except for expansive soils). When the material has greater than 30 percent retained on the  $\frac{3}{4}$  inch (19.0 mm) sieve, follow the methods in ASTM D1557. Tests for moisture content and compaction will be taken at a minimum of one (1) test per 5,000 SF of subgrade. All quality assurance testing shall be done by the Contractor's laboratory in the presence of the RPR, and density test results shall be furnished upon completion to the RPR for acceptance determination.

The in-place field density shall be determined in accordance with ASTM D6938 using Procedure A, the direct transmission method, and ASTM D6938 shall be used to determine the moisture content of the material. The machine shall be calibrated in accordance with ASTM D6938 within 12 months prior to its use on this contract. The gage shall be field standardized daily.

Maximum density refers to maximum dry density at optimum moisture content unless otherwise specified.

If the specified density is not attained, the entire lot shall be reworked and/or re-compacted and additional random tests made. This procedure shall be followed until the specified density is reached.

All cut-and-fill slopes shall be uniformly dressed to the slope, cross-section, and alignment shown on the plans or as directed by the RPR and the finished subgrade shall be maintained.

**152-2.11 Finishing and protection of subgrade.** Finishing and protection of the subgrade is incidental to this item. Grading and compacting of the subgrade shall be performed so that it will drain readily. All low areas, holes or depressions in the subgrade shall be brought to grade. Scarifying, blading, rolling and other

methods shall be performed to provide a thoroughly compacted subgrade shaped to the lines and grades shown on the plans. All ruts or rough places that develop in the completed subgrade shall be graded, re-compact, and retested. The Contractor shall protect the subgrade from damage and limit hauling over the finished subgrade to only traffic essential for construction purposes.

The Contractor shall maintain the completed course in satisfactory condition throughout placement of subsequent layers. No subbase, base, or surface course shall be placed on the subgrade until the subgrade has been accepted by the RPR.

**152-2.12 Haul.** All hauling will be considered a necessary and incidental part of the work. The Contractor shall include the cost in the contract unit price for the pay of items of work involved. No payment will be made separately or directly for hauling on any part of the work.

The Contractor's equipment shall not cause damage to any excavated surface, compacted lift or to the subgrade as a result of hauling operations. Any damage caused as a result of the Contractor's hauling operations shall be repaired at the Contractor's expense.

The Contractor shall be responsible for providing, maintaining and removing any haul roads or routes within or outside of the work area, and shall return the affected areas to their former condition, unless otherwise authorized in writing by the Owner. No separate payment will be made for any work or materials associated with providing, maintaining and removing haul roads or routes.

**152-2.13 Surface Tolerances.** In those areas on which a subbase or base course is to be placed, the surface shall be tested for smoothness and accuracy of grade and crown. Any portion lacking the required smoothness or failing in accuracy of grade or crown shall be scarified to a depth of at least 3 inches (75 mm), reshaped and re-compact to grade until the required smoothness and accuracy are obtained and approved by the RPR. The Contractor shall perform all final smoothness and grade checks in the presence of the RPR. Any deviation in surface tolerances shall be corrected by the Contractor at the Contractor's expense.

- a. **Smoothness.** The finished surface shall not vary more than +/- ½ inch (12 mm) when tested with a 12-foot (3.7-m) straightedge applied parallel with and at right angles to the centerline. The straightedge shall be moved continuously forward at half the length of the 12-foot (3.7-m) straightedge for the full length of each line on a 50-foot (15-m) grid.
- b. **Grade.** The grade and crown shall be measured on a 50-foot (15-m) grid and shall be within +/- 0.05 feet (15 mm) of the specified grade.

On safety areas, turfed areas and other designated areas within the grading limits where no subbase or base is to be placed, grade shall not vary more than 0.10 feet (30 mm) from specified grade. Any deviation in excess of this amount shall be corrected by loosening, adding or removing materials, and reshaping.

**152-2.14 Topsoil.** When topsoil is specified or required as shown on the plans or under Item T-905, it shall be salvaged from stripping or other grading operations. The topsoil shall meet the requirements of Item T-905. If, at the time of excavation or stripping, the topsoil cannot be placed in its final section of finished construction, the material shall be stockpiled at approved locations. Stockpiles shall be located as shown on the plans and the approved CSPP, and shall not be placed on areas that subsequently will require any excavation or embankment fill. If, in the judgment of the RPR, it is practical to place the salvaged topsoil at the time of excavation or stripping, the material shall be placed in its final position without stockpiling or further re-handling.

Upon completion of grading operations, stockpiled topsoil shall be handled and placed as shown on the plans and as required in Item T-905. Topsoil shall be paid for as provided in Item T-905. No direct payment will be made for topsoil under Item P-152.

## METHOD OF MEASUREMENT

**152-3.1** Measurement for payment specified by the cubic yard shall be computed by the comparison of digital terrain model (DTM) surfaces.

**152-3.1** The quantity of unclassified excavation to be paid for shall be the number of cubic yards measured in its original position. Measurement shall not include the quantity of materials excavated without authorization beyond normal slope lines, or the quantity of material used for purposes other than those directed.

**152-3.2** The quantity of embankment in place shall be the number of cubic yards measured in its final position.

## BASIS OF PAYMENT

**152-4.1** Unclassified excavation payment shall be made at the contract unit price per cubic yard. This price shall be full compensation for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the item.

**152-4.2** For embankment in place, payment shall be made at the contract unit price per cubic yard. This price shall be full compensation for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item P-152-4.1	Unclassified Excavation - per cubic yard
Item P-152-4.2	Embankment in place - per cubic yard

## REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO T-180	Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
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ASTM International (ASTM)

ASTM D698	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft <sup>3</sup> (600 kN-m/m <sup>3</sup> ))
ASTM D1556	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft <sup>3</sup> (2700 kN-m/m <sup>3</sup> ))
ASTM D6938	Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

Advisory Circulars (AC)

AC 150/5370-2	Operational Safety on Airports During Construction Software
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Software

FAARFIELD – FAA Rigid and Flexible Iterative Elastic Layered Design

U.S. Department of Transportation

FAA RD-76-66          Design and Construction of Airport Pavements on Expansive Soils

**END OF ITEM P-152**





## ITEM F-162 CHAIN-LINK FENCE

### DESCRIPTION

**162-1.1** This item shall consist of furnishing and erecting a chain-link fence in accordance with these specifications, the details shown on the plans, and in conformity with the lines and grades shown on the plans or established by the RPR.

### MATERIALS

**162-2.1 Fabric.** The fabric shall be woven with a 9-gauge galvanized steel wire in a 2-inch (50 mm) mesh and shall meet the requirements of ASTM A392, Class 2.

**162-2.2 Barbed wire.** Barbed wire shall be 2-strand 12-1/2 gauge zinc-coated wire with 4-point barbs and shall conform to the requirements of ASTM A121, Class 3, Chain Link Fence Grade.

**162-2.3 Posts, rails, and braces.** Line posts, rails, and braces shall conform to the requirements of ASTM F1043 or ASTM F1083 as follows:

Galvanized tubular steel pipe shall conform to the requirements of Group IA, (Schedule 40) coatings conforming to Type A, or Group IC (High Strength Pipe), External coating Type B, and internal coating Type B or D.

The following are acceptable minimum dimensions (in accordance with Federal Specification RR-F-191/3D Table I through VI) for posts, rails and braces:

<u>Description:</u>	<u>Steel Pipe Dimension</u>
Top Rails and Braces	1 5/8" O.D.
Line Posts	2 1/2" O.D.
Terminal, Corner and Intermediate Posts	3" O.D.
Gate Posts (Gates with a span of < 15')	8" O.D.
Bollards	6" O.D.

**162-2.4 Gates.** Gate frames shall consist of galvanized steel pipe and shall conform to the specifications for the same material under Paragraph 162-2.3. The fabric shall be of the same type material as used in the fence.

**162-2.5 Wire ties and tension wires.** Wire ties for use in conjunction with a given type of fabric shall be of the same material and coating weight identified with the fabric type. Tension wire shall be 7-gauge marcelled steel wire with the same coating as the fabric type and shall conform to ASTM A824.

All material shall conform to Federal Specification RR-F-191/4.

**162-2.6 Miscellaneous fittings and hardware.** Miscellaneous steel fittings and hardware for use with galvanized steel fabric shall be of commercial grade steel or better quality, wrought or cast as appropriate to the article, and sufficient in strength to provide a balanced design when used in conjunction with fabric posts, and wires of the quality specified herein. All steel fittings and hardware shall be protected with a zinc coating applied in conformance with ASTM A153. Barbed wire support arms shall withstand a load of 250 pounds (113 kg) applied vertically to the outermost end of the arm. Truss Rods shall be galvanized 3/8" and stretcher bars shall be galvanized 1/4" x 3/4".

**162-2.7 Concrete.** Concrete shall have a minimum 28-day compressive strength of 3000 psi (2670 kPa). High Early Strength concrete of a commercial grade structural concrete with a minimum 28 day compressive strength of 5000 psi may also be used.

**162-2.8 Marking.** Each roll of fabric shall carry a tag showing the kind of base metal (steel, aluminum, or aluminum alloy number), kind of coating, the gauge of the wire, the length of fencing in the roll, and the name of the manufacturer. Posts, wire, and other fittings shall be identified as to manufacturer, kind of base metal (steel, aluminum, or aluminum alloy number), and kind of coating.

**162-2.9 Signs and Sign Posts.** Signs shall be of the dimensions and with the text as shown on the Plans. Signs shall be aluminum, Type A, retro-reflective, in conformance with Section 828 of the Mass Highway Standard Specifications for Highways and Bridges. Signs shall be .080" thick and shall have reflective sheeting in compliance with AASHTO-M268.

Fasteners for all signs shall be stainless steel. All signs shall be mounted to fence fabric.

**162-2.9 Swing Gate.** Gate shall be furnished and installed complete with all required latches, stops, keepers and hinges. When gate is in the closed position, it shall be impossible for the gate to be opened except by mechanical operations provided. Tension bars shall be galvanized steel in accordance with ASTM F 626. Tie wires shall be nine (9) gauge aluminized or galvanized steel. The entire frame and gate assembly shall be hot-dip galvanized after welding. Gate hinges shall have a thrust capacity of 600 lbs per pair. The gate shall be constructed to receive a mechanical latch and lock. The gate shall be the width indicated on the Plans, shall be the same height as the highest adjacent fence or gate section, and shall use the same fabric type as the adjacent fence, or gate section, unless otherwise indicated on the Plans.

**162-2.10 Padlocks And Chains.** One (1) keyed padlock and chain shall be provided for each swing gate. Locks shall be for outdoor commercial application and protected against the weather with a plastic cover. Locks shall have dual locking steel shackles. The lock width and the shackle vertical clearance shall be not less than two inches (2"). Each lock shall have a thirty-six inch (36") long flat-link, zinc-plated chain, trade size 4/0, to secure the lock to the gate when it is unlocked to prevent loss of the lock. The locks shall be high security with a removable cylinder.

All padlocks furnished as part of this project shall be keyed alike.

**162-2.11 Shop Drawings and Certifications.** The Contractor shall submit manufacturer's Shop Drawings and Certification of Compliance on the following: all fence components, fabric, posts, rails, wire ties, gates, signs, and padlocks. A Certification of Compliance shall be submitted on the concrete.

## CONSTRUCTION METHODS

**162-3.1 General.** The fence shall be constructed in accordance with the details on the plans and as specified here using new materials. All work shall be performed in a workmanlike manner satisfactory to the RPR. The Contractor shall layout the fence line based on the plans and coordinate with the RPR prior to the start of fence installation. The Contractor shall span the opening below the fence with barbed wire at all locations where it is not practical to conform the fence to the general contour of the ground surface because of natural or manmade features such as drainage ditches. The new fence shall be permanently tied to the terminals of existing fences as shown on the plans. The Contractor shall stake down the woven wire fence at several points between posts as shown on the plans.

The Contractor shall arrange the work so that construction of the new fence will immediately follow the removal of existing fences. The length of unfenced section at any time shall not exceed 300 feet (90 m). The work shall progress in this manner and at the close of the working day the newly constructed fence shall be tied to the existing fence.

**162-3.2 Clearing fence line.** Clearing shall consist of the removal of all stumps, brush, rocks, trees, or other obstructions that will interfere with proper construction of the fence. Stumps within the cleared area of the fence shall be grubbed or excavated. The bottom of the fence shall be placed a uniform distance above ground, as specified in the plans. When shown on the plans or as directed by the RPR, the existing fences which interfere with the new fence location shall be removed by the Contractor as a part of the construction work unless such removal is listed as a separate item in the bid schedule. All holes remaining after post and stump removal shall be refilled with suitable soil, gravel, or other suitable material and compacted with tampers.

The cost of removing and disposing of the material shall not constitute a pay item and shall be considered incidental to fence construction.

**162-3.3 Installing posts.** All posts shall be set in concrete at the required dimension and depth and at the spacing shown on the plans.

The concrete shall be thoroughly compacted around the posts by tamping or vibrating and shall have a smooth finish slightly higher than the ground and sloped to drain away from the posts. All posts shall be set plumb and to the required grade and alignment. No materials shall be installed on the posts, nor shall the posts be disturbed in any manner within seven (7) days after the individual post footing is completed.

Should rock be encountered at a depth less than the planned footing depth, a hole 2 inches (50 mm) larger than the greatest dimension of the posts shall be drilled to a depth of 12 inches (300 mm). After the posts are set, the remainder of the drilled hole shall be filled with grout, composed of one part Portland cement and two parts mortar sand. Any remaining space above the rock shall be filled with concrete in the manner described above.

In lieu of drilling, the rock may be excavated to the required footing depth. No extra compensation shall be made for rock excavation.

**162-3.4 Installing top rails.** The top rail shall be continuous and shall pass through the post tops. The coupling used to join the top rail lengths shall allow for expansion.

**162-3.5 Installing braces.** Horizontal brace rails, with diagonal truss rods and turnbuckles, shall be installed at all terminal posts.

**162-3.6 Installing fabric.** The wire fabric shall be firmly attached to the posts and braced as shown on the plans. All wire shall be stretched taut and shall be installed to the required elevations. The fence shall generally follow the contour of the ground, with the bottom of the fence fabric no less than one inch (25 mm) or more than 3 inches (75 mm) from the ground surface. Grading shall be performed where necessary to provide a neat appearance.

At locations of small natural swales or drainage ditches and where it is not practical to have the fence conform to the general contour of the ground surface, longer posts may be used and multiple strands of barbed wire stretched to span the opening below the fence. The vertical clearance between strands of barbed wire shall be 6 inches (150 mm) or less.

**162-3.7 Electrical grounds.** Electrical grounds shall be constructed at 500 feet (150 m) intervals. The ground shall be accomplished with a copper clad rod 8 feet (2.4 m) long and a minimum of 5/8 inches (16 mm) in diameter driven vertically until the top is 6 inches (150 mm) below the ground surface. A No. 6 solid copper conductor shall be clamped to the rod and to the fence in such a manner that each element of the fence is grounded. Installation of ground rods shall not constitute a pay item and shall be considered incidental to fence construction. The Contractor shall comply with FAA-STD-019, Lightning and Surge Protection, Grounding, Bonding and Shielding Requirements for Facilities and Electronic Equipment, Paragraph 4.2.3.8, Lightning Protection for Fences and Gates, when fencing is adjacent to FAA facilities.

**162-3.7 Electrical Grounds.** Electrical grounds shall be constructed at five hundred foot (500') intervals. The ground shall be accomplished with a copper clad rod eight feet (8') long and a minimum of

5/8 inch in diameter driven vertically until the top is six inches (6') below the ground surface. A no. six (6) solid copper conductor shall be clamped to the rod and to the fence in such a manner that each element of the fence is grounded. Installation of ground rods shall not constitute a pay item and shall be considered incidental to fence construction.

**162-3.8 Installing Gates.** Gates shall be installed to swing or slide in the direction indicated on the Plans or as directed by the Engineer. All hardware shall be thoroughly secured, properly adjusted and left in perfect working order. Hinges and diagonal bracing in gates shall be adjusted so that the gates will hang level. The Contractor shall install gate supports to support both sides of the gates in their open position. Fabric shall be attached to the gate frame with stretcher bar bands and stretcher bars on all sides and to the mid-point braces by tie wires. The locking device shall be as shown on the Plans and as herein specified. The locking device shall be installed as recommended by the manufacturer and to the satisfaction of the Engineer.

**162-3.9 Installing Signs.** "No Trespassing" signs on fence sections shall be attached securely to the fence fabric using tamper-resistant bolts or metallic clips at a height of five feet (5') to the center of the sign. One (1) sign shall be attached to exterior of each new gate or as directed on the Plans. A sign shall be attached five feet (5') from the beginning and five feet (5') from the end of each continuous run of fence. Additional signs shall be attached to each continuous run of fence such that the signs are no more than 500 feet apart measured along the fence line.

Gate Number Signs shall be furnished and installed on all new gates. The gate numbering system shall be as directed by the Engineer. The signs shall be attached securely to the gate fabric using tamper-resistant bolts or metallic clips at a height of five feet (5') to the center of the sign. One (1) sign shall be attached to the Aviation side of each gate and one (1) shall be attached to the non-aviation side. On gates with multiple leaves, the signs shall be placed on the left leaf as seen from the non-aviation side of the fence.

**162-3.10 Cleaning up.** The Contractor shall remove from the vicinity of the completed work all tools, buildings, equipment, etc., used during construction. All disturbed areas shall be seeded per T-901.

## **METHOD OF MEASUREMENT**

**162-4.1** Chain-link fence will be measured for payment by the linear foot (meter). Measurement will be along the top of the fence from center to center of end posts, excluding the length occupied by gate openings.

**162-4.2** Gates will be measured as complete units.

## **BASIS OF PAYMENT**

**162-5.1** Payment for chain-link fence will be made at the contract unit price per linear foot (meter).

**162-5.2** Payment for vehicle or pedestrian gates will be made at the contract unit price for each gate.

The price shall be full compensation for furnishing all materials, and for all preparation, erection, and installation of these materials, and for all labor equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item F-162-5.1	8' Chain-Link Fence - per linear foot
Item F-162-5.2	New 16-Foot-Wide Double Swing Gate - per each

## REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

### ASTM International (ASTM)

ASTM A121	Standard Specification for Metallic-Coated Carbon Steel Barbed Wire
ASTM A153	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A392	Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric
ASTM A491	Standard Specification for Aluminum-Coated Steel Chain-Link Fence Fabric
ASTM A824	Standard Specification for Metallic-Coated Steel Marcellled Tension Wire for Use with Chain Link Fence
ASTM B117	Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM F668	Standard Specification for Polyvinyl Chloride (PVC), Polyolefin and other Organic Polymer Coated Steel Chain-Link Fence Fabric
ASTM F1043	Standard Specification for Strength and Protective Coatings on Steel Industrial Fence Framework
ASTM F1083	Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
ASTM F1183	Standard Specification for Aluminum Alloy Chain Link Fence Fabric
ASTM F1345	Standard Specification for Zinc 5% Aluminum-Mischmetal Alloy Coated Steel Chain-Link Fence Fabric
ASTM G152	Standard Practice for Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials
ASTM G153	Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials
ASTM G154	Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials
ASTM G155	Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Nonmetallic Materials

### Federal Specifications (FED SPEC)

FED SPEC RR-F-191/3 Fencing, Wire and Post, Metal (Chain-Link Fence Posts, Top Rails and Braces)

FED SPEC RR-F-191/4 Fencing, Wire and Post, Metal (Chain-Link Fence Accessories)

### FAA Standard

FAA-STD-019 Lightning and Surge Protection, Grounding, Bonding and Shielding Requirements for Facilities and Electronic Equipment

### FAA Orders

5300.38 AIP Handbook

**END OF ITEM F-162**



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## Section 310—Graded Aggregate Construction

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### 310.1 General Description

This work includes constructing a base, subbase or shoulder course composed of mineral aggregates. Construct according to these specifications and to the lines, grades, thickness, and typical cross-sections shown on the plans or established by the Engineer.

The provisions of Section 300 apply to this work.

#### 310.1.01 Definitions

General Provisions 101 through 150.

#### 310.1.02 Related References

##### A. Standard Specifications

Section 105—Control of Work

Section 300—General Specifications for Base and Subbase Courses

Section 412—Bituminous Prime

Section 815—Graded Aggregate

Section 821—Cutback Asphalt

Section 823—Cutback Asphalt Emulsion

##### B. Referenced Documents

AASHTO T 180

GDT 21

GDT 59

#### 310.1.03 Submittals

General Provisions 101 through 150.

### 310.2 Materials

Ensure that materials meet the requirements of the following Specifications:

Material	Section
Graded aggregate	815
Cutback asphalt, RC-30, RC-70, RC-250 or MC-30, MC-70, MC-250	821.2.01
Cutback Asphalt Emulsion, CBAE-2	823.2.01
Blotter material (sand)	412.3.05.G.3

#### 310.2.01 Delivery, Storage, and Handling

General Provisions 101 through 150.

### 310.3 Construction Requirements

#### 310.3.01 Personnel

General Provisions 101 through 150.

## Section 310 — Graded Aggregate Construction

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### 310.3.02 Equipment

Provide equipment in satisfactory condition for proper construction of the base, subbase or shoulder course. Use any applicable equipment specified in Subsection 412.3.02, *Equipment for Bituminous Prime*.

### 310.3.03 Preparation

Prepare the subgrade or subbase as specified in Subsection 300.3.03.C, *Preparing the Subgrade* or Subsection 300.3.03.D, *Preparing the Subbase*. Place graded aggregate materials only on dry, thawed subgrade or subbase.

### 310.3.04 Fabrication

General Provisions 101 through 150.

### 310.3.05 Construction

#### A. Placing Material

Use the central plant mix method unless producing aggregates (from an approved source or deposit) that conform to the requirements of Section 815.

Use the following steps to mix base and spread subbase or shoulder course.

##### 1. Mixing

When blending two sizes of aggregate, proportion the aggregate and water, if needed, into the central plant. Mix until producing a homogeneous and uniform mixture.

##### 2. Spreading

To obtain the specified thickness, uniformly spread materials to the proper depth with a mixture spreader. Do not use materials containing frost or frozen particles.

##### a. One-Course Construction

Lay one course to a maximum thickness of 8 in. (200 mm) compacted.

##### b. Multiple-Course Construction

If the thickness of the base, subbase or shoulder course exceeds 8 in. (200 mm), construct it in 2 or more courses of equal thickness.

#### B. Compacting Material

Use the following steps to compact and finish a base, subbase, or shoulder course.

##### 1. Moisture Content

Ensure that the moisture content of materials is uniformly distributed and allows compaction to the specified density.

Unless approved by the Office of Materials and Research, no graded aggregate will be shipped to a project when the moisture content of the material exceeds two percent of optimum moisture.

##### 2. Compaction

After shaping the spread material to line, grade, and cross-section, roll to uniformly compact the course. If using Group 1 aggregate, roll to at least 98 percent of maximum dry density. If using Group 2 aggregate, roll to at least 100 percent of the maximum dry density.

If using graded aggregate mixtures composed of either group as base for paved shoulders 6 ft. (1.8 m) wide or less, compact to at least 96 percent of the maximum dry density.

Regardless of compaction, ensure that the compacted base is sufficiently stable to support construction equipment without pumping. If the base material is unstable from too much moisture, dry and rework the base material. Dry and rework the underlying subgrade, if necessary.

##### a. One-Course Construction

- 1) After compaction, shape to the required grade, line, and cross-section.
- 2) Add water as necessary to develop the proper moisture content.
- 3) Roll until the surface is smooth, closely knit, and free of cracks.
- 4) Correct all defects according to Subsection 300.3.06.B, *Repairing Defects*.

## Section 310 — Graded Aggregate Construction

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### b. Multiple-Course Construction

- 1) After compacting the first course, shape the surface again to line, grade, and cross section.
- 2) Add water as necessary to develop the proper moisture content.
- 3) Spread and compact the second and any succeeding courses without rolling the first course again.
- 4) Finish the surface according to the procedure specified for one-course construction.

### c. Irregular Areas

In places inaccessible to the roller, obtain the required compaction with mechanical tampers approved by the Engineer. Apply the same density requirements as stated above in Subsection 310.3.05.B.

## C. Finishing

Finish the surface of the subbase for Portland cement concrete pavement or the base of asphaltic concrete pavement with automatically controlled screed equipment when required by Subsection 300.3.02.H, *Fine Grading Machine* of the specifications. Furnish, install, and maintain the sensing wires needed to control the finish operation as a part of the Pay Item. When automatically controlled screed equipment is not required, fine grading with motor graders is permitted.

Finish immediately after the placing and compacting operations. After finishing, compact the subbase again, according to Subsection 310.3.05.B, *Compacting Material*.

## D. Protecting the Base, Subbase or Shoulders

Maintain the course until the Engineer determines that it has cured sufficiently and is ready to prime. Maintain by additional wetting, rolling, and blading as necessary. Repair any defects according to Subsection 300.3.06.B, *Repairing Defects*.

These protection measures do not relieve the Contractor of maintaining the Work until final acceptance as specified in Section 105.

## E. Priming the Base

Apply bituminous prime according to Section 412 unless using:

- Graded aggregate base under Portland cement concrete pavement
- Graded aggregate base under asphaltic concrete 5 in. (125 mm) or more in total thickness

## 310.3.06 Quality Acceptance

### A. Compaction Tests

1. Determine the maximum dry density from representative samples of compacted material, according to AASHTO T180, Method D.
2. Determine the in-place density of finished courses according to GDT 21 or GDT 59 , where applicable.

## Section 310 — Graded Aggregate Construction

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### B. Finished Surface

Check the finished surface of the base, subbase, or shoulder course as follows:

1. Check the longitudinal surface using a 15 ft. (4.5 m) straightedge parallel to the centerline.
2. Check the transverse surface by using one of the following tools:
  - A template, cut true to the required cross-section and set with a spirit level on non-super elevated sections
  - A system of ordinates, measured from a string line
  - A surveyor's level
3. Ensure that ordinates measured from the bottom of the template, string line, or straightedge, to the surface do not exceed 1/4 in. (6 mm) at any point. Rod readings shall not deviate more than 0.02 ft. (6 mm) from required readings.
4. Correct any variations from these requirements immediately according to Subsection 300.3.06.B, *Repairing Defects*.

### C. Thickness Tolerances

1. Thickness Measurements
  - a. Thickness requirements apply to shoulder construction where the plans specify a uniform thickness, or where the shoulders will be surfaced.
  - b. Determine the thickness of the base, subbase, or shoulder course, by making as many checks as necessary to determine the average thickness.
2. Deficient Thickness
  - a. If any measurement is deficient in thickness more than 1/2 in. (13 mm), make additional measurements to determine the deficient area.
  - b. Correct any area deficient between 1/2 in. (13 mm) and 1 in. (25 mm) to the design thickness by using one of the following methods according to these specifications:
    - Add additional quantities of the same materials and reconstruct to the required thickness
    - Leave in place and accept payment for the materials and area at ½ the Contract Unit Price for the deficient area.
  - c. Correct any area deficient in thickness by more than 1 in. (25 mm) by adding additional quantities of the same material and reconstructing to the required thickness in accordance with these Specifications.
  - d. If payment is made by the ton (megagram), payment for additional material to correct deficiencies will be made at the Contract Unit Price with no additional cost to the Department for scarification, mixing or compaction.
  - e. If payment is made by the square yard (meter), no payment will be made for additional material required to correct deficiencies or for reconstructing deficient work.
3. Average Thickness
  - a. The average thickness per linear mile (kilometer) is determined from all measurements within the mile (kilometer) increments except the areas deficient by more than 1/2 in. (13 mm) and not corrected.
  - b. The average thickness shall not exceed the specified thickness by more than 1/2 in. (13 mm).
  - c. If the basis of payment is per ton (megagram), and the average thickness for any mile (kilometer) increment exceeds the allowable 1/2 in. (13 mm) tolerance, the excess quantity in that increment will be deducted from the Contractor's payments.
  - d. The excess quantity is calculated by multiplying the average thickness that exceeds the allowable 1/2 in. (13 mm) tolerance by the surface area of the base, subbase, or shoulder.
  - e. If the basis of payment is per square yard (meter), no deduction will be made for excess thickness.

## Section 310 — Graded Aggregate Construction

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### 310.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

## 310.4 Measurement

### A. Graded Aggregate

Where specified for payment by the ton (megagram), graded aggregate base, subbase or shoulder materials are measured in tons (megagrams), mixed and accepted. When hauling material to the roadway, the actual weight of each loaded vehicle is determined with an approved motor truck scale.

Where specified for payment by the square yard (meter) for a certain thickness, the surface length is measured along the centerline, and the width is specified on the plans. Measure irregular areas, such as turnouts and intersections, by the square yard (meter).

### B. Bituminous Prime

Bituminous prime is not measured for separate payment.

### 310.4.01 Limits

General Provisions 101 through 150.

## 310.5 Payment

### A. Graded Aggregate

Graded aggregate base, subbase, or shoulder course will be paid for at the Contract Unit Price per ton (megagram) or per square yard (meter), complete, in place, and accepted. This payment shall be full compensation for:

- Materials
- Shaping and compacting the existing roadbed
- Loading, hauling, and unloading
- Crushing and processing
- Mixing
- Spreading
- Watering
- Compacting and shaping
- Maintenance
- Priming, when required
- All incidentals necessary to complete the work

## Section 310 — Graded Aggregate Construction

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### B. Graded Aggregate with Recycled Concrete Aggregate

If used in lieu of graded aggregate, the pay tons for graded aggregate with Recycled Concrete Aggregate calculated in accordance with Subsection 310.4.C will be paid for at the graded aggregate contract unit price. This pay shall be full compensation for:

- Materials
- Shaping and compacting the existing roadbed
- Loading, hauling, and unloading
- Crushing and processing
- Mixing
- Spreading
- Watering
- Compacting and shaping
- Maintenance
- Priming, when required
- All incidentals necessary to complete the work

Payment will be made under:

<b>Item No. 310</b>	Graded aggregate — including material – 8” thick	Per square yard (meter)
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### 310.5.01 Adjustments

General Provisions 101 through 150.

## Section 402—Hot Mix Recycled Asphaltic Concrete

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### 402.1 General Description

This work includes producing and placing hot mix recycled asphaltic concrete that incorporates reclaimed asphalt pavement (RAP), reclaimed asphalt shingles (RAS), virgin aggregate, hydrated lime, and neat asphalt cement.

#### 402.1.01 Definitions

General Provisions 101 through 150.

#### 402.1.02 Related References

##### A. Standard Specifications

Section 400—Hot Mix Asphaltic Concrete Construction

Section 800—Coarse Aggregate

Section 828—Hot Mix Asphaltic Concrete Mixtures

##### B. Referenced Documents

SOP 41 *Guidelines for RAP Stockpile Approval*

#### 402.1.03 Submittals

##### A. Certified Weight Tickets

Notify the Engineer before removing RAP from a stockpile that belongs to the Department. Submit to the Engineer the certified weight tickets of materials removed from the stockpile.

##### B. Affidavit

Submit to the laboratory an affidavit stating the sources of stockpiled materials to be used on a State project. Include the following information in the letter:

- State project number
- Location from which the material was removed
- Approximate removal dates
- Mix types removed and the estimated quantity of each type in the stockpiles
- Other available information about the stockpiled material such as percentage of local sand in the RAP

Obtain specific approval from the laboratory to use RAP or RAS stockpiles.

Adhere to Guidelines for RAP Stockpile Approval.

## Section 402 – Hot Mix Recycled Asphaltic Concrete

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### 402.2 Materials

#### A. RAP Material Composition

Use RAP materials from any of the following:

- Existing roadway
- Contractor's RAP stockpile that has been approved by the Department
- Department stockpile

**NOTE: The location of Department RAP material stockpiles will be given on the plans.**

Do not use RAP materials that contain alluvial gravel or local sand in any mixture placed on interstate projects except for mixtures used in shoulder construction. When used in shoulder construction, limit RAP containing local sand or alluvial gravel so that the sand or gravel contributes no more than 20 percent of the total aggregate portion of the mix.

##### 1. RAP Percentage

For non-interstate projects, limit the percentage of RAP allowed in recycled mixes so that the overall amount of alluvial gravel does not exceed 5 percent of the total mix. The percentage of alluvial gravel, local sand, and Group I material in the RAP will be determined through petrographic analysis or available records.

##### 2. RAP furnished to the Contractor but not used in the work remains the Contractor's property.

RAP used in the recycled mixtures for mainline or ramps (if applicable) may make up from 0 to 40 percent of the mixture depending on the amount of RAP available, the production facilities, and whether the mixture meets the requirements in Section 828.

The maximum ratio of RAP material to the recycled mixtures other than SMA is 40 percent for continuous mix type plants and 25 percent for batch type plants. The maximum ratio of RAP material to the recycled mixture is 15 percent for Stone Matrix Asphalt (SMA) mixes.

##### 3. Process RAP Material

Process RAP material to be used in the recycled mixture so that 100 percent will pass the 2 in. (50 mm) sieve. Additional crushing and sizing may be required if the RAP aggregate exceeds the maximum sieve size for the mix type as shown in Section 828. Obtain representative materials from the RAP stockpile for the mix design.

#### B. RAS Material

RAS materials are produced as a by-product of manufacturing roofing shingles and/or discarded shingle scrap from the reroofing of buildings.

1. Limit the amount of RAS material used in the recycled mixture to no greater than 5 percent of the total mixture weight.
2. Shred the RAS material before incorporating it into the mix to ensure that 100 percent of the shredded pieces are less than 1/2 in. (12.5 mm) in any dimension.
3. Remove all foreign materials such as paper, roofing nails, wood, or metal flashing.
4. Provide test results for Bulk Sample Analysis, known as Polarized Light Microscopy, if post-consumer shingles are used to certify the RAS material is free of asbestos. Test stockpiles at the rate of one test per 1000 tons (megagrams) prior to processing.

Other than as specifically stated in this Subsection, ensure that RAS material is used according to the same requirements as described for RAP material.

#### C. Asphaltic Concrete Removed from an Existing Roadway

Asphaltic concrete removed from an existing roadway becomes the Contractor's property unless specified otherwise on the plans. RAP material retained by the Department is designated on the plans, and the RAP shall be stockpiled at the location specified on the plans.



## Section 402 – Hot Mix Recycled Asphaltic Concrete

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### D. Local Sand and Group I Material in RAP

Use of local sand in recycled mixes is restricted as stipulated in Section 828 for the Project. However, RAP which contains local sand may be used in surface and intermediate layers of non-interstate projects so long as the RAP percentage used does not contribute more than 5% local sand to the total aggregate portion of the mix. The amount of local sand in the RAP material shall be considered when determining the percentage of local sand in the total mix.

Where Pay Items specify that Group II only aggregate is to be used, RAP which consists primarily of Group II aggregate, but contains some Group I aggregate, shall be limited such that the Group I aggregate makes up no more than 5 percent of the total aggregate portion of the mix. When a Blend I mix is specified, any Group I materials in the RAP will be considered when determining the Group I portion allowed in the total mix as specified in Subsection 828.2.A.2.

### E. Asphalt Cement

Using laboratory evaluations, the Department will determine the asphalt cement grade to be used in the recycled mixture. The asphalt cement shall meet the requirements of Section 820.

When the asphalt cement is blended with asphalt cement recovered from the RAP material and after tests on residue from thin film oven tests, the asphalt cement shall have a viscosity of 6,000 to 16,000 poises (600 to 1600 Pa) or as approved by the Engineer. Recover asphalt cement from the recycled mixture to verify that the specified viscosity is being met.

If the Engineer determines during construction that the selected asphalt cement grade is not performing satisfactorily, the Department may change the asphalt cement grade in the mixture, with no change in the Contract Unit Price.

### F. Recycled Mixture

The recycled mixture shall be a homogenous mixture of RAP or RAS material, virgin aggregate, hydrated lime, and neat asphalt cement. Ensure that the mixture conforms to an approved mixture design outlined in Section 828.

### 402.2.01 Delivery, Storage, and Handling

Separate the stockpiles by Project sources and by Group I and Group II aggregate types. Erect a sign on each stockpile to identify the source(s).

If RAP material from different project sources becomes intermixed in a stockpile, only use those materials when approved by the laboratory.

The Department may reject by visual inspection stockpiles that are not clean and free of foreign materials.

## 402.3 Construction Requirements

### 402.3.01 Personnel

General Provisions 101 through 150.

### 402.3.02 Equipment

#### A. Hot Mix Plant

Use a hot mix plant for the recycling process with necessary modifications approved by the Engineer to process recycled material. Design, equip, and operate the plant so that the proportioning, heating, and mixing yields a uniform final mixture within the job mix formula tolerances.

#### B. Cold Feed Bin

Proportion the RAP or RAS material using a separate cold feed bin. Ensure that the material meets the size requirements in Subsection 402.2, *Materials*. The ratio of the RAP or RAS to virgin aggregate shall be controlled gravimetrically.

## Section 402 – Hot Mix Recycled Asphaltic Concrete

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### C. Electronic Belt Weighing Devices

Use electronic belt weighing devices to monitor the flow of RAP or RAS and the flow of virgin aggregate. For batch-type plants, the RAP or RAS portion of the mix may be weighed in a weigh hopper before incorporating it into the pugmill. The RAP shall be screened through a 2-inch maximum sized screen prior to crossing the cold feed weigh. Ensure the amount of RAP material incorporated into the asphalt plant does not change after this final measurement is processed by the asphalt plant computer.

### D. Feeders and Conveyors

Equip plants with an interlocking system of feeders and conveyors that synchronize the RAP or RAS material flow with the virgin aggregate flow. Ensure that the electronic controls track the flow rates indicated by the belt weighing devices and develop the signal to automatically maintain the desired ratio at varying production rates. Design the RAP or RAS feeder bins, conveyor system, and auxiliary bins (if used) to prevent RAP material from segregating and sticking.

#### 402.3.03 Preparation

General Provisions 101 through 150.

#### 402.3.04 Fabrication

General Provisions 101 through 150.

#### 402.3.05 Construction

Follow the requirements in Section 400 for hot mix recycled asphaltic concrete production and placement, materials, equipment, and acceptance plans except as noted or modified in this specification.

#### 402.3.06 Quality Acceptance

The Department may require additional quality control tests to determine the RAP stockpile consistency and the RAP aggregate quality. In this case, conduct at least three extraction/gradation tests from each individual source. Ensure that aggregate meets the quality standards in Section 800.

#### 402.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

### 402.4 Measurement

Recycled asphaltic concrete mixture, complete in place and accepted, is measured in tons (megagrams). The weight is determined by recorded weights if an approved recording device is used. Or, the weight is determined by weighing each loaded vehicle on an approved motor truck scale as the material is hauled to the roadway.

#### 402.4.01 Limits

General Provisions 101 through 150.

### 402.5 Payment

The work performed and the materials furnished as described in this specification will be paid for at the Contract Unit Price per ton (megagram). Payment is full compensation for providing materials, hauling and necessary crushing, processing, placing, rolling and finishing the recycled mixture, and providing labor, tools, equipment, and incidentals necessary to complete the work, including hauling and stockpiling RAP or RAS material.

## Section 402 – Hot Mix Recycled Asphaltic Concrete

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Payment will be made under:

<b>Item No. 402-1</b>	Recycled asphaltic concrete 19 mm Superpave, group-blend, including bituminous materials	Per ton (megagram)
<b>Item No. 402-2</b>	Recycled asphaltic concrete 9.5 mm Superpave, group-blend, including bituminous materials	Per ton (megagram)

### A. Materials Produced and Placed During the Adjustment Period

An adjustment period is allowed at the start of mixing operations for each type of mix placed on the Contract. A new adjustment period shall not be granted for a change of producer, mix design or asphalt plant location. The adjustment period is provided to adjust or correct the mix and to establish the construction procedures and sequence of operations.

The adjustment period consists of the tons (megagrams) of the affected mix produced and placed on the first day of operation. If this quantity is less than 500 tons (500 Mg), the Engineer may combine the tons (megagrams) produced and placed on the first day of operation with the tons (megagrams) produced and placed on the next production day of the affected mix for the adjustment period.

## Section 402 – Hot Mix Recycled Asphaltic Concrete

The material produced and placed during the mixture adjustment period is one lot. If the mix is adjusted during this period, a new lot may be necessary, but a new adjustment period will not be permitted.

This material shall be paid for at 100 percent of the Contract Unit Price provided it meets the minimum requirements for a 1.00 pay factor for asphalt cement content and a 0.90 pay factor for gradation in the Mixture Acceptance Schedule—Table 9 or 10.

If the material placed during the adjustment period fails to meet the above requirements, it will be paid for using the applicable acceptance schedule. However, when mixture used for leveling at a spread rate of 90 lbs./yd<sup>2</sup> (50 kg/m<sup>2</sup>) or less is also used for the surface mix at a spread rate greater than 90 lbs./yd<sup>2</sup> (50 kg/m<sup>2</sup>), an additional adjustment period will be allowed for compaction only. This material will be paid for at a 1.00 pay factor provided it:

- Meets the minimum requirements for a 1.00 pay factor in the Mixture Acceptance Schedule—Table 9 or 10 for both asphalt content and gradation.
- Meets the minimum requirements for a 0.90 pay factor in Table 12 of Subsection 400.5.01C, *Calculate Mean Pavement Air Voids*.

Mixture which does not meet these requirements shall be paid for using the applicable acceptance schedule.

### B. Determine Lot Acceptance

Pay factor adjustments are based on control sieves and asphalt cement content. The control sieves used in the mixture acceptance schedule for the various types of mix are indicated below:

Control Sieves Used in the Mixture Acceptance Schedule	
Asphaltic concrete 25 mm Superpave	1/2 in., No. 8 (12.5 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 19 mm SMA	1/2 in., No. 8 (12.5 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 19 mm Superpave	3/8 in., No. 8 (9.5 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 12.5 mm Superpave	3/8 in., No. 8 (9.5 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 12.5 mm SMA	3/8 in., No. 8 (9.5 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 9.5 mm Superpave	No. 4, No. 8 (4.75 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 9.5 mm SMA	No. 4, No. 8 (4.75 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 4.75 mm Mix	No. 8 (2.36 mm) sieve and asphalt cement

The Department will perform the following tasks:

1. Using the Mixture Acceptance Schedule—Table 9 or 10, of Subsection 400.3.06 to determine the mean of the deviations from the job mix formula per test results per lot.
2. Determine this mean by averaging the actual numeric value of the individual deviations from the job mix formula; disregard whether the deviations are positive or negative amounts.
3. Use the Asphalt Cement Content and Aggregate Gradation of Asphalt Concrete Mixture Acceptance Schedule—Table 9 or 10 of Subsection 400.3.06 to determine acceptance of surface mixes and the Mixture Acceptance Schedule—Table 10 of Subsection 400.3.06 to determine acceptance of subsurface mixes.

On Contracts involving 1,000 tons (1000 Mg) or less of asphaltic concrete, the mixture is accepted for 100 percent payment of the asphaltic concrete Unit Price provided it meets the following:

4. Minimum requirements for a 1.00 pay factor for asphalt cement content and a 0.90 pay factor for gradation in the applicable Mixture Acceptance Schedule—Table 9 or 10 of Subsection 400.3.06.

## Section 402 – Hot Mix Recycled Asphaltic Concrete

5. Minimum requirements for a 0.90 pay factor in Table 12 of Subsection 402.5.01.C, *Calculate Pavement Mean Air Voids*.

If the material placed on Contracts involving 1,000 tons (1000 Mg) or less of asphaltic concrete does not meet the above requirements, the material will be paid for using the applicable acceptance schedule.

### C. Calculate Pavement Mean Air Voids

The Department will determine the percent of maximum air voids for each lot by dividing the pavement mean air voids by the maximum pavement mean air voids acceptable.

The Department will determine the payment for each lot by multiplying the Contract Unit Price by the adjusted pay factor shown in the following Air Voids Acceptance schedule:

**TABLE 12 - AIR VOIDS ACCEPTANCE SCHEDULE**

Pay Factor	Percent of Maximum Air Voids (Lot Average of Tests)	Percent of Maximum Air Voids (Lot Average all Tests) (for Reevaluations)
1.00	≤100	≤100
0.97	100.1 — 105	100.1 — 104
0.95	105.1 — 112	104.1 — 109
0.90	112.1 — 124	109.1 — 118
0.80	124.1 — 149	118.1 — 136
0.70	149.1 — 172	136.1 — 153
0.50	172.1 — 191	153.1 — 166

When the range tolerance is exceeded, the Department will apply a pay factor of 0.95 as described in Subsection 400.3.06.B.2.

### D. Asphaltic Concrete for Temporary Detours

Hot mix asphaltic concrete placed on temporary detours that will not remain in place as part of the permanent pavement does not require hydrated lime. Hot mix used for this purpose is paid for at an adjusted Contract Price. The payment for this item shall cover all cost of construction, maintenance and removal of all temporary mix. Hot mix asphaltic concrete placed as temporary mix shall meet requirements established in Subsection 400.3.05.F.

Where the Contract Price of the asphaltic concrete for permanent pavement is let by the ton (megagram), the Contract Price for the asphaltic concrete placed on temporary detours is adjusted by subtracting \$0.75/ton (\$0.85/mg) of mix used.

Where the Contract price of the mix in the permanent pavement is based on the square yard (meter), obtain the adjusted price for the same mix used on the temporary detour by subtracting \$0.04/yd<sup>2</sup> (\$0.05/ m<sup>2</sup>) per 1- in. (25-mm) plan depth.

Further price adjustments required in Subsection 400.3.06, *Quality Acceptance*, which are based on the appropriate adjusted Contract Price for mix used in the temporary detour work shall apply should temporary mix be left in place. Hot mix asphalt produced as temporary mix containing no hydrated lime shall be removed and replaced with permanent mix containing hydrated lime.

### E. Determine Lot Payment

Determine the lot payment as follows:

1. When one of the pay factors for a specific acceptance lot is less than 1.0, determine the payment for the lot by multiplying the Contract Unit Price by the adjusted pay factor.

## Section 402 – Hot Mix Recycled Asphaltic Concrete

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2. When two or more pay factors for a specific acceptance lot are less than 1.0, determine the adjusted payment by multiplying the Contract Unit Price by the lowest pay factor.

If the mean of the deviations from the job mix formula of the tests for a sieve or asphalt cement content exceeds the tolerances established in the Mixture Acceptance Schedule—Table 9 or 10 and if the Engineer determines that the material need not be removed and replaced, the lot may be accepted at an adjusted unit price as determined by the Engineer. If the pavement mean air voids exceed the tolerances established in the Air Voids Acceptance Schedule – Table 12, remove and replace the materials at the Contractor's expense.

If the Engineer determines that the material is not acceptable to leave in place, remove and replace the materials at the Contractor's expense.

## Section 412—Bituminous Prime

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### 412.1 General Description

This work includes preparing and treating an existing surface with bituminous material and blotter material, if required. Treat the surface according to these specifications and conform to the lines shown on the plans or established by the Engineer.

#### 412.1.01 Definitions

General Provisions 101 through 150.

#### 412.1.02 Related References

##### A. Standard Specifications

Section 424—Bituminous Surface Treatment

Section 821—Cutback Asphalt

##### B. Referenced Documents

General Provisions 101 through 150.

#### 412.1.03 Submittals

General Provisions 101 through 150.

### 412.2 Materials

Unless otherwise specified, select the types of bituminous materials. The Engineer will determine the grade of materials to be used. The specifications for the bituminous materials include:

Material	Section
Cutback Asphalt, RC-30, RC-70, RC-250 or MC-250, MC-30, or MC-70	821.2.01
Blotter Material (Sand)	412.3.05.G.3

#### 412.2.01 Delivery, Storage, and Handling

General Provisions 101 through 150.

### 412.3 Construction Requirements

#### 412.3.01 Personnel

General Provisions 101 through 150.

#### 412.3.02 Equipment

Provide equipment that is in good repair, including at least the following units that meet the requirements of Subsection 424.3.02, *Equipment*.

- Pressure distributor
- Power broom and blower
- Aggregate spreader (if required)
- Pneumatic-tired roller

## Section 412 — Bituminous Prime

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### 412.3.03 Preparation

See Subsection 412.3.05.B, *Condition of Surface*.

### 412.3.04 Fabrication

General Provisions 101 through 150.

### 412.3.05 Construction

Prime the following bases and other areas:

- Cement or lime stabilized bases or sub-bases, regardless of pavement thickness
- Soil or aggregate bases or sub-bases on which bituminous surface treatment will be placed
- Soil or aggregate bases or sub-bases on which less than 5 in. (125 mm) total thickness of hot mix asphaltic concrete will be placed

Prime is not required on driveway construction and paved shoulders.

#### A. Weather Limitations

Do not apply bituminous prime under any of these conditions:

- Surface is wet.
- Air temperature is below 40 °F (4 °C) in the shade.
- Rain is imminent.
- Weather conditions may prevent proper prime coat construction.

#### B. Condition of Surface

Ensure that the surface to which the prime is to be applied has been finished to the line, grade, and cross-section specified.

Ensure that the surface is uniformly compacted and bonded. Correct surface irregularities according to the specifications for the construction being primed.

#### C. Cleaning

Remove from the road loose material, dust, caked clay, and other material that may prevent bonding of the prime with the surface. Use power sweepers or blowers the full width of the prime and 2 ft. (600 mm) more on each side. Where necessary, sweep by hand.

#### D. Moisture

Ensure that the surface is only slightly damp. If the surface is too wet, allow it to dry. If it is too dry, the Engineer may require that it be sprinkled lightly just before priming.

#### E. Temperature and Surface Texture

The surface texture and condition of the surface determine the bituminous material grades to be used.

The following table shows the bituminous material grades and application temperatures as they are applied to various surface textures.

Base Texture	Tight	Average	Open
Materials and grade	MC-30 RC-30	RC-70 or MC-70	RC-250 or MC-250
Application temperature °F (°C)	80–120 (27–49)	105–180 (41–82)	145–220 (63–104)

The Engineer will determine the temperature for applying bituminous prime within the limits shown above.

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## Section 412 — Bituminous Prime

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Heat and apply bituminous materials as specified in Subsection 424.3.05.D, *Heating Bituminous Material* and Subsection 424.3.05.E, *Applying Bituminous Material*.

### F. Amount and Extent of Prime

The Engineer will determine the exact amount of bituminous material to be used within minimum and maximum rates of 0.15 to 0.30 gal/yd<sup>2</sup> (0.7 to 1.4 liters/m<sup>2</sup>). Apply the specified amount as follows:

1. Apply the determined amount uniformly and accurately. Ensure that the amount applied to any 0.5-mile (800 m) section is within 5 percent of the amount specified.
2. Apply the prime the full width of the proposed wearing surface that will be superimposed plus 6 in. (150 mm) more on each side.

### G. Protection, Curing, and Maintenance

Do the following after priming the surface:

1. Close to Traffic  
Do not allow traffic on the primed surface. Leave the surface undisturbed until the prime thoroughly cures and does not pick up under traffic.
2. Roll  
If the surface becomes soft after it is primed, roll the surface longitudinally with a pneumatic-tired roller at no more than 6 mph (10 kph) until the surface is firmly set.
3. Blot  
If necessary to prevent the prime from being picked up, spread clean, dry, sharp sand over the surface by hand or mechanically. Apply sand only to places that are tacky and use the least amount needed to prevent pick up. No extra payment for this work or material will be made.
4. Open to Traffic  
After rolling and sanding (if required), open the primed surface to ordinary traffic subject to the conditions in Subsection 412.3.05.G.1, *Close to Traffic*.
5. Curing and Maintenance
6. The primed surface is properly cured when it has penetrated the base sufficiently to not be picked up or displaced by traffic. Temperature and weather conditions may increase curing time. Insure the primed surface has cured to the satisfaction of the Engineer prior to its being covered by other construction.
7. Maintain the prime coat and the primed surface course until it is covered by other construction. Repair potholes, scabs, and soft spots prior to covering with other construction. Remove excess bituminous material.

### 412.3.06 Quality Acceptance

General Provisions 101 through 150.

### 412.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

## 412.4 Measurement

Bituminous material for prime is not measured for separate payment.

### 412.4.01 Limits

General Provisions 101 through 150.

## Section 412 — Bituminous Prime

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### 412.5 Payment

Bituminous material for prime is not paid for separately. The cost to clean the surface, furnish, haul and apply materials including water and sand, roll, and perform repairs and maintenance is included in the Unit Price bid for each individual Base Item.

#### 412.5.01 Adjustments

General Provisions 101 through 150.

## Section 413—Bituminous Tack Coat

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### 413.1 General Description

This work includes furnishing and applying a bituminous tack coat on a prepared road surface including cleaning the road surface.

#### 413.1.01 Definitions

General Provisions 101 through 150.

#### 413.1.02 Related References

##### A. Standard Specifications

Section 109—Measurement and Payment

Section 400—Hot Mix Asphaltic Concrete Construction

Section 424—Bituminous Surface Treatment

Section 427—Emulsified Asphalt Slurry Seal

Section 820—Asphalt Cement

Section 822 – Emulsified Asphalt

Section 824—Cationic Asphalt Emulsion

SOP 4

##### B. Referenced Documents

General Provisions 101 through 150.

#### 413.1.03 Submittals

##### A. Invoices

Furnish formal written invoices from a supplier for the bituminous materials for sole use of tack coat when requested by the Department. Show the following on the Bill of Lading:

- Date Manufactured for emulsified asphalt materials.
- Date shipped
- Quantity in gallons
- Included with or without additives

## Section 413 — Bituminous Tack Coat

### 413.2 Materials

Ensure materials meet the following specifications:

**TABLE 1 – BITUMINOUS MATERIALS**

Material	Section
Asphalt cement, performance grade PG 58-22, PG 64-22, or PG 67-22	820.2.01
Approved non-tracking Anionic Emulsified Asphalt	822.2.01
Cationic emulsified asphalt CSS-1h, CRS-1h, CRS-2h, CRS-3, CQS-1h and other approved non-tracking cationic emulsified asphalt products listed on QPL 7	824.2.01

Use any of the materials shown in Table 1 as bituminous tack coat for work performed under Section 400 as directed by the Engineer.

The Department may change the grade or type of bituminous materials without a change in the Contract Unit Price if the Engineer determines the grade or type selected is not performing satisfactorily.

#### 413.2.01 Delivery, Storage, and Handling

General Provisions 101 through 150.

##### Emulsified Asphalt

Maintain all equipment used for the delivery, storage, and handling of anionic emulsified asphalt or cationic emulsified asphalt to prevent contamination of the emulsion. Transfer anionic emulsified asphalt or cationic emulsified asphalt directly to the pressure distributor from the transport tanker. Emulsified asphalt may be stored in an onsite bituminous storage tank in accordance with Note 1.

Provide and maintain temperature measuring devices to continuously monitor the temperature of anionic emulsified asphalt or cationic emulsified asphalt in storage and in the pressure distributor. Do not allow anionic emulsified asphalt or cationic emulsified asphalt to freeze.

**Note 1: Asphalt emulsion that has been stored longer than 30 days from the time of initial manufacture shall be tested and approved for compliance with specified requirements prior to being used as tack coat for work performed under Section 400**

### 413.3 Construction Requirements

#### 413.3.01 Personnel

General Provisions 101 through 150.

#### 413.3.02 Equipment

Provide equipment in good repair, including the following units that meet the requirements of Subsection 424.3.02, *Equipment*.

- Power broom and blower
- Pressure distributor

Provide a properly cleaned distributor to avoid contamination with incompatible materials.

#### 413.3.03 Preparation

General Provisions 101 through 150.

## Section 413 — Bituminous Tack Coat

### 413.3.04 Fabrication

General Provisions 101 through 150.

### 413.3.05 Construction

#### A. Seasonal and Weather Limitation

Do not apply tack coat if the existing surface is wet or frozen. Do not place emulsified asphalt if the air temperature in the shade is less than 40 °F (4 °C).

#### B. Application

Coat the entire areas to be paved with the tack coat unless directed otherwise by the Engineer. Apply tack coat with distributor spray bars instead of hand hoses, except in small areas inaccessible to spray bars.

**Table 2 - Application Rates for Anionic Emulsified Asphalt or Cationic Emulsified Asphalt, gal/yd<sup>2</sup> (L/m<sup>2</sup>)**

Tack Uses	Minimum	Maximum
New Asphaltic Concrete Pavement to New Asphaltic Concrete Pavement or Thin Lift Leveling	0.05 (0.23)	0.08 (0.36)
New Asphaltic Concrete Pavement (≤ 25 % RAP) to Aged Existing Pavement or Milled Surface	0.06 (0.27)	0.10 (0.45)
New Asphaltic Concrete Pavement (> 25 % RAP) to Aged Existing Pavement or Milled Surface	0.08 (0.36)	0.12 (0.54)

- Allow standard anionic emulsified asphalt or cationic emulsified asphalt to break per emulsion manufacturer's recommendation. Proceed with paving only after the anionic emulsified asphalt or cationic emulsified asphalt has cured to the satisfaction of the Engineer.
- Do not use anionic emulsified asphalt or cationic emulsified asphalt under OGFC or PEM on interstates or limited access state routes.

**Note:** Application rates for PG Binder Asphalt Cement are specified in Section 400.3.03.A.3.C.

#### C. Temperature of Material

Apply bituminous materials within the temperature ranges specified below.

**TABLE 3 – BITUMINOUS MATERIALS AND APPLICATION TEMPERATURES**

Bituminous Materials	Temperature of Application °F (°C)
Asphalt cement	350 - 400 (175 - 205)
Approved non-tracking Anionic Emulsified Asphalt	140 - 180 (60 - 80)
Cationic Emulsified Asphalt CSS-1h, CRS- 1h, CRS-2h, CRS-3, CQS-1h and other approved non-tracking cationic emulsified asphalt products listed on QPL 7	140 - 180 (60 - 80)

#### D. Cleaning

Immediately before applying the tack coat, clean the entire area free of loose dirt, clay, and other foreign materials.

## Section 413 — Bituminous Tack Coat

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### E. Application Rate

The Engineer will determine the application rate of the bituminous tack coat.

### F. Limitations and Areas Coated

Apply only enough tack coat to the prepared road surface that can be covered with the new pavement course the same working day the tack coat is applied.

### G. Maintenance and Protection

After applying a standard emulsified asphalt tack coat material, allow it to break per emulsion manufacturer's recommendation. Do not allow construction equipment or traffic on the tack. When directed by the Engineer, provide a revised paving plan when excessive tracking of the tack material by construction related traffic is evident.

### 413.3.06 Quality Acceptance

General Provisions 101 through 150.

### 413.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150 shall apply with specific consideration given to General Provision Sections 105.12, 105.14, and 105.16.

## 413.4 Measurement

Bituminous materials for tack coat applied and accepted are measured as outlined in Subsection 109.02, *Measurement of Bituminous Materials*.

Diluting emulsified tack coat is not ordinarily allowed except when used underneath slurry seal and approved by the Engineer. The composition of diluted emulsified tack coat defined in Subsection 427.3.05, *Construction* is measured by the gallon (liter) of diluted mix.

### 413.4.01 Limits

General Provisions 101 through 150.

## 413.5 Payment

The accepted volume of bituminous material will be paid for at the Contract Unit Price per gallon (liter) for bituminous tack coat of the type and grade and approved by the Engineer, complete in place. Payment is full compensation for preparing, cleaning, furnishing, hauling, applying material, and providing incidentals to complete the work.

Payment will be made under:

<b>Item No. 413</b>	Tack coat	Per gallon (liter)
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## Section 603—Rip Rap

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### 603.1 General Description

This work includes placing protective coverings of sand-cement bag rip rap or stone rip rap.

When required, this work includes placing crushed stone filter material or plastic filter fabric beneath stone rip rap on:

- Fill slopes
- Cut slopes
- End rolls
- Shoulders
- Ditches
- Stream banks
- Channel banks
- Other locations

#### 603.1.01 Definitions

General Provisions 101 through 150.

#### 603.1.02 Related References

##### A. Standard Specifications

Section 800—Coarse Aggregate

Section 801—Fine Aggregate

Section 805—Rip Rap and Curbing Stone

Section 815—Graded Aggregate

Section 830—Portland Cement

Section 832—Curing Agents

Section 880—Water

Section 881—Fabrics

##### B. Referenced Documents

AASHTO T 134

QPL 28

#### 603.1.03 Submittals

General Provisions 101 through 150.

## Section 603 — Rip Rap

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### 603.2 Materials

Ensure that the materials meet the requirements of the following specifications:

Material	Specification
Portland cement	830.2.01
Rip Rap (Stone)	805.2.01
Membrane Curing Compound	832.2.03
Stone Filter Blanket	815.2.01 or 800.2.01_(Size No. 467*)
Fine Aggregate for Sand Cement Rip Rap	801.2.03
Water	880.2.01
Woven Plastic Filter Fabric	881.2.05

\*Except that up to 10% is allowed to pass the No. 4 (4.75 mm) sieve.

#### A. Bags for Sand-Cement Bag Rip Rap

Use cotton, burlap, or fiber reinforced paper bags that can contain the sand-cement mixture without leaking during handling and placing. Do not use bags that previously held sugar or other material that will adversely affect the sand-cement mixture.

Ensure that the capacity is at least 0.75 ft.<sup>3</sup> (0.02 m<sup>3</sup>) but not greater than 2 ft.<sup>3</sup> (0.5 m<sup>3</sup>).

#### B. Stone Dumped Rip Rap

Stone dumped rip rap is designated on the Plans as Type 1 or Type 3 as defined in Subsection 805.2.01.

### 603.2.01 Delivery, Storage, and Handling

General Provisions 101 through 150.

## 603.3 Construction Requirements

### 603.3.01 Personnel

General Provisions 101 through 150.

### 603.3.02 Equipment

General Provisions 101 through 150.

### 603.3.03 Preparation

General Provisions 101 through 150.

### 603.3.04 Fabrication

General Provisions 101 through 150.

### 603.3.05 Construction

Construct this Work according to the following requirements:



## Section 603 — Rip Rap

---

### A. Preparing the Foundations

Prepare the ground surface where the rip rap will be placed to conform with the correct lines and grades before beginning the placement.

1. When filling depressions, compact the new material with hand or mechanical tampers.  
Dispose of excess material by spreading it neatly within the right-of-way as an incidental part of the work.
2. Unless otherwise shown or provided below, begin placing the rip rap in a toe ditch constructed in original ground around the toe of the fill or the cut slope.  
Ensure that the toe ditch is 2 ft. (600 mm) deep in original ground and the side next to the fill or cut has the same slope.
3. After placing the rip rap, backfill the toe ditch and spread the excess dirt neatly within the right-of-way as an incidental part of the work.
4. When beginning rip rap in water or below normal water level, substitute an apron of rip rap for the toe ditch.  
Ensure that the width and thickness of this apron is as shown on the plans or determined by the Engineer.

### B. Placing Stone Rip Rap

Place rip rap to the limits shown on the Plans or as directed by the Engineer. Place and classify rip rap as follows:

1. Stone Plain Rip Rap  
Dump and handle stone plain rip rap into place to form a compact layer to the design thickness.  
Ensure that the thickness tolerance for the course is plus 12 in. (300 mm) with no under-tolerance. If the plans do not show a thickness, place stone rip rap to at least 12 in. (300 mm) thick, but no greater than 2 ft. (600 mm) thick.
2. Stone Dumped Rip Rap  
Dump stone dumped rip rap into place to form a uniform surface as thick as specified in the Plans.
  - a. Ensure that the thickness tolerance for the course is minus 6 in. (150 mm) and plus 12 in. (300 mm). If the plans or proposal do not specify a thickness, place the course to at least 2 ft. (600 mm) thick.
  - b. Recycled concrete that meets the requirements of Subsection 805.2.01 may be used instead of stone when shown on the plans or approved by the Engineer.  
Use recycled concrete only when materials do not contain steel after processing.

**NOTE: Do not use recycled concrete in aesthetically sensitive areas.**

3. Stone Grouted Rip Rap  
Place stone grouted rip rap according to specifications for stone plain rip rap and these guidelines:
  - a. Prevent earth from filling the spaces between the stones.
  - b. After placing the stone, fill the spaces between them with 1:3 grout composed of Portland cement and sand mixed thoroughly with enough water to make a thick, creamy consistency.
  - c. Place the grout beginning at the toe. Finish it by sweeping with a stiff bristle broom.
  - d. After grouting, cover the rip rap and keep it wet for 5 days, or cover and keep wet for 24 hours and then coat with white pigmented membrane curing compound.

## Section 603 — Rip Rap

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### C. Placing Filter

Place woven plastic filter fabric under all rip rap. Follow these requirements for placing the filter fabric:

1. Prepare the surface to receive the fabric until it is smooth and free from obstructions, depressions, and debris.
2. Place the fabric with the long dimension running up the slope. Minimize the number of overlaps.
3. Place the strips to provide a width of at least 1 ft. (300 mm) of overlap for each joint.
4. Anchor the filter fabric in place with securing pins of the type recommended by the fabric manufacturer. Place the pins on or within 3 in. (75 mm) of the centerline of the overlap.
5. Place the fabric so that the upstream strip will overlap the downstream strip.
6. Loosely place the fabric to prevent stretching and tearing during stone placement.  
Do not drop the stones more than 3 ft. (1 m) during construction.
7. Always protect the fabric during construction from clogging due to clay, silts, chemicals, or other contaminants.
8. Remove contaminated fabric or fabric damaged during installation or rip rap placement. Replace with uncontaminated or undamaged fabric at no expense to the Department.

### D. Placing Sand-Cement Bag Rip Rap

Place rip rap to the limits shown on the plans or as directed by the Engineer.

#### 1. Proportioning Materials

Mix sand and Portland cement at the maximum ratio of 5:1 by weight.

- a. Obtain a minimum compressive strength of 500 psi (3 MPa) in 7 days.
- b. For sand-cement bag rip rap, use enough water to make up the optimum moisture content of the aggregate and cement as determined by AASHTO T 134.
- c. When sand-cement rip rap is to be prebagged, mix the sand cement dry. After placing each course, wet the bags until the bags are wet enough for proper cement hydration.

#### 2. Placement

Before placing sand-cement bag rip rap, fill the bags full, but allow room to tie the bags.

- a. Place the bagged rip rap by hand with the tied ends facing the same direction. Produce close, broken joints.
- b. Place header courses when directed by the Engineer or required by the plans.
- c. After placing the bags, ram or pack them against one another to produce the required thickness and form a consolidated mass.
- d. Do not allow the top of each bag to vary more than 3 in. (75 mm) above or below the required plane.

### E. Placing Stone Blanket Protection

Ensure that the stone blanket protection meets the materials Specifications for stone filter blanket as specified in Subsection 603.2, *Materials*, except stone size No. 357 will be allowed instead of size No. 467.

Place stone blanket protection to the limits shown on the plans, or as directed by the Engineer.

Uniformly place this material to the thickness shown on the plans and to a thickness tolerance of 0.5 in. ( $\pm$  15 mm).

Do not use stone blanket protection on slopes steeper than two horizontal to one vertical or in areas highly susceptible to erosion. Do not use plastic filter fabrics with stone blanket protection.

#### 603.3.06 Quality Acceptance

General Provisions 101 through 150.

#### 603.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

## **Section 603 — Rip Rap**

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### **603.4 Measurement**

No separate measurement will be made for this item of work. No separate measurement will be made for fabric overlap joints, seams, or vertical sections at toe of slopes. No separate measurement is made for grout or cushioning sand.

#### **603.4.01 Limits**

General Provisions 101 through 150.

### **603.5 Payment**

No separate payment shall be made for this work item.

#### **603.5.01 Adjustments**

General Provisions 101 through 150.

## Section 652—Painting Traffic Stripe

### 652.1 General Description

This work includes furnishing and applying reflectorized high build standard and high build wet weather traffic line paint according to the plans and these specifications.

This Item also includes applying words and symbols according to plan details, specifications, and the current Manual on Uniform Traffic Control Devices.

#### 652.1.01 Definitions

Painted Stripes: Solid or broken (skip) lines. The location and color are designated on the plans.

Skip Traffic Stripes: Painted segments with unpainted gaps as specified on the plans. The location and color are designated on the plans.

#### 652.1.02 Related References

##### A. Standard Specifications

- General Provisions 101 through 150.
- Section 656—Removal of Pavement Markings
- Section 870 – Paint
- EPA Method 3052
- EPA Method 6010

##### B. Referenced Documents

ASTM	ASTM	Other
D711	E4941	AASHTO M 247
D3335	E1710	QPL 46, QPL 71
D3718	E2177	SOP 39
D4144		TT-P-1952E

#### 652.1.03 Submittals

General Provisions 101 through 150.

### 652.2 Materials

Ensure that materials for painting traffic stripe, words, and symbols meet the following requirements:

#### A. Traffic Line Paint

Material	Section
Traffic Line Paint 6A and 6B	870.2.02.A.4 and 870.2.02.A.5

## Section 652 — Painting Traffic Stripe

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### B. Glass Spheres and Reflective Composite Optics

Use glass spheres and/or reflective composite optics for the reflective media system that ensures the high build paint pavement markings meet the reflectance performance requirements in Subsection 652.3.06. Do not use glass spheres and/or reflective composite optics containing greater than 200 ppm total arsenic, 200 ppm total antimony, or 200 ppm total lead when tested according to the most recent US EPA Methods 3052 and 6010, or other approved methods.

Ensure glass spheres meet the requirements of AAHTO M 247. Use glass spheres produced from an approved source listed on QPL 71. Glass beads conforming to an alternative gradation may be used provided all other requirements of AASHTO M 247 and this specification are met. Obtain approval from the Office of Materials and Research to use alternate gradations.

### 652.2.01 Delivery, Storage, and Handling

#### A. Storage

Ensure the paint does not cake, liver, thicken, curdle, gel, or show any other objectionable properties after storage for six months above 32 °F (0 °C).

#### B. Handling

Mix thoroughly before use.

## 652.3 Construction Requirements

### 652.3.01 Personnel

General Provisions 101 through 150.

### 652.3.02 Equipment

#### A. Traveling Traffic Stripe Painter

Use a traffic stripe painter that can travel at a predetermined speed both uphill and downhill, applying paint uniformly. Ensure that the painter feeds paint under pressure through nozzles spraying directly onto the pavement.

Use a paint machine equipped with the following:

1. Three adjacent spray nozzles capable of simultaneously applying separate stripes, either solid or skip, in any pattern.
2. Nozzles equipped with the following:
  - Cutoff valves for automatically applying broken or skip lines
  - A mechanical bead dispenser that operates simultaneously with the spray nozzle to uniformly distribute glass spheres and/or reflective composite optics at an application rate to meet the reflectance performance requirements in Subsection 652.3.06.
  - Line-guides consisting of metallic shrouds or air blasts
3. Tanks with mechanical agitators
4. Small, portable applicators or other special equipment as needed

#### B. Hand Painting Equipment

Use brushes, templates, and guides when hand painting.

#### C. Cleaning Equipment

Use brushes, brooms, scrapers, grinders, high-pressure water jets, or air blasters to remove dirt, dust, grease, oil, and other foreign matter from painting surfaces without damaging the underlying pavement.

## Section 652 — Painting Traffic Stripe

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### 652.3.03 Preparation

Locate approved paint manufacturers on QPL 46.

Before starting each day's work, thoroughly clean paint machine tanks, connections, and spray nozzles, using the appropriate solvent.

Thoroughly mix traffic stripe paint in the shipping container before putting it into machine tanks.

Before painting, thoroughly clean pavement surfaces of dust, dirt, grease, oil, and all other foreign matter.

### 652.3.04 Fabrication

General Provisions 101 through 150.

### 652.3.05 Construction

#### A. Alignment

Ensure that the traffic stripe is the specified length, width, and placement. On sections where no previously applied markings are present, ensure accurate stripe location by establishing control points at spaced intervals. The Engineer will approve control points.

#### B. Application

Apply traffic stripe paint by machine. If areas or markings are not adaptable to machine application, use hand equipment.

##### 1. Application Rate

Paint will be subject to application rate checks.

Apply 5 in (125 mm) wide traffic stripe at the following minimum rates:

- a. Solid Traffic Stripe Paint: At least 34 gal/mile (80 L/km)
- b. Skip Traffic Stripe Paint: At least 10 gal/mile (24 L/km)

<b>NOTE: Change minimum rate proportionately for varying stripe widths.</b>
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##### 2. Thickness

Maintain 25 mils (0.58mm) minimum wet average thickness above the surface of the pavement.

##### 3. Do not apply paint to areas of pavement when:

- The surface is moist or covered with foreign matter.
- Air temperature in the shade is below 50 °F (10 °C)
- Wind causes dust to land on prepared areas or blows paint and glass spheres and/or reflective composite optics around during application

##### 4. Apply a layer of glass spheres and/or reflective composite optics immediately after laying the paint. Apply glass spheres and/or reflective composite optics at a rate to meet the reflectance performance requirements in Subsection 652.3.06.

#### C. Protective Measures

Protect newly applied paint as follows:

##### 1. Traffic

Control and protect traffic with warning and directional signs during painting. Set up warning signs before beginning each operation and place signs well ahead of the painting equipment. When necessary, use a pilot car to protect both the traffic and the painting operation.

## Section 652 — Painting Traffic Stripe

### 2. Fresh Paint

Protect the freshly painted stripe using cones or drums. Repair stripe damage or pavement smudges caused by traffic according to Subsection 652.3.06.

### D. Appearance and Tolerance of Variance

Continually deviating from stated dimensions is cause for stopping the work and removing the nonconforming stripe. (See Section 656—Removal of Pavement Markings.) Adhere to the following measurements:

#### 1. Width

Do not lay stripe less than the specified width. Do not lay stripe more than 1/2 in. (13 mm) over the specified width.

#### 2. Length

Ensure that the 10 ft. (3 m) painted skip stripe and the 30 ft. (10 m) gap between painted segments vary no more than  $\pm 1$  ft. (300 mm) each.

#### 3. Alignment

- a. Ensure that the stripe does not deviate from the intended alignment by more than 1 in. (25 mm) on straight lines or curves of 1 degree or less.
- b. Ensure that the stripe does not deviate by more than 2 in. (50 mm) on curves exceeding 1 degree.

### 652.3.06 Quality Acceptance

#### A. General

For a minimum of 30 days from the time of placement, ensure the high build traffic paint pavement marking material shows no signs of failure due to blistering, excessive cracking, shipping, bleeding, staining, discoloration, oil content of the pavement materials, smearing or spreading under heat, deterioration due to contact with grease deposits, oil, diesel fuel, or gasoline drippings, spilling, poor adhesion to the pavement material, vehicular damage, and normal wear. In the event that failures mentioned above occur, ensure corrective work is completed at no additional cost to the Department.

Obtain pavement marking retro-reflectivity values with a 30-meter geometry retro-reflectometer.

#### B. Initial Retro-reflectivity

##### 1. Longitudinal Lines

Within 30 days of installation, ensure the in-place markings meet the following minimum reflectance values:

##### a. High Build Wet Weather Traffic Paint

	White	Yellow
Dry (ASTM E 1710)	300 mcd/lux/m <sup>2</sup>	250 mcd/lux/m <sup>2</sup>
Wet recovery (ASTM E 2177)	150 mcd/lux/m <sup>2</sup>	100 mcd/lux/m <sup>2</sup>

##### b. High Build Standard Traffic Paint

	White	Yellow
Dry (ASTM E 1710)	300 mcd/lux/m <sup>2</sup>	250 mcd/lux/m <sup>2</sup>

For each center line, edge line, and skip line, measure retro-reflectivity 9 times for each mile; 3 times within the first 500 feet, 3 times in the middle, and 3 times within the last 500 feet. For projects less than one mile in length, measure retro-reflectivity 9 times as above.

Record all retro reflectivity measurements on the form OMR CVP 66 in SOP 39.

## Section 652 — Painting Traffic Stripe

### 2. Messages, Symbols, and Transverse Lines

Within 30 days of installation, ensure the in-place markings when tested according to ASTM E 1710 meet the following minimum reflectance value of 275 mcd/lux/m<sup>2</sup>.

Perform at a minimum, one retro-reflectivity measurement at one message, one symbol and one transverse line per intersection. Take one measurement per mile for locations other than intersections (i.e. school messages, railroad messages, bike symbols etc.)

### C. Six Month Retro-reflectivity (Longitudinal Lines)

Maintain the following minimum reflectance values for 180 days after installation:

#### a. Wet Weather High Build Wet Weather Traffic Paint

	White	Yellow
Dry (ASTM E 1710)	300 mcd/lux/m <sup>2</sup>	250 mcd/lux/m <sup>2</sup>
Wet recovery (ASTM E 2177)	150 mcd/lux/m <sup>2</sup>	100 mcd/lux/m <sup>2</sup>

#### b. High Build Standard Traffic Paint

	White	Yellow
Dry (ASTM E 1710)	300 mcd/lux/m <sup>2</sup>	250 mcd/lux/m <sup>2</sup>

Retest the in-place markings according to Subsection 652.3.06.B.1, 180 days after installation to ensure these minimum retroreflectance values are maintained.

**NOTE: The Contractor is responsible for retro-reflectivity testing. Furnish initial test results to the Engineer within 30 days of application. Furnish 6-month test results to the Engineer within 180 days of application or prior to final acceptance, whichever comes first.**

### D. Thickness

At the time of installation, check the thicknesses on all skip lines, edge lines and center lines according to ASTM D 4114.

For each center line, edge line, and skip line, measure thickness above the pavement 3 times for each mile; once within the first 500 ft., once in the middle, and once within the last 500 ft. For projects less than one mile in length, measure the thickness above the pavement 3 times.

Record thickness measurements on the form OMR CVP 66 in SOP 39.

Submit results to the Engineer.

### E. Corrective Work

For each mile section, if paint stripe fails to meet plan details or specifications or deviates from stated dimensions, correct it at no additional cost to the Department. If removal of pavement markings is necessary, perform it according to Section 656 and place it according to this specification. No additional payment will be made for removal and replacement of unsatisfactory striping. Ensure corrective work is completed at no additional cost to the Department. Perform testing according to this specification. Any retest due to failures will be performed at no additional cost to the Department. Furnish all test reports to the Department.

Retro-reflectivity and Thickness Longitudinal Line Deficiency: A deficiency will ensue when two or more Location Average results as recorded on form OMR CVP 66 within a One-Mile Section do not meet the performance criteria herein. The entire line within this one-mile section will be determined to be deficient. If the evaluated section is less than 1.0 mile, a single Location Average result not meeting the performance criteria herein will result in the entire line to be determined to be deficient.



## Section 652 — Painting Traffic Stripe

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Retro-reflectivity Transverse Markings and Symbol Deficiency: A single Location Average result on the marking or symbol not meeting the performance criteria herein will result in the marking or symbol to be determined to be deficient.

### F. Acceptance Criteria

Ensure that stripes and segments of stripes are clean-cut and uniform. Markings that do not appear uniform or satisfactory, either during the day or night, or do not meet specifications, will be corrected at the Contractor's expense. Paint will be subject to application rate checks.

#### 1. Correction of Alignment

When correcting a deviation that exceeds the permissible tolerance in alignment, do the following:

- a. Remove the affected portion of stripe, plus an additional 25 ft. (8 m) in each direction according to Section 656—Removal of Pavement Markings.
- b. Paint a new stripe according to these specifications.

#### 2. Removal of Excess Paint

Remove misted, dripped, or spattered paint to the Engineer's satisfaction. Do not damage the underlying pavement during removal.

Refer to the applicable portions of Section 656—Removal of Pavement Markings.

### 652.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

## 652.4 Measurement

When traffic stripe is paid for by the square yard (meter), the number of square yards (meters) painted is measured and the space between stripes is included in the overall measurement.

Linear measurements are made on the painted surface by an electronic measuring device attached to a vehicle. On curves, chord measurements, not exceeding 100 linear feet (30 linear meters), are used.

Traffic stripe and markings, complete in place, are measured and accepted for payment as follows:

### A. Solid Traffic Stripe

Solid traffic stripe is measured by the linear foot (meter), linear mile (kilometer), or square yard (meter). Breaks or omissions in solid lines or stripes at street or road intersections are not measured.

### B. Skip Traffic Stripe

Skip traffic stripe is measured by the gross linear foot (meter) or gross linear mile (kilometer). Unpainted spaces between the stripes are included in the overall measurements if the plan ratio of 1 to 3 remains uninterrupted. Measurement begins and ends on a stripe.

### C. Pavement Markings

Markings are words and symbols completed according to plan dimensions. Markings are measured by the unit.

### 652.4.01 Limits

General Provisions 101 through 150.

## Section 652 — Painting Traffic Stripe

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### 652.5 Payment

Payment will be full compensation for the work under this section, including the following:

- Cleaning and preparing surfaces
- Furnishing materials, including paints, beads, and thinners
- Applying, curing, and protecting paints
- Protecting traffic, including providing and placing necessary warning signs
- Furnishing tools, machines, and other equipment necessary to complete the Item

Payment will be made under:

<b>Item No. 652</b>	Solid traffic stripe, color as indicated on plans	Per lump sum
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#### 652.4.01 Adjustments

General Provisions 101 through 150.

## Section 700—Grassing

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### 700.1 General Description

This work includes preparing the ground, furnishing, planting, seeding, fertilizing, sodding, and mulching disturbed areas within the Right-of-Way limits and easement areas adjacent to the right-of-way as shown on the plans except as designated by the Engineer to remain natural.

#### 700.1.01 Definitions

General Provisions 101 through 150.

#### 700.1.02 Related References

##### A. Standard Specifications

Section 160—Reclamation of Material Pits and Waste Areas

Section 163—Miscellaneous Erosion Control Items

Section 718—Wood Fiber

Section 822—Emulsified Asphalt

Section 882—Lime

Section 890—Seed and Sod

Section 891—Fertilizers

Section 893—Miscellaneous Planting Materials

Section 895—Polyacrylamide

##### B. Referenced Documents

QPL 33

QPL 84

#### 700.1.03 Submittals

Submit manufacturer's product expiration date along with written instructions to ensure proper application, safety, storage, and handling of Polyacrylamide products used in the work.

### 700.2 Materials

Use materials that meet the requirements of the following specifications:

Material	Section
Wood Fiber Mulch	718.2
Agricultural Lime	882.2.01
Seed	890.2.01
Sod	890.2.02
Fertilizer	891.2.01
Plant Topsoil	893.2.01
Mulch	893.2.02
Inoculants	893.2.04

## Section 700 — Grassing

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Material	Section
Tackifiers	QPL 33
Anionic Polyacrylamide	QPL 84 & Section 895

### A. Seeds

Whenever seeds are specified by their common names, use the strains indicated by their botanical names.

### B. Water

Obtain the water for grassing from an approved source. Use water free of harmful chemicals, acids, alkalies, and other substances that may harm plant growth or emit odors. Do not use salt or brackish water.

### C. Agricultural Lime

Agricultural lime rates will be based on a laboratory soil test report. The Contractor is responsible for ensuring the tests are performed by an approved laboratory. Provide a copy of test results to the Engineer. Refer to Section 882 Lime and GSP 18 of the Sampling and Testing Inspection manual for additional information on rates, use, handling and sampling procedures.

### D. Fertilizer Mixed Grade

Fertilizer analysis and rates will be based on a laboratory soil test report. The Contractor is responsible for ensuring the tests are performed by an approved laboratory. Provide a copy of test results to the Engineer. Refer to Section 891 Fertilizer and GSP 18 of the Sampling and Testing Inspection manual for additional information on rates, use, handling and sampling procedures.

### E. Mulch

Use straw or hay mulch according to Subsection 700.3.05.G.

Use wood fiber mulch in hydroseeding according to Subsection 700.3.05.F.1.

## 700.2.01 Delivery, Storage, and Handling

General Provisions 101 through 150.

## 700.3 Construction Requirements

### 700.3.01 Personnel

General Provisions 101 through 150.

### 700.3.02 Equipment

Use grassing equipment able to produce the required results.

Never allow the grading (height of cut) to exceed the grassing equipment's operating range.

#### A. Mulch Material Equipment

Use mulching equipment that uniformly cuts the specified materials into the soil to the required control depth.

#### B. Hydroseeding Equipment

For hydroseeding equipment, see Subsection 700.3.05.F.

### 700.3.03 Preparation

General Provisions 101 through 150.

### 700.3.04 Fabrication

General Provisions 101 through 150.

## Section 700 — Grassing

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### 700.3.05 Construction

Follow the planting zones, planting dates, types of seed, seed mixtures, and application rates described throughout this Section. The Engineer has the authority to alter the planting dates as set forth by a period of 2 weeks. This 2-week period may be applied to either the beginning of the specified planting and/or to the end of the end of the specified planting season.

In general:

- Obtain the Engineer's approval before changing the ground cover type.
- Do not use annual rye grass seeds with permanent grassing.
- Follow the planting zones indicated on the Georgia State Planting Zone Map, below.
- Sod may be installed throughout the year, weather permitting.
- For permanent grassing, apply the combined amounts of all seeds for each time period within each planting zone and roadway location listed in the Seeding Table, below. Do not exceed the amounts of specified seed.

Planting Zone Map



**Section 700 — Grassing**

**NON-NATIVE GRASS SEEDING TABLE 1**

(Temporary and Permanent Seed Types for Shoulders, Medians and Slopes 3:1 or Flatter)

Common Name	Botanical Name	Class/Type	Rate/Acre	Planting Zone	Planting Dates
Common Bermuda Grass (Hulled)	<i>Cynodon dactylon</i>	Required Permanent Grass	10 (11)	1	April 16 – August 31
Common Bermuda Grass (Unhulled)			10 (11)		
Common Bermuda Grass (Hulled)	<i>Cynodon dactylon</i>	Required Permanent Grass	10 (11)	2,3,4	April 1 – October 15
Common Bermuda Grass (Unhulled)			10 (11)		
Bahaia Grass			<i>Paspalum motatum</i>		
Rye Grass, Millet, Cereal Grass (Oats)	<i>Lolium penne</i> ssp. <i>Multiflorum</i> , <i>Echinochloa cursgalli</i> , <i>Avena sativa</i>	Temporary Grass	50 (56)	1	September 1- April 15
Rye Grass, Millet, Cereal Grass (Oats)	<i>Lolium penne</i> ssp. <i>Multiflorum</i> , <i>Echinochloa cursgalli</i> , <i>Avena sativa</i>	Temporary Grass	50 (56)	2,3,4	October 16- March 31

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**NON-NATIVE SEEDING TABLE 2**

(Temporary and Permanent Seed Types for back slopes, fill slopes and areas which will not be subject to frequent mowing, slopes steeper than 3:1)

Common Name	Botanical Name	Class/Type	Rate/Acre	Planting Zone	Planting Dates
Interstate Lespedeza	<i>Lespedeza sericea</i>	Permanent Grass	50(56)	1,2	March 1 – August 31
Weeping Lovegrass	<i>Eragrostis curvula</i>	Temporary Grass	10(11)		
Interstate Lespedeza	<i>Lespedeza sericea</i>	Permanent Grass	75(84)	1,2	September 1- February 28
Tall Fescue	<i>Festuca arundinacea</i>	Temporary Grass	50(56)		
Interstate Lespedeza	<i>Lespedeza sericea</i>	Permanent Grass	50(56)	3,4	April 1 – October 31
Weeping Love Grass	<i>Eragrostis curvula</i>	Temporary Grass	10(11)		
Interstate Lespedeza	<i>Lespedeza sericea</i>	Permanent Grass	50(56)	3,4	November 1 – March 31
Weeping Love Grass	<i>Eragrostis curvula</i>	Temporary Grass	10(11)		



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**NATIVE GRASS SEEDING TABLE 3**

**For Non-mowable Slopes or Areas Designated as Permanent Native Grass Plots.**

(Plant native seed mixes on back slopes, fill slopes and areas which will not be subject to frequent mowing (slopes steeper than 3:1).

Common Name	Botanical Name	Class/Type	Rate/Acre	Planting Zone	Planting Dates
Canada Wild Rye	<i>Elymus canadensis</i>	Cool Season	Minimum 2 (2)	1,2,3,4	October 31 - March 31
Virginia Wild Rye	<i>Elymus virginicus</i>	Cool Season	Minimum 2 (2)	1,2,3,4	October 31 - March 31
Bottle-brush Grass	<i>Hystrix patula</i>	Cool Season	Minimum 2 (2)	1,2,3,4	October 31 - March 31
Little Bluestem	<i>Schizachyrium scoparium</i> ( <i>Andropogon scoparius</i> )	Warm Season	Minimum 2 (2)	1,2,3,4	March 31- August 31
Indiangrass	<i>Sorghastrum nutans</i>	Warm Season	Minimum 2 (2)	1,2,3,4	March 31- August 31
Eastern Gama Grass	<i>Tripsacum dactyloides</i>	Warm Season	Minimum 2 (2)	1,2,3,4,1,2,3,4	March 31- August 31
Rice Cut Grass	<i>Leersia oryzoides</i>	Warm Season	Minimum 2 (2)	1,2,3,4	March 31- August 31
Deertongue	<i>Panicum clandestinum</i>	Warm Season	Minimum 2 (2)	1,2,3,4	March 31- August 31
Switchgrass	<i>Panicum virgatum</i>	Warm Season	Minimum 2 (2)	1,2,3,4	March 31- August 31
Woolgrass	<i>Scirpus cyperinus</i>	Cool Season	Minimum 2 (2)	1,2,3,4	October 31 - March 31
River Oats	<i>Chasmanthium latifolium</i>	Cool Season	Minimum 2 (2)	1,2,3,4	October 31 - March 31
Purple Top	<i>Tridens flavus</i>	Warm Season	Minimum 2 (2)	1,2,3,4	March 31- August 31

See plan sheets/plant lists for detailed native restoration and riparian mitigation seed mix combinations to be applied at a minimum rate total of 10 (11) lbs. per acre (kg/hectare) for each combined mix. If the mix is not provided in the plan sheets, use a minimum of 3 species based on planting dates shown above.

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**HERBACEOUS PLANT SEEDING TABLE 4**

(Approved for Riparian Mitigation or for Seed Mixes on Slopes Steeper than 3:1- Requiring Permanent Planting)

<b>Common name</b>	<b>Botanical name</b>	<b>Class/type</b>	<b>Rate/Acre</b>	<b>Planting Zone</b>	<b>Planting Dates</b>
Joe Pye Weed	<i>Eupatorium fistulosum</i>	Herbaceous Perennial	Minimum 2 (2)	1,2,3,4	September 1 – May 1
Ironweed	<i>Vernonia novaboracensis</i>	Herbaceous Perennial	Up to 10(11)	1,2,3,4	March 1 - August 31,
White snakeroot	<i>Ageratina altissima</i> ( <i>Eupatorium rugosum</i> )	Herbaceous Perennial	Up to 10(11)	1,2,3,4	September 1 – May 1
Swamp milkweed	<i>Asclepias incarnata</i>	Herbaceous Perennial	Up to 10(11)	1,2,3,4	March 1 - August 31,
Frost aster	<i>Aster pilosus</i> ( <i>Symphotrichum pilosum</i> )	Herbaceous Perennial	Up to 10(11)	1,2,3,4	September 1 – May 1
Partridge pea	<i>Chamaecrista fasciculata</i> ( <i>Cassia fasciculata</i> )	Herbaceous Perennial	Up to 10(11)	1,2,3,4	March 1 - August 31,
Lance-leaf coreopsis	<i>Coreopsis lanceolata</i>	Herbaceous Perennial	Up to 10(11)	1,2,3,4	September 1 – May 1
Tall coreopsis	<i>Coreopsis tripteris</i>	Herbaceous Perennial	Up to 10(11)	1,2,3,4	September 1 – May 1
Boneset	<i>Eupatorium perfoliatum</i>	Herbaceous Perennial	Up to 10(11)	1,2,3,4	September 1 – May 1
Sneezeweed	<i>Helenium autumnale</i>	Herbaceous Perennial	Up to 10(11)	1,2,3,4	September 1 – May 1
Swamp sunflower	<i>Helianthus angustifolius</i>	Herbaceous Perennial	Up to 10(11)	1,2,3,4	March 1 - August 31,
Fringed loosestrife	<i>Lysimachia ciliata</i>	Herbaceous Perennial	Up to 10(11)	1,2,3,4	September 1 – May 1

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Wild bergamot	<i>Monarda fistulosa</i>	Herbaceous Perennial	Up to 10(11)	1,2,3,4	September 1 – May 1
Mountain mint	<i>Pycnanthemum tenuifolium</i>	Herbaceous Perennial	Up to 10(11)	1,2,3,4	September 1 – May 1
Black-eyed susan	<i>Rudbeckia hirta</i>	Herbaceous Perennial	Up to 10(11)	1,2,3,4	September 1 – May 1
Goldenrod	<i>Solidago nemoralis</i>	Herbaceous Perennial	Up to 10(11)	1,2,3,4	September 1 – May 1
Butterfly Weed	<i>Aesclepias tuberosa</i>	Herbaceous Perennial	Up to 10(11)	1,2,3,4	March 1 - August 31,

Species	Rates per 1000 sq. ft.	Rates per Acre	Planting Date By Zone		
			1 & 2	2	3 & 4
Rye (Grain)	3.9 lbs	168 lbs	8/1 - 11/30	8/15 - 12/1	9/1 - 2/28
Ryegrass	0.9 lbs	40 lbs	8/1 - 11/30	9/1 - 12/15	9/15 - 1/1
Rye & Annual Lespedeza	0.6 lbs 0.6 lbs	28 lbs 24 lbs	3/1 - 4/1	2/1 - 3/1	2/1 - 3/1
Weeping Lovegrass	0.1 lbs	4 lbs	3/15 - 6/15	3/15 - 7/15	3/15 - 7/15
Sudangrass	1.0 lbs	60 lbs	4/1 - 8/31	4/1 - 8/31	3/15 - 8/1
Browntop Millet	1.1 lbs	50 lbs	4/1 - 6/30	4/1 - 7/15	4/1 - 7/15
Wheat	3.9 lbs	168 lbs	9/1 - 12/31	9/1 - 12/31	9/15 - 1/31

For native restoration and riparian mitigation seed mix combinations, use Table 4 for approved native herbaceous seed types in combination with Table 3 of native grass seeds. Native restoration and riparian seed mixes should incorporate a mix of 60% native grass types (see Table 3) and 40% native herbaceous types (see Table 4) applied at a minimum rate total of 10 (11) lbs. per acre (kg/hectare) for each combined mix.

**TABLE 5: TEMPORARY GRASS - SPECIES, SEEDING RATES AND PLANTING DATES**

When stage construction or other conditions prevent completing a roadway section continuously, apply temporary grassing to control erosion. Temporary grassing is used to stabilize disturbed areas for more than sixty (60) calendar days. Temporary grass may be applied any time of the year, utilizing the appropriate seed species and application rate as shown in the chart above. Apply mulch to areas planted in temporary grass at the rate of ¾ inch to 1.5 inches. Do not place slope mats on areas planted in temporary grass.

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### A. Ground Preparation

Prepare the ground by plowing under any temporary grass areas and preparing the soil as follows:

1. Slopes 3:1 or Flatter

On slopes 3:1 or flatter, plow shoulders and embankment slopes to between 4 in. and 6 in. (100 mm and 150 mm) deep.

Plow front and back slopes in cuts to no less than 6 in. (150 mm) deep. After plowing, thoroughly disk the area until pulverized to the plowed depth.

2. Slopes Steeper Than 3:1

Serrate slopes steeper than 3:1 according to plan details when required.

On embankment slopes and cut slopes not requiring serration (sufficient as determined by the Engineer), prepare the ground to develop an adequate seed bed using any of the following methods as directed by the Engineer:

- Plow to a depth whatever depth is practicable.
- Use a spiked chain.
- Walk with a cleated track dozer.
- Scarify.

Disking cut slopes and fill slopes is not required.

3. All Slopes

a. Obstructions

Remove boulders, stumps, large roots, large clods, and other objects that interfere with grassing or may slide into the ditch.

b. Topsoil

Spread topsoil stockpiled during grading evenly over cut and fill slopes after preparing the ground.

Push topsoil from the top over serrated slopes. Do not operate equipment on the face of completed serrated cuts.

4. Native Restoration Areas, Riparian Areas, Stream Restoration Areas, and Wetland and Stream Mitigation Areas.

For Permanent Grassing in native restoration areas, multitrophic native planting areas, riparian areas, stream restoration areas, and wetland and stream mitigation areas, provide the minimum ground preparation necessary to provide seed to soil contact. Riparian areas may also be seeded using the no-till method. The no-till method is defined by planting permanent grass seeds using a drill-type seeder over existing vegetation without plowing or tilling soil. Ensure that existing vegetation is less than 3 inches in height (this may be achieved by mowing or using a mechanical string trimmer).

### B. Grassing Adjacent to Existing Lawns

When grassing areas adjacent to residential or commercial lawns, the Engineer shall change the plant material to match the type of grass growing on the adjacent lawn. The Contract Unit Price will not be modified for this substitution.

### C. Temporary Grassing

Apply temporary grassing according to Subsection 163.3.05.F. Determine lime requirements by a laboratory soil test. Refer to seeding Table 5 for species, amounts of seed and planting dates.

In March or April of the year following planting and as soon as the weather is suitable, replace all areas of temporary grass with permanent grass by plowing or overseeding using the no-till method. If the no-till method is used, ensure that temporary grass is less than 3 in. in height (this may be achieved by mowing). Additional mulch will be required only if the temporary grass does not provide adequate mulch to meet the requirements of Subsection 700.3.05.G, *Mulching*.

Temporary grass, when required, will be paid for according to Section 163.

Projects that consist of asphalt resurfacing with shoulder reconstruction and/or shoulder widening: Type II Wood Fiber Blanket is used to stabilize disturbed areas, no till seeding will be used when permanent grassing is applied and the areas will not be re-disturbed.

## Section 700 — Grassing

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### D. Applying Agricultural Lime and Fertilizer Mixed Grade

Apply and mix lime and fertilizer as follows:

#### 1. Agricultural Lime

Uniformly spread agricultural lime on the ground at the approximate rate determined by the laboratory soil test.

a. Agricultural Lime may be used as filler material in mixed grade fertilizer in lieu of inert material. The use of agricultural lime as filler material is to be shown on the fertilizer bag or invoice from the supplier. Do not deduct any amount of fertilizer when lime is used as filler.

#### 2. Fertilizer Mixed Grade

Uniformly spread the fertilizer selected according to Subsection 700.2.D over the ground or by use of hydroseeding.

For bid purposes base estimated quantities on an initial application of 400 lb./acre of 19-19-19.

#### 3. Mixing

Before proceeding, uniformly work the lime and fertilizer into the top 4 in. (100 mm) of soil using harrows, rotary tillers, or other equipment acceptable to the Engineer.

On cut slopes steeper than 3:1, other than serrated slopes, reduce the mixing depth to the maximum practical depth as determined by the Engineer.

Omit mixing on serrated slopes.

#### 4. Native Restoration Areas, Multitropic Native Planting Areas, Riparian Areas, Stream Restoration Areas, and Wetland and Stream Mitigation Areas

Omit the application of lime and fertilizer within riparian areas.

### E. Seeding

Prepare seed and sow as follows:

#### 1. Inoculation of Seed

Inoculate each kind of leguminous seed separately with the appropriate commercial culture according to the manufacturer's instructions for the culture.

When hydroseeding, double the inoculation rate.

Protect inoculated seed from the sun and plant it the same day it is inoculated.

#### 2. Sowing

Weather permitting, sow seed within 24 hours after preparing the seed bed and applying the fertilizer and lime.

Sow seed uniformly at the rates specified in the seeding tables. Use approved mechanical seed drills, rotary hand seeders, hydroseeding equipment, or other equipment to uniformly apply the seed. Do not distribute by hand.

To distribute the seeds evenly sow seed types separately, except for similarly sized and weighted seeds. They may be mixed and sown together.

Do not sow during windy weather, when the prepared surface is crusted, or when the ground is frozen, wet, or otherwise non-tillable.

#### 3. Overseeding

Temporary grass areas that were prepared in accordance with Subsection 700.3.05.A, may be overseeded using the no-till method. The no-till method is defined by planting permanent grass seeds using a drill-type seeder over existing temporary grass without plowing or tilling soil and in accordance with Subsection 700.3.05.C.

#### 4. Riparian Seed Mix shall be used when specified in the plans. A mix of at least three (3) species from Seeding Table 3 (Native Grasses) and at least two (2) species from Seeding Table 4 (Approved Riparian Mitigation - Herbaceous Plants). The seed, shall be applied as Permanent Grassing within those areas designated on the plans. The kinds of seed, shall be used according to the appropriate Planting Dates given in the tables.

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### F. Hydroseeding

Hydroseeding may be used on any grassing area. Under this method, spread the seed, fertilizer, and wood fiber mulch in the form of a slurry. Seeds of all sizes may be mixed together. Apply hydroseeding as follows:

1. Use wood fiber mulch as a metering agent and seed bed regardless of which mulching method is chosen. Apply wood fiber mulch at approximately 500 lbs./acre (560 kg/ha).
2. Prepare the ground for hydroseeding as for conventional seeding in Subsection 700.3.05.A.
3. Use specially designed equipment to mix and apply the slurry uniformly over the entire seeding area.
4. Agitate the slurry mixture during application.
5. Discharge slurry within one hour after being combined in the hydroseeder. Do not hydroseed when winds prevent an even application.
6. Closely follow the equipment manufacturer's directions unless the Engineer modifies the application methods.
7. Mulch the entire hydroseeded area according to Subsection 700.3.05.F.1, above, and Subsection 700.3.05.G, below. Native Restoration Areas, Multitropic Native Planting Areas, Riparian Areas, Stream Restoration Areas, and Wetland and Stream Mitigation Areas may be hydroseeded. When hydroseeding in these areas only use water, seed and wood fiber mulch.

### G. Mulching

Except as noted in Subsection 700.3.05.B and Subsection 700.3.05.C, apply mulch immediately after seeding areas as follows:

Areas with permanent grass seed and covered with slope mats or blankets will not require mulch.

Evenly apply straw or hay mulch between 3/4 in. and 1-1/2 in. (20 mm and 40 mm) deep, according to the texture and moisture content of the mulch material.

Mulch shall allow sunlight to penetrate and air to circulate as well as shade the ground, reduce erosion, and conserve soil moisture. If the type of mulch is not specified on the plans or in the Proposal, use any of the following as specified.

#### 1. Mulch with Tackifier

Apply mulch with tackifier regardless of whether using ground or hydroseeding equipment for seeding.

- a. Mulch uniformly applied manually or with special blower equipment designed for the purpose. When using a blower, thoroughly loosen baled material before feeding it into the machine so that it is broken up.
- b. After distributing the mulch initially, redistribute it to bare or inadequately covered areas in clumps dense enough to prevent new grass from emerging (if required).  
Do not apply mulch on windy days.
- c. Apply enough tackifier to the mulch to hold it in place. Immediately replace mulch that blows away.  
If distributing the mulch by hand, immediately apply the tackifier uniformly over the mulched areas.
  - Tackifier: Use a tackifier listed in the Laboratory Qualified Products Manual and apply at the manufacturer's recommended rates.

#### 2. Walked-in-Mulch

Apply walked-in-mulch on slopes ranging in steepness from 5:1 to 2:1 and treat as follows:

- a. Immediately walk it into the soil with a cleated track dozer. Make dozer passes vertically up and down the slope.
  - b. Where walked-in-mulch is used, do not roll or cover the seeds as specified in Subsection 700.3.05.E.3.
3. Apply only wheat straw mulch on Riparian Areas, Stream Restoration Areas, and Wetland and Stream Mitigation Areas after they have been seeded. The wheat straw mulch is to be applied with a maximum thickness of 1 in.

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### H. Sod

Furnish and install sod in all areas shown on the plans or designated by the Engineer.

#### 1. Kinds of Sod

Use only Common Bermudagrass (Cynodon dactylon) or one of the following Bermudagrass varieties:

Tifway 419

Tifway II

Tift 94

Tifton 10

Midlawn

Midiron

GN-1

Vamont

No dwarf Bermuda types shall be used. Sod shall be nursery-grown and be accompanied with a Georgia Department of Agriculture Live Plant License Certificate or Stamp. Sod shall consist of live, dense, well-rooted material free of weeds and insects as described by the Georgia Live Plant Act.

#### 2. Type and Size Of Sod:

Furnish either big roll or block sod. Ensure that big roll sod is a minimum of 21 in. wide by 52 ft. long. Minimum dimensions for block sod are 12 in. wide by 22 in. long. Ensure all sod consists of a uniform soil thickness of not less than 1 in.

#### 3. Ground Preparation

Excavate the ground deep enough and prepare it according to Subsection 700.3.05.A to allow placing of sod. Spread soil, meeting the requirements of Subsection 893.2.01, on prepared area to a depth of 4 in.

#### 4. Application of Lime and Fertilizer

Apply lime and fertilizer according to Subsection 700.3.05.D within 24 hours prior to installing sod.

#### 5. Weather Limitation

Do not place sod on frozen ground or where snow may hinder establishment.

#### 6. Install Sod

Install Sod as follows:

- Place sod by hand or by mechanical means so that joints are tightly abutted with no overlaps or gaps. Use soil to fill cracks between sod pieces, but do not smother the grass.
- Stake sod placed in ditches or slopes steeper than 2:1 or any other areas where sod slipping can occur.
- Use wood stakes that are at least 8 in (200 mm) in length and not more than 1 in. ( 25 mm) wide.
- Drive the stakes flush with the top of the sod. Use a minimum of 8 stakes per square yard (meter) to hold sod in place.
- Once sod is placed and staked as necessary, tamp or roll it using adequate equipment to provide good contact with soil.
- Use caution to prevent tearing or displacement of sod during this process. Leave the finished surface of sodded areas smooth and uniform.

#### 7. Watering Sod

After the sod has been placed and rolled or tamped, water it to promote satisfactory growth. Additional watering will be needed in the absence of rainfall and during the hot dry summer months. Water may be applied by Hydro Seeder, Water Truck or by other means approved by the Engineer.

#### 8. Dormant Sod

Dormant Bermuda grass sod can be installed. However, assume responsibility for all sod through establishment and until final acceptance.

#### 9. Establishment

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### I. Application of Nitrogen

Apply nitrogen at approximately 50 lbs./acre (56 kg/ha) when specified by the Engineer after plants have grown to 2 in. (50 mm) in height.

One application is mandatory and must be applied before Final Acceptance.

Apply nitrogen with mechanical hand spreaders or other approved spreaders capable of uniformly covering the grassed areas. Do not apply nitrogen on windy days or when foliage is damp.

Do not apply nitrogen between October 15 and March 15 except in Zone 4.

1. Native Restoration Areas, Multitropic Native Planting Areas, Riparian Areas, Stream Restoration Areas, and Wetland and Stream Mitigation Areas

Do not apply nitrogen to these areas.

### J. Application of Polyacrylamide (PAM)

1. Prepare soil according to project plans and specifications prior to applying PAM.
2. Apply PAM according to manufacturer's recommendations and the requirements listed herein.
3. Apply Polyacrylamide (PAM) to all areas that receive permanent grassing.
4. Apply PAM (powder) before grassing or PAM (emulsion) to the hydroseeding operation.
5. Use only anionic PAM.
6. Ensure that the application method provides uniform coverage to the target and avoids drift to non-target areas including waters of the state.
7. Achieve > 80% reduction in soil loss as measured by a rainfall simulator test performed by a certified laboratory (1-hour storm duration, 3 in. (75 mm) rainfall per hour).
8. Ensure uniform coverage to the target area and minimize drift to non-target areas. Apply anionic PAM to all cut and fill slopes, permanently grassed or temporarily grassed, either prior to grassing or in conjunction with hydroseeding operations. Mulch will not be eliminated.
9. Use application rates in accordance with manufacturer's instructions.
10. Do not exceed 200 lbs./acre/year (224 kg/ha/year).
11. Do not include polyacrylamide when planting in Riparian Areas, Stream Restoration Areas, and Wetland and Stream Mitigation Areas

### 700.3.06 Quality Acceptance

The Engineer may require replanting of an area that shows unsatisfactory growth for any reason at any time.

Except as otherwise specified or permitted by the Engineer, prepare replanting areas according to the specifications as if they were the initial planting areas. Use a soil test or the Engineer's guidance to determine the fertilizer type and application rate, then furnish and apply the fertilizer.

### 700.3.07 Contractor Warranty and Maintenance

#### A. Plant Establishment

Before Final Acceptance, provide plant establishment of the specified vegetation as follows:

1. Plant Establishment  
Preserve, protect, water, reseed or replant, and perform other work as necessary to keep the grassed areas in satisfactory condition.
2. Watering  
Water the areas during this period as necessary to promote maximum growth.
3. Mowing  
Mow seeded areas of medians, shoulders, and front slopes at least every 6 months. Avoid damaging desirable vegetation.



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In addition, mow as necessary to prevent tall grass from obstructing signs, delineation, traffic movements, sight distance, or otherwise becoming a hazard to motorists.

Do not mow lespedezas or tall fescue until after the plants have gone to seed.

4. Do not mow riparian areas, stream restoration areas, or wetland and stream mitigation areas after planting.

### B. Additional Fertilizer Mixed Grade

Apply fertilizer based on the initial soil test report at half the recommended rate each spring after initial plant establishment. For bid purposes apply 200 lbs./acre of 19-19-19. Continue annual applications until Final Acceptance. This additional fertilizer will be measured and paid for at the Contract Unit Price for fertilizer mixed grade.

Do not apply additional fertilizer to Native Restoration Areas, Multitropic Native Planting Areas, Riparian Areas, Stream Restoration Areas, and Wetland and Stream Mitigation Areas.

### C. Growth and Coverage

Provide satisfactory growth and coverage, ensuring that vegetation growth is satisfactory with no bare spots larger than 1 ft.<sup>2</sup> (0.1 m<sup>2</sup>). Bare spots shall comprise no more than 1 percent of any given area. An exception is given for seed not expected to have germinated and shown growth at that time.

### D. Permissible Modifications

When all Items of the work are ready for Final Acceptance except for newly planted repaired areas or other areas with insufficient grass, the Contractor may fill the eroded areas or treat bare areas with sod obtained, placed, and handled according to Subsection 700.3.05.H.

Carefully maintain the line and grade established for shoulders, front slopes, medians, and other critical areas.

Sod as described above will not be paid for separately but will be an acceptable substitute for the satisfactory growth and coverage required under this specification. These areas treated with sod are measured for payment under the Item for which the sod is substituted.

## 700.4 Measurement

### A. Permanent Grassing

Permanent Grassing will be measured for payment by the acre (hectare).

### B. Mulches

Straw or hay mulch applied to permanent grassing areas will be measured by the ton (megagram). Wood fiber mulch furnished by the Contractor for permanent grassing is not measured for separate payment.

### C. Quantity of Sod

Sod is measured for payment by the number of square yards (meters) , surface measure, completed and accepted.

### D. Water

Water furnished and applied to promote a satisfactory growth is not measured for payment.

### E. Quantity of Lime and Fertilizer Mixed Grade

Lime and fertilizer are measured by the ton (megagram). Lime used as a filler in fertilizer is measured by the ton (megagram).

### F. Quantity of Nitrogen Used for Permanent Grassing

Nitrogen is measured in pounds (kilograms) based on the weight of fertilizer used and its nitrogen content.

### G. Replanting and Plant Establishments

No measurement for payment is made for any materials or work required under Subsection 700.3.06 and Subsection 700.3.07.

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### H. Temporary Grass

Temporary grass is measured for payment by the acre (hectare) according to Section 163.

### I. Seeded Native Restoration Areas, Multitropic Native Planting Areas, Riparian Areas, Stream Restoration Areas, and Wetland and Stream Mitigation Areas

Seeded Native Restoration Areas, Multitropic Native Planting Areas, Riparian areas, Stream Restoration area, and Wetland and Stream Mitigation areas will be measured by the acre (hectare) and included under the pay item *Native Restoration and Riparian Seeding*.

#### 700.4.01 Limits

General Provisions 101 through 150.

## 700.5 Payment

As grassing and planting progress, the Contractor will receive full measurement and payment on regular monthly estimates provided the work complies with the specifications.

### A. Permanent Grassing

Permanent grassing will be paid for at the Contract Price per acre (hectare), complete and in place. Payment is full compensation for preparing the ground, seeding, wood fiber mulch, polyacrylamide, and providing plant establishment, soil tests and other incidentals.

### B. Straw or Hay Mulch

Straw or hay mulch required for Permanent Grassing will be paid for according to Section 163.

### C. Fertilizer Mixed Grade

Fertilizer mixed grade will be paid for at the Contract Price per ton (megagram). Payment is full compensation for furnishing and applying the material.

### D. Lime

Lime will be paid for at the Contract Price per ton (megagram). Lime used as filler in fertilizer will be paid for per ton (megagram). Payment is full compensation for furnishing and applying the material.

### E. Nitrogen

Nitrogen will be paid for at the Contract Price per pound (kilogram) of nitrogen content. Payment is full compensation for furnishing and applying the material.

### F. Sod

1. Sod will be paid by the square yard (meter) in accordance with the following schedule of payments. Payment is full compensation for ground preparation, including addition of topsoil, furnishing and installing live sod, and for Plant Establishment.
2. 70 percent of the Contract Price per square yard will be paid at the satisfactory completion of the installation.
3. 20 percent of the Contract Price will be paid upon satisfactory review of sod which is healthy, weed free and viable at the inspection made at the end of the first spring after installation.
4. 10 percent of the contract price will be paid upon satisfactory review of sod that is healthy, weed free and viable at the Final Acceptance.

### G. Temporary Grass

Temporary Grass will be paid for under Section 163.

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### H. Seeded Native Restoration Areas, Multitropic Native Planting Areas, Riparian Areas, Stream Restoration Areas, and Wetland and Stream Mitigation Areas

Seeded Native Restoration Areas, Multitropic Native Planting Areas, Riparian areas, Stream Restoration area, and Wetland and Stream Mitigation areas will be paid for at the Contract Price per acre (hectare), complete and in place. Payment is full compensation for preparing the ground, seeding, and providing plant establishment and other incidentals. and included under the pay item “Native Restoration and Riparian Seeding”.

Payment will be made under:

<b>Item No. 700-1</b>	Permanent grassing	Per acre (hectare)
<b>Item No. 700-2</b>	Sod	Per square yard (meter)

#### 700.5.01 Adjustments

General Provisions 101 through 150.

## **ITEM T-905: TOPSOILING**

### **DESCRIPTION**

**905-1.1** This item shall consist of preparing the ground surface for topsoil application, removing topsoil from designated stockpiles or areas to be stripped on the site or from approved sources off the site, and placing and spreading the topsoil on prepared areas in accordance with this specification at the locations shown on the plans or as directed by the Engineer.

### **MATERIALS**

**905-2.1 TOPSOIL.** Topsoil shall be the surface layer of soil with no admixture of refuse or any material toxic to plant growth, and it shall be reasonably free from subsoil and stumps, roots, brush, stones (2 inches or more in diameter), and clay lumps or similar objects. Brush and other vegetation that will not be incorporated with the soil during handling operations shall be cut and removed. Ordinary sods and herbaceous growth such as grass and weeds are not to be removed but shall be thoroughly broken up and intermixed with the soil during handling operations. The topsoil or soil mixture, unless otherwise specified or approved, shall have a pH range of approximately 5.5 pH to 7.6 pH, when tested in accordance with the methods of testing of the association of official agricultural chemists in effect on the date of invitation of bids. The organic content shall be not less than 3% nor more than 20% as determined by the wet-combustion method (chromic acid reduction). There shall be not less than 20% nor more than 80% of the material passing the 200 mesh (0.075 mm) sieve as determined by the wash test in accordance with ASTM C117.

Natural topsoil may be amended by the Contractor with approved materials and methods to meet the above specifications.

**905-2.2 INSPECTION AND TESTS.** Within 10 days following acceptance of the bid, the Engineer shall be notified of the source of topsoil to be furnished by the Contractor. The topsoil shall be inspected to determine if the selected soil meets the requirements specified and to determine the depth to which stripping will be permitted. At this time, the Contractor may be required to take representative soil samples from several locations within the area under consideration and to the proposed stripping depths, for testing purposes as specified in 905-2.1.

### **CONSTRUCTION METHODS**

**905-3.1 GENERAL.** Areas to be topsoiled shall be shown on the plans. If topsoil is available on the site, the location of the stockpiles or areas to be stripped of topsoil and the stripping depths shall be shown on the plans.

Suitable equipment necessary for proper preparation and treatment of the ground surface, stripping of topsoil, and for the handling and placing of all required materials shall be on hand, in good condition, and approved by the Engineer before the various operations are started.

**905-3.2 PREPARING THE GROUND SURFACE.** Immediately prior to dumping and spreading the topsoil on any area, the surface shall be loosened by discs or spike-tooth harrows, or by other means approved by the Engineer, to a minimum depth of 2 inches to facilitate bonding of the topsoil to the covered subgrade soil. The surface of the area to be topsoiled shall be cleared of all stones larger than 2 inches in any diameter and all litter or other material which may be detrimental to proper bonding, the rise of capillary moisture, or the proper growth of the desired planting. Limited areas, as shown on the plans, which are too compact to respond to these operations shall receive special scarification.

Grades on the area to be topsoiled, which have been established by others as shown on the plans, shall be maintained in a true and even condition. Where grades have not been established, the areas shall be smooth-graded and the surface left at the prescribed grades in an even and properly compacted condition to prevent, insofar as practical, the formation of low places or pockets where water will stand.

**905-3.3 OBTAINING TOPSOIL.** Prior to the stripping of topsoil from designated areas, any vegetation, briars, stumps and large roots, rubbish or stones found on such areas, which may interfere with subsequent operations, shall be removed using methods approved by the Engineer. Heavy sod or other cover, which cannot be incorporated into the topsoil by discing or other means shall be removed.

When suitable topsoil is available on the site, the Contractor shall remove this material from the designated areas and to the depth as directed by the Engineer. The topsoil shall be spread on areas already tilled and smooth-graded, or stockpiled in areas approved by the Engineer. Any topsoil stockpiled by the Contractor shall be rehandled and placed without additional compensation. Any topsoil that has been stockpiled on the site by others, and is required for topsoiling purposes, shall be removed and placed by the Contractor. The sites of all stockpiles and areas adjacent thereto which have been disturbed by the Contractor shall be graded if required and put into a condition acceptable for seeding.

When suitable topsoil is secured off the airport site, the Contractor shall locate and obtain the supply, subject to the approval of the Engineer. The Contractor shall notify the Engineer sufficiently in advance of operations in order that necessary measurements and tests can be made. The Contractor shall remove the topsoil from approved areas and to the depth as directed. The topsoil shall be hauled to the site of the work and placed for spreading, or spread as required. Any topsoil hauled to the site of the work and stockpiled shall be rehandled and placed without additional compensation.

**905-3.4 PLACING TOPSOIL.** The topsoil shall be evenly spread on the prepared areas to a uniform depth of 2 inches after compaction, unless otherwise shown on the plans or stated in the special provisions. Spreading shall not be done when the ground or topsoil is frozen, excessively wet, or otherwise in a condition detrimental to the work. Spreading shall be carried on so that turfing operations can proceed with a minimum of soil preparation or tilling.

After spreading, any large, stiff clods and hard lumps shall be broken with a pulverizer or by other effective means, and all stones or rocks (2 inches or more in diameter), roots, litter, or any foreign

matter shall be raked up and disposed of by the Contractor. after spreading is completed, the topsoil shall be satisfactorily compacted by rolling with a cultipacker or by other means approved by the Engineer. The compacted topsoil surface shall conform to the required lines, grades, and cross sections. Any topsoil or other dirt falling upon pavements as a result of hauling or handling of topsoil shall be promptly removed.

### **METHOD OF MEASUREMENT**

**905-4.2** Topsoil obtained off the site shall be measured by the number of cubic yards (cubic meters) of topsoil measured in its original position and stripped or excavated. Topsoil shall be measured by volume in cubic yards (meters) computed by the method of end areas.

### **BASIS OF PAYMENT**

**905-5.1** Payment will be made at the contract unit price per cubic yard (cubic meter) for topsoiling. This price shall be full compensation for furnishing all materials and for all preparation, placing, and spreading of the materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item T-905-5.1 – Topsoiling (On-Site Stripping and Final Placement) – per cubic yard

### **TESTING MATERIALS**

ASTM C117 Materials Finer than 75- $\mu$ m (No. 200) Sieve in Mineral Aggregates by Washing

**END OF ITEM T-905**

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